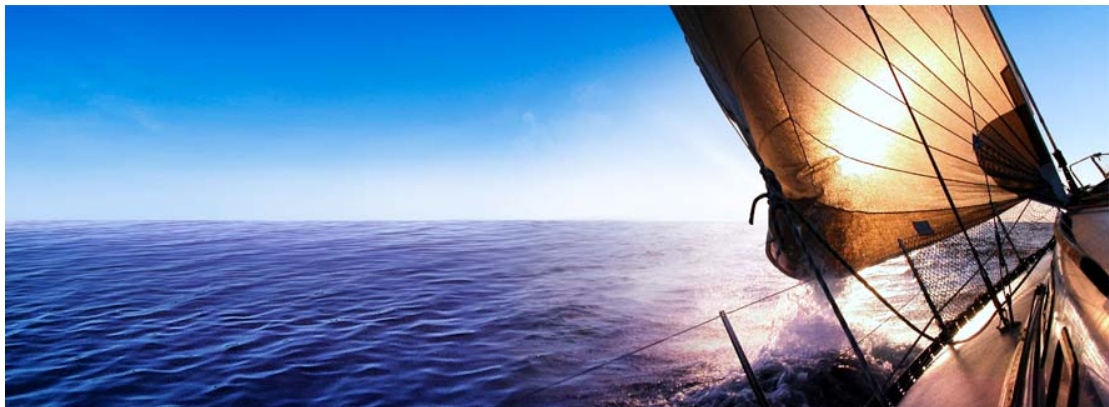


Hytera DMR Conventional Series

Back-to-Back Repeater Application Notes



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Back-to-Back Repeater

Application Notes

Version 1.0

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Web: <http://www.hytera.com>

Revision History

Version	Date	Description	Remarks
R1.0	01-28-2011	Initial release	

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1. Overview

1.1 Definition

The “back-to-back” is a system solution based on accessory pin. It is used to achieve cross-band communication among analog and digital terminals.

1.2 Principle

1.2.1 Back-to-back Repeaters

The back-to-back function realizes communication between analog and digital terminals. It works as below:

1) When the portable radio R1 transmits, the repeater 1 will retransmit the signals from R1 to the portable radio R2 and R3.

2) During retransmitting, the repeater 1 will output the audio signals to the repeater 2 via accessory pin and activate its external Mic PTT, triggering the repeater 2 to transmit. This operation is not subject to the working mode and frequency of two repeaters.

3) The portable radio R4, R5 and R6 receive audio signals from repeater 2. In this way, R1 achieves communication with R2, R3, R4, R5 and R6 successfully.

4) The repeater 2 can also output the audio signals to repeater 1 via the accessory pin, enabling all portable radios within the coverage of two repeaters to communicate with each other.

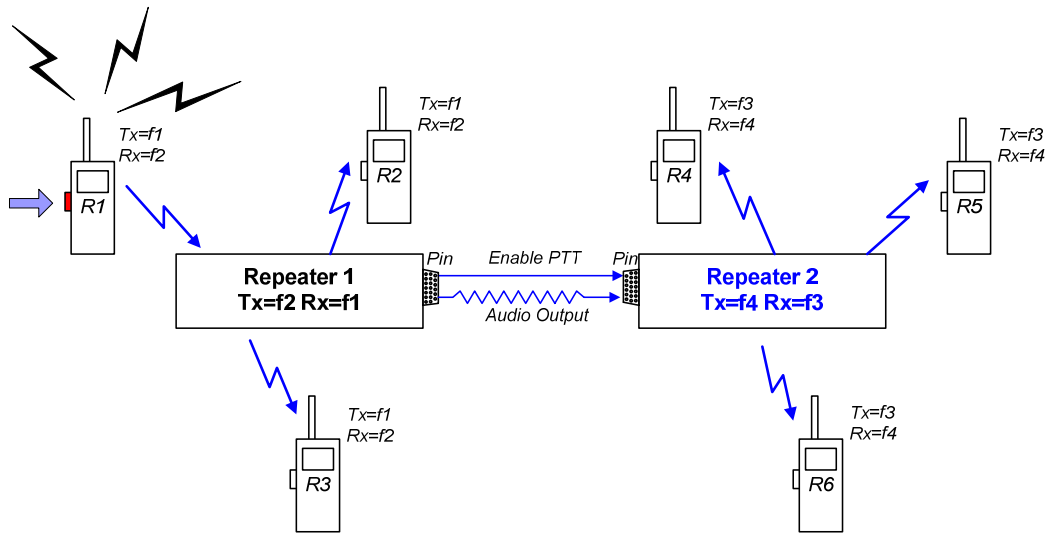


Figure 1.2.1-1 Back-to-Back Work Principle

1.2.2 Accessory Pin

1.2.2.1 Input

On both analog and digital channels, the repeater transmission can be triggered or terminated via the accessory pin, and the audio signals to be transmitted will be sampled via the input pin as well.

Function	Type	Applicable Mode	Definition
EXT Mic PTT	Programmable	Analog and Digital	When a valid level is input, the repeater will trigger its external PTT and transmit the audio signal sampled from Codec. However, the transmission will stop in case of invalid level.
Tx Audio	A fixed function	Analog and Digital	When the external PTT is enabled, the repeater will transmit the audio signals.

Table 1.2.2.1-1 Definition of Accessory Pin Input

1.2.2.2 Output

On both analog and digital channels, the repeater can output (in level form) the status of call request as well as the call content from a terminal via the accessory pin. The definition of involved pins is given below:

Function	Type	Applicable Mode	Definition
Carrier Detect	Programmable	Analog	<p>Upon receiving the call request from an analog portable radio, the repeater will output a valid level if the carrier matches; when the portable radio stops the call, the repeater will output an invalid level for there is no carrier input.</p> <p><i>Note: not applicable to users with CTCSS/CDCSS enabled. The level can indicate that whether the repeater is working.</i></p>
CTCSS/CDCSS Detect	Programmable	Analog	<p>Upon receiving the call request from an analog portable radio, the repeater will output a valid level if the CTCSS/CDCSS signaling matches; when the portable radio stops the call, the repeater will output an invalid level for there is no CTCSS/CDCSS signaling input.</p> <p><i>Note: applicable to users with CTCSS/CDCSS enabled. The level can indicate that whether the repeater is working.</i></p>
Rx Audio	A fixed function	Analog	During its working, the repeater will

Output			retransmit the received audio signals via the accessory pin.
Voice Detect	Programmable	Digital	When receiving the call request from a digital portable radio, the repeater will output a valid level if the signaling matches; when the portable radio stops the call, the repeater will output an invalid level for there is no signaling input. The level can indicate that whether the repeater is working.
Audio Playback Slot-A/Audio Playback Slot-B	A fixed function	Digital	During its working, the repeater will retransmit the received audio signals via the accessory pin. You can select and monitor the time slot output.

Table 1.2.2.1-1 Definition of Accessory Pin Output

1.3 Version

1) DMR Conventional Series R3.0: back-to-back repeater available (A/D conversion).

2. Required Equipment

1) Repeaters (see Hytera device list for details)

2) Accessory pin cable

** Please refer to Hytera DMR Conventional Series Terminal List. You can contact your dealer for specific model.*

** The cable is provided by the third-party supplier.*

3. References

N/A

4. Equipment Connection

You can connect two repeaters using the accessory pin cable. The following sections give a general description on connection method. For any customized or expansion design, the method may vary.

4.1 Analog-Digital Repeaters

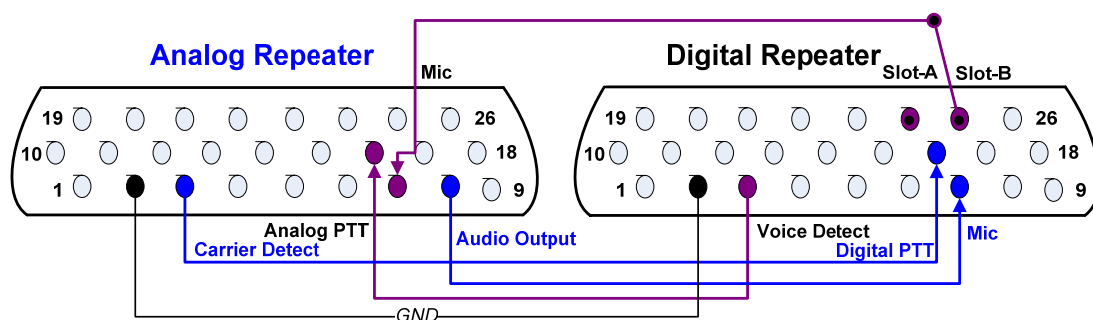


Figure 4.1-1 Connecting Analog-Digital Repeaters

1) Ground wire

To connect PIN2 of analog repeater and that of digital repeater.

2) Activation of digital repeater transmission

To connect PIN3 of analog repeater and PIN16 of digital repeater.

3) Analog audio output

To connect PIN8 of analog repeater and PIN7 of digital repeater.

4) Activation of analog repeater transmission

To connect PIN16 of analog repeater and PIN3 of digital repeater.

5) Digital audio output

To connect PIN7 of analog repeater and PIN24 or PIN25 of digital repeater.

Note: Pin3 is programmable and can be replaced by Pin12, Pin20 and Pin22. All other pins must be connected.

4.2 Analog-Analog Repeaters

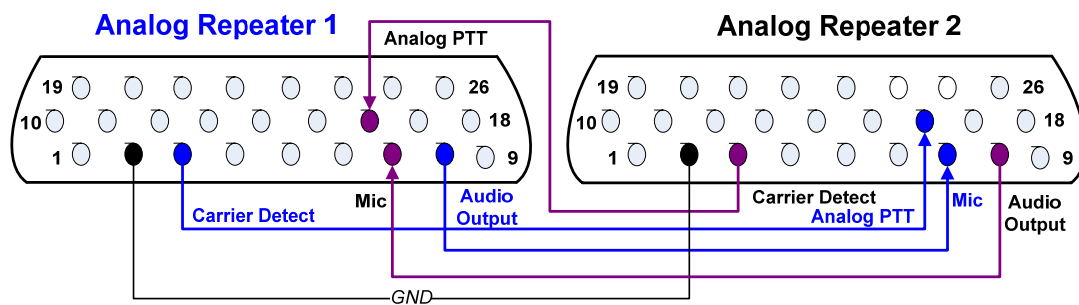


Figure 4.2-1 Connecting Analog-Analog Repeaters

1) Ground wire

To connect PIN2 of analog repeater 1 and that of analog repeater 2.

2) Activation of repeater transmission

To connect PIN3 of analog repeater 1 and PIN16 of analog repeater 2.

To connect PIN16 of analog repeater 1 and PIN3 of analog repeater 2.

3) Analog audio output

To connect PIN8 of analog repeater 1 and PIN7 of analog repeater 2.

To connect PIN7 of analog repeater 1 and PIN8 of analog repeater 2.

4.3 Digital-Digital Repeaters

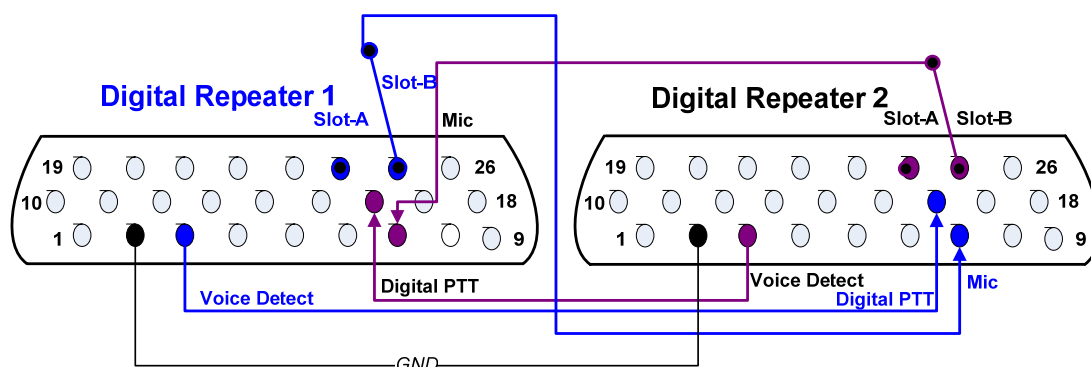


Figure 4.3-1 Connecting Digital-Digital Repeaters

1) Ground wire

To connect PIN2 of digital repeater 1 and that of digital repeater 2.

2) Activation of repeater transmission

To connect PIN3 of digital repeater 1 and PIN16 of digital repeater 2.

To connect PIN16 of digital repeater 1 and PIN3 of digital repeater 2.

3) Digital audio output

To connect PIN24 or PIN25 of digital repeater 1 and PIN7 of digital repeater
2.

To connect PIN7 of digital repeater 1 and PIN24 or PIN25 of digital repeater
2.

5. Equipment Configuration

5.1 Tools

DMR CPS V3.0 or above.

* *Contact your dealer for details.*

5.2 Configuring an Analog Repeater

- 1) Run the CPS and read the existing configuration data.
- 2) Go to “General Setting -> Accessories”. See Figure 5.2-1.

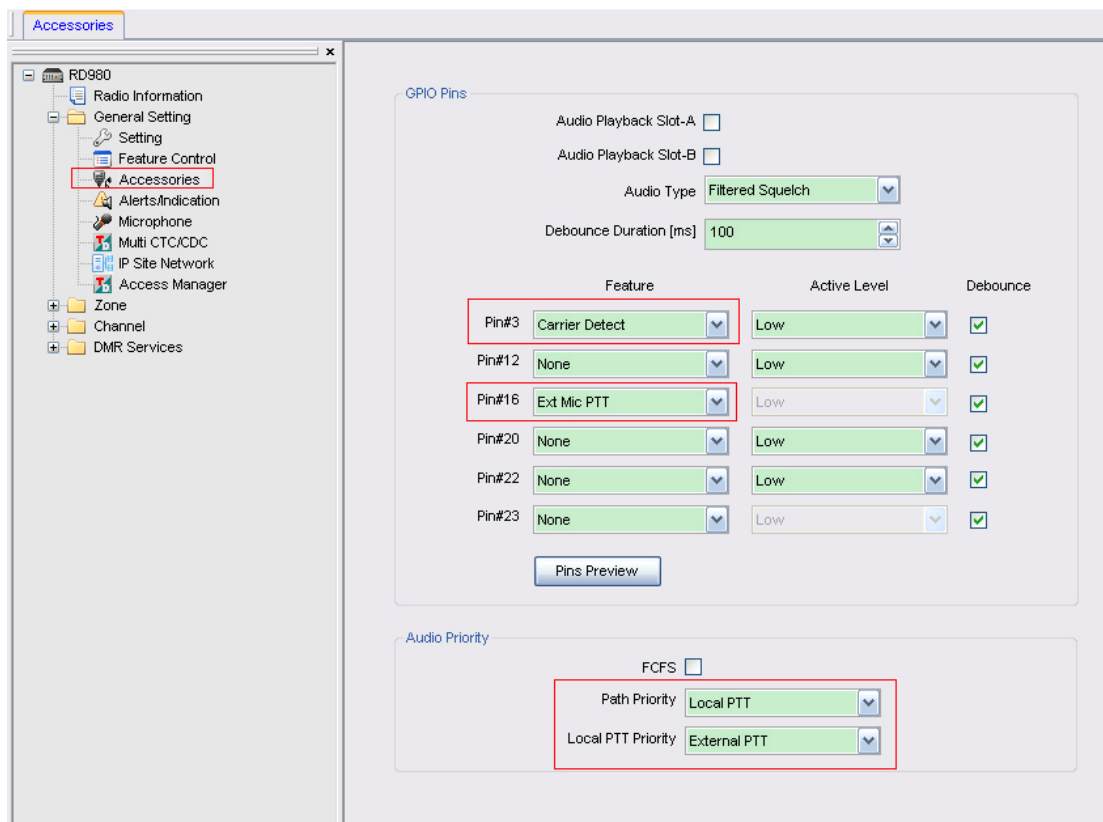


Figure 5.2-1 Accessories Configuration for Analog Repeater 1

3) In the “GPIO Pins” box, set the option “Pin#3” to “Carrier Detect” (this option shall be set to “CTCSS/CDCSS Detect” when it is one of the conditions for signal retransmission). See Figure 5.2-1.

4) In the “GPIO Pins” box, set the option “Pin#16” to “Ext Mic PTT”. See Figure 5.2-1.

5) In the “Audio Priority” box, set the option “Path Priority” to “Local PTT”, and set the option “Local PTT Priority” to “External PTT”. See Figure 5.2-1.

(This enables the external PTT to enjoy higher priority, which can prevent the back-to-back signal retransmission from being interrupted by local signal. However, local signal failure may result.)

6) Go to “Channel -> Analog Channel” and select the channel which the repeater is working on. See Figure 5.2-2.

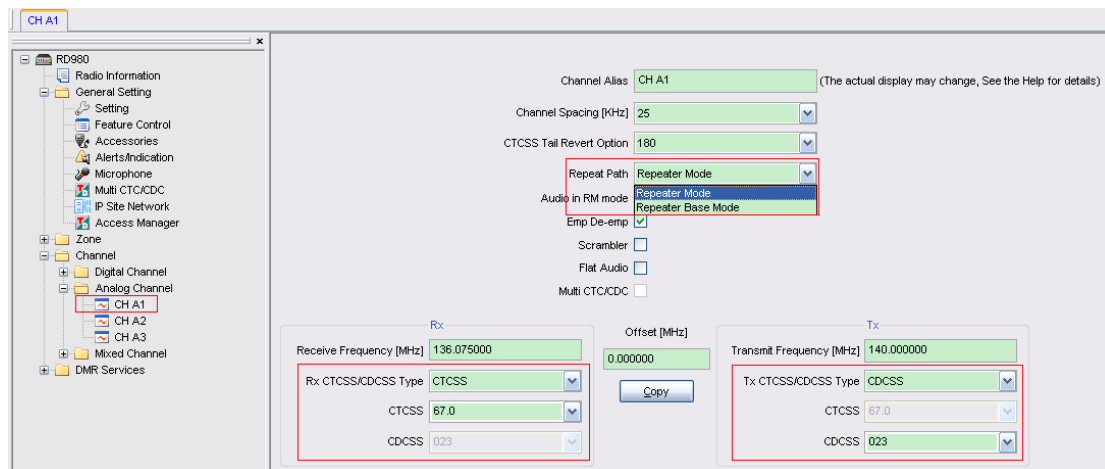


Figure 5.2-2 Analog Repeater Configuration 2

7) Set the option “Repeat Path” to “Repeater Mode”. When the option is set to “Repeater Base Mode”, the repeater shall operate in Direct mode. See Figure 5.2-2.

8) In “Rx” or “Tx” box, you can set CTCSS/CDCSS type. When the option is enabled, CTCSS/CDCSS match will be a must for the repeater to receive and transmit. See Figure 5.2-2.

9) After the above steps are finished, write the configuration data into the repeater.

5.3 Configuring a Digital Repeater

1) Run the CPS and read the existing configuration data.

2) Go to “General Configuration -> Accessories”. See Figure 5.3-1.

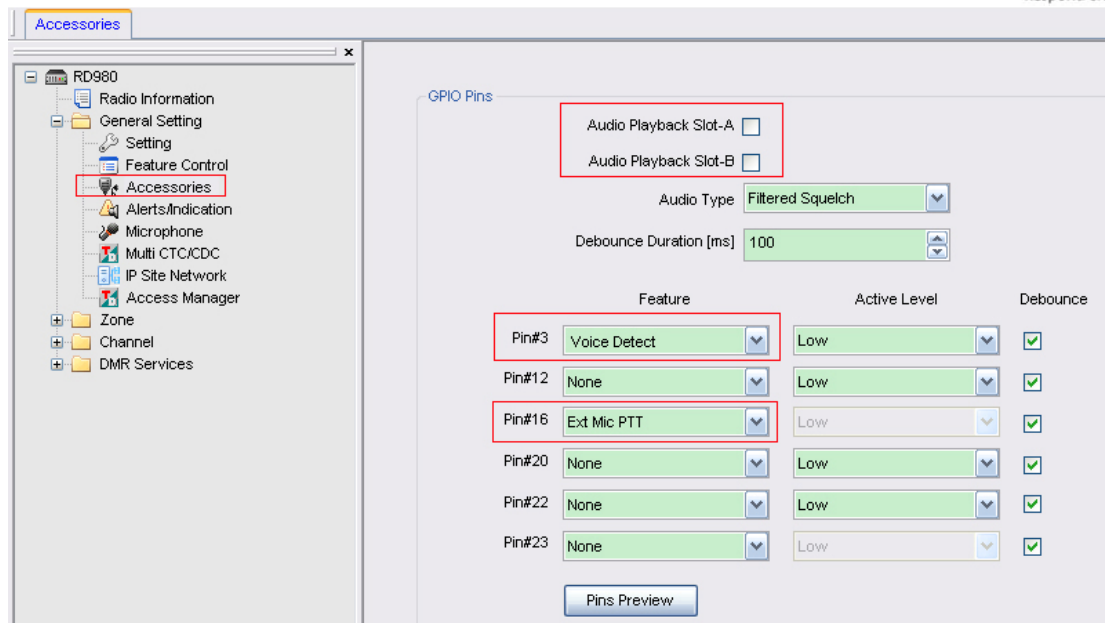


Figure 5.3-1 Digital Repeater Configuration 1

3) In the “GPIO Pins” box, set the option “Pin#3” to “Voice Detect”. See Figure 5.3-1.

4) In the “GPIO Pins” box, set the option “Pin#16” to “Ext Mic PTT”. See Figure 5.3-1.

5) Check the option “Audio Playback Slot-A” (PIN24) or “Audio Playback Slot-B” (PIN25), depending on your actual requirements. See Figure 5.3-1.

(Back-to-back function supports signal input via one time slot only. When both slot A and B are checked, the one connected to repeater shall work.)

6) Go to “Channel -> Digital Channel” and select the channel which the repeater is working on. Select the right slot from the option “Slot Operation”: slot 1 for slot A (PIN24), and slot 2 for slot B (PIN25). See Figure 5.3-2.

7) From the dropdown box “Tx Contact Name”, select your desired contact, which will be used for repeater reception and transmission. At present, only one contact is supported. See Figure 5.3-2.

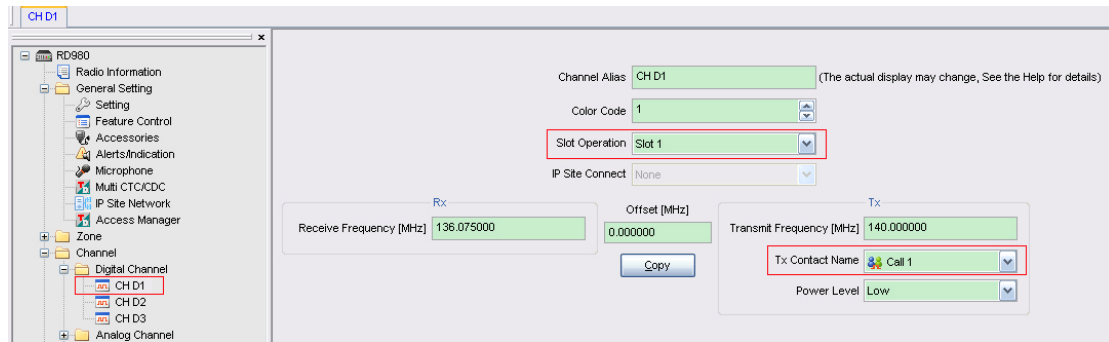


Figure 5.3-2 Digital Repeater Configuration 2

8) After the above steps are finished, write the configuration data into the repeater.

6. Application Demo

The back-to-back function can realize cross-band communication among analog and digital repeaters. Working with IP Multi-site Connect, it still enables you to enjoy remote communication services.

6.1 Communication among Analog-Digital Repeaters

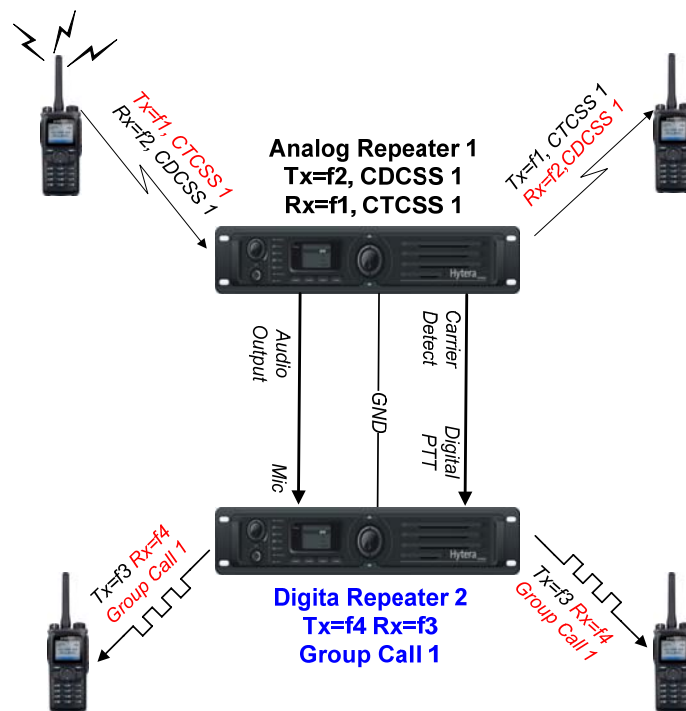


Figure 6.1-1 Communication among Analog-Digital Repeaters 1

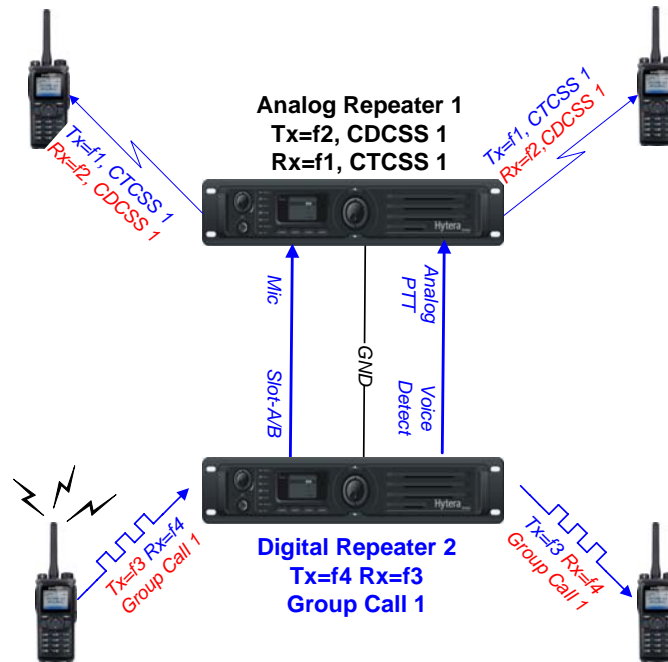


Figure 6.1-2 Communication among Analog-Digital Repeaters 2

6.2 Communication among Analog-Analog Repeaters

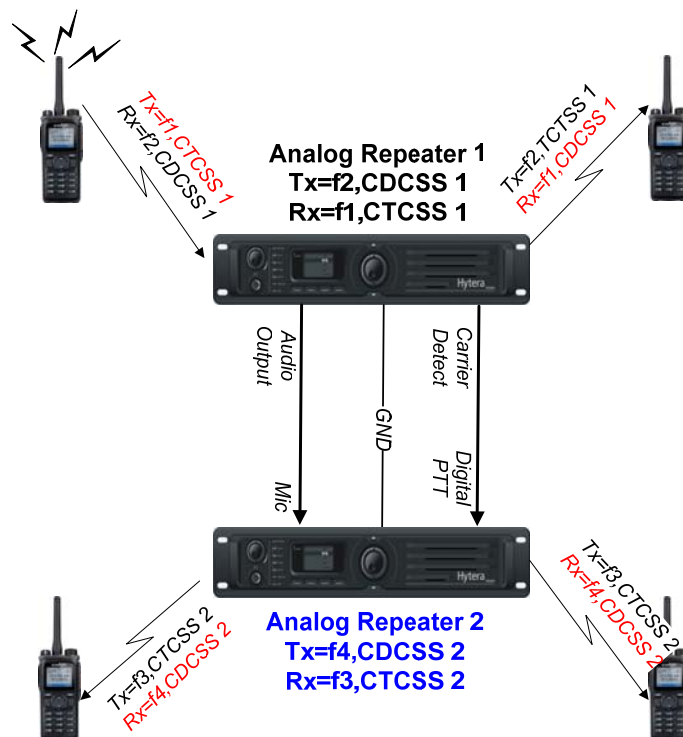


Figure 6.2-1 Communication among Analog-Analog Repeaters 1

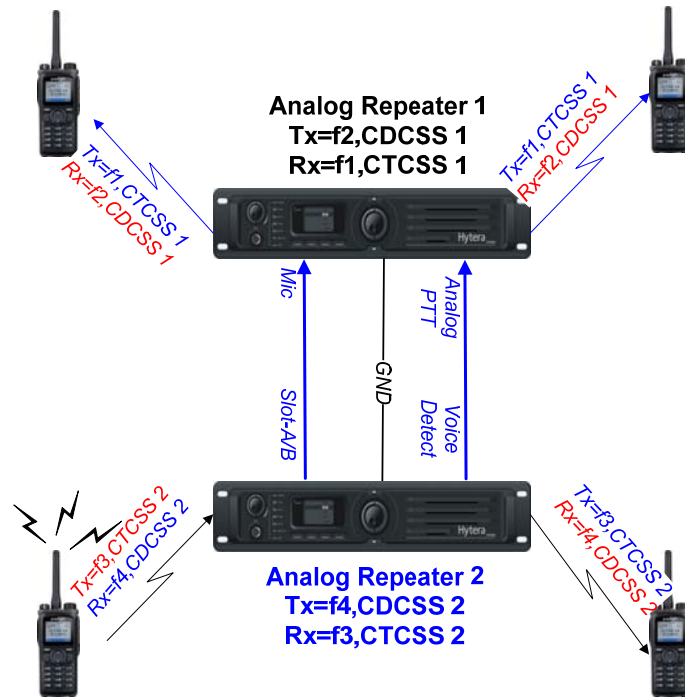


Figure 6.2-1 Communication among Analog-Analog Repeaters 2

7. FAQ

7.1 How many repeaters can be connected in the back-to-back way?

To ensure an optimal performance, only two repeaters are supported at the present stage.

7.2 Can the communication go with the same frequency?

It is recommended to use different frequencies to avoid signal interference.

7.3 Is there any suggestion for configuring the frequency?

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

7.4 Is there any requirement on the bandwidth?

The bandwidth of two repeaters can be different. For example, the bandwidth of digital repeater is 12.5 KHz, and the bandwidth of analog repeater is 12.5 KHz, 20 KHz, or 25 KHz. The bandwidth difference does not affect the back-to-back performance.

7.5 How long is the accessory pin cable?

It is recommended to keep the cable length within 1M.

7.6 Why does the prompt “Service Rejected” appear frequently?

The reason is that the repeater is transmitting via the external Mic PTT, making it unable to handle other call requests. You can try it again later.

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

When the back-to-back function does not work, take the steps below:

- 1) Check whether the accessory pin cable is connected properly. If not, reconnect it;**
- 2) Restart the repeater;**
- 3) If the above steps do not help, please contact your dealer.**