

Analog Radio Interface Board
Installation and Setup
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This document covers the installation and setup of the Analog Radio Interface Board. It is assumed that the user is familiar with interfacing repeater controllers to repeaters, the way telephone line signaling works, and is aware of the terminology and customs used.

The function of the analog radio interface board is to provide a bridge between telephony signaling standards and FM two-way signaling standards.

Capabilities and Features

Receive Audio sources may be de-emphasized or flat (discriminator).

Carrier Operated Relay (COR) polarities may be positive or negative true, and levels can be anything from 1 volt to 9 volts. The sense threshold is adjustable.

The Push To Talk (PTT) output can be isolated (dry contacts) or referenced to ground.

The transmit audio level is jumper selectable and continuously adjustable from 0-0.3V in the low range and from 0-3V in the high range.

A Communications Specialists TS-64DS CTCSS encoder/decoder may be mounted on the board, or an open-collector decoder output may be brought in from an external source.

The board may be configured for 2 wire or 4 wire operation. 2 wire operation is used with remote bases (half duplex). 4 wire operation is used with repeaters (full duplex).

When operated in 4 wire mode, both the TX and RX pairs can be configured to come out on one modular jack (RJ14), or on independent jacks (RJ11).

Connectors

There are 3 user connectors. The DB9 connector at J3 is used to connect your repeater to the interface board, and the two Modular Jack (J1 and J2) connectors are used to connect the interface board to your telephony hardware and Asterisk system.

DB9 Connector

The DB9 repeater interface connector has the following pinout:

Pin	Function
1	+13.8V in
2	Transmit Audio Out
3	Receive Audio In
4	COR in
5	Ground
6	TX CTCSS out
7	PTT1
8	PTT2
9	External CTCSS decoder input

+12V in

This pin connects to a good FUSED source of 13.8 volts in your repeater cabinet. The fuse rating should be 2 amp maximum.

Transmit Audio Out

Connect this pin to the audio input on your repeater transmitter. If you are using the microphone input, try removing the 20DB jumper to attenuate the audio output by 10X the audio level down enough to get a reasonable adjustment range for the TX level pot. Note: some microphone inputs are so sensitive, that it might be better to inject the TX audio at a point past the microphone amplifier, or attenuate the signal in the transmitter itself. Use miniature coax such as RG-174/U, or multi-conductor shielded wire to make this connection.

Receive Audio In

Connect this pin to the discriminator output of your repeater receiver. Use of the discriminator output from your repeater receiver is required if you want to mount a TS-64DS CTCSS decoder on the board, and is suggested as the best point to pick off audio from your repeater receiver. Use miniature coax such as RG-174/U, or multi-conductor shielded wire to make this connection.

COR in

Connect this pin to a point in the repeater receiver which swings a few volts when transitioning from a squelched to unsquelched state. It is important that the signal not go above 9 volts as the comparator on the interface board is supplied from a +10V supply. If your COR swings to +13.8V, use a resistor voltage divider to cut the swing in half. If your COR output is open collector, there is a jumper on the board you can install to pull the signal up.

Ground

This pin should be connected to the 13.8V DC return in your repeater system.

TX CTCSS Out

If you have installed a TS-64DS CTCSS encode/decoder, then this pin should be connected to the deviation pot wiper in your repeater transmitter, if you would like to encode CTCSS. This pin can remain unconnected if there is no encode/decoder present on the interface board.

PTT1

This is the main PTT output from one side of the PTT relay. Connect this pin to the PTT line on your transmitter.

PTT2

This is the PTT return. You may connect this to ground in your repeater transmitter, or in the rare case of a positive-referenced PTT, to 13.8V. There is also a jumper on the interface board to connect this to ground which is installed by default.

External CTCSS Decoder Input

This input is connected to an the logic output of an external CTCSS decoder. The decoder logic output must be configured as open collector, referenced to ground. If there is a TS-64DS installed on the interface board, this input is not used.

Modular Jack Connectors

2W Common/4W TX J1

This jack is for the transmit audio and signaling. Additionally, it may be configured in RJ14 mode via jumpers and carry both the transmit and receive pairs. Note: The connections to this jack are polarity sensitive. If the line polarity is not correct, the signaling will not work. For full duplex configurations, the transmit pair, and the receive pairs are used. For half-duplex configurations, the transmit pair doubles as the receive pair. Tip conductors are positive, and ring conductors are negative. The pinout of this jack is:

1	N/C
2	Receive Ring (If jumpers installed)
3	Transmit Tip
4	Transmit Ring
5	Receive Tip (If Jumpers installed)
6	N/C

4W RX J2

This jack is for the receive audio and signaling. This jack will only be used in full duplex configurations in which J1 isn't configured for RJ14 mode. Note: The connections to this jack are polarity sensitive. If the line polarity is not correct, the signaling will not work. Tip conductors are positive, and ring conductors are negative. The pinout of this jack is:

1	N/C
2	N/C
3	Receive Tip
4	Receive Ring
5	N/C
6	N/C

Switches, Jumpers, and Adjustments

There are several switches, jumpers and potentiometers which are used to configure the board for a desired mode of operation.

Switches

De Emp

The De Emp switch is used to insert or remove a de-emphasis network in the receive audio path. The switch has two settings: IN and OUT. With the switch set to the IN position, you must supply discriminator audio to the interface board. With the switch set to the OUT position, you must supply de-emphasized audio to the interface board. If you plan to using on-board TS-64DS, you must set the switch to the IN position. Even if you are not planning to use the TS-64DS, using discriminator audio is usually easier than finding de-emphasized audio whose level isn't affected by the setting of the repeater receiver's volume control.

PL

The setting of this switch determines whether CTCSS will be required on a signal received. When the switch is in the DIS position, the board will only look for the presence of a COR signal. When the switch is in the ENA position, the output of the CTCSS decoder will also be required for the interface board to recognize a signal on the input of the repeater.

COR POL

This switch determines the sense of the COR signal. The switch has two settings: '-' and '+' When the switch is in the '-' position, a the COR signal must be lower than the COR threshold setting to be recognized. When the switch is in the '+' position, the COR signal must be higher than the COR threshold setting to be recognized. The COR threshold setting is discussed in the adjustments section.

4W 2W

This switch configures the interface board for either half-duplex (2 wire) or full duplex (4 wire) operation. 4 wire operation is the most common configuration and is used when the application is a repeater. 2 wire operation is used for remote base applications where one is not transmitting and receiving at the same time.

Jumpers

RJ-14

Determines whether J1 will be an RJ-14 or an RJ-11 jack. There are actually two jumpers for this setting. They are located between J1 and J2. These jumpers are installed by default.

PTT GND

When this jumper is installed, the PTT2 signal will be shorted to ground. This is the most common setting for ground-referenced PTT's. This jumper is installed by default. If your transmitter does not reference PTT to ground, this jumper must be removed. This jumper is located between the J3 (DB9 connector) connector and J2.

20 DB

When this jumper is installed, the transmit audio will be set to the high range (300 mV to 3V). When this jumper is removed, the transmit audio will be set to the low range (0 -300 mV). This jumper is installed by default. This jumper is located to the right of and below J3.

NO TS-64

When this jumper is removed, the audio will be routed through the TS-64DS's high pass filter. This jumper needs to be removed if a TS-64DS is installed on the interface board. If there is no TS-64DS installed, this jumper needs to be installed. This jumper is located to the right of and below J3.

COR P/U

This jumper is used to pull up or pull down the COR input. It has 3 settings. removed, installed to the VREF position, and installed to the GND position. The default setting is removed. If your repeater receiver has an open collector output referenced to ground, you may install this jumper to the VREF position to pull up your COR signal.

Adjustments

There are 3 25 turn potentiometers (pots) which are used to set the receive and transmit audio levels, and the COR threshold.

RX Gain

This pot is used to adjust the receive audio level. Audio level adjustments are covered in a separate document. It is important to follow those instructions precisely so that all audio levels are balanced on every node. Initially, one may set the receive audio level high enough so that DTMF commands can be decoded. This will allow you to enable the calibrated source required to correctly set the receive audio level.

TX Gain

This pot is used to adjust the transmit audio level. Audio level adjustments are covered in a separate document. It is important to follow those instructions precisely so that all audio levels are balanced on every node. Initially, one may set the transmit audio level high enough by ear to hear the responses to DTMF commands. This will allow you to complete the more rigorous level setting procedure.

COR Thresh

This pot sets the trip or threshold voltage for the COR input. It is usually set to midpoint of the swing of the COR input signal. If you want to measure the COR threshold level with a DVM or scope, there is a pad between S3 and the threshold pot to attach your measurement instrument. The threshold level is referenced to ground.