

# Electro-Resales

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## Code Practice Oscillator (CPO)

**For kit building instructions turn to Page 3.**

### Overview

Many thanks for your purchase of this code practice oscillator or CPO, this guide is intended to allow you to quickly get operational.

The CPO comprises an approx. 2 x 3 inch PCB that contains the oscillator and a small amplifier. The oscillator is based on the Twin T circuit configuration and produces a tone that is much closer to the side-tone produced by a transceiver. The oscillator output feeds an amplifier built around the LM386. This amplifier allows the oscillator to be used with a loudspeaker if required or headphones.

### Operation & Use

Please refer to the photo on the next page to help identify the components on board. These instructions are also good for the cased versions of this oscillator.

The CPO requires 9 volts DC to operate, but can tolerate up to 12 volts DC Max. This voltage can be supplied by a battery (preferred) or a bench power supply. The power jack is a 2.1 mm x 5.5 mm barrel jack with center positive connection. After plugging in suitable power attach the Morse code key to be used, by means of the screw terminal block marked "Key Jack", this is a non-polarized connection. Plug a loudspeaker into the 3.5 mm jack plug socket. The loudspeaker may be 4 – 8 ohms, 8 ohms gives optimal results.

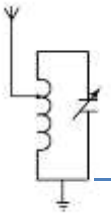
Before switching on the unit, adjust the AF gain potentiometer fully anti-clockwise, then a quarter turn clockwise, this ensures the volume is not too loud, adjust as needed after initial tests are completed.

When all connections have been made, move the on/off switch to the 'ON' position. Closing the code key at this time will produce the oscillator tone.

If it is preferred to practice quietly, ear phones or ear buds may be employed. Before inserting headphones make sure the AF gain control is full anti-clockwise when the AF Gain control is on the right side with the PCB facing you.

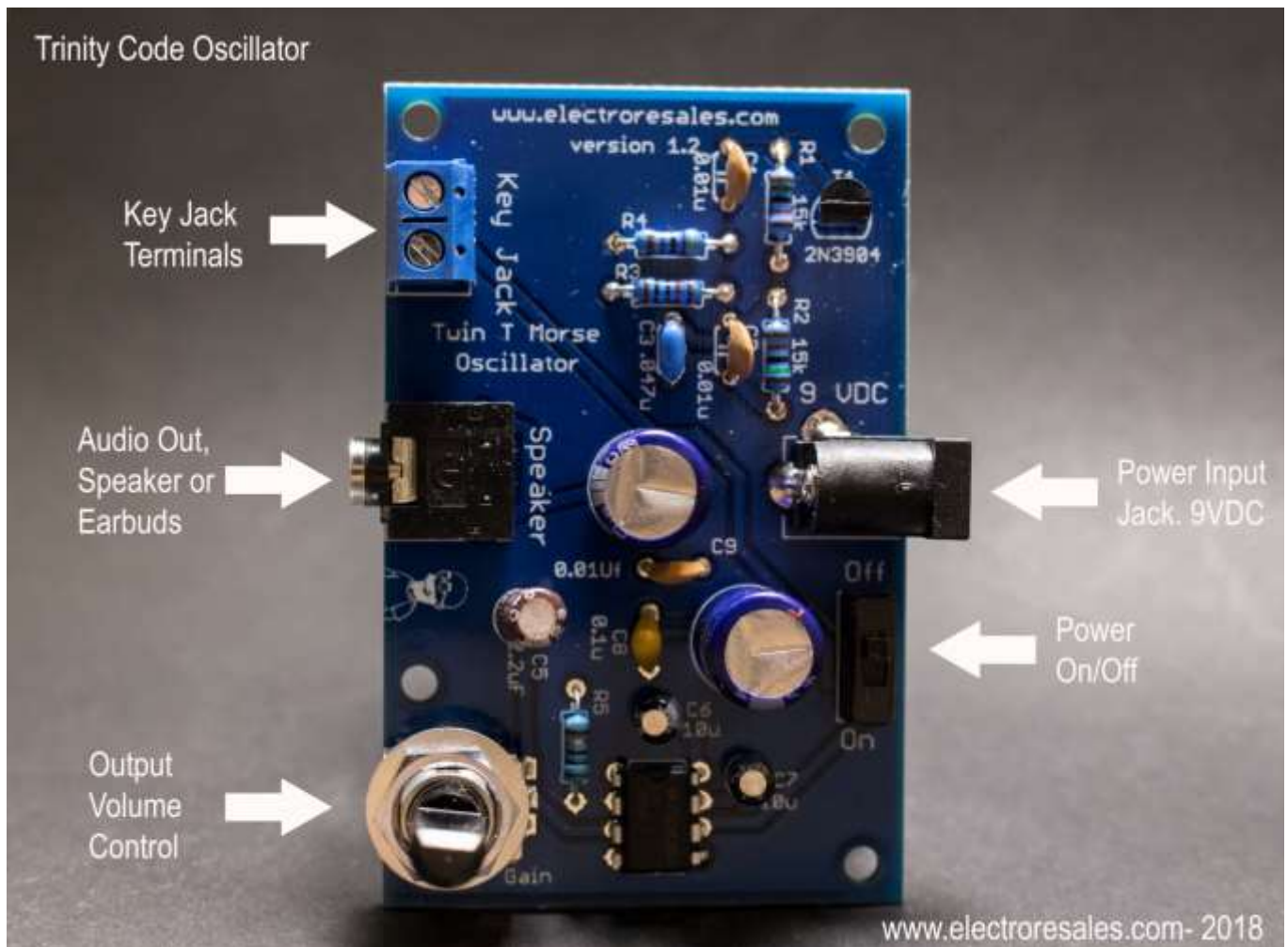
After inserting the head set slowly advance the gain control while keying the oscillator, until a satisfactory listening volume is achieved

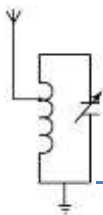
You are now ready to practice or improve your Morse code sending proficiency. Good luck!



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## CPO layout and external connection diagram





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## Kit Builders guide

If you have purchased the CPO kit, these instructions are intended to guide you in getting the CPO constructed.

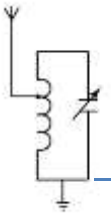
### Parts List

The complete parts list. Please Note: C4 does not exist. Note some components are polarized; there orientation on the board is important.

Part Name	Part Number	Part Value	Part Identification
Resistor	R1 & R2	15 K	Brown Green Orange (5 band = BRN/GRN/BLK/RED/BRN)
	R3	10 K	Brown Black Orange (5 band = BRN/BLK/BLK/RED/BRN)
	R4	4.7 K	Yellow Purple Red (5 band = Yell/Violet/Blk/Brn)
	R5	10 Ohm	Brown Black Black (5 band = BRN/BLK/BLK/Gold/BRN)
Capacitor	C1, C2 & C9	0.01uF	Marked 103 (blue or brown body color)
	C3	0.047uF	Marked 473 (A blue or yellow body)
	C5	2.2UF	Polarized Electrolytic
	C6 & C7	10uF	Polarized Electrolytic
	C8	0.1uF	Marked 104 (yellow body)
	C10 & C11	470uF	Polarized electrolytic
Potentiometer	AF Gain	10 K	PCB Mount – marked 103
Semiconductors	T1	2N3904	Black plastic transistor, marked 2N3904
	IC	LM386	8 Pin DIP package, marked LM386-3 or LM386-4
Hardware	Key Jack		Blue 2 pin screw terminal block
	Speaker Jack		3.5 mm black PCB mount jack socket
	On/off switch		SPST slide switch
	Power jack		5.1 mm PCB mount barrel jack
	PCB		Double sided PCB (various colors)

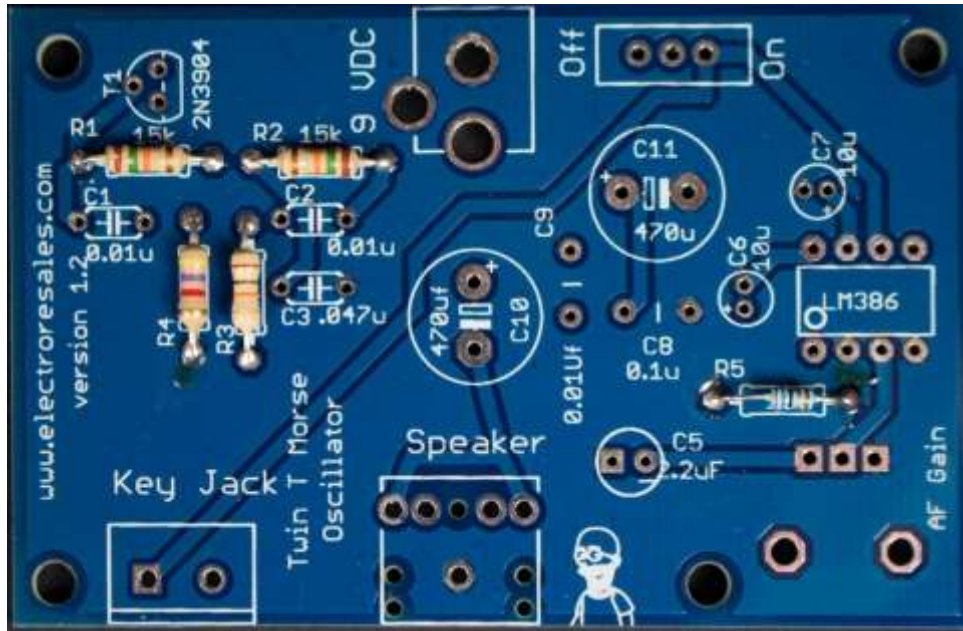
Before starting construction make sure you have a clean work space, with room to layout parts and work easily on the PCB. When unpacking the components a set of small plastic trays or bins is advised to ensure no parts can be lost or roll away.

Carefully unpack the components, noting the above advice, make sure all parts are included and nothing is missing. Each component has an identifying mark or color code, use a magnifier if needed to identify the components. If parts are missing contact us by email: [steve@electroresales.com](mailto:steve@electroresales.com)

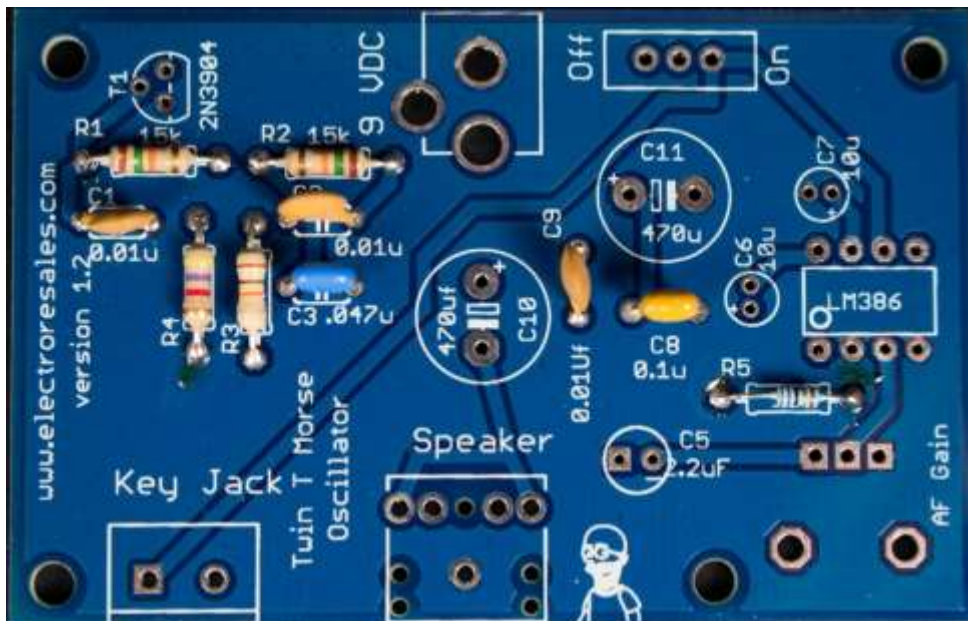


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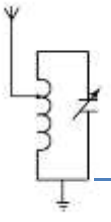
Stage 1 – Insert all resistors (R1,R2,R3,R4 & R5) - compare to this picture, note this picture shows the 3 band resistor style.



Stage 2 – Insert non polarized capacitors (C1,C2,C3,C8 & C9) – compare to this picture, orientation of these capacitors is not important

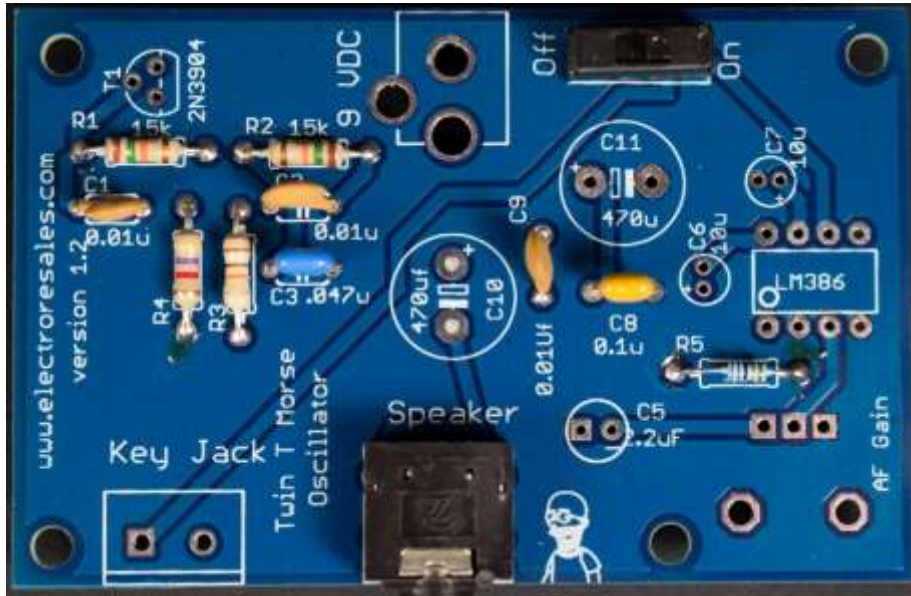






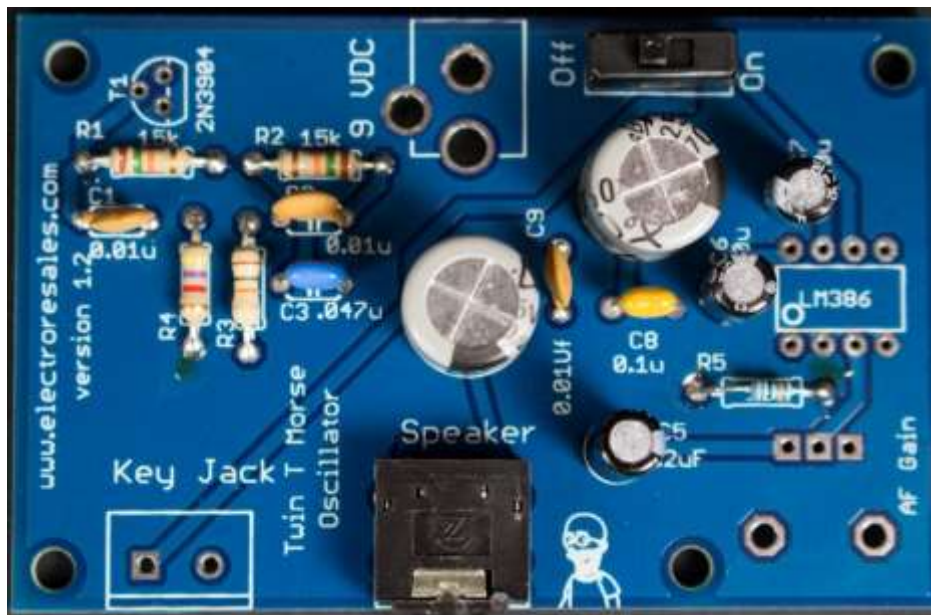
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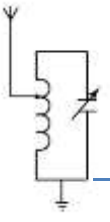
Stage 3 – This is a good point to add the on/off switch and speaker jack. Use the picture below to assist in identifying these parts.



Stage 4 - At this step, add polarized capacitors C5, C6, C7, C10 & C11. Polarity is important, make sure to align the component +/- with the board markings for +/-

Note: C6 can be omitted if less audio gain is desired, the output will still be sufficient to drive loudspeakers, however, the output will be more controlled at the lower end of the AF gain pots travel.



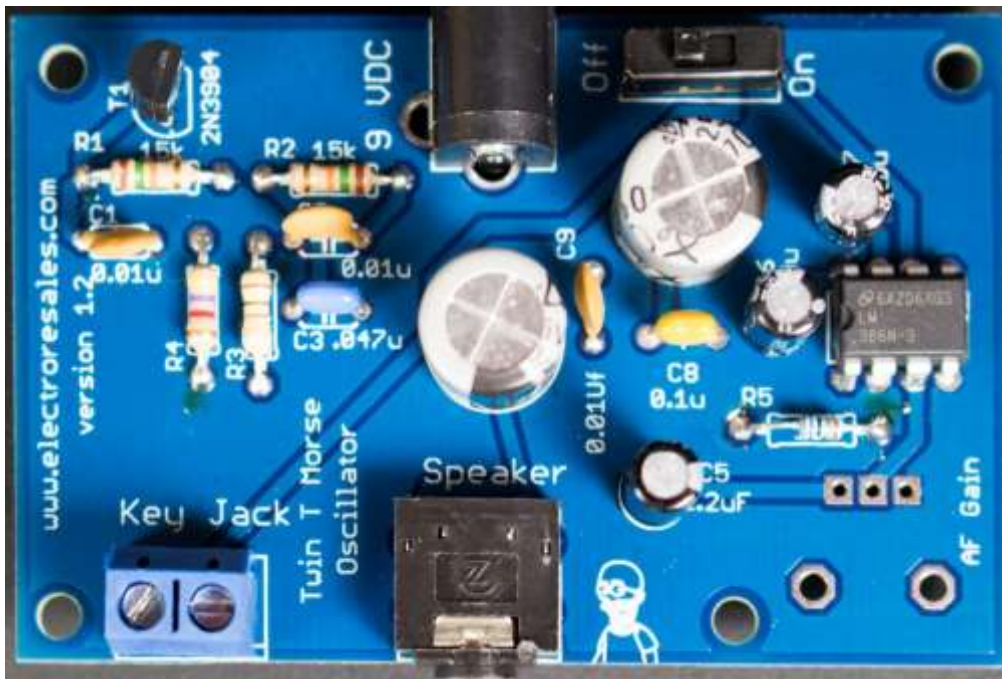


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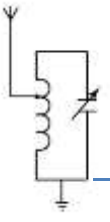
Stage 5 – Insert Semiconductors - align T1 with outline on the PCB and insert , insert the IC LM386, make sure to align the dot or indent on the IC with the dot on the PCB that indicates Pin 1. To hold the IC in place during soldering use a piece of tape or a piece of removable putty such as Elmer's removable adhesive putty. Your board should look like this now:



Stage 6 – Add the key jack screw terminal block and the power jack

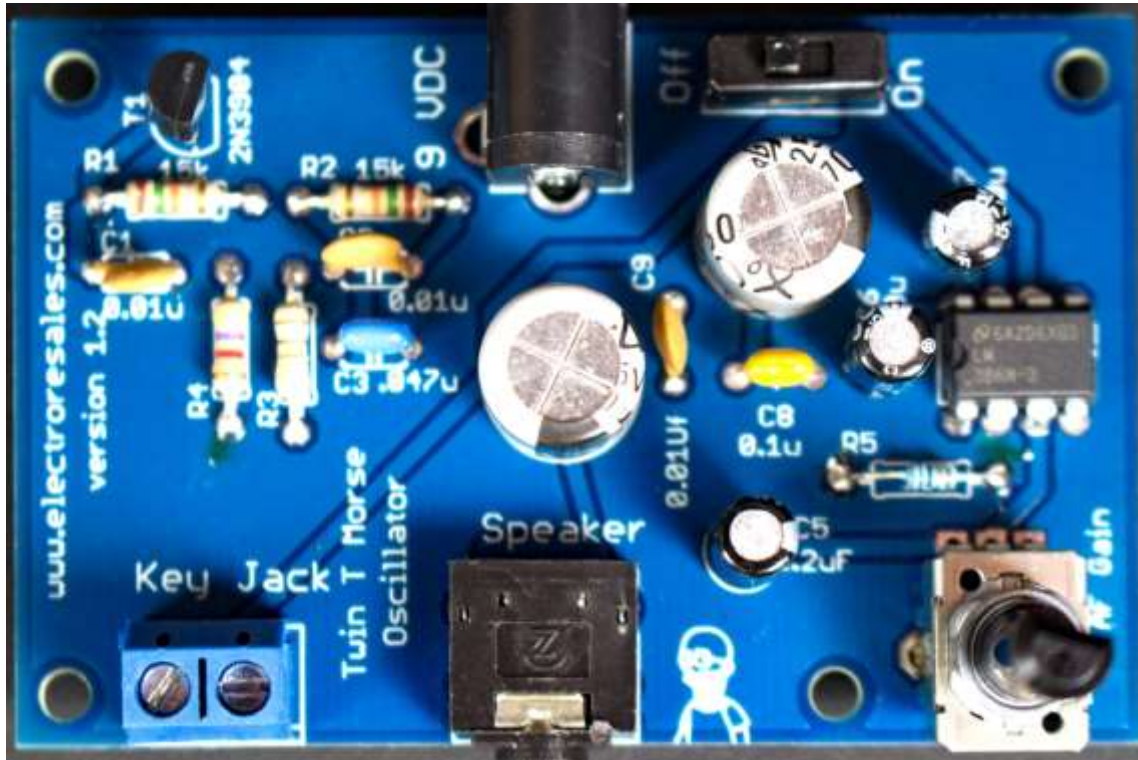






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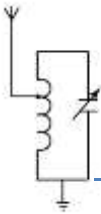
Stage 7 – This is the last step, add the AF gain pot. This part ‘snaps’ in to the board. First line up the front solder pins and insert part way into the board, then gently ease the mounting lugs into their holes, applying downward pressure. If you have difficulty, gently squeeze the mount lugs in a little, prior to mounting this part. Don’t forget to solder the mount lugs also.



This stage completes the PCB construction, however, before applying power and testing the unit, spend a few minutes checking the position of each part, especially the polarization of the electrolytic capacitors and semiconductors.

Make sure that all solder joints are well made, reflow any that you are doubtful about. Check for shorts and solder splashes, remove all shorts and extra solder.

To test the unit, follow the instructions at the start of this document under Operation & Use.



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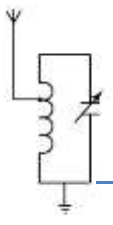
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## Troubleshooting

Careful construction and soldering will produce a working unit, however, issues can occur, and in the event of the CPO not working try the suggestions below.

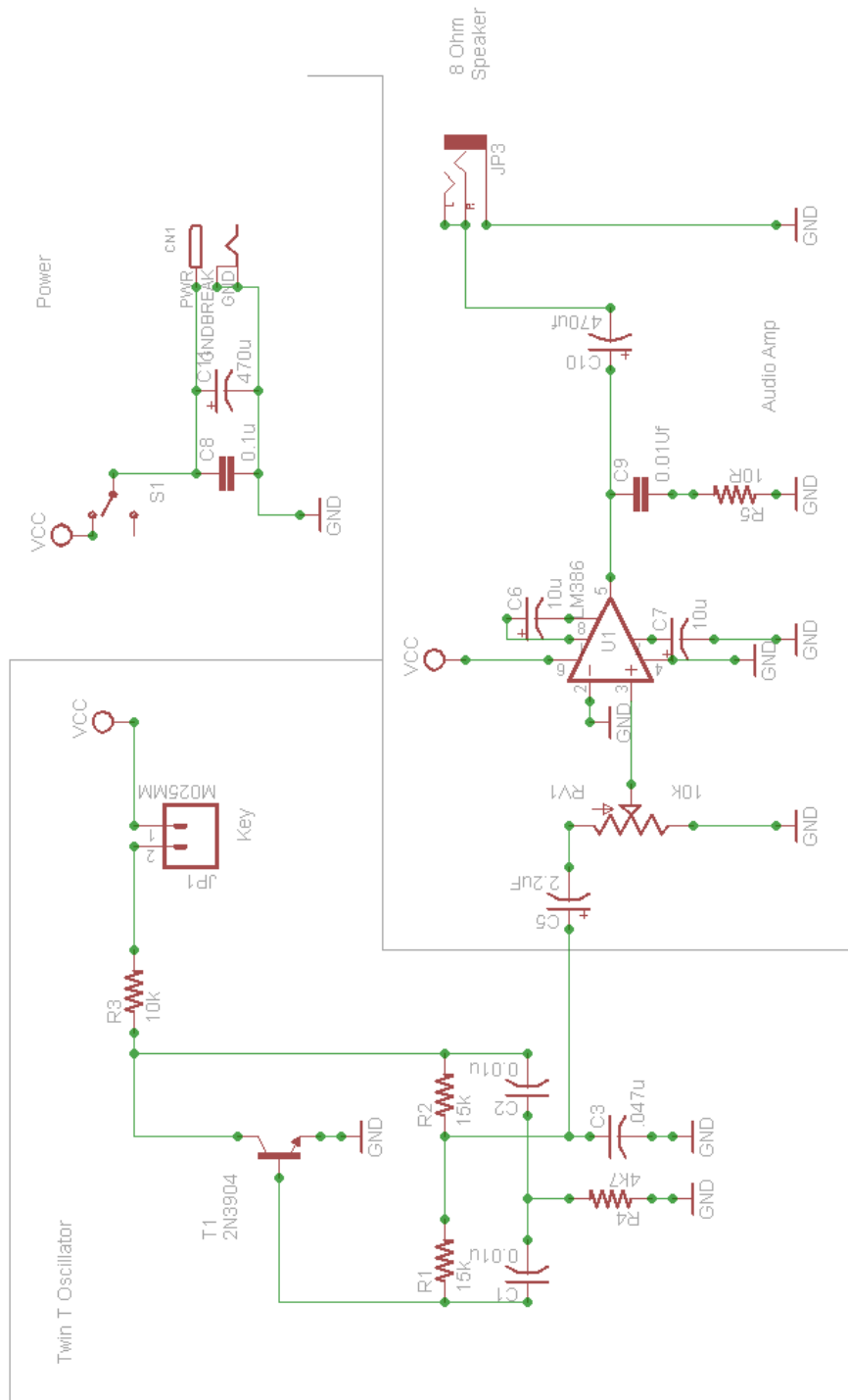
1. Check all component positions for correct value
2. Check polarization of the electrolytic capacitors
3. Make sure no solder shorts are present. Examine solder joints carefully using an eye glass/loupe
4. Have a friend check over the board for you, they may see things you have missed.
5. Try a new battery or a 9-12 volt DC plug pack - make sure connection is center positive.
6. Clicks when keying,
  - a. If the oscillator clicks with no audio check the resistor values R3 and R4 are correct
  - b. If the oscillator clicks with a little audio heard when key is down, check R4 value
  - c. If oscillator clicks and faint audio is heard R3 and R4 maybe transposed
  - d. No audio can also indicate an issue with T1, the 2N3904 transistor, it may need to be replaced, we can supply a new part if needed.
7. Additionally, if you have the access to a test meter and/or oscilloscope, and want to try more advanced troubleshooting, the CPO schematic is included in appendix 1 & 2. Appendix 2 has some voltage test points and scope waveforms.
8. If all else fails contact us for further assistance – [steve@electroresales.com](mailto:steve@electroresales.com)



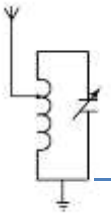


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## Appendix 1 – Complete schematic

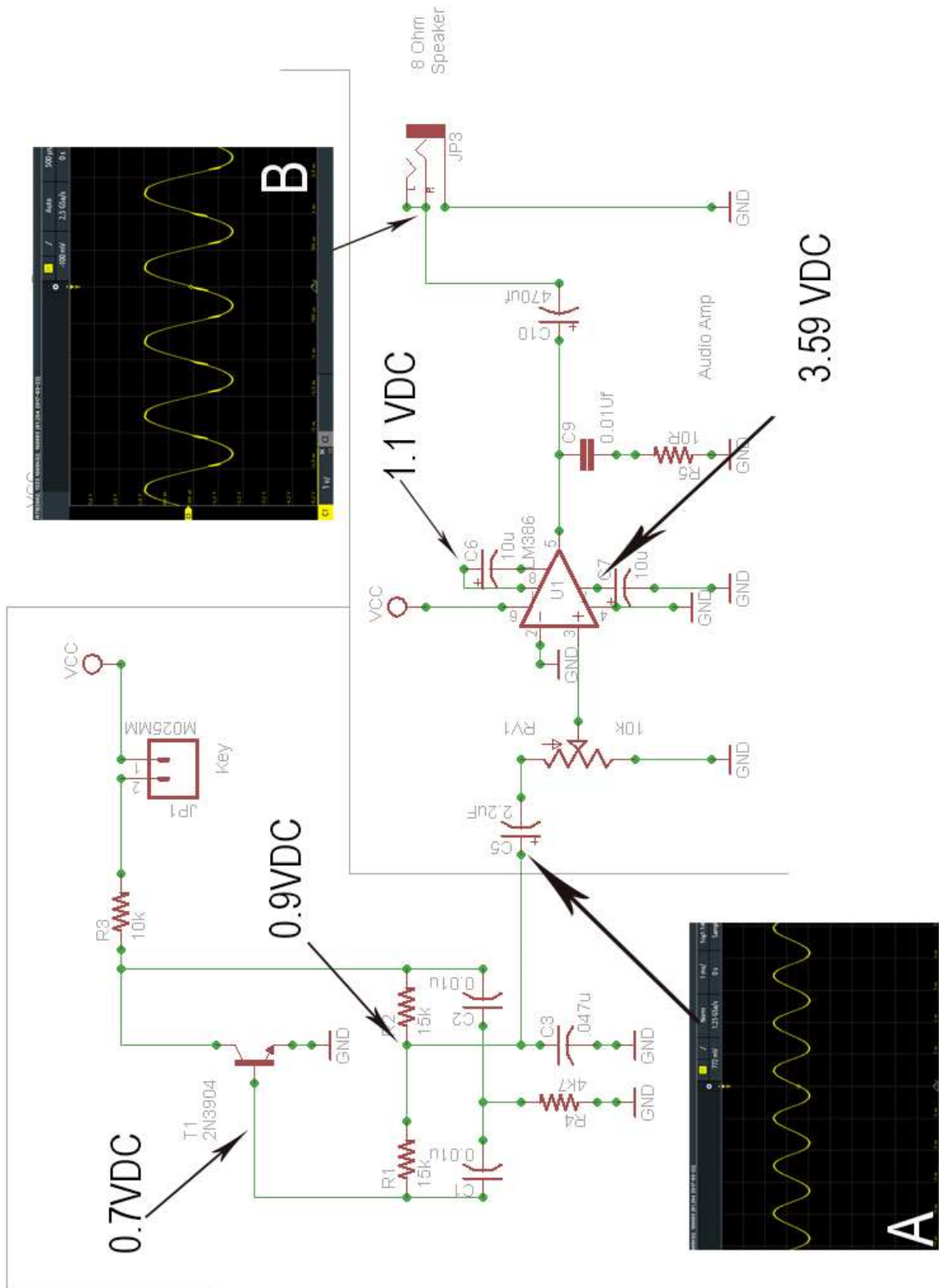


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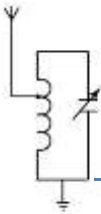
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## Appendix 2 – Schematic with voltages and waveforms



Voltages are typical for an 8 VDC VCC, test conditions are, key down, speaker attached, Volume at mid point. Waveform 'A' is for the Twin T output, while 'B' is after amplification.

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## **DISCLAIMER**

**Any person who constructs or works on electronic equipment may be exposed to hazards, including physical injury, the risk of electric shock or electrocution.. These hazards can result in health problems, injury, or death. Only qualified persons who understand and are willing to bear these risks themselves should attempt the construction of electronic equipment. By purchasing this item, the buyer acknowledges these risks.**

**There is a risk of electric shock, electrocution, burns, or fires that is inherent in the construction and use of electronic equipment. By purchasing this item, the buyer acknowledges these risks.**

**IN NO EVENT SHALL THE SELLER BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY NATURE including, but not limited to, property damage, personal injury, death or legal expenses. Buyer's recovery from Seller for any claim shall not exceed the purchase price paid by Buyer for the goods, irrespective of the nature of the claim, whether in warrant, contract or otherwise. By purchasing this item, BUYER AGREES TO INDEMNIFY, DEFEND AND HOLD SELLER HARMLESS FROM ANY CLAIMS BROUGHT BY ANY PARTY REGARDING ITEMS SUPPLIED BY SELLER AND INCORPORATED INTO THE BUYER'S PRODUCT.**