Hytera

DMR Mobile Radio Back-to-Back Application Notes

Copyright Information

Disclaimer

Contents

Preface

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

Conventions

Icon Conventions

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.

Notation Conventions

Item	Description
" "	The quotation marks enclose the name of a software interface element. For example, click "OK".
Boldface	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	September 2018	• Updated document outline. • Added the application scenario that the mobile radio connects to the repeater to realize Back-to-Back feature.
R1.0	January 2011	Initial release.

1. Overview

1.1 Definition

The back-to-back is a feature based on accessory pin. Two mobile radios or one mobile radio and one repeater are connected through a pin cable to realize cross-band communication among analog and digital radios

This document introduces how two mobile radios or one mobile radio and one repeater perform the Back-to-Back feature.

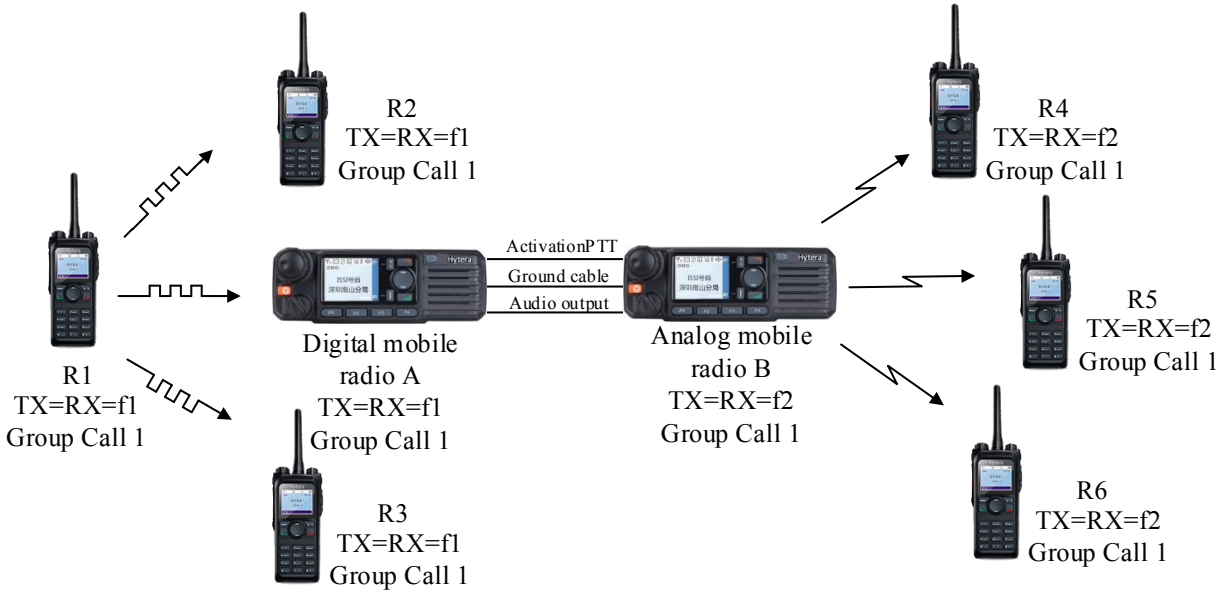
1.2 Principle

1.2.1 Working Principle

The Back-to-Back is realized through accessory pin features. For definition about involved accessory pin, see 1.2.2 and 1.2.3.

The following takes connection between two mobile radios for example to describe working principle.

- R1, R2, and R3 are digital portable radios. They work within communication coverage of the digital mobile radio A.
- R4, R5, and R6 are analog portable radios. They work within communication coverage of the analog mobile radio B.
- The digital mobile radio A and analog mobile radio B are connected through the accessory pin cable.



The following process describes communication from R1 to R4, R5, and R6.

1. R1 makes a group call.

R2, R3, and mobile radio A receive the audio signal simultaneously.

2. The mobile radio A sends audio signal to the mobile radio B through accessory pin, and activates the external MIC PTT of the mobile radio B.

   Because the mobile radio A and mobile radio B are connected through the cable, the audio transmission is not affected by operation mode (e.g. digital or analog mode) and frequency band.

3. The mobile radio B starts transmission.

   R4, R5, and R6 receives audio signal from the mobile radio B. Finally, R1 can communicate with R4, R5, and R6.

The mobile radio B also can transmit audio signal to the mobile radio A through the accessory pin. In this case, portable radios within communication coverage of the two mobile radios can communicate with each other.

1.2.2 Accessory Pin of the Mobile Radio

Input

On either analog channel or digital channel, the mobile radio starts or stops transmission through accessory pin, and samples the audio signals to be transmitted through the corresponding input pin.

Item	Type	Applicable Mode	Definition
EXT Mic PTT (through external Mic PTT)	Programmable function	Analog and digital	When a valid level is input, the mobile radio will trigger its transmission circuitry, activate its external MIC PTT, and transmit the audio signal sampled from Codec. If the input level is invalid, the mobile radio will stop transmission.
TX Audio (for MIC signal input)	Fixed function	Analog and digital	When the external MIC PTT is enabled, the mobile radio will transmit the audio signals.

Output

On either analog channel or digital channel, the mobile radio can output (in level form) the audio signal and its receiving status through accessory pin. The following table describes the pin definition.

Item	Type	Applicable Mode	Definition
Speaker Open Detect (for speaker detection)	Programmable function	Analog and digital	When the mobile radio detects that the speaker unmutes, the mobile radio will output a valid level. After the speaker is muted, the mobile radio will output an invalid level.

Item	Type	Applicable Mode	Definition
Rx Audio Output (for audio output)	Fixed function	Analog and digital	When the mobile radio receives audio signal, it will output such signal through accessory pin.
Carrier Detect (For carrier detection)	Programmable function	Analog and digital	When the mobile radio detects matched carrier signal, it will output a valid level.

1.2.3 Accessory Pin of the Repeater

Input

On either analog channel or digital channel, the repeater starts or stops transmission through accessory pin, and samples the audio signals to be transmitted through the corresponding input pin.

Item	Type	Applicable Mode	Definition
EXT Mic PTT (through external Mic PTT)	Programmable function	Analog and digital	When a valid level is input, the repeater will trigger its transmission circuitry, activate its external MIC PTT, and transmit the audio signal sampled from Codec. If the input level is invalid, the repeater will stop transmission.
TX Audio (for MIC signal input)	Fixed function	Analog and digital	When the external MCI PTT is enabled, the repeater will trigger its transmission circuitry and transmit the audio signals.

Output

On both analog channel and digital channels, the repeater can output (in level form) the audio signal and its receiving status through accessory pin.

Item	Type	Applicable Mode	Definition
Carrier Detect (carrier detection)	Programmable function	Analog	When an analog radio makes a call request, the repeater will output a valid level if detecting the matched carrier. When the analog radio stops transmission, the repeater will output an invalid level if no matched carrier is detected. Note: this feature is not applicable to repeaters with CTCSS/CDCSS enabled. The level

Item	Type	Applicable Mode	Definition
			indicates whether the repeater is working.
CTCSS/CDCSS Detect	Programmable function	Analog	When an analog radio makes a call request, the repeater will output a valid level if the matched CTCSS/CDCSS signaling is detected. When the analog radio stops transmission, the repeater will output an invalid level if no matched CTCSS/CDCSS signaling is detected. Note: this feature is applicable to repeaters with CTCSS/CDCSS enabled. The level indicates whether the repeater is working.
Rx Audio Output	Fixed function	Analog	When the repeater repeats audio signal, it will output such signal through accessory pin.
Voice Detect	Programmable function	Digital	When a digital radio makes a call request, the repeater will output a valid level if detecting the matched digital signaling. When the radio stops transmission, the repeater will output an invalid level. This level indicates whether the repeater is working.
Audio Playback Slot-A, Audio Playback Slot-B	Fixed function	Digital	When the repeater repeats the audio signal, it will output such signal through accessory pin.

1.3 Versions

- R9.0: Realized Back-to-Back via mobile radio and repeater.
- R2.5: Realized Back-to-Back via mobile radios.

2. Device Requirements

- Back-to-Back via mobile radios: The firmware version of the mobile radio is V2.5 or later.
- Back-to-back via the mobile radio and repeater:
  - Mobile radio firmware: V9.00.04.405.iM or later
  - Repeater firmware: V9.00.08.508.iM or later
- Accessory pin cable
  - Back-to-back via mobile radios: PC49
  - Back-to-back via the mobile radio and repeater: POA147

Note

For specific accessories about the mobile radio and repeater, refer to the related *User Manual*. For specific radio model, consult your dealer.

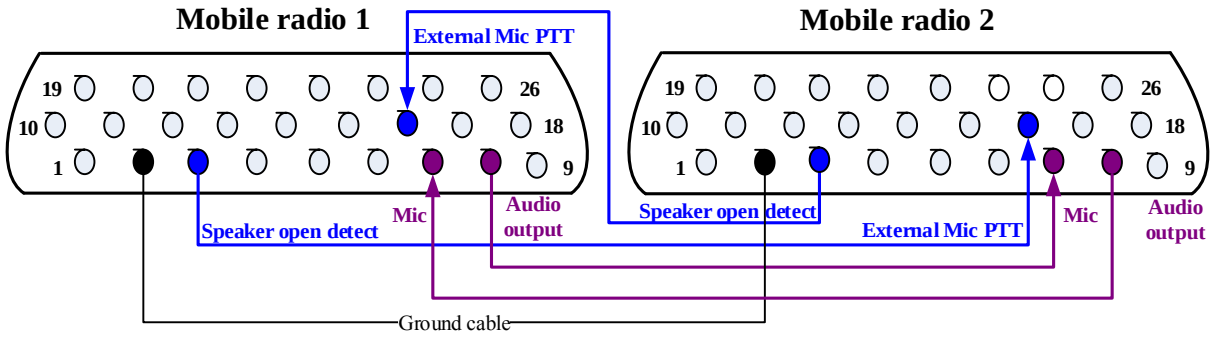
3. Connection

You can connect two mobile radios or one mobile radio and one repeater through the accessory pin cable. For customized or expansion design, refer to the following pin position and features.

3.1 Connecting the two mobile radios

You can connect either the two analog mobile radios or two digital mobile radios according to the following figure.

Both Pin 3 and Pin 16 are programmable ports. They can be replaced by Pin 12, Pin 20, Pin 22, and Pin 23.



- **Ground cable**

  Connects the Pin 2 of the mobile radio 1 to the Pin 2 of the mobile radio 2.

- **Activation of mobile radio transmission**
  - Connects the Pin 3 of the mobile radio 1 to the Pin 16 of the mobile radio 2.
  - Connects the Pin 3 of the mobile radio 2 to the Pin 16 of the mobile radio 1.
- **Audio signal output**
  - Connects the Pin 8 of the mobile radio 1 to the Pin 7 of the mobile radio 2.
  - Connect the Pin 8 of the mobile radio 2 to the Pin 7 of the mobile radio 1.

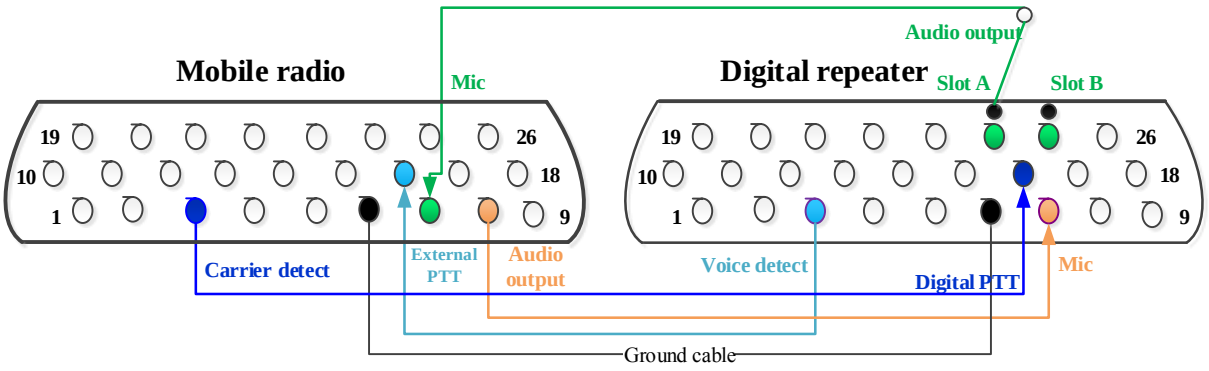
3.2 Connecting the mobile radio and repeater

Mobile radio and the digital repeater

You can connect either the analog mobile radio or digital mobile radio to the digital repeater according to the following figure.

Both Pin 3 and Pin 16 on the mobile radio are programmable ports. They can be replaced by Pin 12, Pin 20, Pin 22, and Pin 23.

Both Pin 3 and Pin 16 on the digital repeater are programmable ports. Pin 3 can be replaced by Pin 12, Pin 20, and Pin 22. Pin 16 can be replaced by Pin 12, Pin 20, Pin 22, and Pin 23.



- **Ground cable**

  Connects the Pin 6 of the mobile radio to the Pin 6 of the digital repeater.

- **Activation of digital repeater transmission**

  Connects the Pin 3 of the mobile radio to the Pin 16 of the digital repeater.

- **Audio signal output of mobile radio**

  Connects the Pin 8 of the mobile radio to the Pin 7 of the digital repeater.

- **Activation of mobile radio transmission**

  Connects the Pin 3 of the digital repeater to the Pin 16 of the mobile radio.

- **Audio signal output of digital repeater**

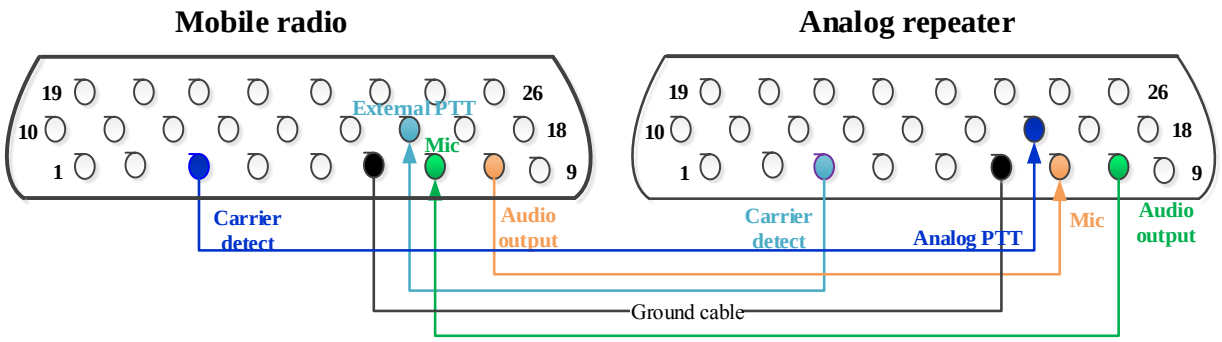
  Connects Pin 24 or Pin 25 of the digital repeater to Pin 7 of the mobile radio.

Mobile radio and analog repeater

You can connect either the analog mobile radio or digital mobile radio to the analog repeater according to the following figure.

Both Pin 3 and Pin 16 on the mobile radio are programmable ports. They can be replaced by Pin 12, Pin 20, Pin 22, and Pin 23.

Both Pin 3 and Pin 16 on the analog repeater are programmable ports. Pin 3 can be replaced by Pin 12, Pin 20, and Pin 22. Pin 16 can be replaced by Pin 12, Pin 20, Pin 22, and Pin 23.



- **Ground cable**

  Connects the Pin 6 of the mobile radio to the Pin 6 of the analog repeater.

- **Activation of analog repeater transmission**

  Connects the Pin 3 of the mobile radio to the Pin 16 of the analog repeater.

- **Audio signal output of mobile radio**

  Connects the Pin 8 of the mobile radio to the Pin 7 of the analog repeater.

- **Activation of mobile radio transmission**

  Connects the Pin 3 of the analog repeater to the Pin 16 of the mobile radio.

- **Audio signal output of analog repeater**

  - For the analog repeater RD98XS: connects the Pin 24 to Pin 7 of the mobile radio.
  - For other analog repeaters: connects Pin 8 to Pin 7 of the mobile radio.

4. Configuration

This chapter describes how to configure the Pin port and other parameters of the digital and analog channel through the customer programming software (CPS).

4.1 Tools

- CPS V2.5 or later: applicable to back-to-back via the mobile radios.
- CPS V9.00.07.712.iM or later: back-to-back via the mobile radio and repeater.

4.2 Back-to-back via the mobile radios

The section describes how to configure the mobile radios through the CPS.

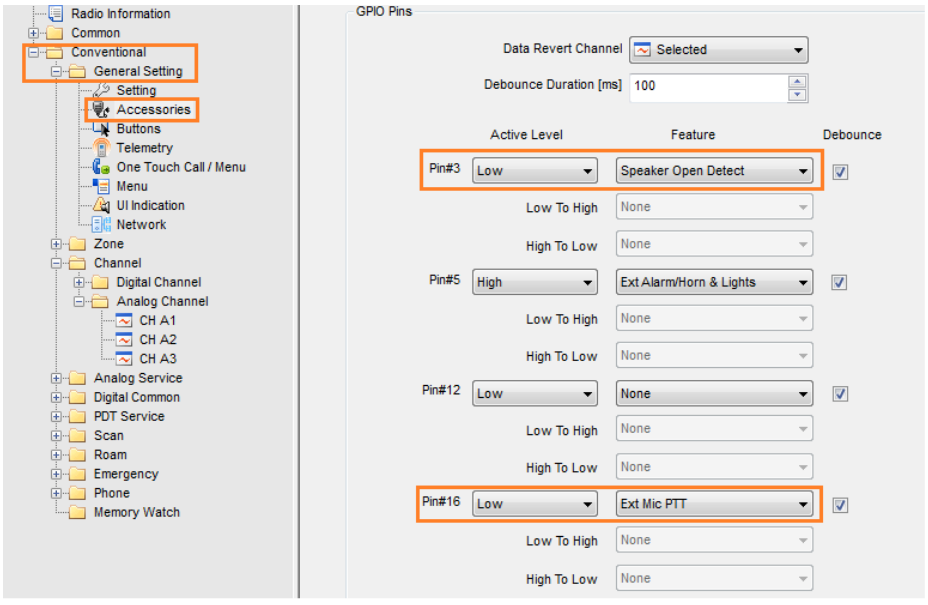
For an analog mobile radio

Step 1 Open the CPS and read the existing configuration data from the analog mobile radio.

Step 2 Go to "Conventional > General Setting > Accessories".

Step 3 In the "GPIO Pins" box, select "Speaker Open Detect" from the "Feature" drop-down list for Pin#3, and select "Ext Mic PTT" from the "Feature" drop-down list for Pin#16.

For details, refer to the CPS Help.

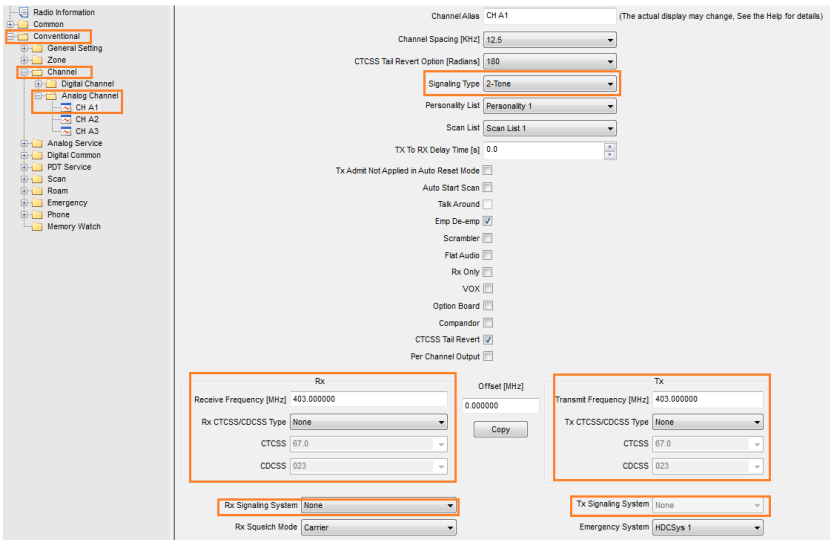


Step 4 Go to "Conventional > Channel > Analog Channel".

Step 5 Select the analog channel and set the channel parameters.

For details, refer to the CPS Help.

Set the signaling type. Parameters in "Rx" and "Tx" box can specify the conditions for receiving and transmitting.



For a digital mobile radio

Step 1 Select "Speaker Open Detect" from the "Feature" drop-down list for "Pin#3".

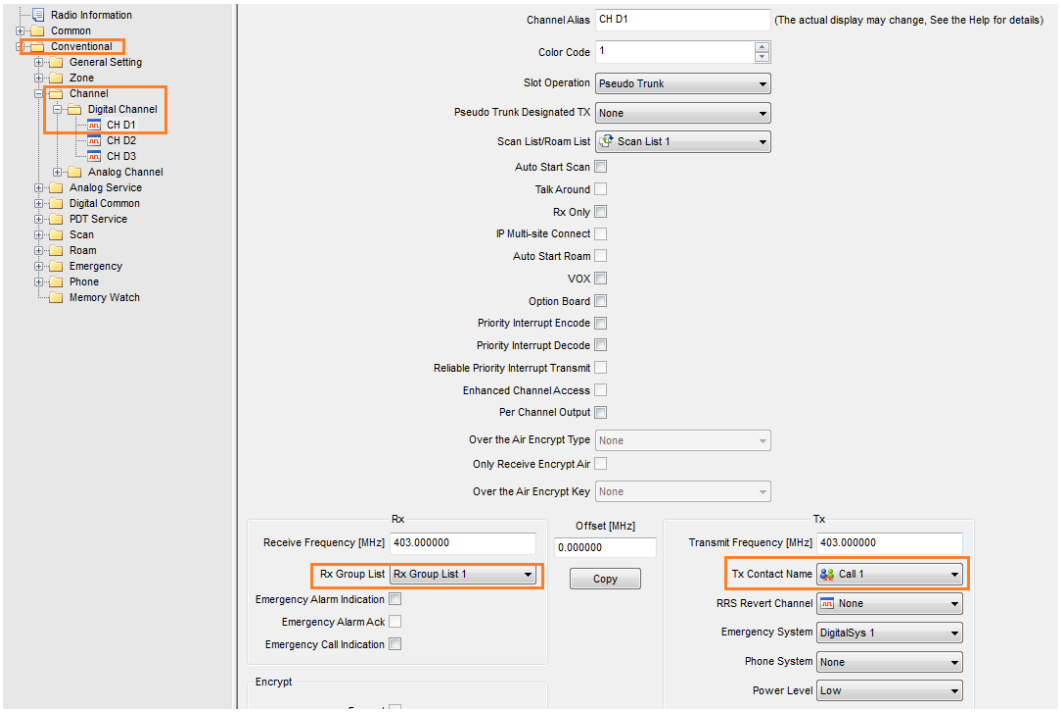
For details, see Step 1 in For an analog mobile radio.

Step 2 Go to "Conventional > Channel > Digital Channel".

Step 3 Select the analog channel and set the channel parameters.

For details, refer to the CPS Help.

The “Rx Group List” defines the groups that can be responded (not required for private call and all call), and the “Tx Contact Name” defines the destination address.



4.3 Back-to-back via the mobile radio and repeater

This section describes how to configure the mobile radio and repeater through the CPS.

For mobile radios

- For details about configuring an analog mobile radio, see For an analog mobile radio.
- For details about configuring a digital mobile radio, see For a digital mobile radio.

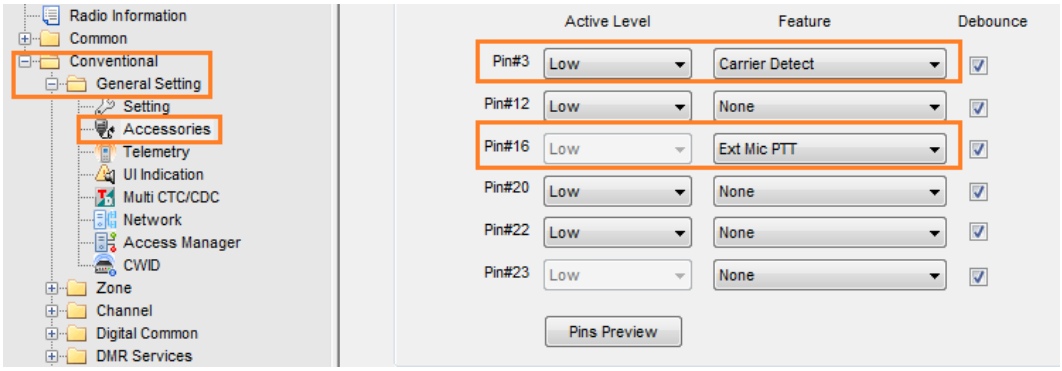
For an analog repeater

Step 1 Open the CPS and read the existing configuration data from the analog repeater.

Step 2 Go to "Conventional > General Setting > Accessories".

Step 3 In the "GPIO Pins" box, select "Carrier Detect" from the "Feature" drop-down list for "Pin#3", and select "Ext Mic PTT" from the "Feature" drop-down list for "Pin#16".

For details, refer to the CPS Help.



Step 4 In the "Priority control" box, set "Path Priority" to "PTT Request", and set "PTT Priority" to "External PTT".

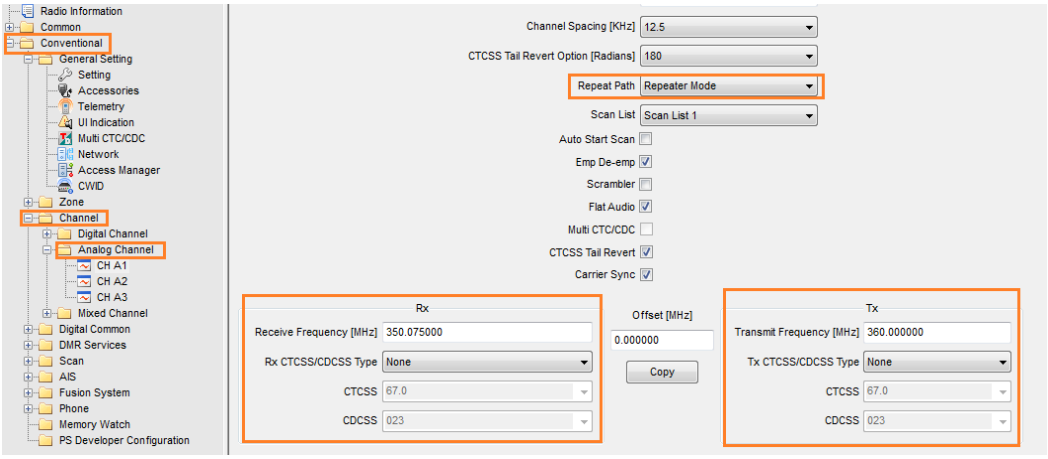
For details, refer to the CPS Help.

Step 5 Go to "Conventional > Channel > Analog Channel".

Step 6 Select the analog channel, set "Repeat Path" to "Repeater Mode", and set the parameters in "Rx" and "Tx" box.

For details, refer to the CPS Help.

The parameters in "Rx" and "Tx" box can specify the conditions for receiving and transmitting.



Note

Do not select "Flat Audio". Otherwise, the audio signal will be interrupted during repeating.

For a digital repeater

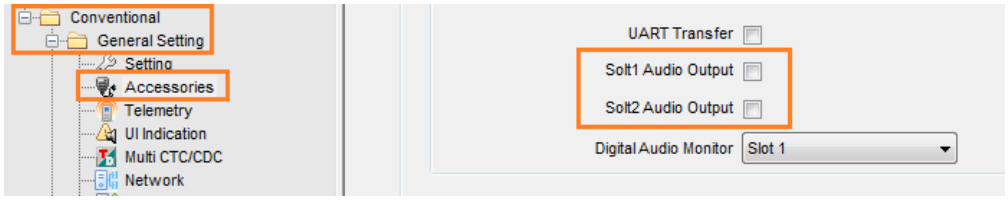
Step 1 Open the CPS and read the existing configuration data from the analog repeater.

Step 2 Go to "Conventional > General Setting > Accessories".

Step 3 In the "GPIO Pins" box, set "Slot1 Audio Output" and "Slot2 Audio Output".

For details, refer to the CPS Help.

- To output the audio signal from Pin 24, select "Slot1 Audio Output".
- To output the audio signal from Pin 25, select "Slot2 Audio Output".

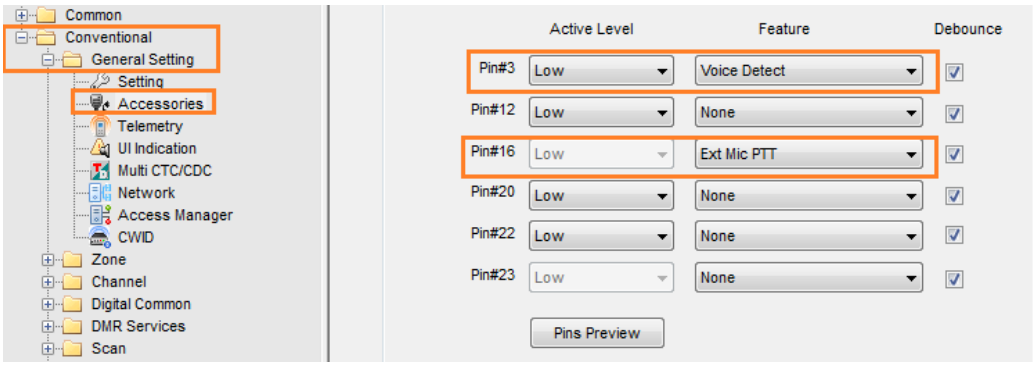


Note

The digital repeater can use only one Pin to output audio signal. If you select "Slot1 Audio Output" and "Slot1 Audio Output" at the same time, only the Pin (e.g. Pin 24 or Pin 25) connected to Pin 7 on the mobile radio can output audio signal.

Step 4 In the "GPIO Pins" box, select "Voice Detect" from the "Feature" drop-down list for Pin#3, and select "Ext Mic PTT" from the "Feature" drop-down list for Pin#16.

For details, refer to the CPS Help.

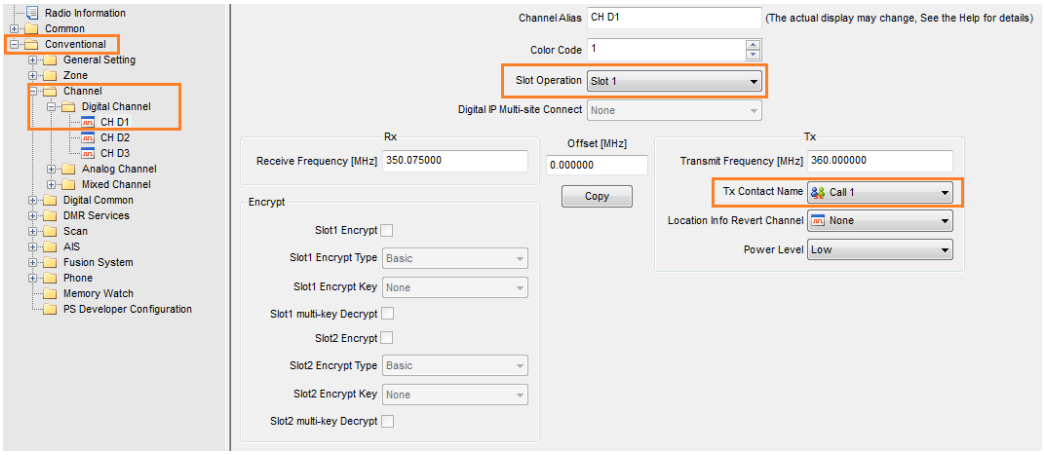


Step 5 Go to "Conventional > Channel > Digital Channel".

Step 6 Select the digital channel, and set "Slot Operation" and other parameters.

For details, refer to the CPS Help.

- To output the audio signal from Pin 24, set "Slot Operation" to "Slot 1".
- To output the audio signal from Pin 25, set "Slot Operation" to "Slot 2".



Note

The "Tx Contact Name" in the "Tx" box can be a group call contact or an all call contact. This contact will be used for repeater reception and transmission.

5. Application Scenarios

This chapter describes how the back-to-back feature realizes cross-band communication among analog and digital radios.

In addition, The Back-to-Back feature (via mobile radio and repeater) can works with IP Multi-site Connect feature to further expand the communication range.

5.1 Analog-digital Communication

This section takes communication between the analog portable radios and digital portable radios through the back-to-back feature for example.

Analog mobile radio and digital mobile radio

Figure 5.1-1 Analog-Digital Communication 1

Analog mobile radio and digital repeater

Figure 5.1-2 Analog-Digital Communication 2

5.2 Digital-digital Communication

Digital mobile radio and digital mobile radio

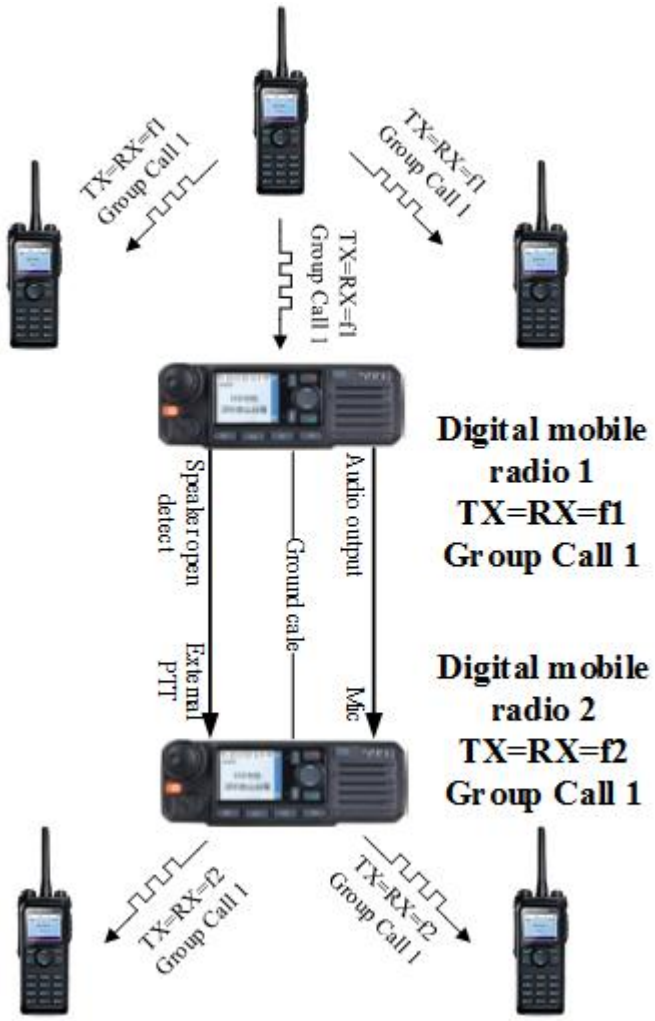


Figure 5.2-1 Digital-digital Communication 1

Digital mobile radio and digital repeater

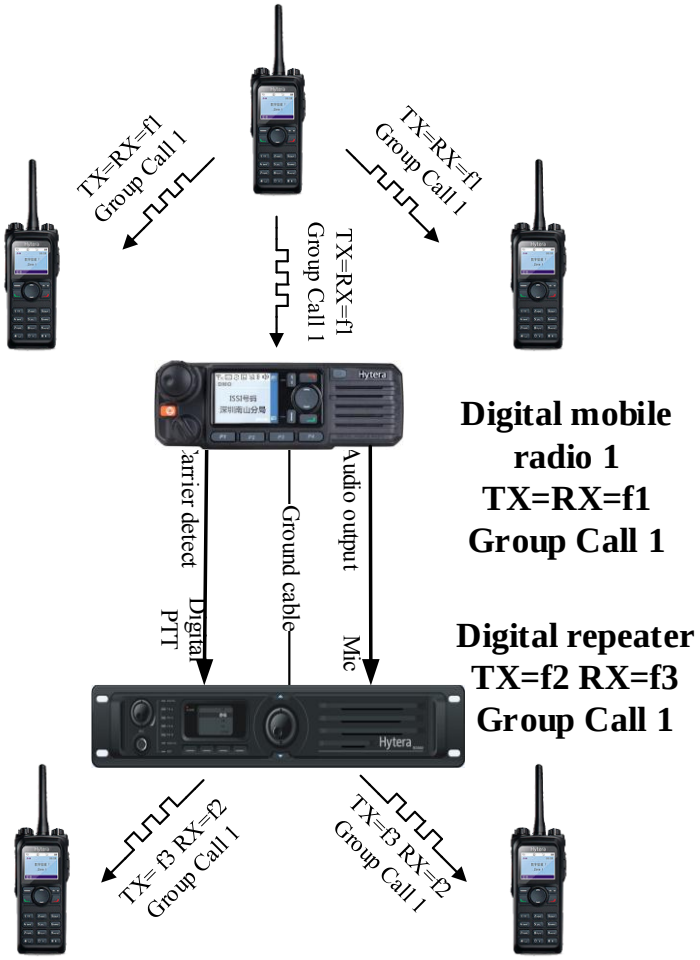


Figure 5.2-2 Digital-digital Communication 2

5.3 Analog-analog communication

Analog mobile radio and analog mobile radio

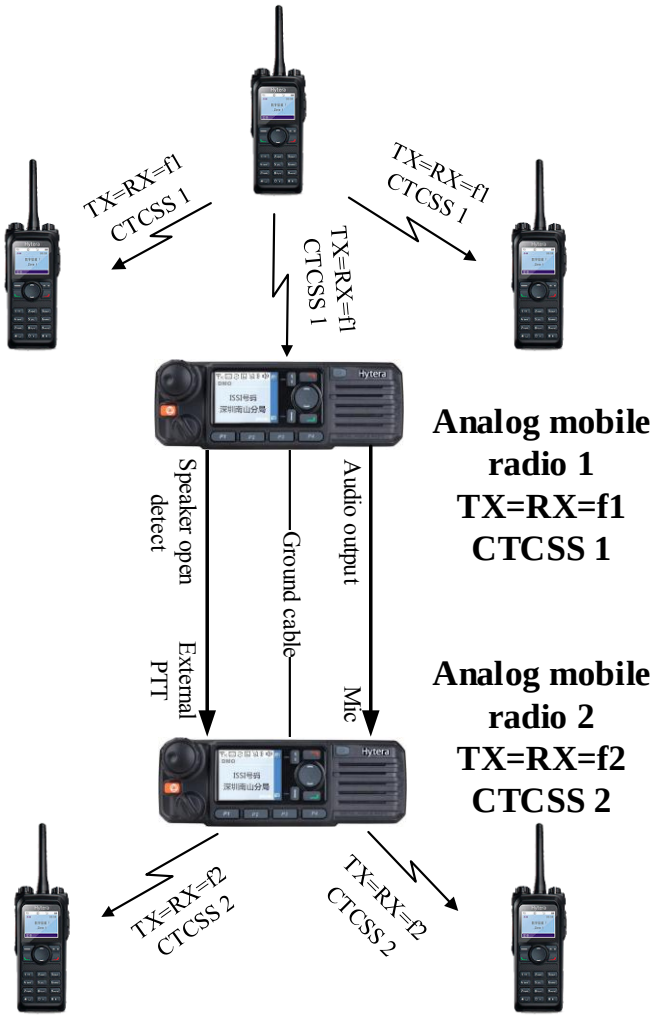


Figure 5.3-1 Analog-Analog Communication 1

Analog mobile radio and analog repeater

Figure 5.3-2 Analog-Analog Communication 2

6. FAQ

6.1 How many mobile radios or repeaters can be connected in the back-to-back way?

Only two mobile radios or one mobile radio and one repeater. This ensures an optimal performance.

6.2 Can the mobile radio use the same frequency to realize A/D communication?

No. It is recommended to use different frequencies to avoid signal interference.

6.3 Is there any suggestion for configuring the frequency?

To ensure better communication, it is suggested to maintain the frequency space at 100 kHz or more.

6.4 Is there any requirement on the bandwidth?

The bandwidths of two mobile terminals can be different. For example, the bandwidth of a digital mobile radio is12.5 kHz and the bandwidth of an analog mobile radio is 12.5 kHz, 20 kHz, or 25 kHz. The bandwidth difference does not affect the back-to-back performance.

6.5 How long is the accessory pin cable?

One meter at most.

6.6 Why does the prompt “Service rejected” appear frequently when the radio is transmitting?

The reason is that the mobile radio or repeater is transmitting through the external Mic PTT. However, the mobile radio or repeater will not receive such prompt if the option “Tx Admit” is set to “Always Allow”. Therefore, it is recommended to set the option “Tx Admit” to “Channel Free”. In this case, the mobile radio will alert “Channel Busy!” instead when transmitting through the external Mic PTT.

6.7 How to deal with back-to-back function failure?

To solve the back-to-back failure, do as follows:

1. Check whether the accessory pin cable is connected properly;
2. If the cable gets loose, reconnect it;
3. Restart the mobile radio or repeater;
4. If the above steps do not help, please contact your dealer.

Address: HYT Tower, Hi-Tech Industrial Park North, Beihuan RD., Nanshan District, Shenzhen, China
Postcode:518057
http://www.hytera.com