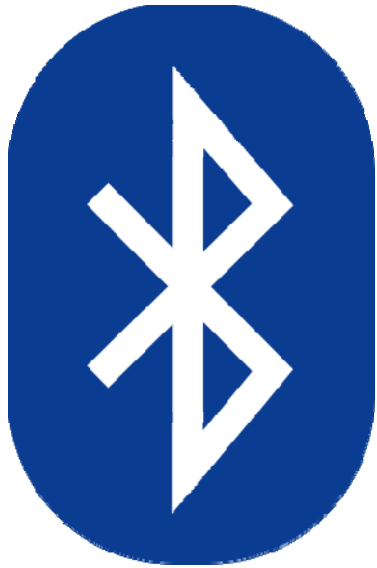




Bluetooth Input for Antique Radios

Al Klase – N3FRQ
New Jersey Antique Radio Club
14 Feb 2020



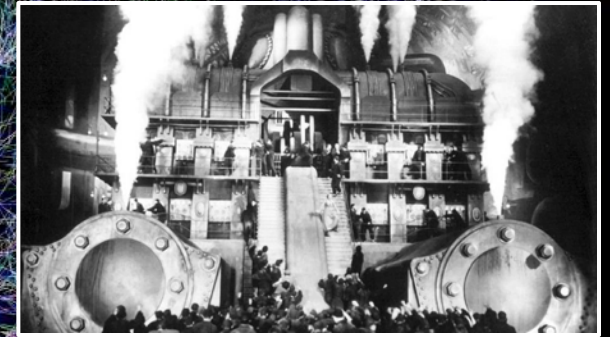
Stone Age



Bronze Age



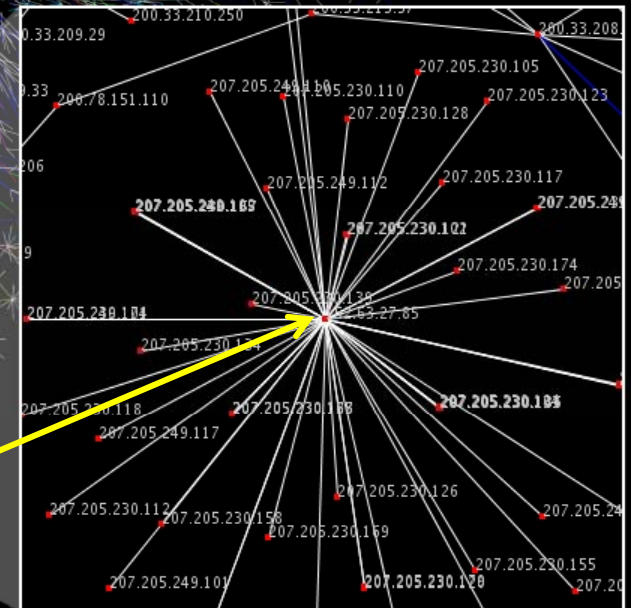
The Scientific Revolution



Machine Age

**You are living in the
Information Age!**

You are here!

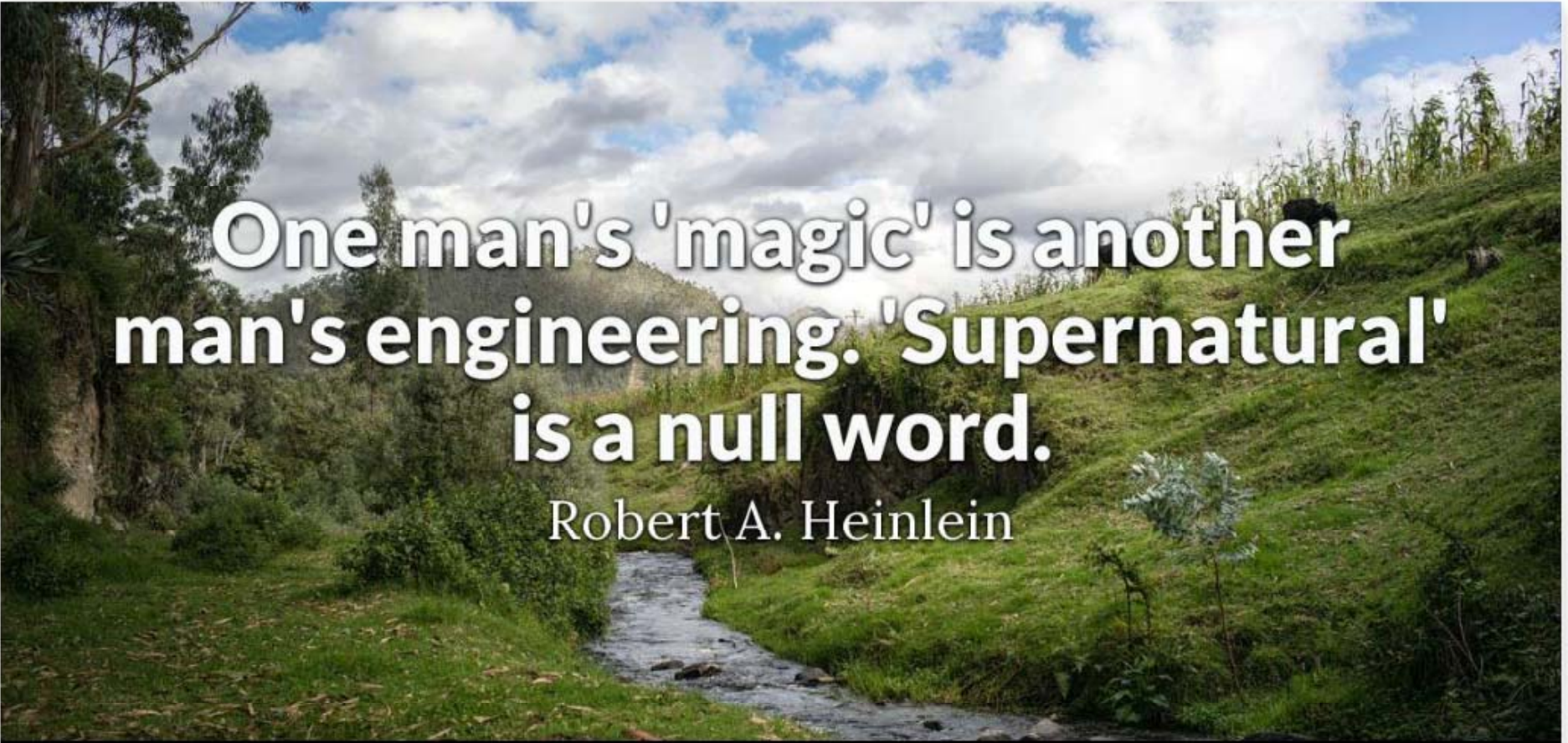


Clarke's Laws

1. When a distinguished but elderly scientist states that something is possible, he is almost certainly right. When he states that something is impossible, he is very probably wrong.
2. The only way of discovering the limits of the possible is to venture a little way past them into the impossible.
3. Any sufficiently advanced technology is indistinguishable from magic.

Arthur C. Clarke, "Profiles of The Future", 1962

British science fiction writer, science writer and futurist (1917 - 2008)



**One man's 'magic' is another
man's engineering. 'Supernatural'
is a null word.**

Robert A. Heinlein

For Instance



Bluetooth

- **Short-range, Bi-direction Radio Connection**
- Ericsson Mobile in Sweden – 1989
- First consumer Bluetooth device was launched in 1999.
 - Hands-Free Mobile Headset
- 2,4 GHz
- Operates on the “FM” principle:
 - Adaptive Frequency-Hopping spread spectrum (AFH)
 - Flow Control and Retransmission Modes
- **Enables Personal-Area Networks**
- **Turn your radio into a Bluetooth speaker.**

What's in a Name?

The name *Bluetooth* is an Anglicized version of the Scandinavian *Blåtand/Blåtann* (Old Norse *blátǫnn*), the epithet of the tenth-century **king Harold Bluetooth who united dissonant Danish tribes into a single kingdom**. The implication is that Bluetooth unites communication protocols.

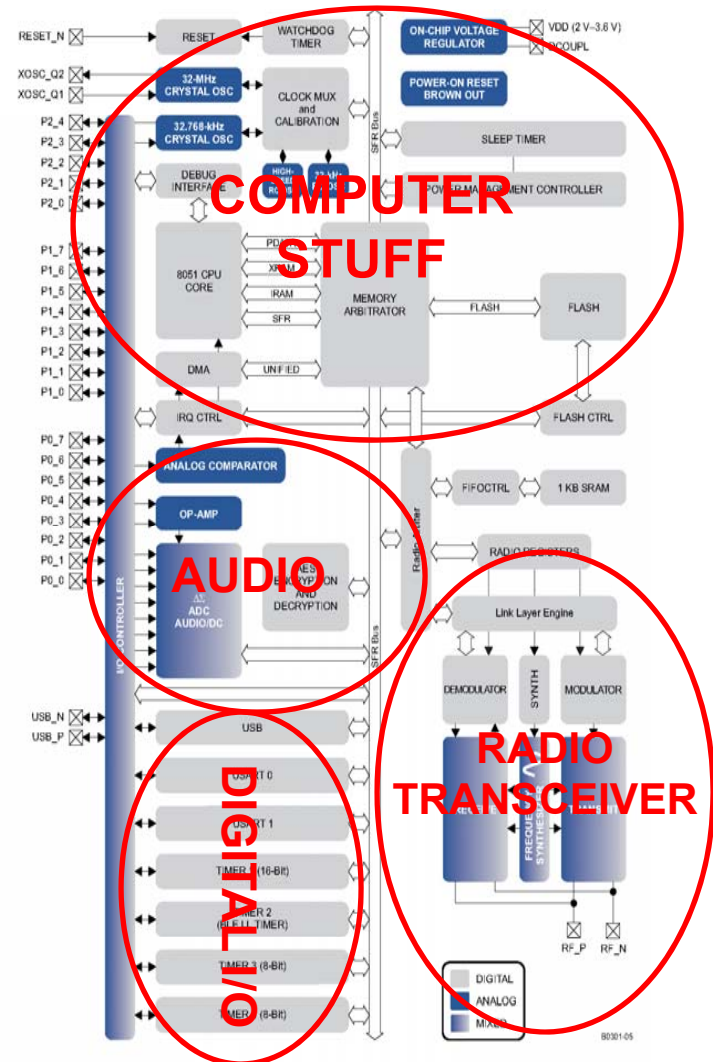


The Bluetooth logo is a bind rune, merging the Younger Futhark runes (*, Hagall) and (ᚷ, Bjarkan), Harold's initials.

SoC

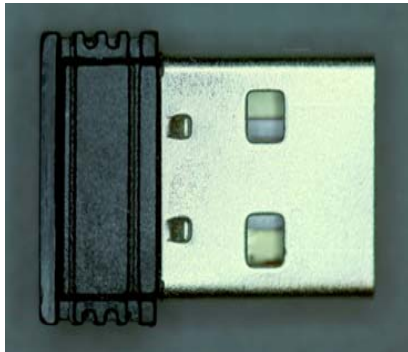
A System on a Chip

- Traditional integrated circuits are produced using various fabrication processes tailored to specific functions.
 - Random Logic (Processors, etc.)
 - Memory
 - RAM (Random Access Memory)
 - ROM (Read Only Memory)
 - Flash (Permanent re-writeable data storage)
 - Analog
 - Audio Circuits
 - Radio Circuits
- Modern SoC processes offer all in one device!



Texas Instruments - 2.4-GHz Bluetooth® low energy System-on-Chip

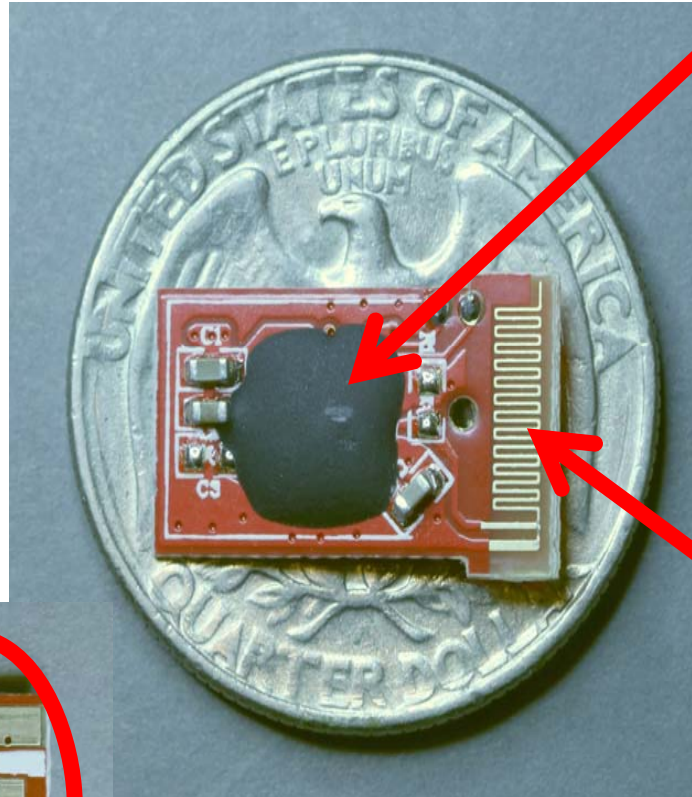
A USB Two-Way Radio to Connect to a Wireless Keyboard



16 MHz Quartz-Crystal
Frequency Reference



USB Signal and Power Connections



Complete Radio System

One Integrated Circuit
Bonded Directly to Circuit Board
Protected by Epoxy

Known as Chip-on-Board Construction
Eliminates the cost of an IC package.

The Antenna

Launches and Intercepts Radio
Waves

Can be small due to:
High Frequency – 2.4 GHz
Yields
Short Wavelength – 125 MM

So an effective Quarter-Wave
antenna can be folded to fit.

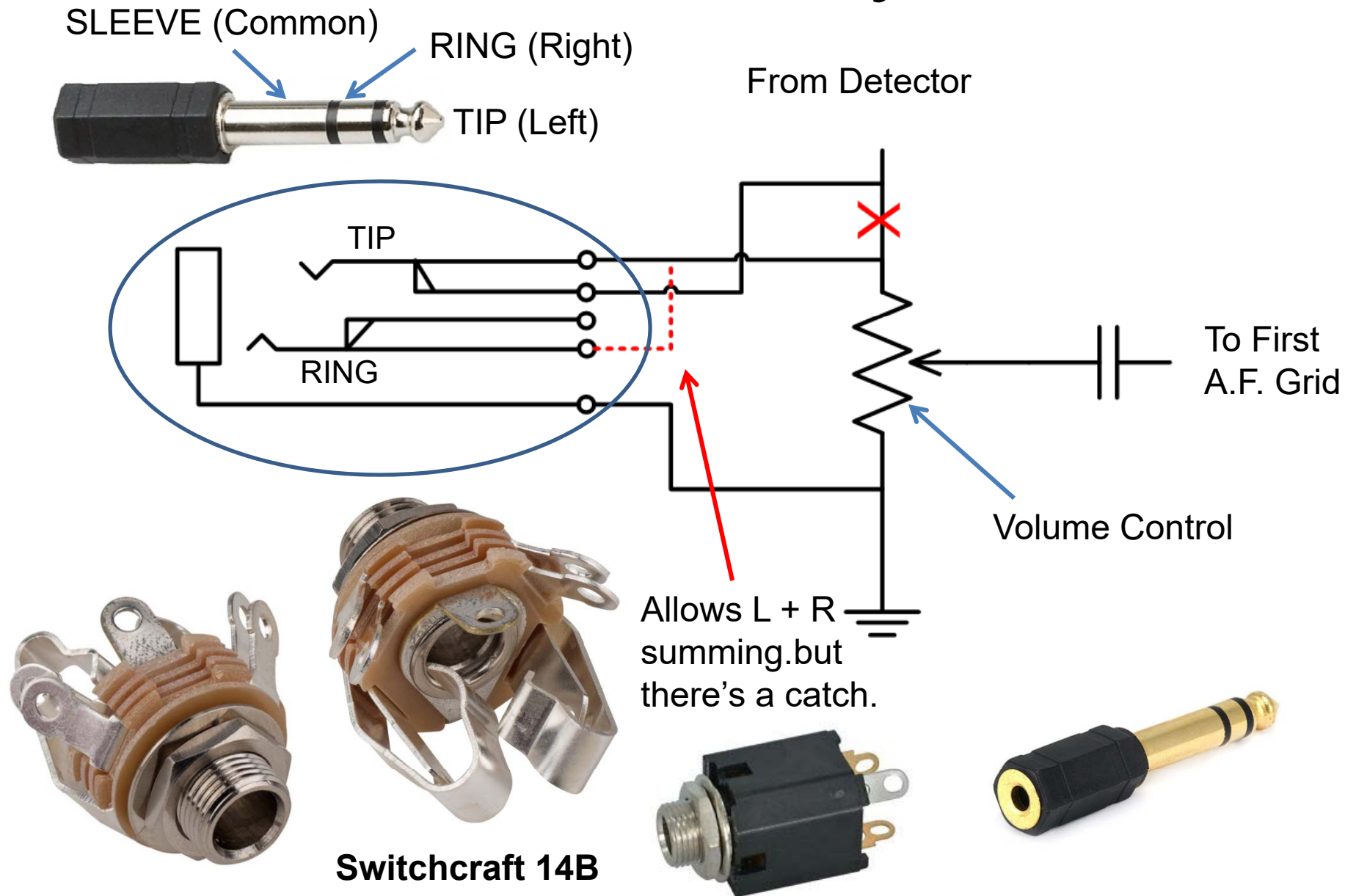
Retail Price
About a Buck!

Available Hardware

- 1/8" (3.5 MM) Audio Connectors
- Internal Battery – USB Charging
- Car adaptors have microphones.
- Use you radio for a speakerphone!



Easiest Way

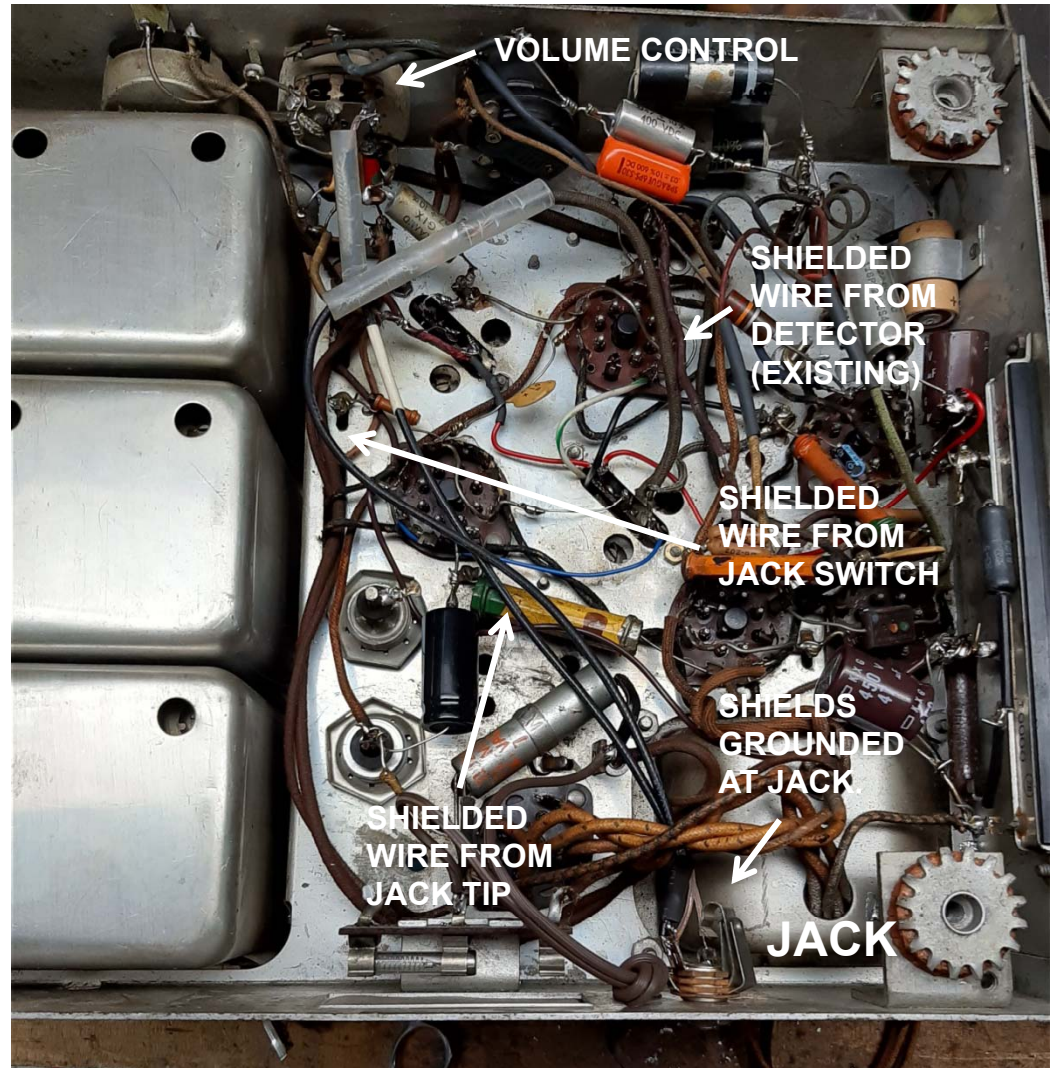
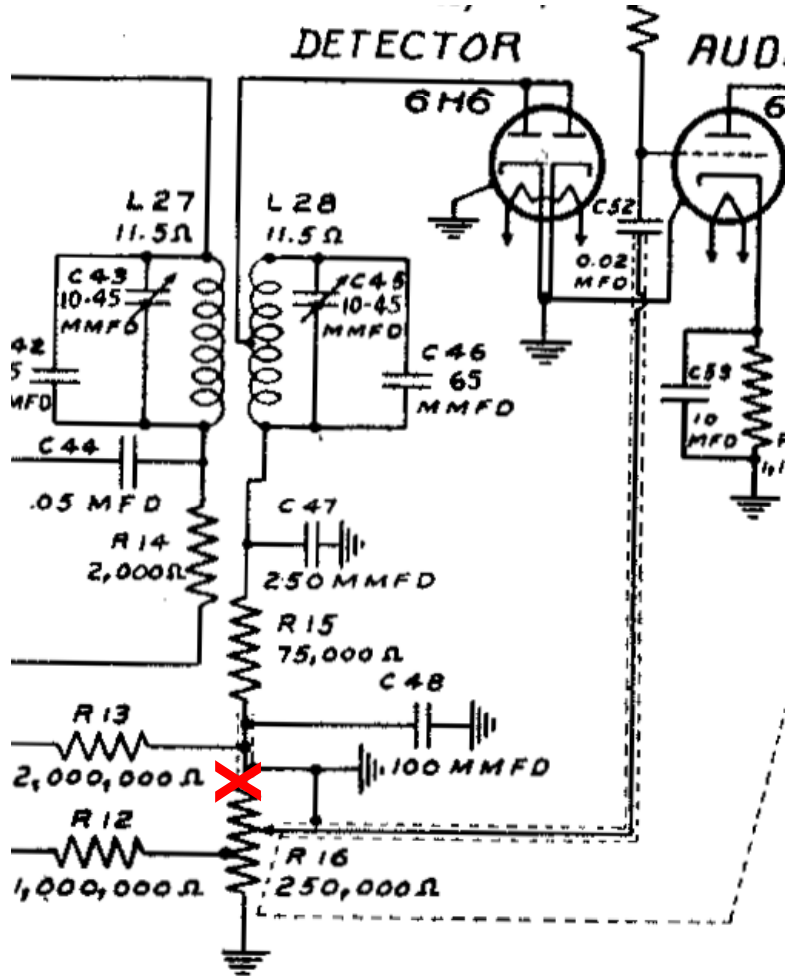


An Actual Installation

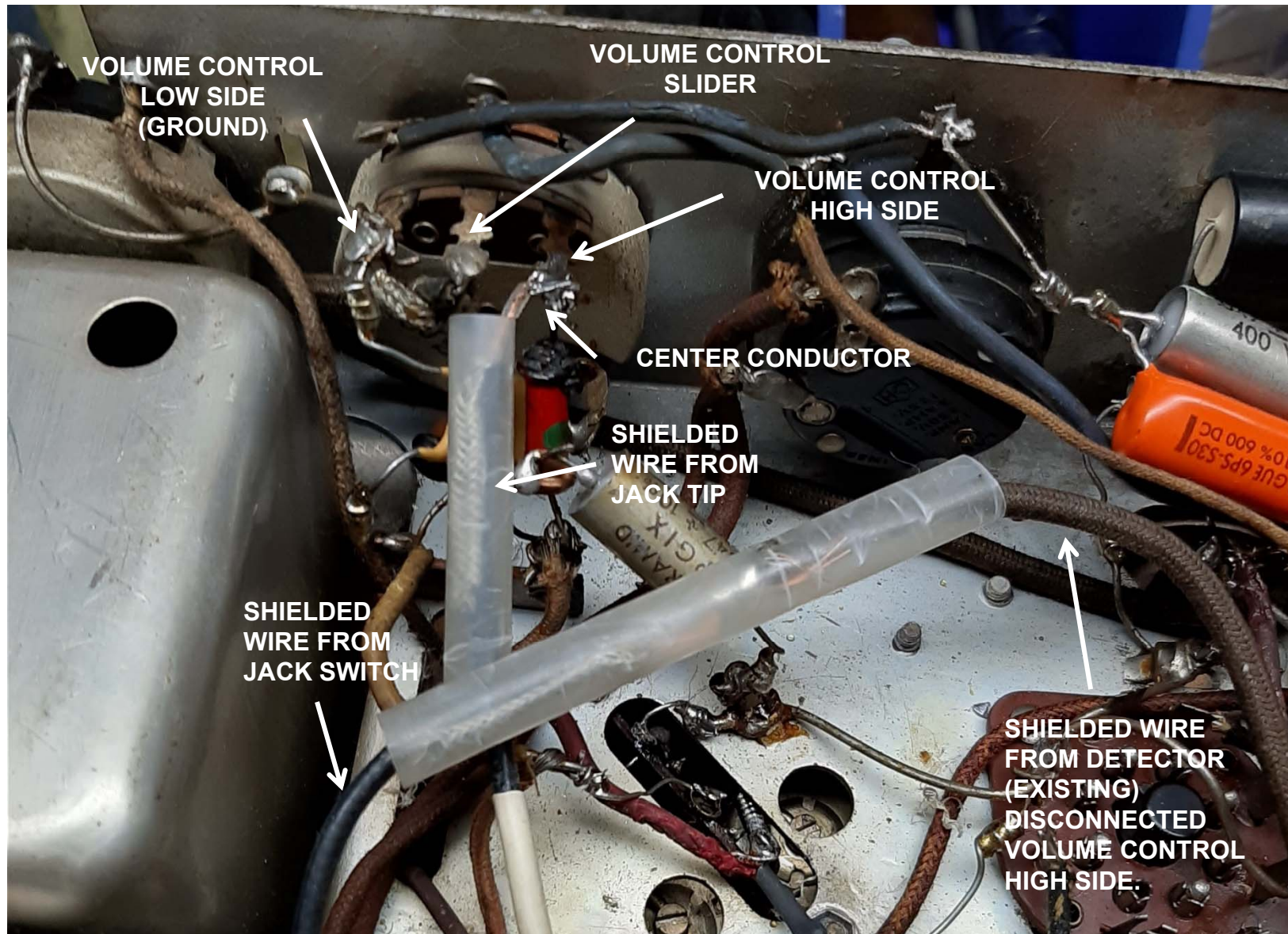


General Electric A-82

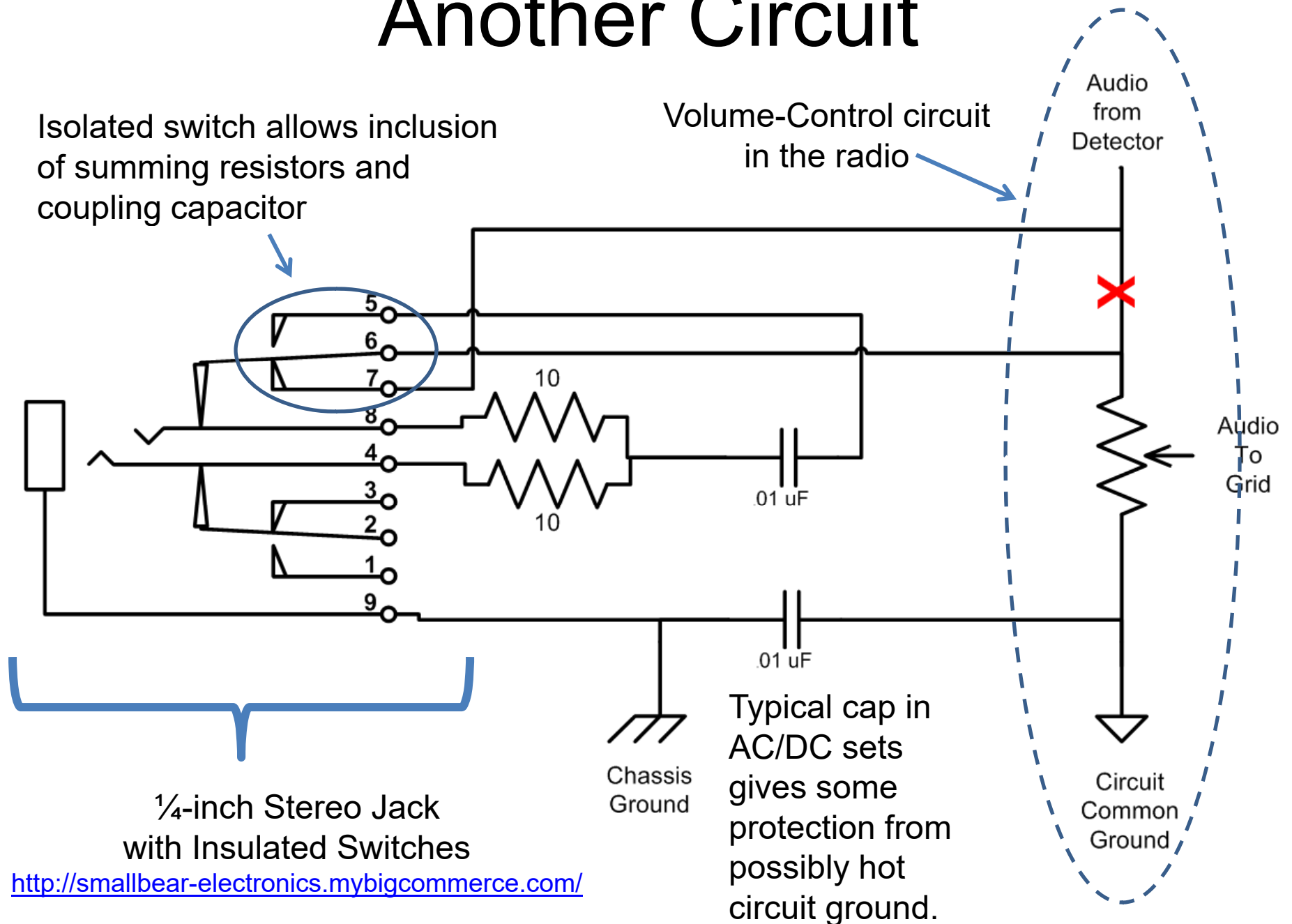
An Actual Installation



“Lysdexia” Strikes Every 15 Seconds!



Another Circuit



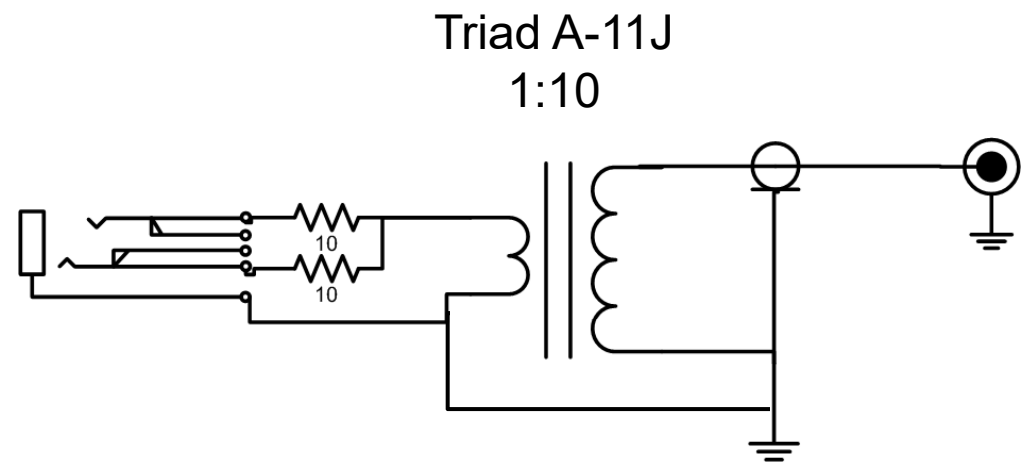
1/4-inch Stereo Jack
with Insulated Switches

<http://smallbear-electronics.mybigcommerce.com/>

But, There's not enough Gain

- Typical Bluetooth device puts out about 1 volt peak to peak.
- Typical tube radio has about 10 volts P-P out of the detector.
- So, you're 20dB behind the game. (That's half-way up on the volume control.)
- ACE-KISS (Avoid creeping elegance. Keep it simple stupid!)
 - Add an external step-up transformer.
 - No power supply required.
 - Poor low-frequency response in cheap transformers.
- Add an External Amp
 - Keeps radio modifications to a minimum.
- Add an internal amplifier, and maybe embed the Bluetooth module.
 - You better be an expert technician.

N3FRQ's Transformer Box



Microphone Input Transformer



Hi-Fi Frequency Response

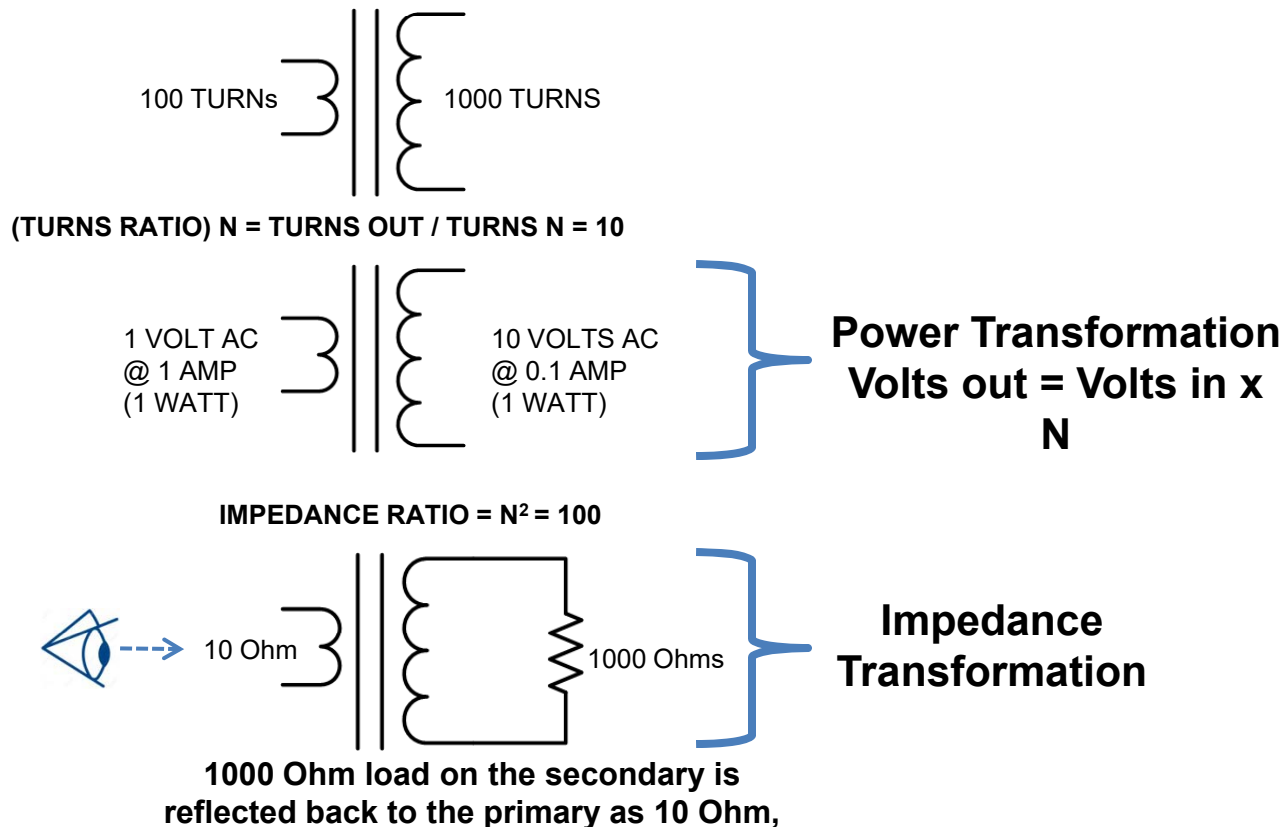
Triad A-11J \$10.70 in 1953

UTC O-1 \$14

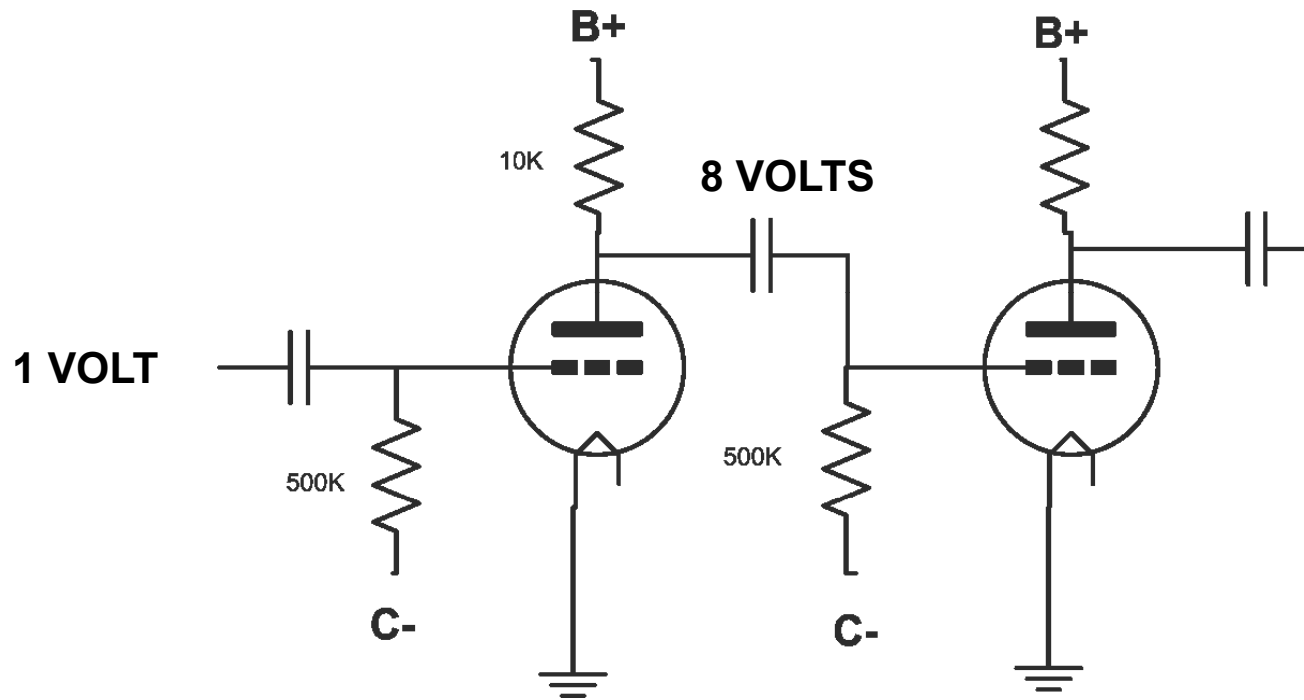
Multiply by 9.66 to cover inflation.

Transformer Wisdom

- Transformers are used to match impedances.
- Power Out = Power In x Efficiency, but voltages and current change.
- Impedance matching is like horseshoes and hand grenades:
Close Counts!
- Transformers don't have impedances. They have turns ratios.

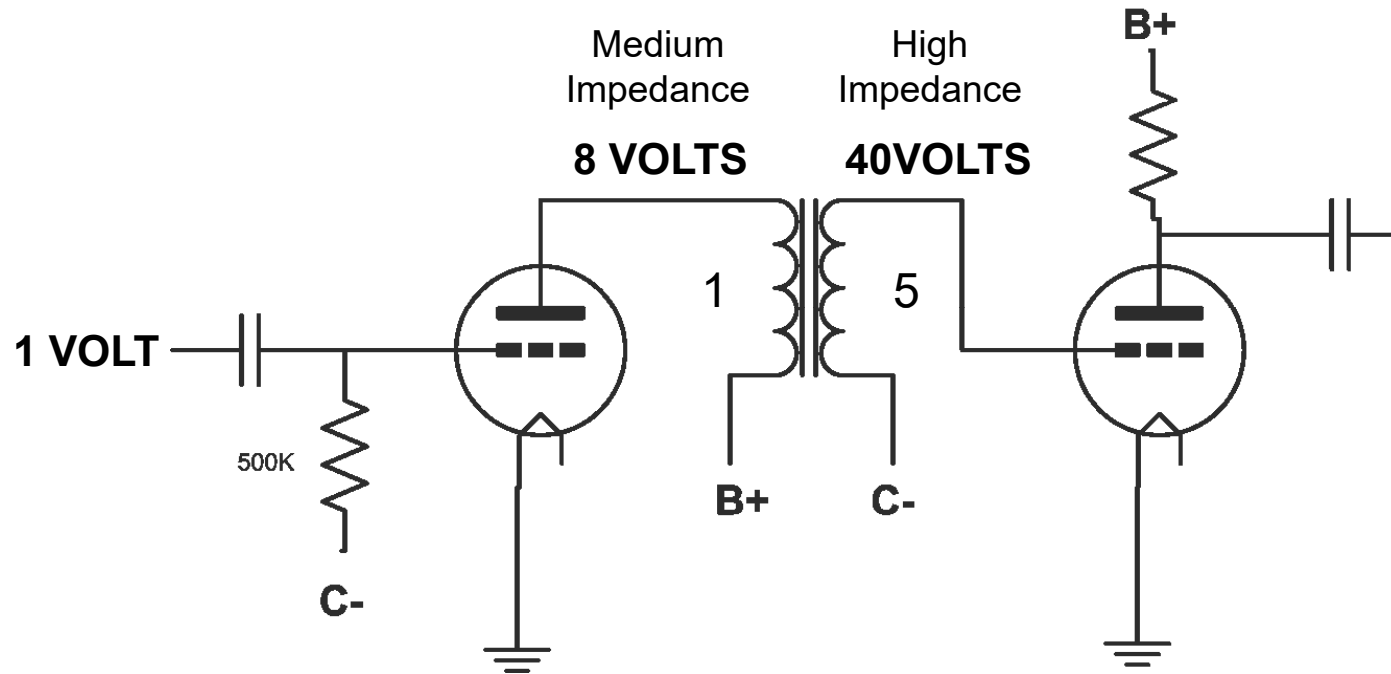


RC-Coupled Amplifier



- 201A Tube - Amplification Factor = 8
- Stage voltage gain = $20 \text{ LOG } V_{\text{out}} / V_{\text{in}} = 18 \text{ dB}$

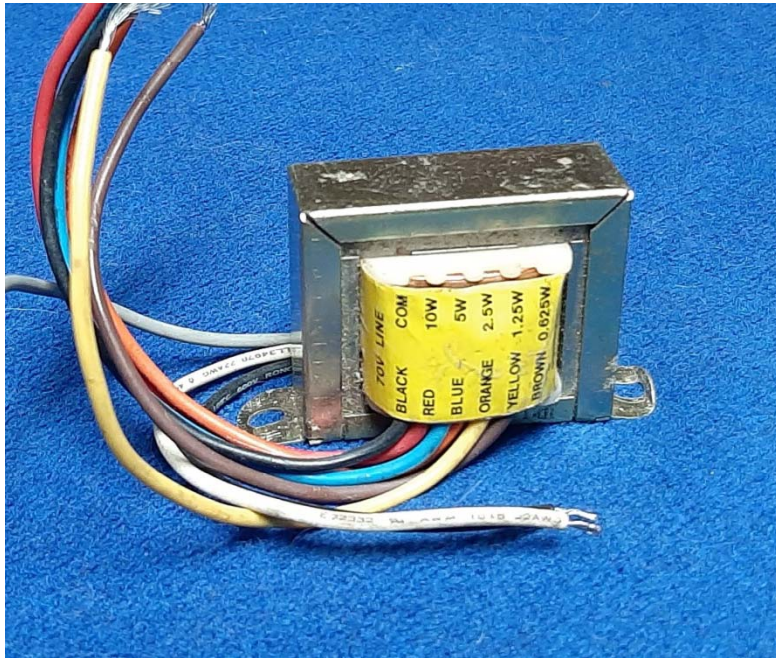
Transformer-Coupled Amplifier



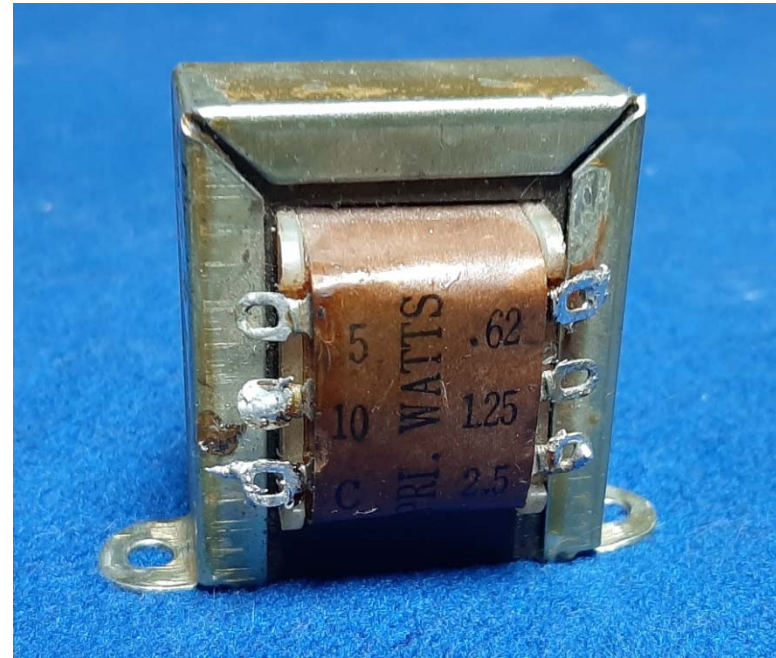
- 201A Amplification Factor = 8
- Transformer with 1:5 Turns Ratio
- Stage voltage gain = $20 \text{ LOG } V_{\text{out}} / V_{\text{in}} = 32 \text{ dB}$

Line-to-Voice-Coil Transformer

a.k.a. Line Matching Transformer



SPECO T7010
Made in Taiwan
About \$15 shipped
On Amazon

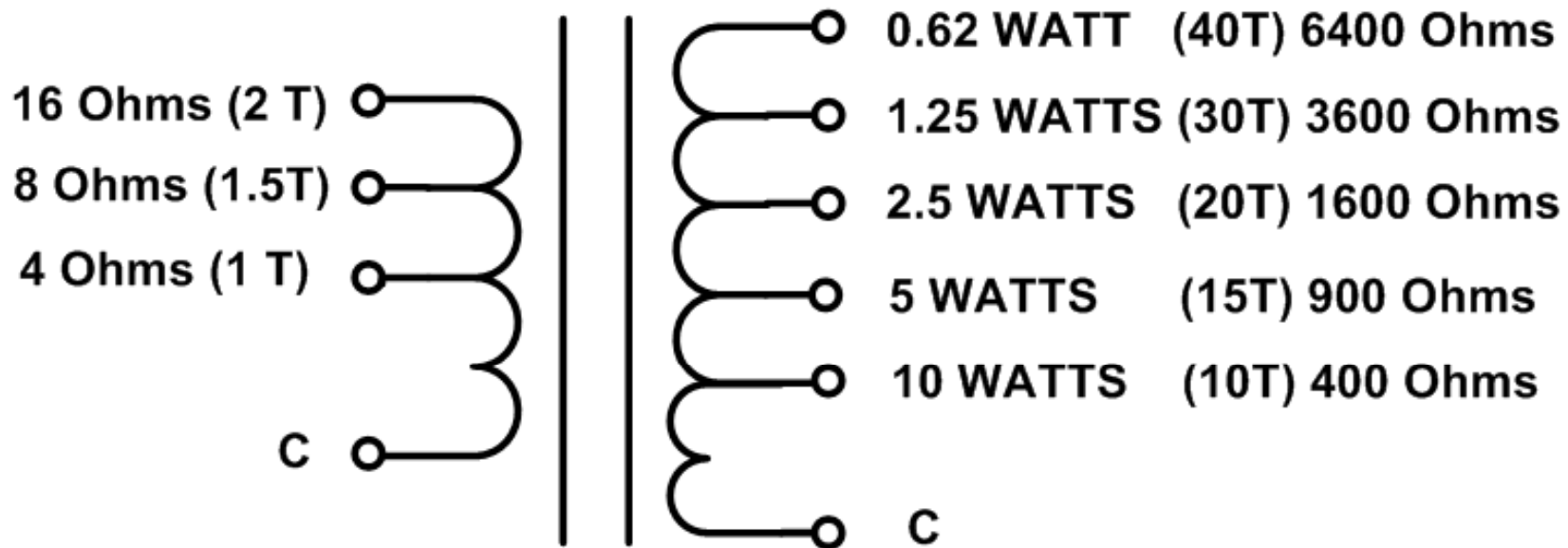


Realistic 32-1031
Made in Taiwan

Bogen T-725
\$11 on Amazon Prime

Line-to-Voice-Coil Transformer

- Public-Address systems use high voltage to distribute audio to multiple speakers, avoiding excessive line loss.
- The standard is a 70-volt line.
- Transformers feed a selectable amount of power to each speaker.



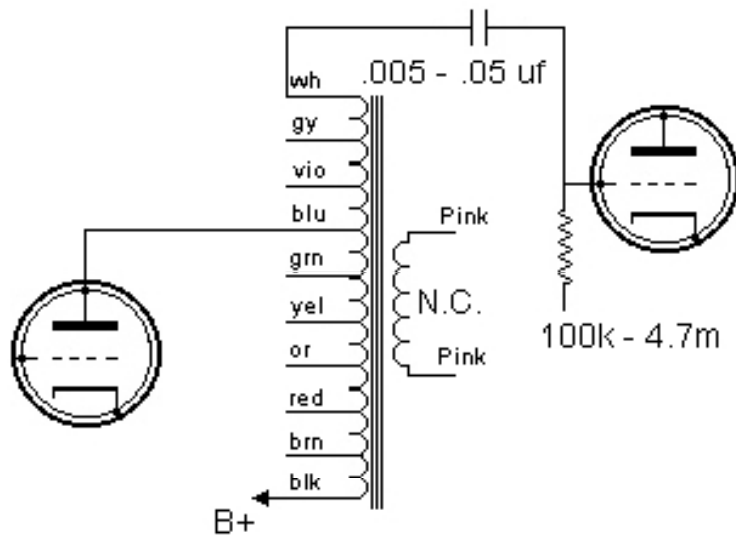
Line-to-Voice Coil Transformer
Radio Shack (Realistic) 32-1031 is typical.

Replacing Transformers in Battery Sets

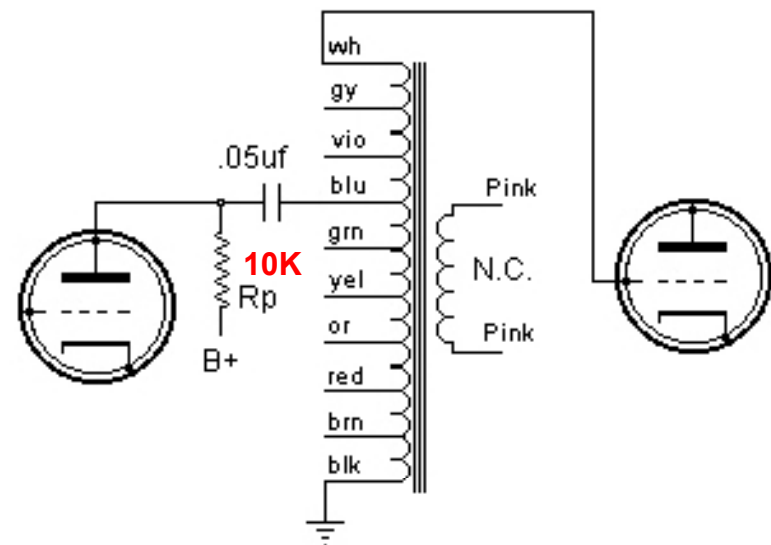
Visit Dave's Homemade Radios

Dave Schmarder

- <http://makearadio.com/misc-stuff/t-725.php>



Bogen T-725 as an Interstage Auto-transformer

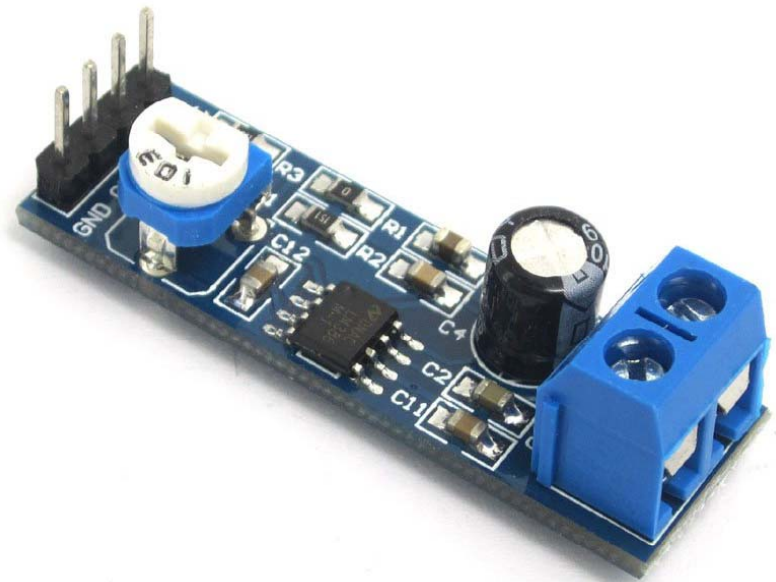
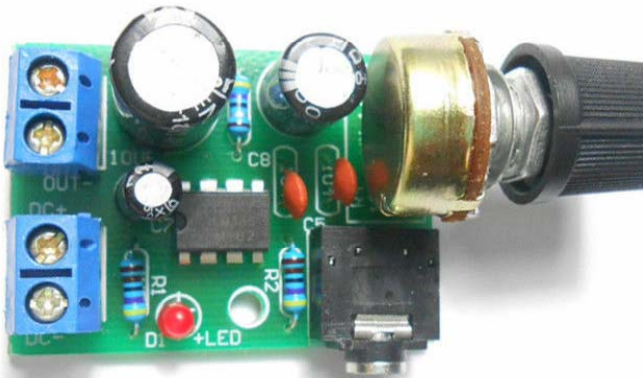


Bogen T-725 as an Interstage Auto Transformer Version 2

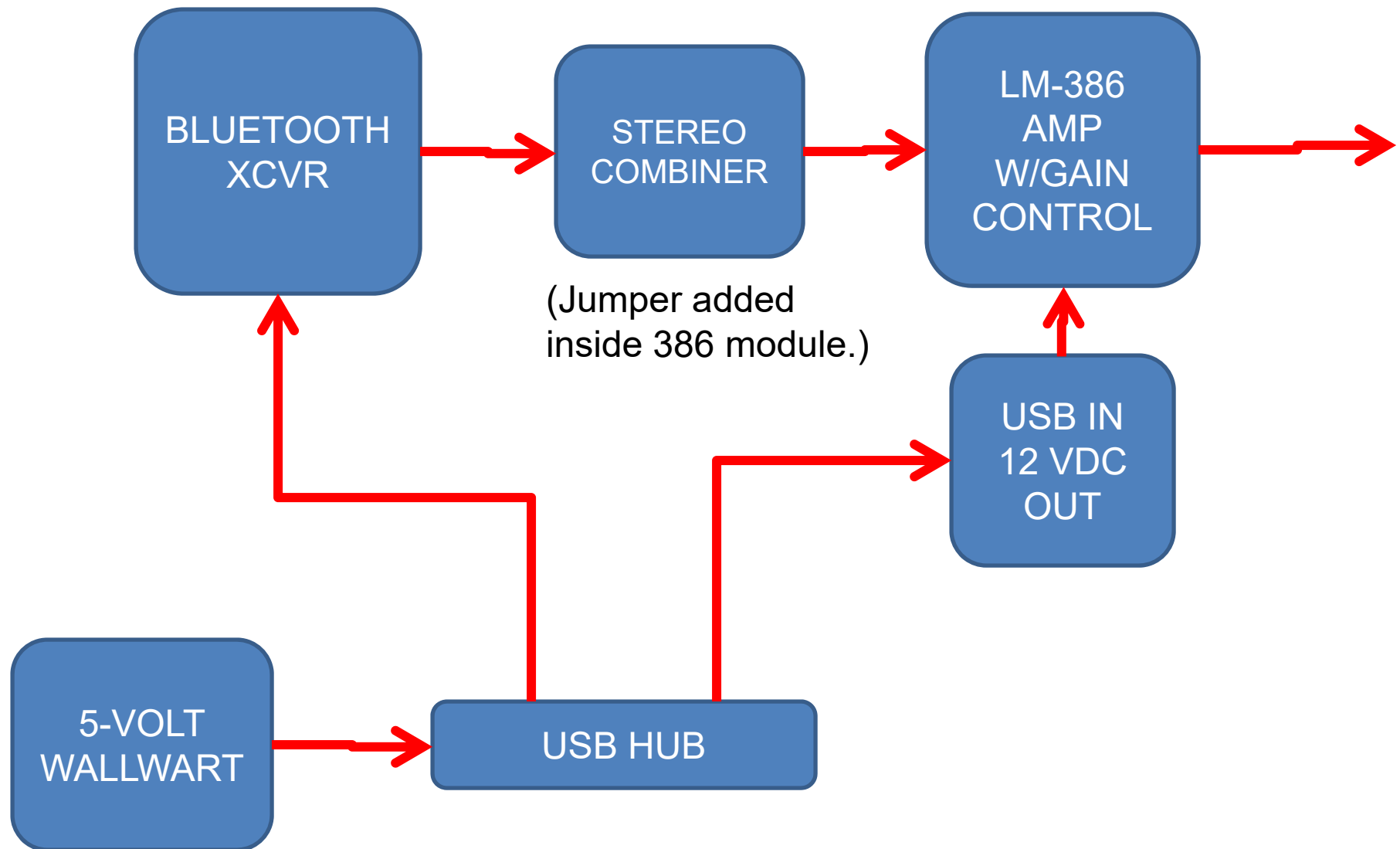
This arrangement keeps plate current out of the transformer. A good thing to do.

Add an Amplifier

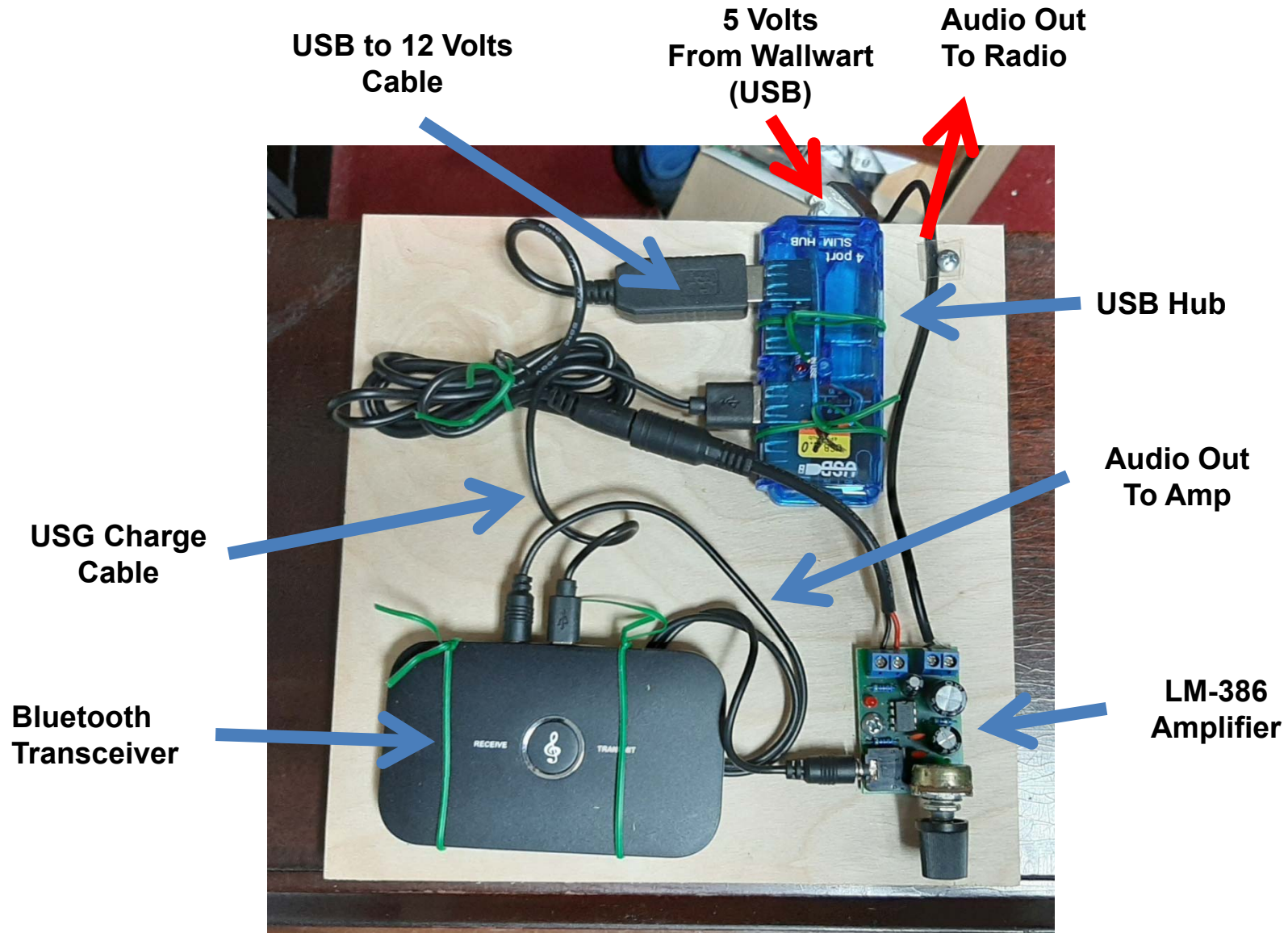
- An LM-386 IC Amplifier will swing 8 volts with a 12-volt supply.
- Inexpensive modules available.
- Avoid amp using “bridged” outputs. LM-386 does not.



A 21st Century Solution



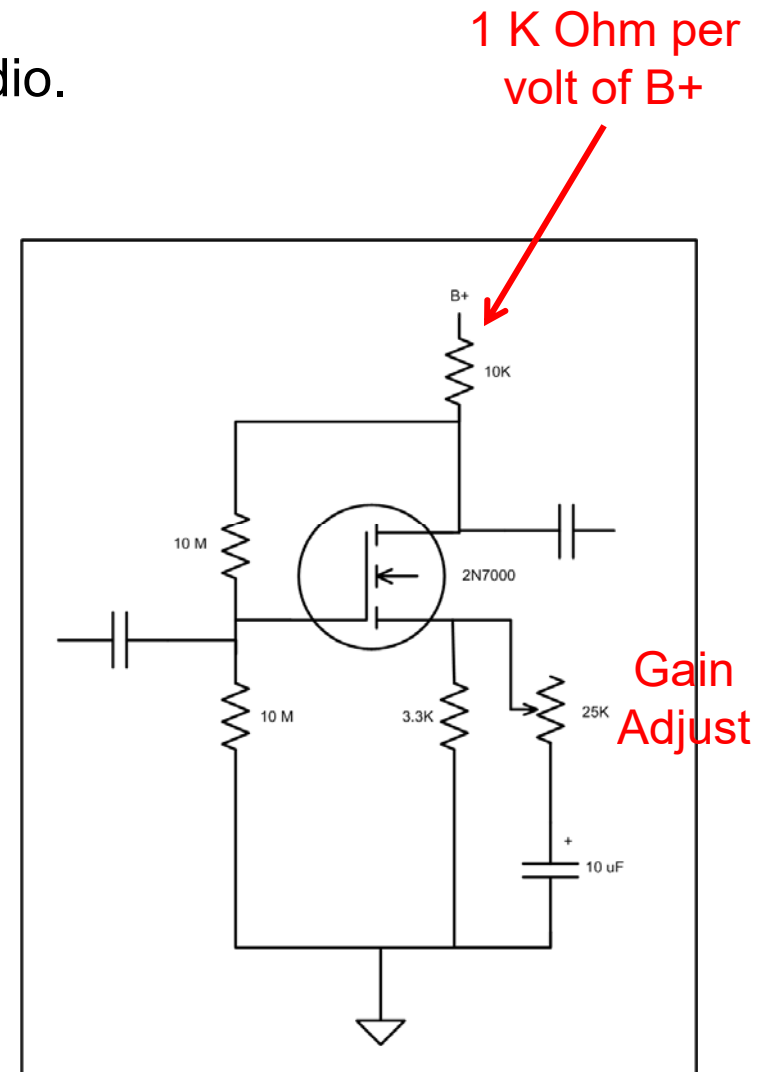
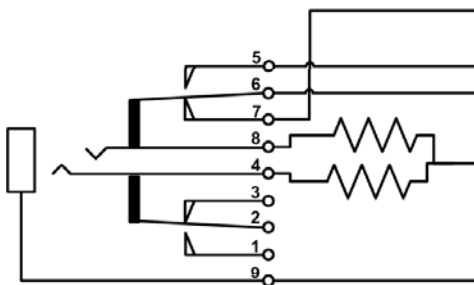
No Solder Joints



Adding Internal Electronics

Talk to Lou Lombardi

- Add an amplifier inside the radio.
- Embed the Bluetooth device in the Radio.
- Possible power sources
 - B+
 - Cathode bias from audio output
 - Added power supply
- Each case is going to be different.
- Don't try this at home!



Enjoy Bluetooth!

