This derives from the formula for power: P=I^2R. A wire or resistor can stand an overload for a short time due to thermal lag. This is the formula for fusing: F=I^2 T where F is the fusing rating and T is the time. If the rating is nine, the wire will fuse at three amps in one second or 9.5 amps in 0.1 seconds.

**SMALL TRANSMITTER AND RECEIVER**

When my dog was a puppy, I had to use a Remote Trainer to keep him from getting in trouble. The Trainer had two functions: one was an Audible Tone; the other was a small Static Shock that was variable in strength. I hated to use the Static Shock even though I tested it on myself first and it does not really hurt, it just startles the dog. He is now a well-behaved dog in most circumstances. The only problems I have are when he is off leash. For example, if someone nearby has food, he has to stick his nose in it to see if there is anything for him. I no longer have to use the Static Shock and the Audible Tone works like a charm to get him to behave, but I hate changing out his collars to use the Trainer.

I would like to build a small transmitter and mini receiver. The receiver needs to be very small and light weight so I can attach it to his collar when needed. It needs to be battery powered and last for up to eight to 10 hours. An inexpensive battery type would be helpful. The transmitter can be larger,
but small would be better. It needs a range of 100 to 200 feet (or longer if possible). The transmitter needs one function to activate an audible tone on the dog's collar with another louder tone as a second function for when he does not listen to the first one. I'd like it to be immune from outside interference if possible. Can you help me out with these two circuits?

— Jim Meng (Cypress, CA)

Some years ago, Mouser carried a ceramic antenna for 433 MHz that was about two inches long. I was intrigued and bought two of them. I got a transmitter and receiver from QKits in Canada [www.qkits.com](http://www.qkits.com) ($10 each) and found that the antenna worked very well. I used a reflector at the transmitter and got 1,000 feet range. Without the reflector, the range would be much less, probably 100 feet. The problem is that I don't know where to find that antenna; Mouser no longer lists it and the manufacturer (Yageo) does not even list antennas on its website. The bottom line is: You can purchase a helix antenna which is bulky, or just use a six inch piece of wire.

QKits has some newer transmitters and receivers; the 500 mW transmitter should have a lot more range than the 80 mW version I used. The online documentation is sparse; I don't know the pinout but labeled the pins as I think they will be. See Figure 5 for the schematics. The transmitter and receiver are rated 4.5 to five volts, so should work with four AAA cells.

In order to have some interference rejection, I put a 555 timer running at 1 kHz feeding the data input of the transmitter. At the receiver, a 4046 PLL locks on to 1 kHz and the lock signal at pin 1 turns on a MOSFET to energize the buzzer. The buzzer is only 1/2 inch in diameter but it is loud; the dog won't like it. Any logic level MOSFET will work like the VN2222LL for example. The buzzer is Mouser part number 665-Al-1622WT5VR.