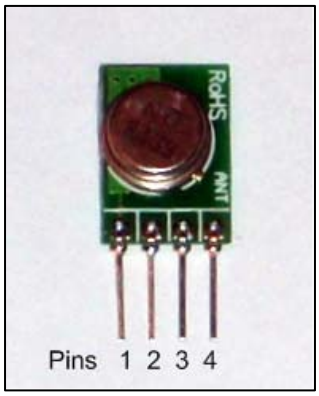
Activity 3: Wireless Communication Student Handout

Name: _____

Date: _____

For this activity, you will be modifying your wired communication system to make it wireless. In the end, the transmitter/receiver pair will behave exactly the same as it did with the wired system, except that the wire transmitting the data has been replaced with a radio frequency (RF) link. The only additional components in these circuits are the RF transmitter chip and the RF receiver chip.

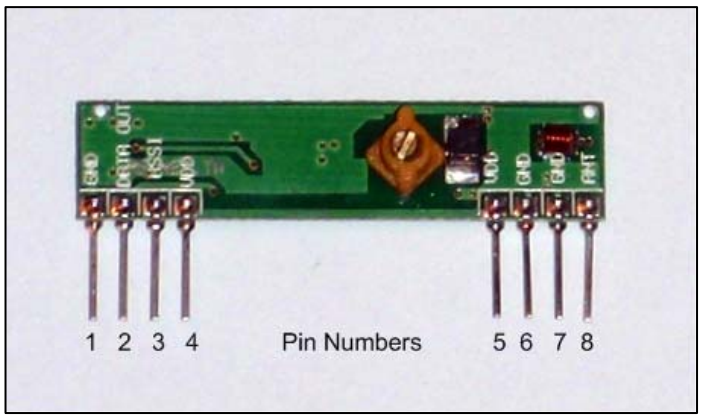
Parts Descriptions



RF Transmitter Chip
The RF Transmitter Chip is shown to the left. It takes the electrical signal from the decoder and radiates it as a radio signal. This radio signal is transmitted in all directions.

RF Receiver Chip
The RF Receiver Chip is shown to the right. It receives the radio signal sent by the transmitter. It is connected to the decoder where the wire was connected in the wired system.

Radio signals are sent at different frequencies. This receiver operates at the same radio frequency as the transmitter, 433 MHz.



Steps for Building RF Receiver Circuit

Before beginning to modify your current receiver circuit, connect your transmitter and receiver circuits from the last activity to make sure they are still working. If they do not work, follow the troubleshooting steps in Activity 2.

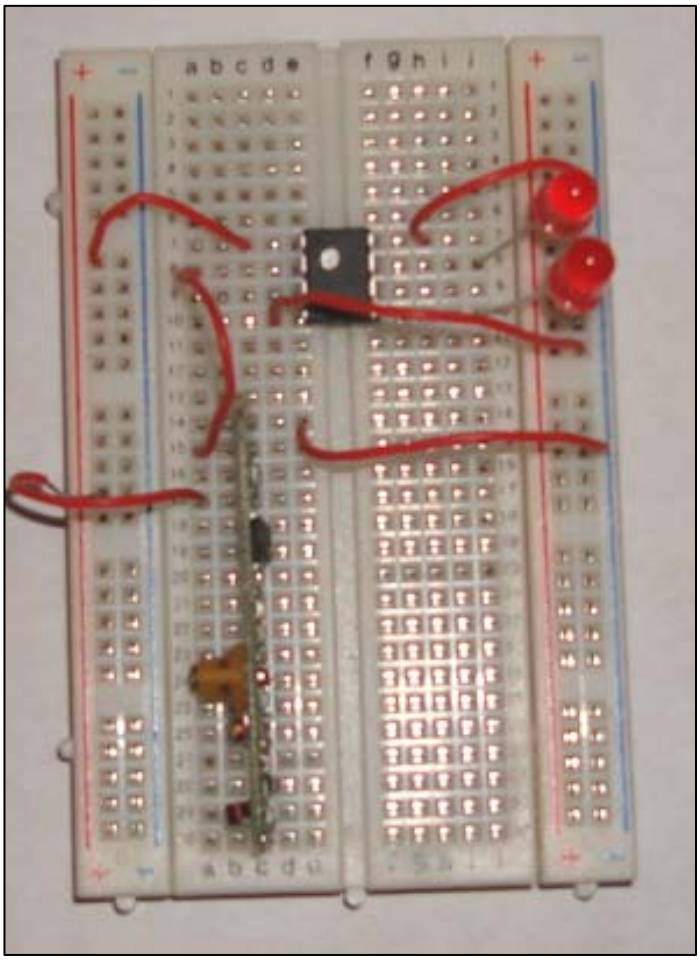
Now, you will remove the wire links between the transmitter and receiver and replace the wires with radio frequency (RF) transmitter and receiver chips.

Step	Component	Placement Location *(Suggested holes)*
1	Battery Pack	• If connected, disconnect the battery pack from the transmitter and receiver.
2	Long Wires	• If connected, disconnect two long wires connecting transmitter and receiver circuits.
3	RF Receiver Chip	• Insert the RF receiver chip into the breadboard. Make sure all the pins are in the same column of the breadboard and are not bending. Do not put the RF receiver chip in a power rail. • *(Position the RF receiver chip so that the text and copper wire loop face to the left, and so that the bottom pin is in the bottom row of the breadboard (row 30).)* • *(Pin 1 in C14 and pin 8 in C30)*
4	2” jumper	• Connect pin 1 of the RF receiver chip to anywhere on the blue negative power rail on the right. • *(E14 to right blue rail)*
5	2” jumper	• Connect pin 4 of the RF receiver chip to the red positive power rail on the left. • *(A17 to left red rail)*
6	2” jumper	• Connect pin 2 of the RF receiver chip to pin 2 of the decoder chip. • This will carry the signal.*(A16 to C8)*
7	Battery Pack	• Don’t connect the battery pack yet. The battery pack will be connected **after** you have completed the receiver circuit. Next, build the transmitter circuit according to the directions. In your group, some students may not build transmitters. In this case, borrow one of you friends’ transmitters.

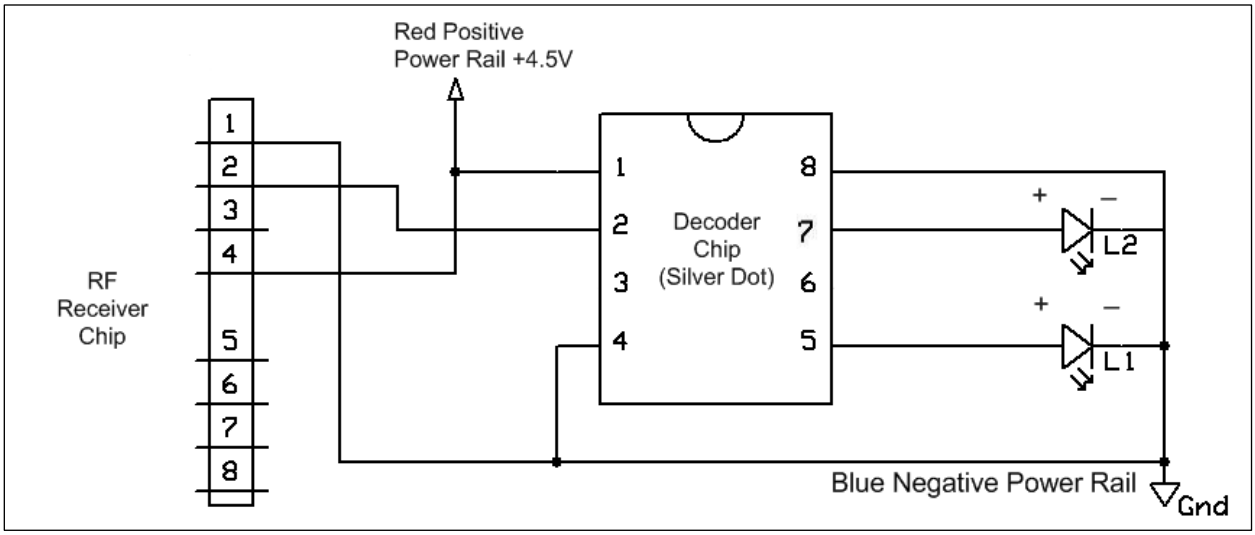
RF Receiver Circuit

Receiver Parts

- 1 Receiver circuit from Activity 2 with decoder chip (silver dot)
- 1 RF Receiver chip
- 2” Jumper Wires
- 3 AA Batteries
- Battery case



RF Receiver Circuit Diagram



Steps for Building RF Transmitter Circuit

Now, you'll modify your transmitter circuit to use the RF transmitter chip.

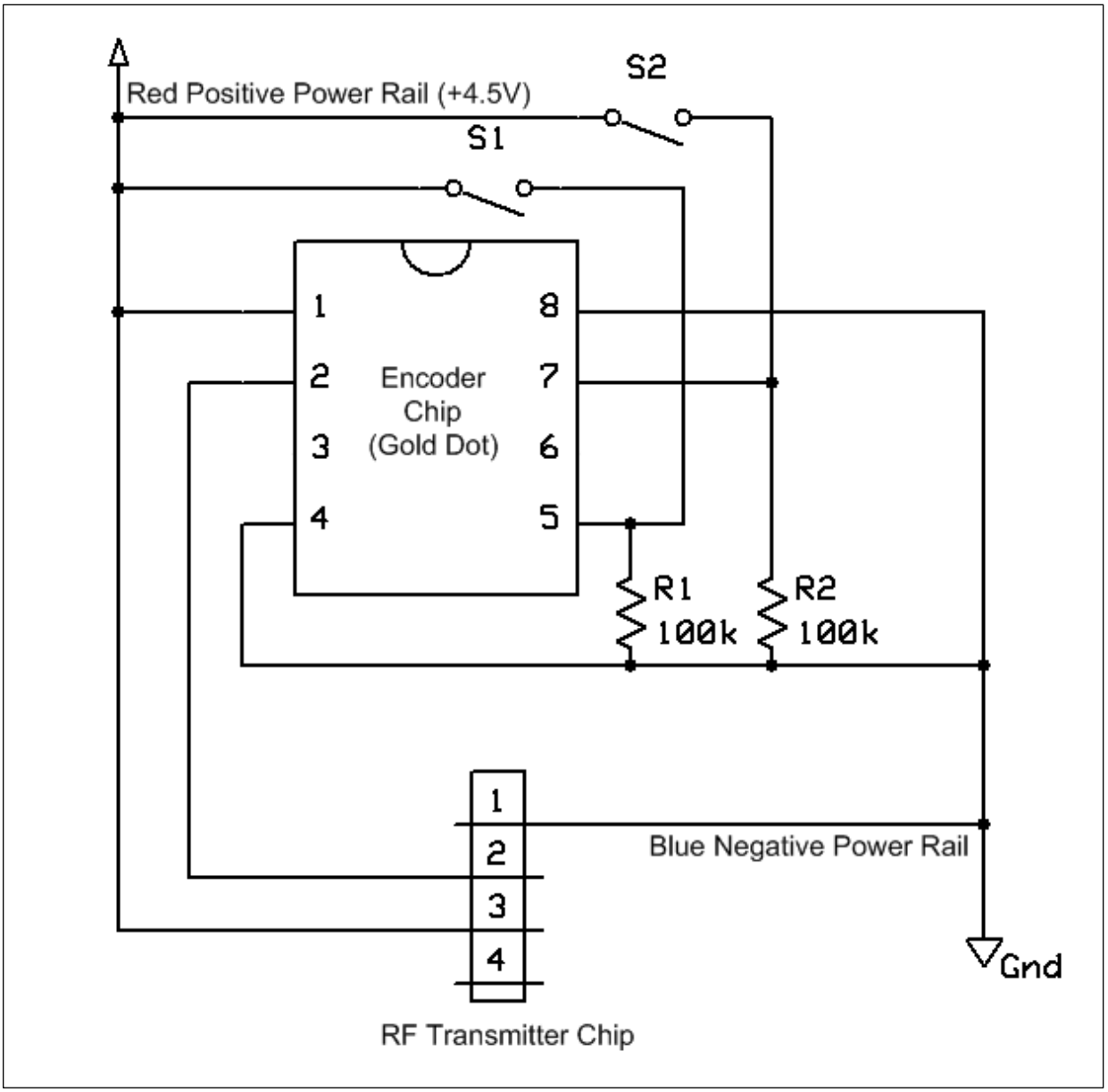
Step	Component	Placement Location *(Suggested holes)*
1	Battery Pack	• If connected, disconnect the battery pack from the transmitter and receiver.
2	RF Transmitter Chip	• Insert the RF transmitter chip into the breadboard. Make sure all the pins are in the same column of the breadboard and are not bending. Do not put the RF transmitter chip in a power rail. • *(Position the RF transmitter chip so that the text and silver disc face to the left, and so that the bottom pin is in row 20.)* • *(Pin 1 in C17 and pin 4 in C20)*
3	2" jumper	• Connect pin 1 of the RF transmitter chip to anywhere on the blue negative power rail on the right. • *(E17 to right blue rail)*
4	2" jumper	• Connect pin 3 of the RF transmitter chip to the red positive power rail on the left. • *(A19 to left red rail)*
5	2" jumper	• Connect pin 2 of the of the RF transmitter chip to pin 2 of the encoder chip. • This will carry the signal. • *(A18 to C8)*
7	Battery Pack	• Instructions for connecting your battery packs are on the following page.

RF Transmitter Circuit

RF Transmitter Parts

- 1 Transmitter circuit from Activity 2 with encoder chip (gold dot)
- 1 RF Transmitter chip
- 2” Jumper Wires
- 3 AA Batteries
- Battery case

RF Transmitter Circuit Digram



RF Transmitter Circuit Photos

Photo of complete RF Transmitter Circuit without battery pack (Right).

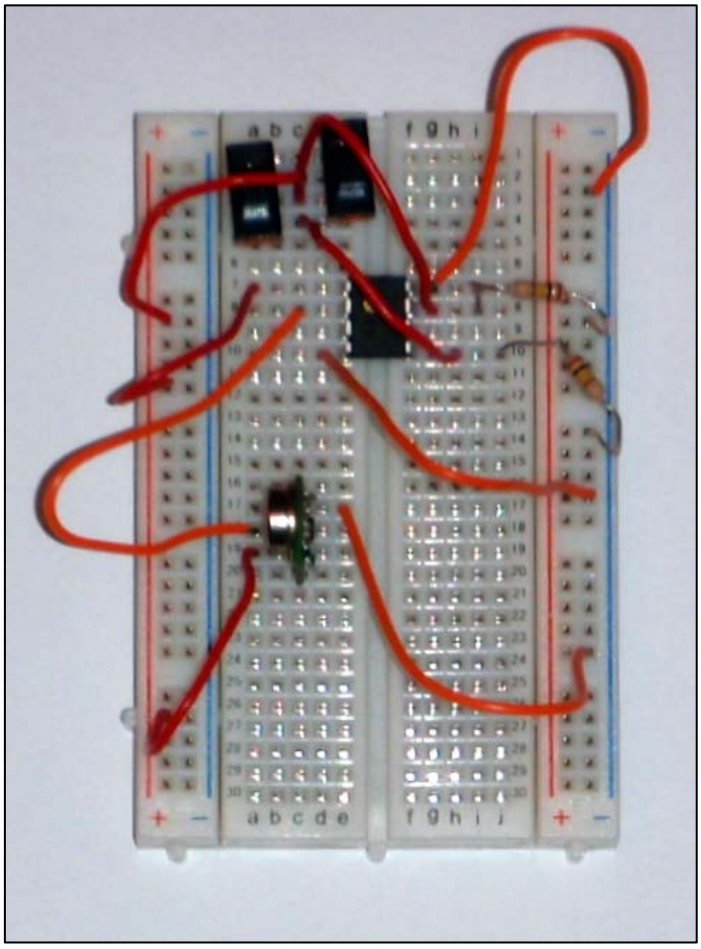
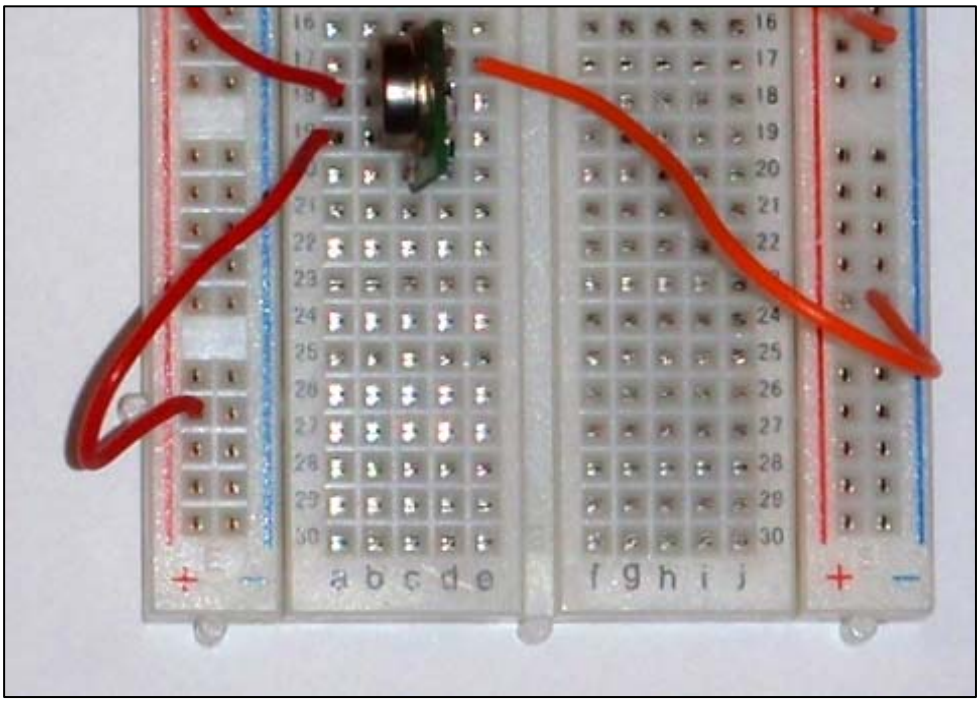


Photo of RF Transmitter Circuit zoomed in on the RF Transmitter Chip connections.



Testing your RF Transmitter and Receiver

This circuit should operate exactly the same as the wired one from Activity 2 – the only change you've made is to replace the wired connection between the breadboards with a wireless one. The electrical signal goes from the encoder chip to the RF transmitter chip which then transmits the radio signal. The RF receiver chip receives the radio signal and sends the electrical signal to the decoder. The decoder interprets the signal and determines which LEDs to turn on.

Step	Component	Placement Location *(Suggested holes)*
1	Receiver Battery Pack	• Connect red wire of battery pack to anywhere on the left red positive power rail of the receiver. • Connect the black wire of the battery pack to anywhere on the right blue negative power rail of the receiver.
2	Transmitter Battery Pack	• Connect red wire of battery pack to anywhere on the left red positive power rail of the transmitter. • Connect the black wire of the battery pack to anywhere on the right blue negative power rail of the transmitter.
3	Test Circuit	• Try flipping each switch to make sure that it controls an LED on the receiver.
4	Troubleshooting	• If either of the LEDs do not work, move on to the troubleshooting section to figure out what is wrong.

Troubleshooting

If one or both LEDs are not working when you move the switches, you will need to troubleshoot your circuit. Troubleshooting is the process of figuring out why a circuit does not work. It is a very important part of being an electrical engineer. The problem with the circuit will be one of the mistakes listed below. You must go through each step carefully until you find and correct the problem.

Step 1. Follow troubleshooting steps from Activity 2.

Step 2. Check that the RF transmitter and RF receiver chips are both inserted with their wording to the left.

Step 3. Check the connection to each pin of the RF transmitter and RF receiver chips using the above instructions as a guide.

Exploring the Wireless Transmitter and Receiver

Only one group at a time can test its transmitter circuit, and all of the other groups will test their receiver circuits based on the signals from this single transmitter circuit. When that group is testing its transmitter, all other groups will receive its signal.

How reliable is the wireless communication? Turn one of the LEDs on, and try to block the signal by putting objects between the transmitter and receiver. Are you able to break the link? (If the LED starts flashing, this typically means the receiver is not getting a strong signal).

How far can you separate the transmitter from the receiver before they start to lose the connection?	
Insert a wire (2" jumper or longer) into the breadboard row connected to pin 4 of the RF transmitter chip *(RF transmitter circuit hole E20)*. This will act as an **antenna**. Record the distance that you can now separate your transmitter and receiver.	
You can also try using an antenna on the receiving end by putting a wire (2" jumper or longer) into pin 8 of the RF receiver *(RF receiver circuit hole E30)*. Record the distance that you can now separate your transmitter and receiver.	

What are advantages of using an RF transmitter and receiver compared to a wired transmitter and receiver?

What might be some advantages of the wired system you built last time over the wireless system you built today?