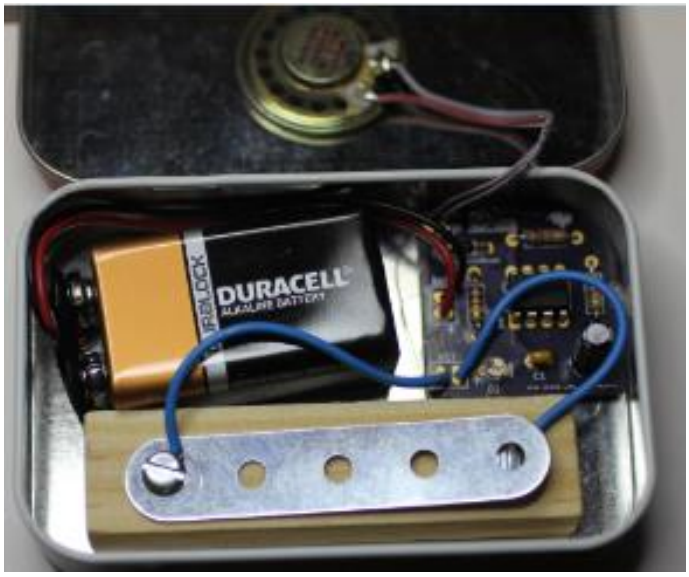
INTRODUCTION TO ELECTRONICS

Morsey: A Morse code Practice Kit



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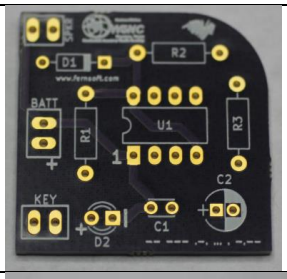
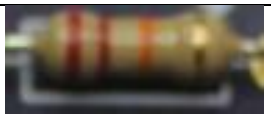
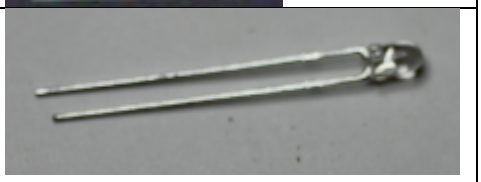
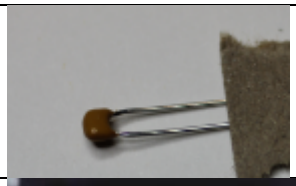
Morsey: A Morse code Practice Kit

Welcome to the world of electronics kits. This kit will help you learn to solder, and also teach you about basic electronic components. When you complete Morsey he will greet you with a happy buzz – buzz! You can utilize the completed Morsey practice key to learn how to send Morse code.

Let's start by examining the components of your kit:

Circuit board	This is a purple part that is curved on one side to be able to fit the curve of a metal mint tin such as used for Altoids ™.	
9 Volt Battery snaps	This is the connector that attaches to a nine volt battery.	
Resistor 1KΩ	These are small cylinders with wires coming out of each end. These components are the resistors. Brown – Black - Red	
Resistor 22kΩ	This is another resistor with different colored bands, these will be explained in a bit. Red – Red - Orange	
Resistor 4.7kΩ	This is another resistor with different colored bands, these will be explained in a bit. Yellow – Violet - Red	
Green LED	There is one component with a clear blob and two wires coming out of one end. This is the LED or Light Emitting Diode. Even though it looks clear it will be green.	
Capacitor 10 µF	There is a cylindrical component with two wire leads coming out of one end and a flat metallic top on the other end. This is a capacitor.	

Capacitor 0.1 µF	The smaller value capacitor has a flattened circular appearance.	
555 timer chip	There is a small rectangular component with four metal feet on each side. This is an integrated circuit. This particular integrated circuit or IC is a 555 timer chip.	
Speaker	There is a small round speaker with two contact wires already connected.	
Piece of wood	There is a small piece of wood which will be glued into your tin to support the key.	
Metal piece	A metal piece to act as the key for the Morse code key.	
Two wires	Two solid wires in a variety of colors will be used to connect the key to the oscillator circuit.	
2 Screws	There are two screws. One will be used to attach your metal key to the wood. The other will provide the contact to close your key and activate the buzzer.	
1 N418 diode	The diode is a cylindrical component that looks a bit clear.	
Not included in the kit but needed 9 Volt battery	The battery will power your key.	
Not included in the kit but needed to assemble as shown: An Altoids™ or other metal tin of the appropriate size	This mounts the key to keep it stable and makes it portable and cute.	

More about the components and how they work:

Let's start with the resistors. Remember these were the cylindrical components with wires coming out of each end. A resistor restricts the flow of electrons. A resistor is made of materials such as carbon that are less conductive than metal wire. A resistor resists the flow of electrons much as a smaller section of pipe would resist the flow of water. Imagine your milkshake straw that is allowing the icy treat to flow nicely then you squish it between your fingers and the milkshake flow slows down or stops. This is very similar to how a resistor works, but without the delicious milkshake. The resistor can be inserted into the circuit board in either direction. Resistors are labelled with colored stripes to indicate their value. The colors represent values from 0 to 9.

Black- 0	Brown-1	Red -2	Orange 3	Yellow 4	Green 5	Blue 6	Violet 7	Grey 8	White 9

For example, brown black red gold would indicate 1 from the brown and 0 from the black. The third stripe tells how many zeros to add after the first two numbers. A Red is a 2 so we add two zeros to give us a value of 1000. The unit of resistance is called the ohm and is usually written as the Greek letter, Ω, and resembles an upside down horseshoe. The 1000 is typically read as kilo abbreviated as 'k' or 1000 ohms is written as 1 k Ω. The last color bar indicates the tolerance of the part and is either +/- 5% indicated as gold or +/- 10% indicated as silver.

As the resistor can be thought of as a component that resists the flow of electrons much as a smaller pipe for plumbing resist the flow of water coming from a larger pipe, a capacitor can be thought of as a bucket which can hold electrons. A simple capacitor is made of two or more conducting plates separated by a non-conducting layer. Charges will build up on the plates when the capacitor is charging and will flow from the plates when the capacitor is discharging. There is a positive and negative side of a capacitor and it must be inserted correctly.

This kit is powered by a nine volt battery supplied by the user. Many common 9 volt batteries are alkaline batteries which provide power as a result of a chemical reaction.

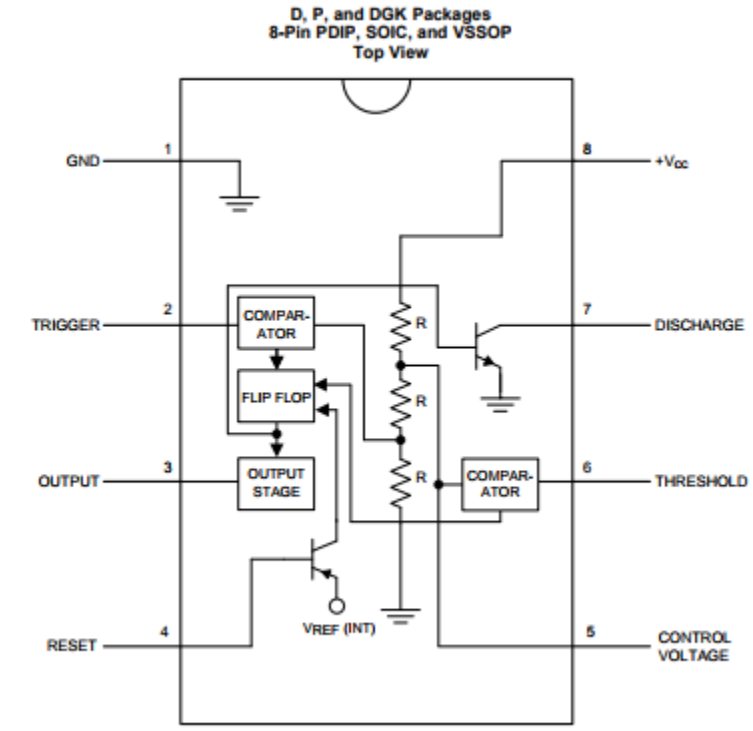
The diode is an electrical component that allows current to only flow in one direction. The one included in the circuit protects the remaining components in the event that the 9v battery is connected in the reverse direction accidently. Without this diode, even briefly touching the 9V battery to the battery connector backwards might burnout the 555 timer chip!

The LED is a light emitting diode that will light up when powered. The LED is activated when the voltage across it is greater than a threshold voltage but less than a maximum voltage value. The LED can be damaged by having an excessive current through it so this is usually limited by a resistor such as included in your kit.

The circuit board is composed of layers which are manufactured together to produce a single board. The top layer with the text is the silk screen as the words were once silk screen printed onto the board. Another layer is the conducting layer which provides the connections for your circuit. The through holes or pads connect to these internal wires and after you connect your components to these your circuit will be complete. The circuit board is much simpler and less prone to the errors and fragility caused by just connecting your circuit with wires.

555 Timer chip is an integrated circuit that is useful for providing timing oscillations. Component parts such as this come with a small document that describes how they work, this is called a data sheet. A data sheet for the 555 timer is available from TI at http://www.ti.com/lit/ds/symlink/lm555.pdf. This will provide you with a bit more information than you probably want, but it is interesting to read.

Looking at that datasheet you will see what the pins on the IC are.



Soldering

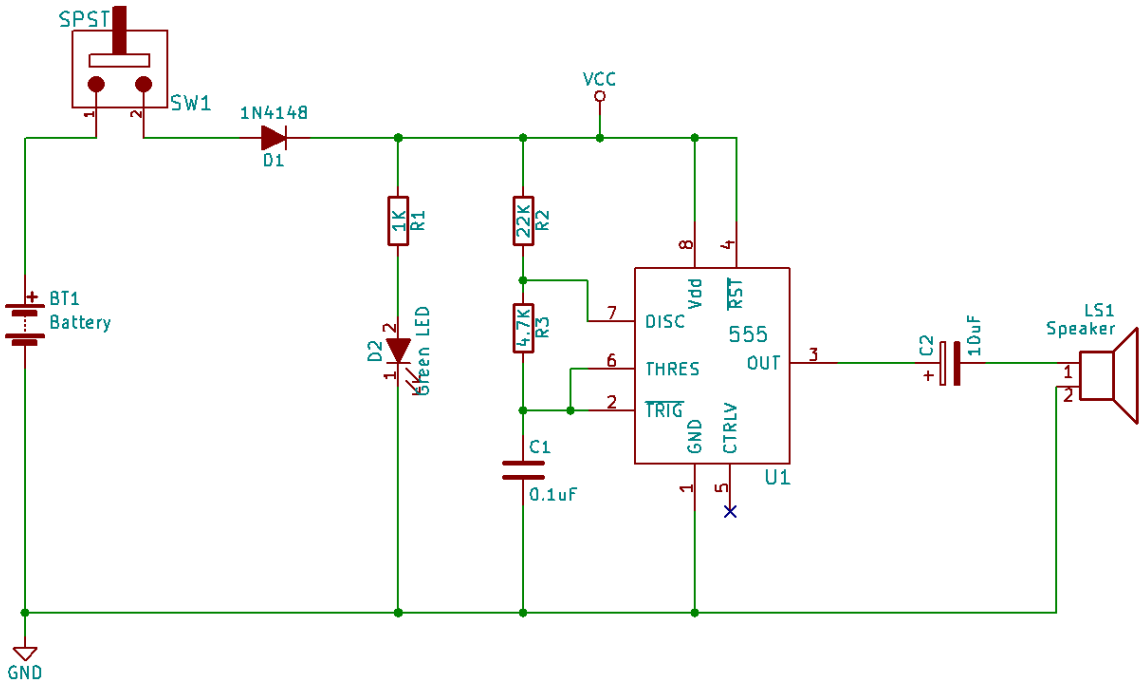
In order to assemble your kit, you will have to solder the components into place. This connects them to the circuit board with small blobs of melted metal. Soldering irons are hot in order to melt the solder. While your fingers will not melt, it is quite easy to burn them if you are not careful. Be careful. Although solder is available that does not contain lead, unless you purchased it yourself assume that it has lead in it and treat it accordingly. Do not eat or drink around a soldering area. Do not eat or drink until washing your hands after soldering. Even if it does not have lead in it, it might have something else that you do not want to eat so even if you are using lead-free solder save the food till after.

Although many experienced hobbyist assemble kits without eye protection, it is always a good idea to wear safety glasses when soldering.

The first step in soldering is to put a little bit of solder on the soldering iron. This is called tinning and helps coat the soldering iron a bit and make the solder melt easier.

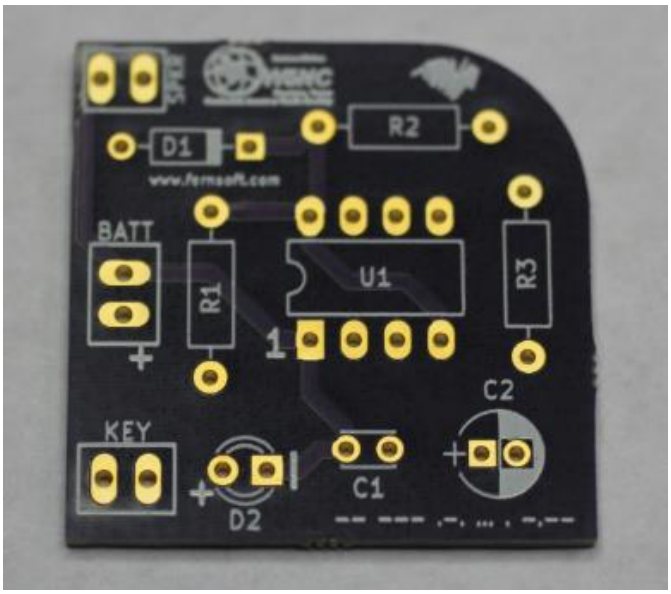
You will hold the soldering iron at an angle with your dominant hand. The other hand will hold a small piece of solder and move it so that it connects with the soldering iron at the point that needs solder. Do not press hard with the soldering iron on the board or you might burn it.

Morsey Circuit Diagram

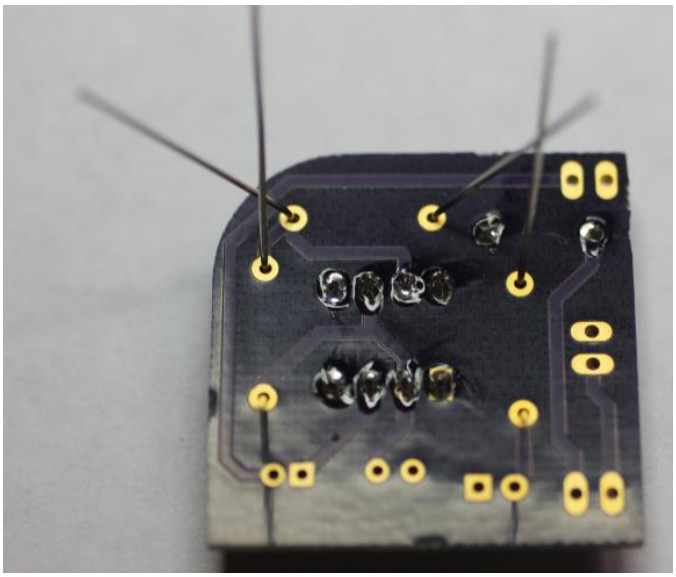


Building the Morse code Key

1. Take the circuit board out and orient it so that the silk screen (writing) is visible.
   Generally the order of assembly is a matter of personal preference, but putting components that are shorter first can make assembly easier as the circuit board is less likely to rock while soldering the other components. Similarly, installing some larger components can make installation of smaller nearby components difficult. The following is a suggested order, but it is not the only workable order of installation.



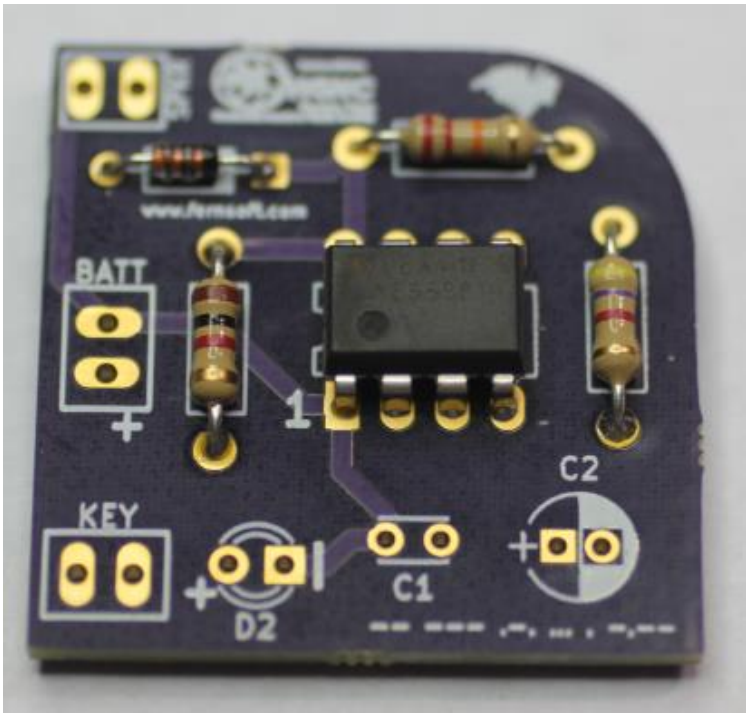
2. Insert the resistors. Bend the wire leads so that the resistor and the leads form a U-shape. Take care to make the bend very close to the body of the resistor to ensure that it fits easily into the circuit board. Insert into the board from the silk screen side of the board. In R1 insert the 1kΩ resistor marked Brown – Black – Red. In the R2 resistor location insert the 22k resistor marked Red-Red-Orange. In the R3 resistor location insert the 4.7 kΩ resistor marked Yellow Violet Red.
   Once the leads of the resistors are through the board, push them slightly wider apart from the back of the board so that the pressure on the side of the through holes is holding the resistor in place.



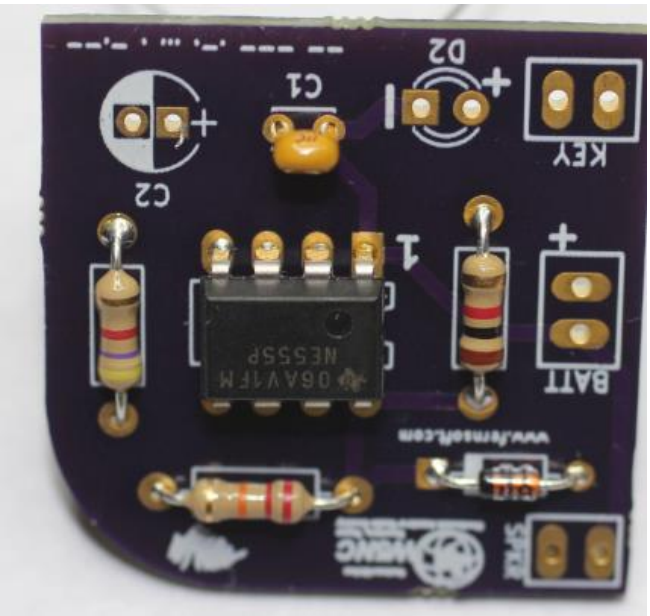
Hold the soldering iron where the resistor lead meets the through hole and solder in place using a small amount of solder. Repeat with the other leads.
After soldering in place, trim the excess lead off of the resistor leaving it close to the board. Take care to hold on to the leads that you are trimming, otherwise they care fly off and hurt someone. You should be wearing your safety glasses while trimming the leads just in case you are not holding the leads and they fly up at you.

Follow the same procedure with the other resistors.

3. In D1 insert the diode. Bend the wire leads so that the diode and the leads form a U-shape. Take care to make the bend very close to the body of the diode to ensure that it fits easily in the circuit board. Take careful note to put the diode in correctly. The body of the diode has a black band on it, this must be placed to match the band on the circuit board. If this is not done correctly, your kit will not function. See the below picture.

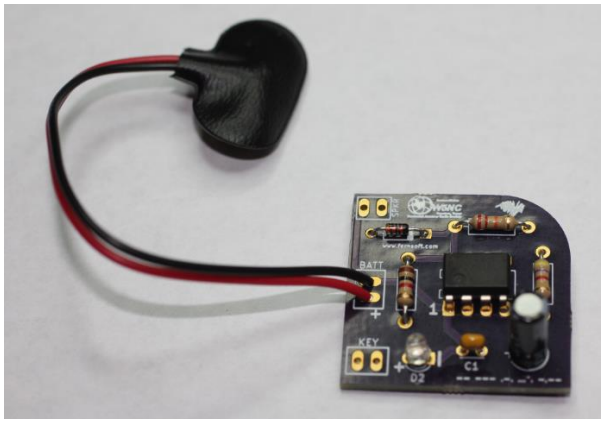


4. Insert the 0.1 µF capacitor into C1. Solder carefully in place.



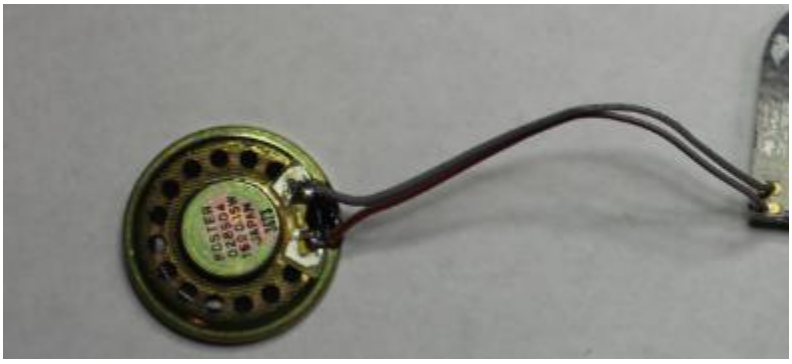
5. Insert the green LED into D2.
Insert the LED so that the longer leg of the LED is in the positive spot on the board. Again make the leads spread out so that the pressure holds it in place and then solder carefully in place.

6. Insert the leads to the 9 volt batter clip into the Batt position on the circuit board.
The red wire should go into the positive position as shown.

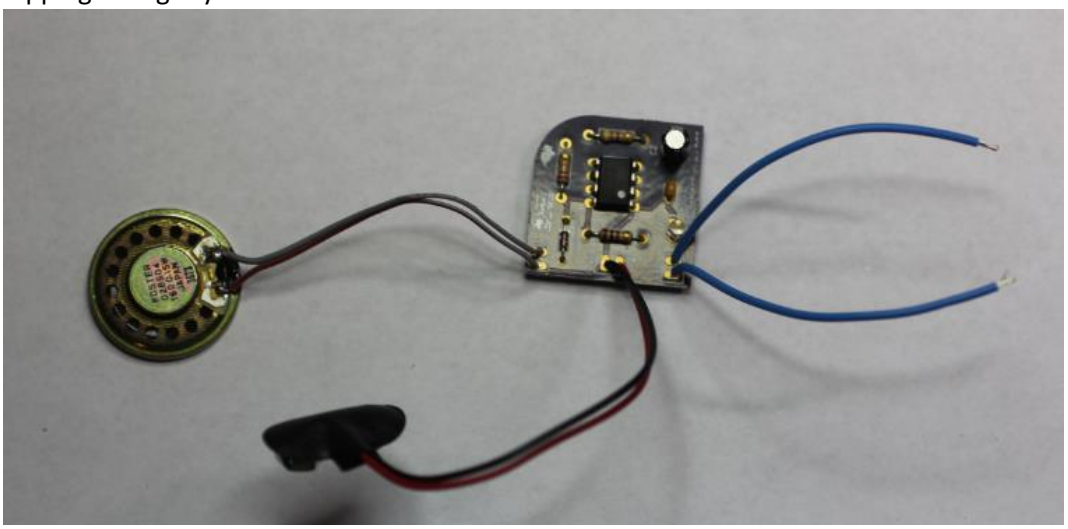


7. Connect the wire pieces provided to the pads labelled KEY as shown.

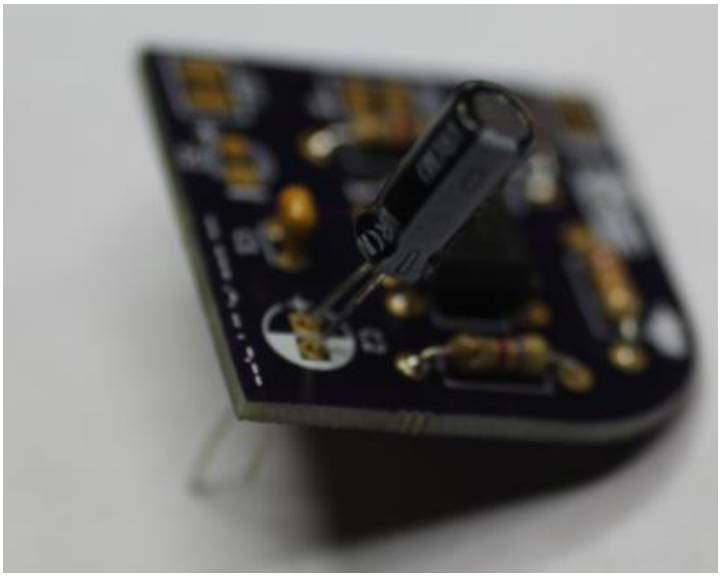
8. Connect the speaker leads to the SPKR position on the circuit board.



9. Insert the IC so that the divot or circle on the package is at the pin 1 end of the set of holes for the IC. Solder each pin carefully being careful not to drag solder from pin to pin and connect multiple pins together. You may need to slightly angle the leads of the IC by placing the IC leads flat on the table and gently bending inward then flipping to slightly bend the other side.



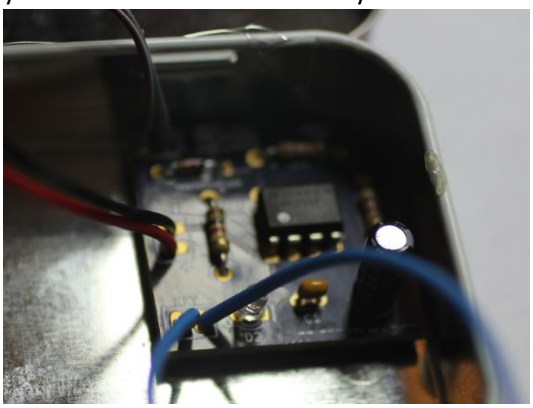
10. Insert the capacitor so that the lead marked with the white stripe (-) is in the negative position on the board, and the other lead (positive) by the plus sign on the board.



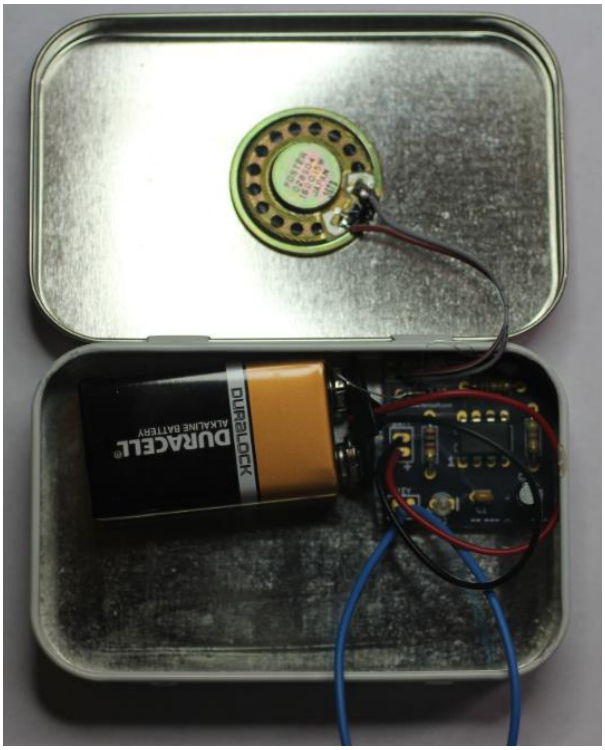
11. To mount the Morse code key in a metal mint tin such as an Altoids ™, eat or save off the mints to free up the tin.

12. Apply a small amount of hot glue to the corner of the tin where the circuit board will be placed to hold the board still.

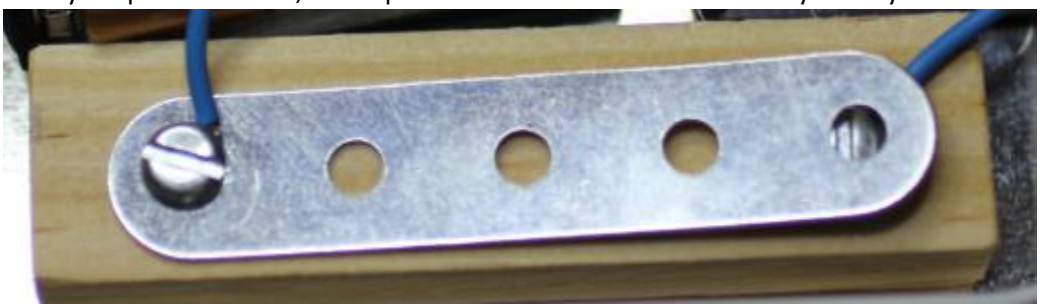
13. Seat the circuit board before the hot glue cools. Make sure that you use enough glue so that it prevents the board from touching the metal of the can directly. Otherwise the leads of the components with short out and your kit will not work correctly.



14. The magnet in the speaker will stick to the lid of the tin holding it in place.



15. Take your piece of wood, metal piece and two screws to assemble your key.



Begin with the contact for the key on the right. Loop the wire around the screw and tighten the screw into the wood. It is preferable to loop in a direction that will tighten as you tighten the screw rather than the opposite way. Place the metal piece over the hole in the wood. Start the other screw in that end, similarly loop the second wire and tighten. Depending on your preference, a small black spacer has been provided to raise the level of the metal. Some people might prefer putting this under the metal key instead of bending it up.
You could also at this point connect the buzzer to any commercially available straight key.

Congratulations!! You did it!

What comes next?
You have had a taste of electronics and would like to continue learning. Where can you go from here? There are many resources available to learn more about electronics.

For more about the 555 timer, the Wikipedia page provides a good overview.
https://en.wikipedia.org/wiki/555_timer_IC

Getting Started in Electronics by Forrest M Mims III

Practical Electronics for Inventors by Simon Monk

Boy Scout Electronics Merit Badge Booklet available at your local scout shop or
http://www.scoutstuff.org/bsa/literature-media/merit-badge-pamphelts.html

To find out how to design circuit boards such as the one used here see the series by Chris Gammell of Contextual Electronics https://contextualelectronics.com .
Enjoy more kits such as our Blinky Kit.
Check out the Fernsoft.com website for more information and kits.

You might want to utilize your key to learn Morse code or improve your ability to send and copy the code reliably. There are many opinions on the best method to learn Morse code, but all agree that practice sending and receiving are crucial to improving.

Letters

A: •–	J: •–––	R: •–•
B: –•••	K: –•–	S: •••
C: –•–•	L: •–••	T: –
D: –••	M: ––	U: ••–
E: •	N: –•	V: •••–
F: ••–•	O: –––	W: •––
G: ––•	P: •––•	X: –••–
H: ••••	Q: ––•–	Y: –•––
I: ••		Z: ––••

Numbers & Punctuation

1: •–––––	6: –••••	. •–•–•–
2: ••–––	7: ––•••	, ––••––
3: •••––	8: –––••	? ••––••
4: ••••–	9: ––––•	- –••••–
5: •••••	0: –––––	

Some suggest learning the letters in groups and one grouping suggested by a Boy Scout merit badge book is the following:

Group 1 – the letters with only dots	Group 2 – the letters with only dashes
E: ●	T: –
I: ●●	M: ––
S: ●●●	O: –––
H: ●●●●	
Group 3 – the letters with a single dot followed by dashes	**Group 4 – the letters with a single dash followed by dots**
A: ●–	N: –●
W: ●––	D: –●●
J: ●–––	B: –●●●
Group 5: - letters with dot dot dash	**Group 6: - letters with dash dash dot**
U: ●●–	G: ––●
F: ●●–●	Q: ––●–
Group 7: - letters with dot dash dot	**Group 7: - letters with dash dot dash**
R: ●–●	K: –●–
L: ●–●●	Y: –●––
P: ●––●	X: –●●–
V: ●●●–	C: –●–●
Z: ––●●	