RA-2 BI-DIRECTIONAL REPEATER ADAPTOR FOR MOTOROLA RADIOS

NEW USERS: PLEASE REVIEW ALL INSTRUCTIONS BEFORE BEGINNING

Affordable RICK alternative
Ideal for cross-band linking
Installs easily
Works great
No radio modifications
Plugs into rear accessory connectors of two radios
Compatible with all CDM and many 16-pin Motorola radios (see below)

FEATURES:

- Great sounding audio!

- Repeat levels fully adjustable in both directions

- Radios operate normally with RA-2 switched off

- May be left connected when not in use

- Compact unit measures 1.6 x 3.2 x .80". 18" radio cables.

- Mounts securely with 3M Dual Lock fasteners, included.

Introducing the RA-2, Bi-Directional Repeater Adaptor. This handy device connects two mobile radios back to back as a two-direction repeater. Signals received on radio A are retransmitted by radio B <u>and vice versa</u>). If you want to repeat signals in only one direction (signals from radio A are retransmitted by radio B, but <u>not</u> vice-versa), please check out the RA-1 Repeater Adaptor (click on "View Seller's Other Items").

WHICH MOTOROLA RADIOS CAN THIS BE USED WITH?
All CDM models, and
Many 16-pin models, i.e.: Radius, Maxtrac, GM300 (those with an active-low COS output on accessory Pin 8 – see below).

Mix or Match:
Any two compatible radios can be linked with this adaptor. They can be the same model, but do not have to be. For example, you could use two CDMs, or one CDM and a GM300, or one GM300 and a 16-pin Maxtrac, etc.

To use this adaptor:
A: You must be equipped to <u>program</u> both radios, and,
B: If either of the radios is a 16-pin (non-CDM) model, then pin 8 of its 16-pin accessory connector must provide an active-low COS output.

1

How can I verify my 16-pin radio has active-low COS output on Pin 8?
(Steps 1-4 below are necessary only for 16-pin models):
(Steps 1-4 below are not necessary for CDM models. All CDMs are compatible).

1. First, read the radio with RSS. Go to the Radio Wide Configuration screen (F2). Here, (if the radio has an expanded logic board), you will find a choice of F9. Press F9. This takes you to the Accessory Connector Configuration screen, where the functions of pins 4,6,8,9,12 & 14 can be viewed or changed. Check to see if Pin 8 is already set as: (Description = PL/DPL & CSQ Detect; Data Direction = Output; Debounce = No; Active Level = Low).   If yes, this radio can be used with the RA-2. If no, change pin 8 to: (Description = PL/DPL & CSQ Detect; Data Direction = Output; Debounce = No; Active Level = Low); and write this change to the radio. Now it can be used.

I have read my radio with RSS, but there is no option for changing the accessory connector (F9 does not appear on the Radiowide Config. screen) What now?

2. It might still be usable. On some 16-pin radios, pin 8 provides an active low COS output, even though the accessory connector is not fully programmable. Check pin 8 with a dc voltmeter (positive probe to pin 8, negative probe to ground).   Do you see approximately +5 volts on pin 8 with the receiver squelched, and less than 0.1 volts when receiving a signal with the correct PL? If yes, this radio will work with the RA-2. No? Go to step 3.

3. Repeat the measurement from step 2, but this time, use a pull-up resistor to +12v (wrap one end of a 10k resistor around the positive voltmeter probe and connect the other end of the resistor to +12v). Reconnect the positive voltmeter probe to pin 8. You should now see +12 volts on pin 8 with the receiver squelched. Does this drop to less than 0.1 volts when receiving a signal with the correct PL?   If yes, this radio will work with the RA-2.

Where do I find Pin 8 on the accessory connector?
(16-pin radios): With the radio upside down and the accessory jack facing you, pin 8 is on the bottom row, 4th pin from the right.

I've measured the voltage on Pin 8 as described in steps 2 and 3, but I am not seeing an active-low transition when the radio unsquelches. What now?
On some radios, even though the accessory connector is not fully programmable, Pin 8 can be made to provide active-low COS, simply by programming the radio in Repeater Mode (see step 4).

4. From the Main Menu, select F3 (GET/SAVE). Do you see an option here of F6 (Change to Repeater Mode)? If so, try the following steps:

Press F6 (Change to Repeater Mode).

Press F2 (Read Repeater), and then press F10 for a Generic Repeater.

Press F10 again to skip the transmit radio. Connect the programming cable to the receive radio and press F2 to read it. Keep pressing F2 until you reach the GET/SAVE menu. Then press F10, followed by F4. You will now be back at the CHANGE/VIEW menu, in Repeater Mode.

Press F5 (Mode Configuration). Set the repeater type to <u>Generic</u> and enter your receive frequency and PL. There is only room to enter ONE (receive only) frequency & PL on this screen, but that's okay.

Write this change back to the radio. This should cause Pin 8 to provide an active-low COS output (verify this with a voltmeter as described in steps 2 & 3 above).

After you've programmed the radio as a repeater receiver (to get Pin 8 to behave as active-low COS), return to the GET/SAVE menu and change it back to Radio Mode, which will allow you to program in all of your receive & transmit frequencies. Pin 8 will remain set as active-low COS.

RA-2 INSTALLATION:

1. Programming the Radios
CM & CDM Models:
a. Program the desired frequencies & PLs, then:
b. Enable the radio's timeout timer on all channels
c. From the <u>Main Tree View</u>, click on *Radio Configuration*
d. Go to the <u>Accessory Configuration</u> tab
e. Set the <u>RX Audio Type</u> to *Filtered Audio*
f. Set the <u>Data PTT Audio Source</u> to *Ext. Mic Audio*
g. Set the <u>Ext. PTT Audio Source</u> to *Ext. Mic Audio*
h. Do *not* check <u>Data PTT Overrides Voice</u>
i. Go to the <u>Accessory Pins</u> tab
j. Set <u>Pin 3</u> as *Ext. Mic PTT (Input), Active Level = Low, Debounce = Yes.*
k. Set <u>Pin 8</u> as *PL and CSQ Detect/Talkgroup Detect (Output), Active Level = Low, Debounce = No*
l. Set <u>all other pins</u> as *Null*

Models other than CM & CDM :
a. Program the desired frequencies & PLs, then:
b. Enable the radio's timeout timer on all channels
c. Refer to the instructions on page 2 to verify your 16-pin radio provides an active-low carrier operated switch (COS) output on Pin 8 of the accessory connector.

2. Connecting the Radios:
After programming both radios as described above, plug the A & B cables from the RA-2 into the rear accessory connectors of the radios. If either of the two radios is a 16-pin (non-CDM) model, first install a black 2-inch jumper wire on that radio's plug (see page 5).

On CDM radios, the black jumper wire is not needed. Simply insert the 16-pin plug into the radio's 20-pin jack, leaving 2 unused radio pins on either side of the plug. This configuration (16-pin plug inserted into a 20-pin jack) is normal. The 20-pin jack on the CDM radio is designed to accept *either* a 16 or 20-pin plug (a 20-pin plug is only needed for applications that use pins 17 thru 20). The 16-pin plug and 20-pin jack fit perfectly and are keyed (mistake proof). They can only go together the correct way.

3. Set Repeat Audio Levels

Turn both radios on and place the RA-2's switch in the up position.

While transmitting on Radio A's receive frequency, monitor Radio B's transmit frequency on a service monitor or receiver and adjust R1 (A to B) for the desired repeat audio level.

While transmitting on Radio B's receive frequency, monitor Radio A's transmit frequency on a service monitor or receiver and adjust R2 (B to A) for the desired repeat audio level.

General Considerations:

Ensure that both radios are grounded to the same power supply and have adequate ventilation. If the two radios will be heavily used in repeat mode, or if duty cycles will be prolonged, consider turning down the transmit power levels on both radios and using a fan to increase airflow across the heat sinks. If either radio's heat sink temperature rises to the point you cannot touch it for longer than a few seconds, then it's too hot. You will need to reduce the transmit power level, or increase cooling, or both.

The RA-2 is intended primarily for *cross-band* linking of conventional *simplex channels*. It works best, for example, with a VHF radio and a UHF radio connected back to back to link two conventional *simplex* channels in *different bands*. If either of the two channels to be linked is a *repeater channel*, then the dropout delay of the repeater(s) on those channel(s) should be set as short as possible (zero dropout delay is best). If either of the channels to be linked is a repeater channel, and the repeater's dropout delay cannot be disabled, then it will be necessary to train users to wait for the repeater to drop before replying to a transmission. It will also be necessary (in all cases, including simplex linking) for users to pause briefly at the beginning of each transmission (after keying but before beginning to speak) when talking through the RA-2 (or any repeater), particularly when tone-coded squelch is being used on either of the linked channels.

In-Band Operation: The RA-2 *can* be used with two radios operating in the *same band*, if adequate frequency separation is maintained and the antenna system provides sufficient isolation. As frequency separation is decreased, transmit power will also need to be decreased (and distance between antennas increased), in order to maintain sufficient isolation between radios. Otherwise, receiver desensitization will occur.

## INTERNAL SPEAKER JUMPER WIRE INSTALLATION

FOR 16-PIN RADIOS ONLY (i.e.: Maxtrac, GM300, etc.)

(NOT FOR USE WITH CDM MODELS)

Install one of the 2" black jumper wires between pins 15 & 16 of the radio connector.

Insert the terminal pins into the back of the connector housing with their locking tab fingers DOWN, as shown below, until they click into place.

1. Insert one end of the jumper into position # 16.
2. Bend the wire up and insert the other end into position # 15.

TERMINAL PIN
WIRE
LOCKING TAB FINGER
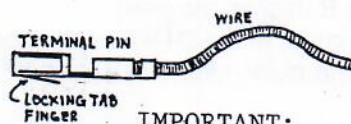
IMPORTANT:
Insert terminal pin into rear of housing with this locking tab finger DOWN, toward the strain relief.

Strain Relief
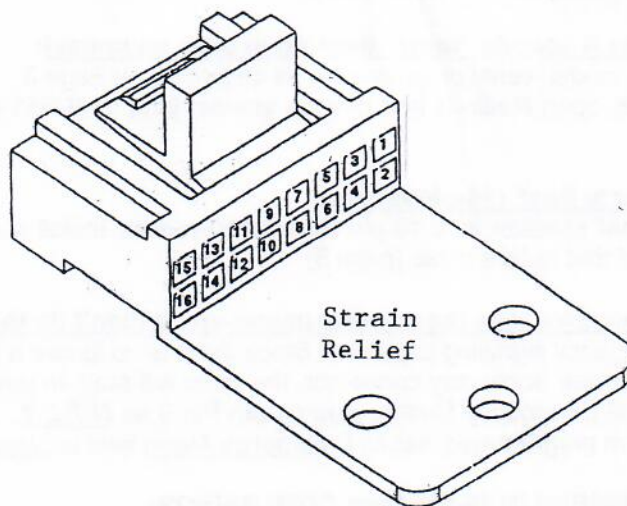
If either of the radios used with the RA-2 is a 20-pin (CDM) model, DO NOT install the jumper wire on that radio's connector.

If the RA-2 is originally used with a 16-pin radio and then later used with a CDM, simply remove the jumper, either by clipping the wire, or extracting its pins from the connector housing (pin extraction tools available from mre1032 @ $3.00 each including postage).

Troubleshooting

Radio B does not key up when Radio A is receiving a signal with the correct PL:
Plug a microphone into Radio B. Does the mic key the radio? (If no, investigate and correct fault in Radio B). If Yes:
Verify both radios are grounded to the same power supply.
Verify Radio A is programmed as described on Page 3 and is providing an active-low COS signal on Pin 8 of its accessory connector as described on Page 2.

Radio A does not key up when Radio B is receiving a signal with the correct PL:
Plug a microphone into Radio A. Does the mic key the radio? (If no, investigate and correct fault in Radio A). If Yes:
Verify both radios are grounded to the same power supply.
Verify Radio B is programmed as described on Page 3 and is providing an active-low COS signal on Pin 8 of its accessory connector as described on Page 2.

Low repeat audio in one or both directions and adjusting R1/R2 does not help enough:
If the radio with low TX audio is a CDM model, verify programming as described on Page 3. Also check the mic gain setting. Use CPS to adjust mic gain as necessary.
If the radio with low TX audio is not a CDM model, open the radio and change internal jumper JU651 on the logic board to position B (higher mic gain).
If the radio with low TX audio is equipped with a DTMF microphone, or a microphone with an LED on it, these mics often load down the audio circuit. Unplug the DTMF/LED mic, or substitute a standard mic, when using the RA-2.

Repeat audio from A to B sounds "tinny" (lacking in bass response):
If either radio is a CDM model, verify programming as described on Page 3.
If Radio A is not a CDM, open Radio A and change internal jumper JU551 on the logic board to Position B.

Repeat audio from B to A sounds "tinny" (lacking in bass response):
If either radio is a CDM model, verify programming as described on Page 3.
If radio B is not a CDM, open Radio B and change internal jumper JU551 on the logic board to Position B.

Internal Radio Speaker is Deaf (16-pin radios):
If the radio with the deaf speaker is a 16-pin (non-CDM) model, install a speaker jumper wire (included) on the plug of that radio's cable (page 5).

The radio now emits an error tone (boop) after power-up. It didn't do this before:
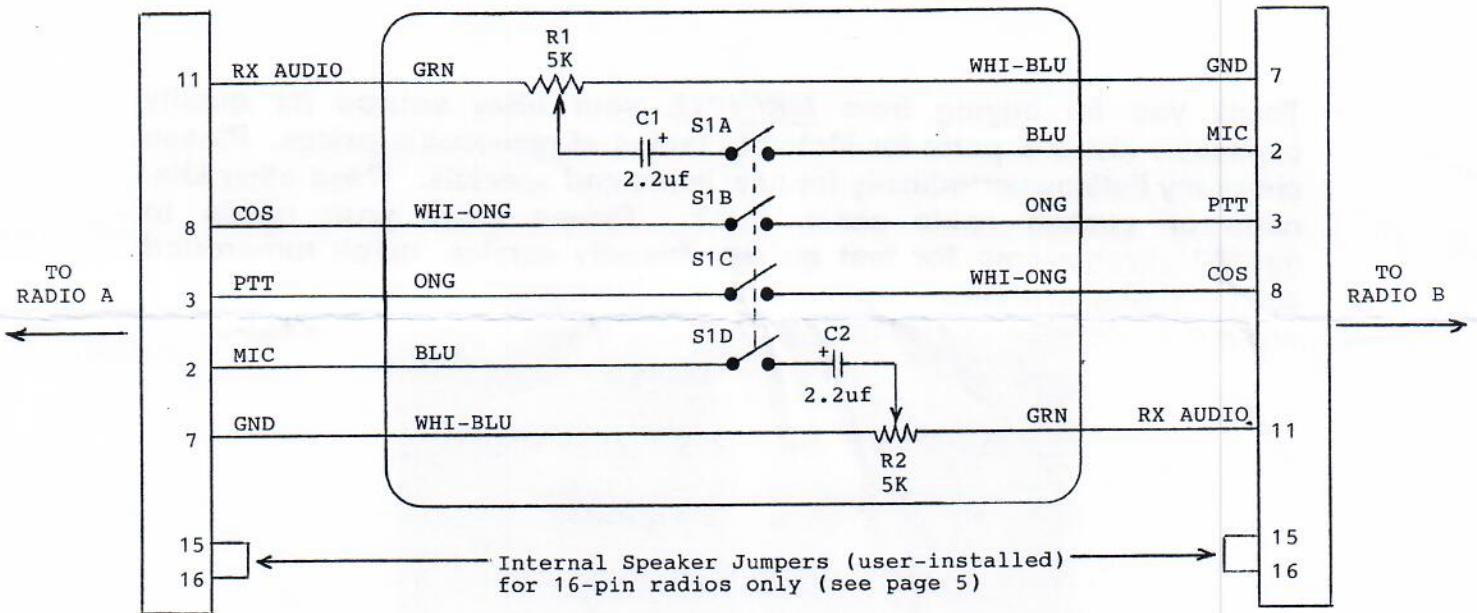16-pin radios with emergency signaling capability: Since there is no longer a jumper wire between Pin 9 and ground on the rear accessory connector, the radio will emit an error tone if Pin 9 is left programmed as External Emergency Switch. Reprogram Pin 9 as *NULL 1*. And, if the radio has an MDC signaling system programmed, set its Emergency Alarm field to *None*.

ABOUT INTERNAL JUMPERS IN 16-PIN (non-CDM) RADIOS:
JU551 and JU651 are 3-pin headers, with 2-position removable shorting jumpers, located on the logic board inside 16-pin radios. Look for their designations printed on the board (they are designated P551 and P651 on some radio models – same thing). Remove the two front panel screws and the two rear heat sink screws. Then take out the two smaller screws from each side of the radio's case. Remove the outer plastic cover from the lower half of the radio and pull off the shield to expose the logic board.

JU551 must be set to **B** in all cases (filtered, squelch-gated RX audio sent to Pin 11).
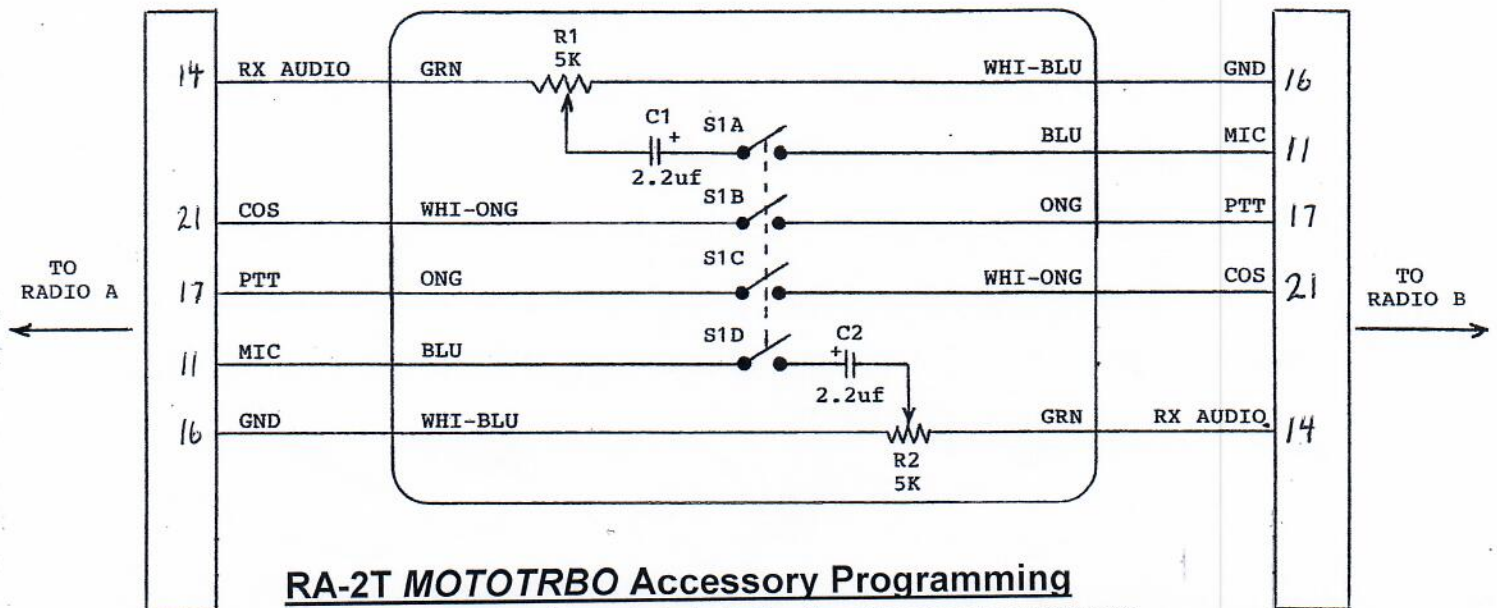**JU651** can be set to either **A or B**. Try A first. If TX audio is not loud enough, use B.

RX AUDIO — GRN — R1 5K — WHI-BLU — GND 7
11

TO RADIO A

C1 2.2uf — S1A — BLU — MIC 2

COS — WHI-ONG — S1B — ONG — PTT 3
8

PTT — ONG — S1C — WHI-ONG — COS 8
3

TO RADIO B

MIC — BLU — S1D — C2 2.2uf 2
2

GND — WHI-BLU — R2 5K — GRN — RX AUDIO 11
7

15
16

Internal Speaker Jumpers (user-installed)
for 16-pin radios only (see page 5)

15
16

RA-2

MRE1032   2005

RA-2T (*MOTOTRBO*) ADDENDUM

RA-2T *MOTOTRBO* Accessory Programming

Mode 1 = Bi-Directional (repeats in both directions for cross-band linking):
Program both radios as shown below.

Mode 2 = Uni-directional (repeats in one direction only, like a regular repeater):
Program both radios as shown below with the following exceptions:

RX Radio: Make Pin 17 "Unassigned"
TX Radio: Make Pin 21 "Unassigned"

Accessories

Top	GPIO Physical Pins	Horn & Lights

Digital Rear Mic Gain (dB)	-6
RX Audio Type	Filtered Squelch
Data Revert Channel	Selected
Debounce Duration (ms)	100
Cable Type	Motorola Solutions

GPIO Physical Pins

	Feature	Active Level	Debounce
Pin #17	Ext Mic PTT	Low	☑
Pin #19	Unassigned	Low	☑
Pin #20	Unassigned	High	☑
Pin #21	PL/Talkgroup Detect	Low	☐
Pin #22	Unassigned	Low	☑
Pin #24	Unassigned	Low	☑
Pin #26	Unassigned	High	☑