



# THE OHM TOWN NEWS

*Voice of the Bridgerland Amateur Radio Club*

>>>>>>> <http://www.barconline.org> <<<<<<<<

## February 2014

### *Some Contents...*

President's Message .....	2
Upcoming Activities .....	3
ARRL News and Information .....	4
Audio Cable Construction .....	7
BARC Club Membership Application .....	14
Test Questions for Extra Class License .....	15
2014 Club Officers .....	16

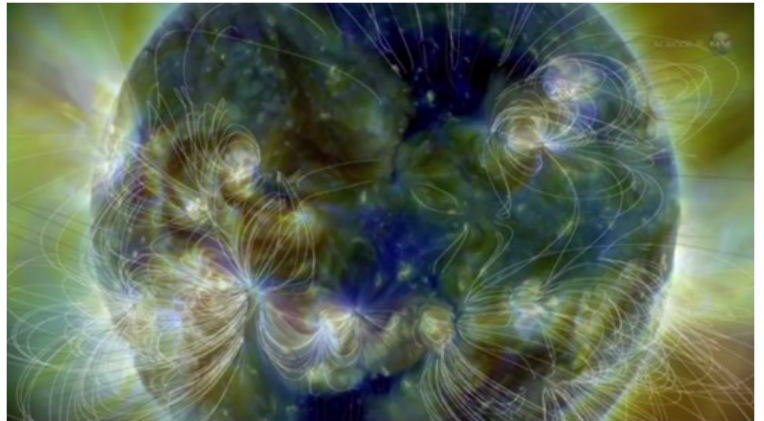


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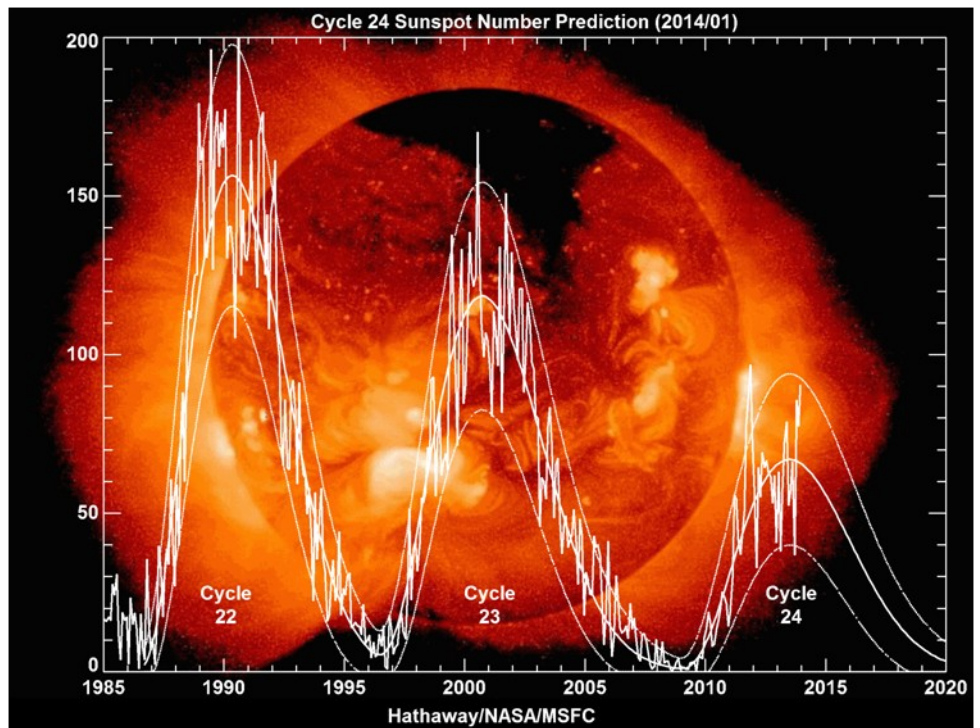
# PRESIDENT'S MESSAGE

[Solar Cycle 24](#) has reached its mid-point where both halves of the sun have reversed magnetic poles. Up until recently, just the upper half had reversed. But in late December, the lower half finally caught up. The sun's current space-weather cycle is the most anemic in 100 years, scientists say.



Our star is now at "solar maximum," the peak phase of its 11-year activity cycle. During a solar maximum, the number of [sunspots](#) increases. These dark temporary regions on the surface of the sun are thought to be caused by interplay between the sun's plasma and its magnetic field. Sunspots are the source of the solar flares and ejections that can send charge particles hurtling toward Earth, which can damage satellites, surge power grids, cause radio blackouts and, more benignly, produce dazzling auroras above the planet. But this solar max is weak, and the overall current cycle conjures up comparisons to the famously feeble Solar Cycle 14 in the early 1900s, researchers said. The number of spots counted since it kicked off in December 2008 is well below the average observed over the last 250 years. In fact, it's less than half. In the first year of the cycle, during which solar activity should have risen, astronomers counted 266 days without a single sun spot.

Previous predictions indicated this solar cycle might have two peaks. In 1989 and 2001, those solar cycles had not one but two peaks. The solar activity went up, dipped and then resumed, performing a mini-cycle that lasted about two years. The similarities between the current cycle and Solar Cycle 14, which happened between February 1902 and August 1913, experienced a double peak. If the two cycles are in fact twins, that it would mean one peak in late 2013 and another in 2015.



What does this mean for hams? We should have reasonably good propagation for three or more years.

73,  
Cordell  
KE7IK

# UPCOMING 2014 ACTIVITIES

- 8** February, 10:00 AM — BARC Club Meeting
- 9** February — The Swapfest (Brighton, CO) [More Info](#)
- 12** February, 7:30 PM - ARRL Rocky Mountain Division Net IRLP Node: 9871
- 20** Feb, 8:00 PM - RACES VHF Net 147.18 Snowbird 147.20 IRLP 146.72 Mt. Logan
- 22** February, 9:00 AM—VHF Society Swap Meet More Info: <http://utahvhfs.org/>
- 1** March, 8:00 AM — VE Test Session at the USU ASTE Bldg RM 108
- 8** March, 10:00 AM — BARC Club Meeting
- 12** March, 7:30 PM - ARRL Rocky Mountain Division Net IRLP Node: 9871
- 15** March 8:00 AM — RACES HF Net 3920 KHz
- 5** April — Longmont ARC LARCFest (Longmont, CO) [More Info](#)
- 9** April, 7:30 PM — ARRL Rocky Mountain Division Net IRLP Node: 9871
- 12** April, 10:00 AM — BARC Club Meeting
- 17** April, 8:00 PM - RACES VHF Net 147.18 Snowbird 147.20 IRLP 146.72 Mt. Logan
- 5** June, 7:00 PM — VE Test Session at the USU ASTE Bldg RM 108

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## Local Radio Nets:

The **Weekly BARC net** is for BARC members and anyone else that would like to check in, held **every Tuesday night at 9:00 p.m.** local time on the Mt Logan BARC Repeater and Linked Systems (146.720)

The **BARC Ladies Net** is every **2nd and 4th Tuesday at 8:00 p.m.** on the BARC Repeater and Linked Systems (146.720). All licensed lady amateur radio operators are welcome to check in.

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**BARC Club Meetings** are normally on the 2nd Saturday of the month at 10:00 A.M. on the 3rd floor of the Cache County Sheriffs Complex on 200 North and 1225 West, Logan, Utah.

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**ARES Meetings** are usually held on the Third Wednesday of each month at 7 P.M. at the Cache County Sheriffs Complex. Contact Tyler Griffiths for more information.

## The ARRL Letter for January 23, 2013

### *International: Canada to Get Five 60 Meter Channels*

Industry Canada [has granted](#) Amateur Radio operators there the use of five 60 meter channels on a non-interference basis. The center-channel frequencies harmonize with those available to US radio amateurs on 60 meters: 5332 kHz, 5348 kHz, 5358.5 kHz, 5373 kHz, and 5405 kHz.



"[G]iven that use of these frequencies was requested, in part, to allow for cross-border communications in times of emergency," Industry Canada said, "harmonization of the frequencies with the United States would facilitate such communications between the Canadian and the US Amateur Radio communities."

Amateur stations will be restricted to USB, data, RTTY and CW modes, with a maximum bandwidth of 2.8 kHz, and a maximum power output of 100 W ERP -- the same as the US allows.

"Canadian amateur operations shall not cause interference to fixed and mobile operations in Canada or in other countries," Industry Canada ruled, "and, if such interference occurs, the Amateur Service may be required to cease operations. The Amateur Service in Canada may not claim protection from interference by the fixed and mobile operations of other countries."

Elsewhere, Unión de Radioaficionados Españoles ([URE](#)) General Secretary Salvador Bernal, EA7SB, [reported](#) recently that Spain's telecommunications regulatory agency has authorized the use of several 60 meter frequencies through June 30, 2014. The authorized center frequencies are 5268, 5295, 5313, 5382, 5430, and 5439 kHz, with a power of 100 W PEP and a maximum bandwidth of 3 kHz. Center channels authorized for the US and Canada differ. The URE is recommending that hams in Spain use USB on 60 meters, the mode employed in most countries authorizing operation on 60 meters.

In the Czech Republic, up to 10 radio amateurs are being permitted to operate on 60 meters on an experimental basis until the end of 2014. This experimental phase of 5 MHz operation follows an initial trial that ended two years ago. Czech Republic radio amateurs holding a special permit may use six channels that are common to many current 5 MHz ham radio allocations. The USB dial frequencies are 5288.5, 5330.5, 5366.5, 5371.5, 5398.5, and 5403.5 kHz. Experimenters will be allowed to operate 100 W ERP on USB and CW (+1.5 kHz from the USB dial frequency). -- *Thanks to Industry Canada and Bryan Rawlings, VE3QN, URE and [Southgate ARC](#)*

## ***ARRL Centennial: A Century of Amateur Radio and the ARRL***

This week we'll look at early Amateur Radio as seen through the viewing port of the December 1915 issue of *QST* -- the magazine's first issue -- whose cover proclaims, "An Amateur Wireless Magazine ... Price 10 cents ... *QST* de The American Radio Relay League."

The December "Radio Relay Bulletin" discusses the fact that the US and other countries face a serious situation, with war clouds on the horizon. It was obvious to the officers of the League that the service of its members as operators could become quite important. Therefore, the League sent a letter to the Secretary of the Navy, offering the services of its members in the event of a national emergency.

For day-to-day operation, regular listening hours are suggested, to listen for stations with messages on their hooks. Lists of members and information on their stations had been circulated before that first issue; additions to that list were published in the first QST and in subsequent issues.

At that time, League membership and a subscription to QST were separate. Membership was free, and a three-month trial subscription to QST cost 25 cents. Among the blanks on the membership application are, "Is your spark gap rotary, fixed, or quenched?" "What tone has your spark?" and "Approximate wave length?" That tells you much about the then-current state of the art.

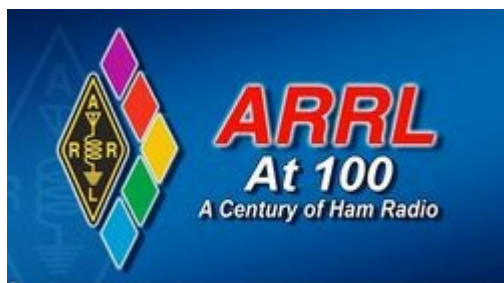
The ads in that first issue touted the various parts available for radio operators. These included the Jove Detector Holder, "for holding one or two crystals and a cat-whisker" (\$1); the Bunnell "renewable contact radio key" (\$7.50); a Stromberg-Carlson radio headset (\$8.25), and the Chambers rotary spark gap (\$12.50): "Gives a tone similar to a flute, on 60 Cycles." *Next time*: The art and science of radio advances by leaps and bounds.



## The ARRL Letter for January 30, 2013

### ARRL Centennial: ARRL Debuts "ARRL at 100" Video

As part of its Centennial celebration, the ARRL has debuted a video, "ARRL at 100 -- A Century of Ham Radio," which explains the League's history and mission over the past century. Past ARRL Manager for Media and Public Relations Allen Pitts, W1AGP, wrote and produced the half-hour presentation. It is available for club meetings and other gatherings. Pitts said he got started on the project about a year ago with a personal study of the League's history.



"Using books, old QSTs, and documents stored in Newington as sources, I eventually created a 28 foot long timeline that rolled across my office floor," he recalled. "This paper roll was then posted in the main hallway, where staff and visitors were invited to write comments and additional events on it."

Last fall, the unwieldy roll was transformed into a more permanent graphic banner that became the basis for the new [timeline booklets](#). These will be freely available at major Cen-

tennial conventions in 2014.

Pitts said he realized that the timeline held an interesting storyline about the ARRL and its protection of Amateur Radio for 100 years, and he decided the next step would be to use it as the basis for scripting a video. "Unlike the classic 'Amateur Radio Today,'" Pitts said, "this new video would *not* be hampered by any TV broadcast restrictions, so it was made to fit into a 30 minute time slot." Al Petrunti, KA1TCH, of [The New Day Group](#) was chosen for the video production. Securing a "personality" to host the video turned out to be easier than it first seemed.

"After inquiries to professional television personalities, it was apparent that the budget could not meet their expense requirements," Pitts explained. As it happened, a host was right at hand, as QST Managing Editor Becky Schoenfeld, W1BXY, stepped forward. "Once again an amateur did excellent professional-grade work," Pitts said. "Becky had done a fair amount of stage work in the past and absolutely lights up the video with her knowledge of ham radio and obvious true interest in the topic. We couldn't be happier."



Becky Schoenfeld, W1BXY.

Pitts solicited brief "I am the ARRL" cameo clips from around the country and included these along with impromptu clips taken at hamfests.

Pitts feels the video represents some of the best script writing he's ever done, "but then, it is one of the best stories I have ever found," he added. "We often say 'If not for the ARRL we would not have ham radio as we know it,' but few people know how very true that is and how close we came on several occasions to not having ham radio."

Pitts credited Petrunti's ability to quickly understand "the visions I had in my head for many video shots. Better yet, he was excellent at putting people at ease in front of the camera -- and we had a lot of people."

First to view the video was the ARRL Board of Directors at its annual meeting earlier this month. "Since then it has already received many compliments from hams and professional videographers," Pitts said.

The video can be seen and/or downloaded from the [ARRL website](#) and viewed on [YouTube](#). [DVDs](#) are for sale from the ARRL online store. ARRL Directors and Section Managers received courtesy copies of the DVD and booklets.

If you have the ability to show the DVD on a TV or cable outlet, contact Media and Public Relations Manager [Sean Kutzko](#), KX9X, for special DVDs or extra high-resolution files.

## ***Milestones: IARU President Appointed Queen's Counsel in Alberta***

International Amateur Radio Union ([IARU](#)) President Tim Ellam, VE6SH/G4HUA, of Calgary was among those appointed Queen's Counsel in the Canadian Province of Alberta. Attorney General Jonathan Denis, QC, [announced](#) the names of 114 lawyers to be admitted as Queen's Counsel for "outstanding contributions to legal and public life." The list includes both public and private sector lawyers who have practiced in communities across the province.

"The Queen's Counsel designation recognizes the exceptional capabilities and talents of this year's impressive group," said Jonathan Denis, Alberta's Minister of Justice and Solicitor General. "These lawyers are a credit to their profession and to their province." Read [more](#).



IARU President Tim Ellam, VE6SH/G4HUA.  
[Tony Waltham, HS0ZDX, photo]

**This article was provided by Tyler Griffiths, N7UWX, and will be part of a presentation at the BARC club meeting this Saturday, the 8th of February.**

## **Dave's Shopping List**

<u>Part #</u>	<u>Description</u>	<u>Price</u>	<u>Qty</u>
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

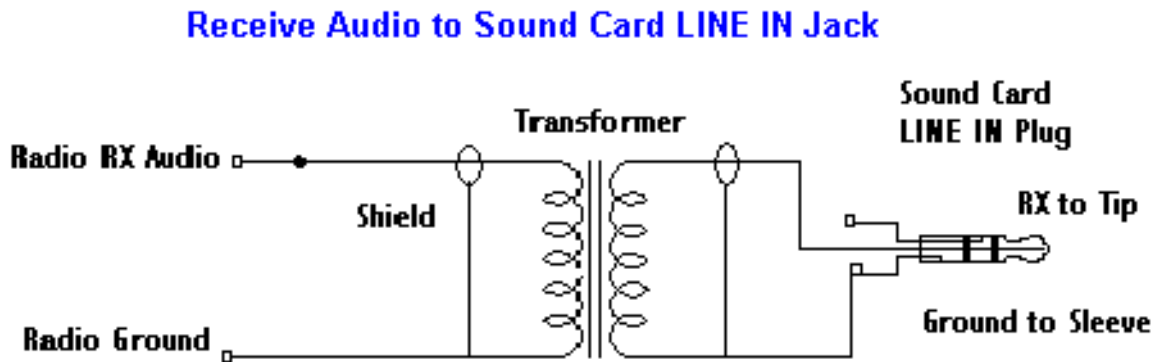
At the sound card, you want to use the LINE IN jack. It is normally a good match to a typical radio's RX audio voltage. If you need to use the sound card's more sensitive MIC jack, [see the MIC schematic below](#) for more information including a schematic that adds in a voltage divider circuit. You 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

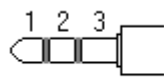
You should also use shielded cable to reduce the risk of any RFI (Radio Frequency Interference) getting on the RX signal.

Here's the schematic for an isolated RX cable:



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.



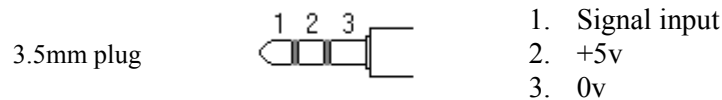
1. Left channel +
2. Right channel +
3. Left and right channel -



## 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.)

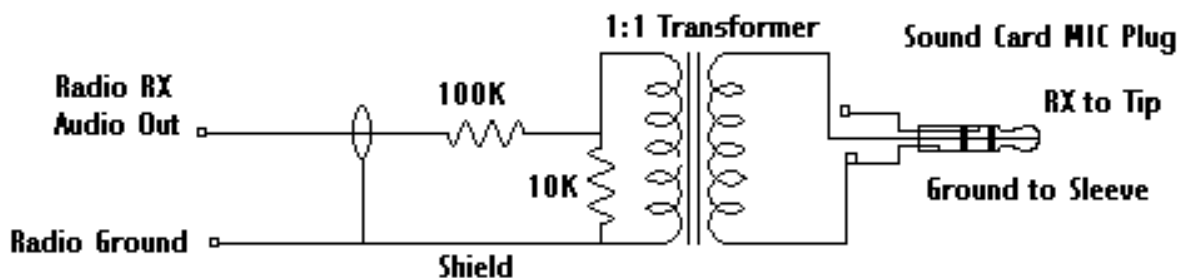
**Warning:** On most sound cards, the Microphone (MIC) jack **does not** allow stereo input, i.e. a left and right channel. Typically, the ring in the MIC jack is used to provide a +5 bias voltage to power electret microphones. It is **not** used for stereo (right channel) input. For that reason, you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



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

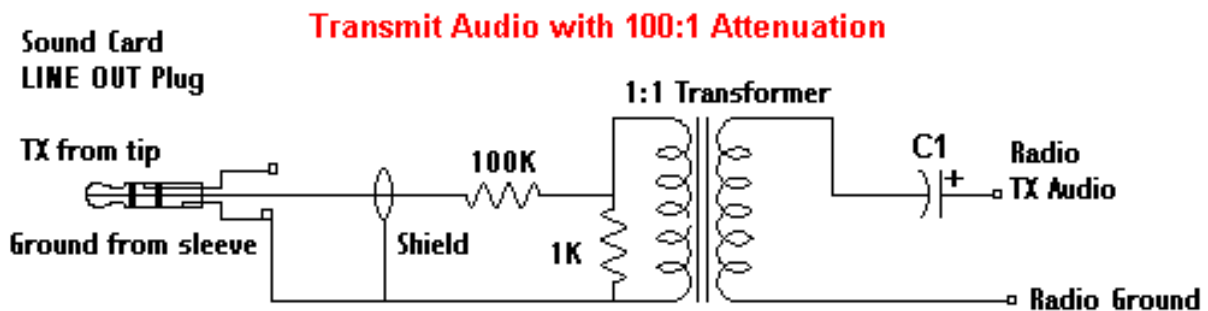
This page has advice for those building their own interface.

The TX audio cable can be a little more complicated than 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<sub>p-p</sub>) down to the level your radio normally would expect for microphone (20 -40 millivolt<sub>p-p</sub>). For example, a 50:1 attenuation works better for me, since I use my radio's data jack which has a maximum input voltage of 40 mV<sub>p-p</sub>.

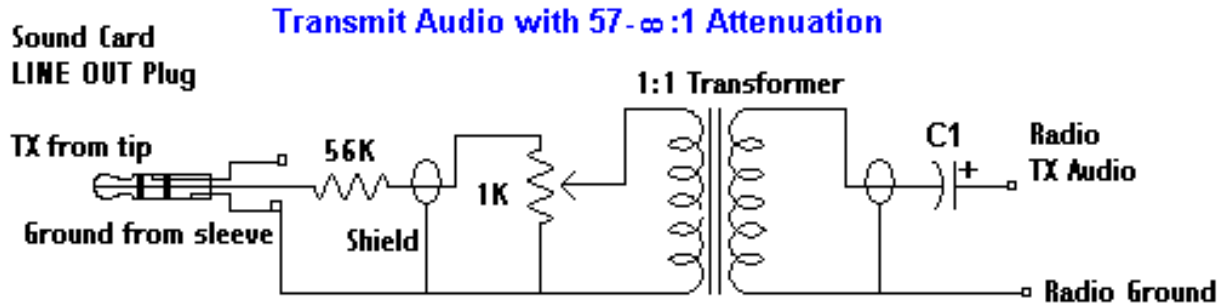
Here's a schematic for the attenuation circuit:



**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 it easier to adjust:

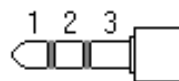


**C1 = optional capacitor blocks DC voltage; may be required for radios sharing TX and PTT lines, e.g. hand held radios**

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:

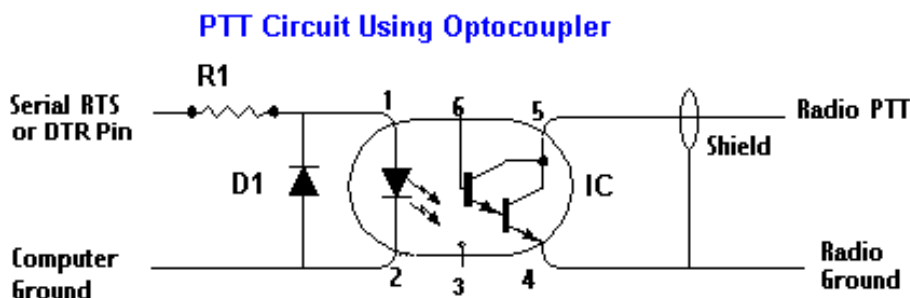
1. [Build a cable with an isolated 'gate' circuit](#) that opens the radio's PTT circuit when it receives a signal from the serial or parallel port.

### 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.

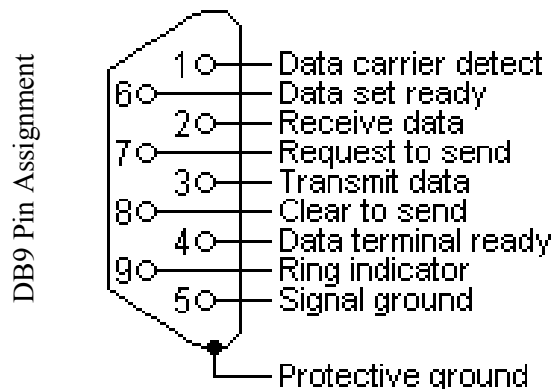
(Note: to identify pin #1, look for a small embossed circle on the top of the IC above pin 1; or looking into the notch in one side of the IC with the pins down, pin #1 is to the right of the notch.)

**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.

Membership in **The Bridgerland Amateur Radio Club, Inc. (BARC)** is open to anyone interested in Amateur Radio. You do not need an amateur license to join. Learn more online at <http://www.barconline.org/> or by emailing [membership@barconline.org](mailto:membership@barconline.org).

The Bridgerland Amateur Radio Club provides the following to its members:

- A repeater system that covers northern Utah from Bear Lake to Salt Lake Valley.
- Events where you can practice your radio skills in a fun learning environment.
- Club meetings are held the second Saturday each month from October to May. An opportunity to meet and learn from other amateur operators.
- Social activities where members can make friends and interact with other members.



Your tax deductible membership supports club activities and the BARC repeater system.

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### The Bridgerland Amateur Radio Club, Inc.

#### Membership application for the year 2014

*Dues are in effect January 1, 2014 through December 31, 2014  
New Members Only, individual membership dues prorated quarterly  
Please indicate if you or family member is an American Radio Relay League (ARRL) member*

Name \_\_\_\_\_ Call Sign \_\_\_\_\_ Date Paid \_\_\_\_\_

ARRL member

P.O. Box \_\_\_\_\_ Street Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip Code \_\_\_\_\_

Home Phone ( ) \_\_\_\_\_ Work Phone ( ) \_\_\_\_\_

E-mail \_\_\_\_\_

(The club's newsletter, THE OHM TOWN NEWS, is sent to the E-mail Address)

Individual Membership - \$25 \$ \_\_\_\_\_

Addition Family members in same household - \$3 ea \$ \_\_\_\_\_

Donation for Repeater upgrades / equipment purchases \$ \_\_\_\_\_

Total \$ \_\_\_\_\_

#### Names and Call Signs of additional family members

Name \_\_\_\_\_ Call Sign \_\_\_\_\_

ARRL member E-mail \_\_\_\_\_

Name \_\_\_\_\_ Call Sign \_\_\_\_\_

ARRL member E-mail \_\_\_\_\_

Name \_\_\_\_\_ Call Sign \_\_\_\_\_

ARRL member E-mail \_\_\_\_\_



Bridgerland Amateur Radio Club is an ARRL affiliated club

Mail your completed form and a check to: B.A.R.C., P.O. Box 111, Providence UT 84332-0111 or pay online at <http://www.barconline.org/?q=node/242>

*B.A.R.C. is a non-profit organization*

## Questions for Extra Class License

1. (E1B01) Which of the following constitutes a spurious emission?
  - A. An amateur station transmission made at random without the proper call sign identification
  - B. A signal transmitted to prevent its detection by any station other than the intended recipient
  - C. Any transmitted bogus signal that interferes with another licensed radio station
  - D. An emission outside its necessary bandwidth that can be reduced or eliminated without affecting the information transmitted
2. (E2A01) What is the direction of an ascending pass for an amateur satellite?
  - A. From west to east
  - B. From east to west
  - C. From south to north
  - D. From north to south
3. (E3A03) When scheduling EME contacts, which of these conditions will generally result in the least path loss?
  - A. When the Moon is at perigee
  - B. When the Moon is full
  - C. When the Moon is at apogee
  - D. When the MUF is above 30 MHz
4. (E4A08) Which of the following instruments would be best for measuring the SWR of a beam antenna?
  - A. A spectrum analyzer
  - B. A Q meter
  - C. An ohmmeter
  - D. An antenna analyzer
5. (E5A06) What is the magnitude of the circulating current within the components of a parallel LC circuit at resonance?
  - A. It is at a minimum
  - B. It is at a maximum
  - C. It equals 1 divided by the quantity 2 times Pi, multiplied by the square root of inductance L multiplied by capacitance C
  - D. It equals 2 multiplied by Pi, multiplied by frequency "F", multiplied by inductance "L"
6. (E6A16) What are the majority charge carriers in N-type semiconductor material?
  - A. Holes
  - B. Free electrons
  - C. Free protons
  - D. Free neutrons
7. (E7A02) How many output level changes are obtained for every two trigger pulses applied to the input of a T flip-flop circuit?
  - A. None
  - B. One
  - C. Two
  - D. Four
8. (E8A03) What type of wave is made up of sine waves of a given fundamental frequency plus all its harmonics?
  - A. A sawtooth wave
  - B. A square wave
  - C. A sine wave
  - D. A cosine wave
9. (E9D03) How does the beamwidth of an antenna vary as the gain is increased?
  - A. It increases geometrically
  - B. It increases arithmetically
  - C. It is essentially unaffected
  - D. It decreases
10. (E0A03) Which of the following would be a practical way to estimate whether the RF fields produced by an amateur radio station are within permissible MPE limits?
  - A. Use a calibrated antenna analyzer
  - B. Use a hand calculator plus Smith-chart equations to calculate the fields
  - C. Use an antenna modeling program to calculate field strength at accessible locations
  - D. All of the choices are correct

[\(For answers to test questions see page 16\)](#)

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[Answers to questions on page 15](#): 1-D, 2-C, 3-A, 4-D, 5-B, 6-B, 7-C, 8-A, 9-D, 10-C

