Dave's Shopping List

Part #	Description	Price	Qty
SK2041	opt isolator	$1.89	1
NTE435P6	6P DIP socket (pair) (optional)	$1.46	1
1N4007	diode, protection rectifier	$0.19	1
R.25W1.2K	1.2K resistor (10 pack)	$1.20	1
R.25W10K	10K resistor (10 pack)	$1.20	1
R.25W56K	56K resistor (10 pack)	$1.20	1
VT1K	1.0K trimmer pot	$0.49	2
CA006	3.5mm stereo plug, gold	$0.44	3
TT-AC1028	stereo audio cable, 25 ft.	$1.59	1
274-025	R/S 8P mic plug	$3.99	1
270-283	Enclosure + breadboard	$3.99	1
	mic cord or suitable cable		1
	1:1 transformer removed from sacrificial PC modems		2

This project copied from

http://www.patmedia.net/ralphmilnes/soundcardpacket/index.html

Receive (RX) Audio Cable

Radio RX Audio to Sound Card "Line In" or Microphone Jack

At the sound card, you want to use the LINE IN jack. It is normally a good match to a typical radio's RX audio voltage. If you need to use the sound card's more sensitive MIC jack, see the MIC schematic below for more information including a schematic that adds in a voltage divider circuit. You may also have success using the Volume Control program (instead of the divider circuit) to limit RX audio into the MIC jack (requires some fine adjustments), but the divider circuit will make it easier to regulate.

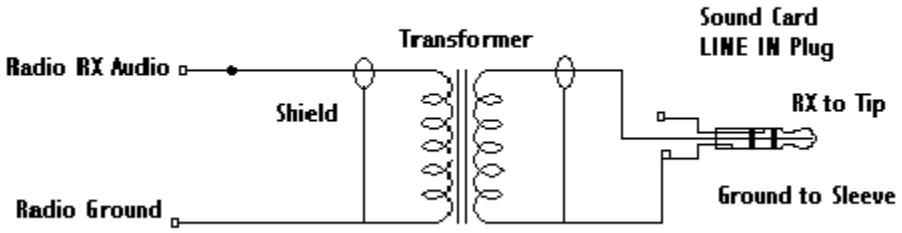
In the RX audio cable, I strongly recommend the use of an in-line transformer to break the ground path between the radio and computer grounds for two reasons:

- **to eliminate any potential ground loop hum on the signal,**
- **and more importantly, to reduce the risk of any damage to the computer or radio from any difference in voltage potential**

You should also use shielded cable to reduce the risk of any RFI (Radio Frequency Interference) getting on the RX signal.

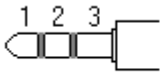
Here's the schematic for an isolated RX cable:

Receive Audio to Sound Card LINE IN Jack



To build your RX cable:

- **Cable material: Use a cable with a single insulated wire and a braided shield. Small coaxial cable like RG-174U should work well; even RG-58U would work. The shield can act as ground line if you are using a transformer. If you aren't using a transformer, attach the shield at the radio ground only, and not at the computer/sound card ground.**
- **Sound card connector: You will need a plug that will fit the sound card LINE IN/Microphone jack, probably a 1/8" (3.5mm) stereo 3 conductor male mini-plug (e.g. Radio Shack part #274-284). Do not use a mono 2 conductor plug.**



1. Left channel +
2. Right channel +
3. Left and right channel -

RX Audio to the "Microphone" jack on your sound card

If you want or need to use the sound card's Microphone jack instead of the LINE IN jack, then you will probably need to add an attenuation circuit on the RX audio line so that you do not overdrive the sound card. The exact attenuation will depend on the maximum output voltage of your radio RX line and the maximum input voltage on the MIC jack of your sound card. (The Sound Blaster card I have has a maximum of 200 mVpp on the Microphone jack, where the Line In jack has a maximum of 2 Vp-p. Other cards accept a maximum of 100 mV.)

Warning: On most sound cards, the Microphone (MIC) jack does not allow stereo input, i.e. a left and right channel. Typically, the ring in the MIC jack is used to provide a +5 bias voltage to power electret microphones. It is not used for stereo (right channel) input. For that reason, you can't use MIC input if you want to interface one sound card to two radios.

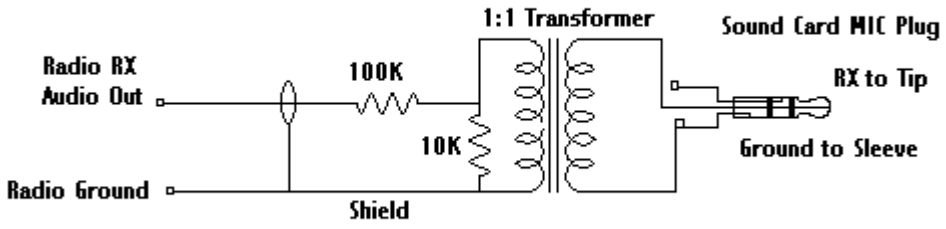
1. Signal input
2. +5v
3. 0v

3.5mm plug

If you do use the MIC jack, it is better to use a stereo plug instead of a mono plug. Just leave the ring unwired. A mono plug can be used, but it will short circuit the ring (+5V) to the sleeve (0V), although the card's circuitry is designed to cope with this -- a resistor severely limits current flow.

Here's a schematic for a 10:1 attenuation circuit that should work fairly well in many microphone jack setups. The 1:1 audio transformer provides an electrical separation of the computer from the radio and may be especially important on cables used in microphone jacks and laptops.

Receive Audio to Sound Card MIC Jack with 10:1 Attenuation



When you're done, tape a "MIC" label on the sound card end of this RX audio cable so you don't confuse it with the TX "Line out" cable.

Dave's note – for adjustable 10:1, use TX option 2 below using a 1K pot and 10K resistor.

Transmit (TX) Audio Cable

Sound Card "Line Out" to Radio TX Audio

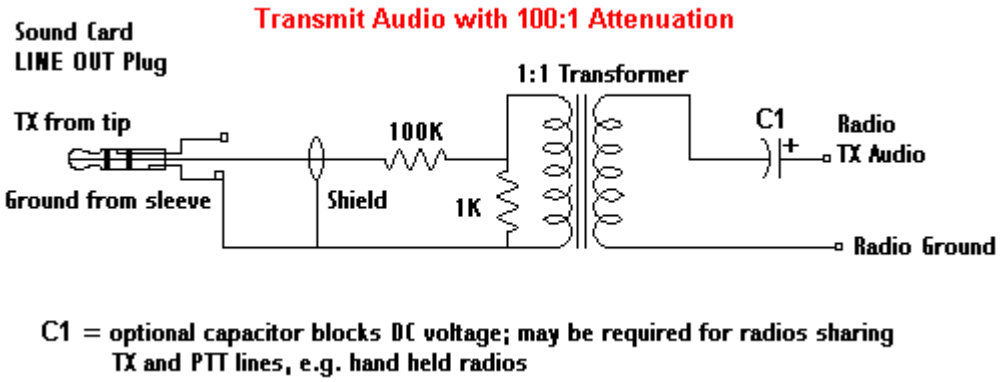
This page has advice for those building their own interface.

The TX audio cable can be a little more complicated then the RX audio cable. Normally, this cable must have a circuit to attenuate the voltage leaving the sound card's LINE OUT jack, otherwise the radio's transmit circuit will be overdriven.

Note: Use the LINE OUT jack, do not use the SPEAKER jack (which is found on some older sound cards). If your card or laptop only has a HEADPHONE jack, it can be used, but you will need to lower the sound card's TX audio volume. Quality will usually not be quite as good as a LINE OUT.

The exact attenuation will depend on both your radio and sound card. An approximation is a 100:1 attenuation (40 dB) which will reduce the sound card output level (max. 2 Volt $_{p-p}$) down to the level your radio normally would expect for microphone (20 -40 milliVolt $_{p-p}$). For example, a 50:1 attenuation works better for me, since I use my my radio's data jack which has a maximum input voltage of 40 mV $_{p-p}$.

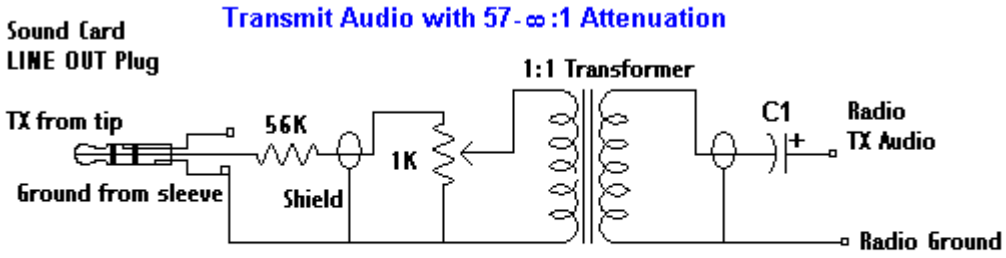
Here's a schematic for the attenuation circuit:



C1 = optional capacitor blocks DC voltage; may be required for radios sharing TX and PTT lines, e.g. hand held radios

Option #1: Instead of the two resistors, you could use a 4K7 (4.7K) Ohm variable resistor (potentiometer/pot). The pot would actually give you more control over the attenuation, although a pot is bulkier.

Option #2: Or here's a schematic of a circuit that combines a pot with a fixed resistor to give the pot a less delicate range of settings and make is easier to adjust:

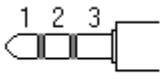


C1 = optional capacitor blocks DC voltage; may be required for radios sharing TX and PTT lines, e.g. hand held radios

To build your TX cable:

- **Sound card connector: You will need a plug that will fit the sound card LINE OUT jack, probably a 1/8" (3.5mm) stereo 3 conductor male mini-plug (e.g. Radio Shack part #274-284 -- pkg. of 2). Do not use a mono plug 2 conductor plug.**

  Note: The middle conductor (ring) of the sound card plug (right channel) should be left unwired, unless you are building a TX cable for a second radio



1. Left channel +
2. Right channel +
3. Left and right channel -

PTT (Push to Talk/Transmit) Cable

This page has advice for those building their own interface.

AGWPE will generate the transmit audio, but you also need a way to open the radio's PTT circuit so that the audio can be transmitted. AGWPE and other sound card programs provide for this by sending a signal to:

- **the serial (COM) port's RTS pin (#7) and**
- **the parallel (LPT) port's Data Bit 0 and 1 pin (pins #2 and #3)**

For those home-brewing a PTT cable, this gives you several options:

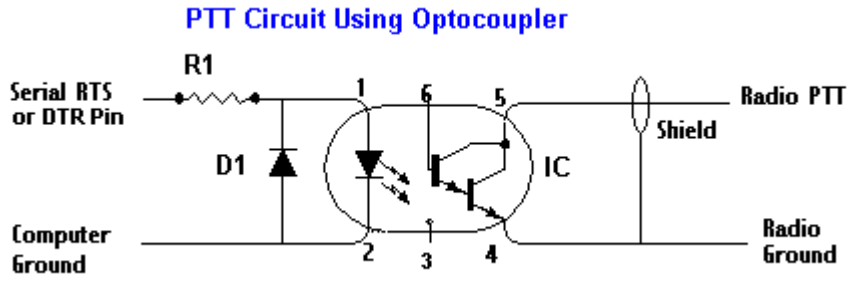
1. **Build a cable with an isolated 'gate' circuit that opens the radio's PTT circuit when it receives a signal from the serial or parallel port.**

A. Building A Cable With An Isolated Gate Circuit

Note: Because a sound card has two audio channels, it is possible to interface two (2) radios to a single sound card. This page describes how to make a cable to control the PTT for a single (1) radio. See the Interfacing 2 Radios to 1 Soundcard page for a dual PTT cable.

You may find other variations of the circuit below, most commonly one using a simple transistor (in fact, there's one in the AGWPE 'Help' file). While these circuits will work, they do create a direct ground connection between the computer and radio, and thus create a risk of radio/computer damage in the event of different voltage potentials between the two components. For that reason, I don't recommend them.

Instead, I recommend an isolated 'gate' circuit. Here's a schematic for a single port (one Radio) AGWPE setup which uses a phototransistor/optocoupler as the gate:



Dave's note: add indicator LED inline, before pin 1

R1 = Resistor, e.g. 1K2, to reduce voltage on the IC pin 1
IC = Integrated Circuit; this sketch shows an IC, such as a 4N33 or PS2603 Optocoupler, which uses a Darlington pair transistor. (Note: to identify pin #1, look for a small embossed circle on the top of the IC above pin 1; or looking into the notch in one

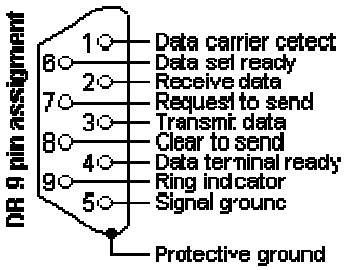
side of the IC with the pins down, pin #1 is to the right of the notch.)

D1 = Diode, e.g. IN4001, would shunt any potential reverse voltage that might damage the sensitive diode/emitter in the IC. (Note: the band printed on the diode marks the cathode end, which attaches to the Serial Port/IC Pin 1 line in the sketch above. The opposite/anode end attaches to Ground.)

The ideal components for your circuit may vary because of your radio's requirements. For example, you might be able to use a different type of IC, such as a 4N25 or PS2601, but that may require a different value for R1.

If you plan to build your own interface, Bux CommCo can provide advice on components for your radio (Bux CommCo components page). You might also want to consider a Bux CommCo's RASCAL kit . It will have all the right components for your radio for a good price.

- Other U.S. outlets for parts include , Radio Shack, Digikey, and Newark Electronics.
- Use a cable with a single insulated wire and a braided shield. Attach the shield on each side of the optocoupler to either the radio or computer ground, but do not connect the grounds together.
- If you have a DB9 Serial port (COM), use RTS (Request To Send) pin # 7 for PTT control on a one radio cable. Ground will be pin #5



Do not use the #4 DTR (Data Terminal Ready) pin for single port PTT control despite what the AGWPE Help file or AGWPE web site may say. The DTR pin is used by AGWPE only if you interface a second radio and use AGWPE's Dual Port feature to control PTT on a radio attached to AGWPE port #2. DTR will not be triggered if AGWPE is set to use only a single port/radio.

To test your completed circuit, hook up the cable to your radio and then use a 9 volt battery to simulate the computer signal. Connect the positive + side of the battery to the signal pin in the COM/LTP connector and the negative — side of the battery to the ground pin in the connector.