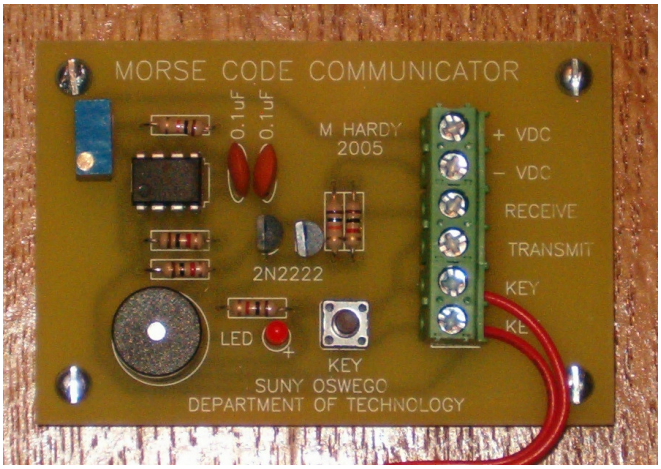
Project: Morse Code Communicator

TEL 240 - Electronics Technology **Name:**_____



Samuel F. B. Morse was born on April 27, 1791 in Charlestown, Massachusetts. After graduating from Yale, Morse undertook a career as an artist. When traveling home from Europe in 1832, Morse heard about electromagnetism, and conceived the idea of using electromagnets as a means of transmitting messages. In 1837, Morse applied for a patent for his telegraph. The original communications plan was to transmit a series of numbers using dots and dashes. The receiver would use a special dictionary to translate the numbers into words and phrases. In 1838, Morse demonstrated transmission of messages at an exhibition in New York. He had given up on the dictionary, and established a code for letters and numbers. Using this, he was able to transmit messages at a rate of 10 words per minute. In 1844, using government support, Morse successfully transmitted a message from the Capitol Building in Washington, DC to Baltimore, Maryland. In 1846, telegraph lines were established from Washington, DC to Buffalo and Boston.

The telegraph revolutionized communications. Prior to this invention, news would only travel the speed of a sailing ship at sea or a horse on land. By sending messages through the telegraph, information could reach across the country in minutes. In 1858, the first transatlantic cable was laid, and was an unsuccessful venture. In 1866, a second attempt was made, and it was now possible to communicate between Ireland and Newfoundland. In 1894, Sir Oliver Lodge demonstrated the first radio transmission of Morse Code. These developments allowed for communication worldwide.

The concept of sending data through pairs of wires is now nearly 170 years old. Our communications systems today utilize the Binary system of ON and Off signals to send text data using the American Standard Code for Information Interexchange (ASCII) code. While much of our high-speed communications is now being transmitted as binary on laser and fiber optic based systems, much of our communication depends on the same basic principled developed by Morse.

Web Resources

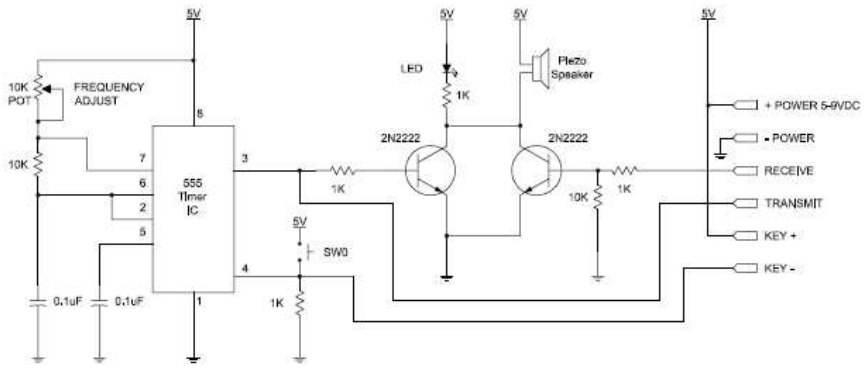
For more information on Morse Code and Communications, check out the following websites.

Title and URL	Description
Locust Grove Website www.morsehistoricsite.org	This links to the website for Locust Gove, historical home of Samuel Morse. The museum has information on Morse and educational opportunities for visitors.
Library of Congress Morse Archives http://lcweb2.loc.gov/ammem/atthtml/mrshome.html	Samuel Morse's papers will be available online soon from the Library of Congress.
Wikipedia Article http://en.wikipedia.org/wiki/Samuel_F._B._Morse	Wikipedia is a free online encyclopedia. This article is rich with history and links to related technologies and people.
American Radio Relay League http://www.arrl.org/	The ARRL is an organization for amateur radio operators. They have several educational programs to assist with getting started in amateur radio. There are local affiliate clubs throughout the world.
CGI Morse Code Translator http://morsecode.scphillips.com/cgi-bin/morse.cgi	Web based Morse Code translator written by Stephan C. Phillips. This will take text and translate it into an audio file for you.

Morse Code Communicator Circuit Board

This circuit board has been developed for use as an electronics project and communications teaching aid for Technology Education laboratories. The circuit board produces an audible tone on a speaker. When combined with a telegraph key or other switch, this oscillator can be used to produce Morse Code communications. Two boards can be connected together through wires to allow students in different areas to communicate back and forth. Instructional applications include the following,

- Teach basic electronics theory including oscillators, resistors, transistors, capacitors, and integrated circuits.
- Teach basic communications through Morse Code.
- Teach history of communications and illustrate communications systems from a century ago.
- Introduce radio communications, networking, and telephony.
- Link two boards together using LASERs and photodiodes.
- Link several boards together using a central switchboard.
- Have communications competitions to develop code proficiency.
- Have the students play "telephone" with the code system and see how a message gets changed when relayed.
- Connect an external light to have students communicate using light signals.



MORSE CODE COMMUNICATOR
TRANSMIT & RECEIVE CIRCUIT BOARD
SCHEMATIC

Circuit Board Operation Theory

This circuit board uses a simple 555 astable timer circuit to produce an audible frequency square wave. The timer frequency is controlled by a 0.1uF capacitor, a 10K resistor, and a 10K potentiometer. The speed that the capacitor charges controls the frequency. The resistors control the current flow into and out of the capacitor. By adjusting the potentiometer, the frequency or note that the board produces can be raised and lowered.

The 555 timer IC drives one of a pair of 2N2222 transistors. The second transistor is connected to the RECEIVE connection on the circuit board. These two transistors are set up in an OR configuration. This allows either the 555 or the RECEIVE connection to turn the speaker on and off at a high frequency producing a sound. An indicator LED is also on the circuit board for visual feedback.

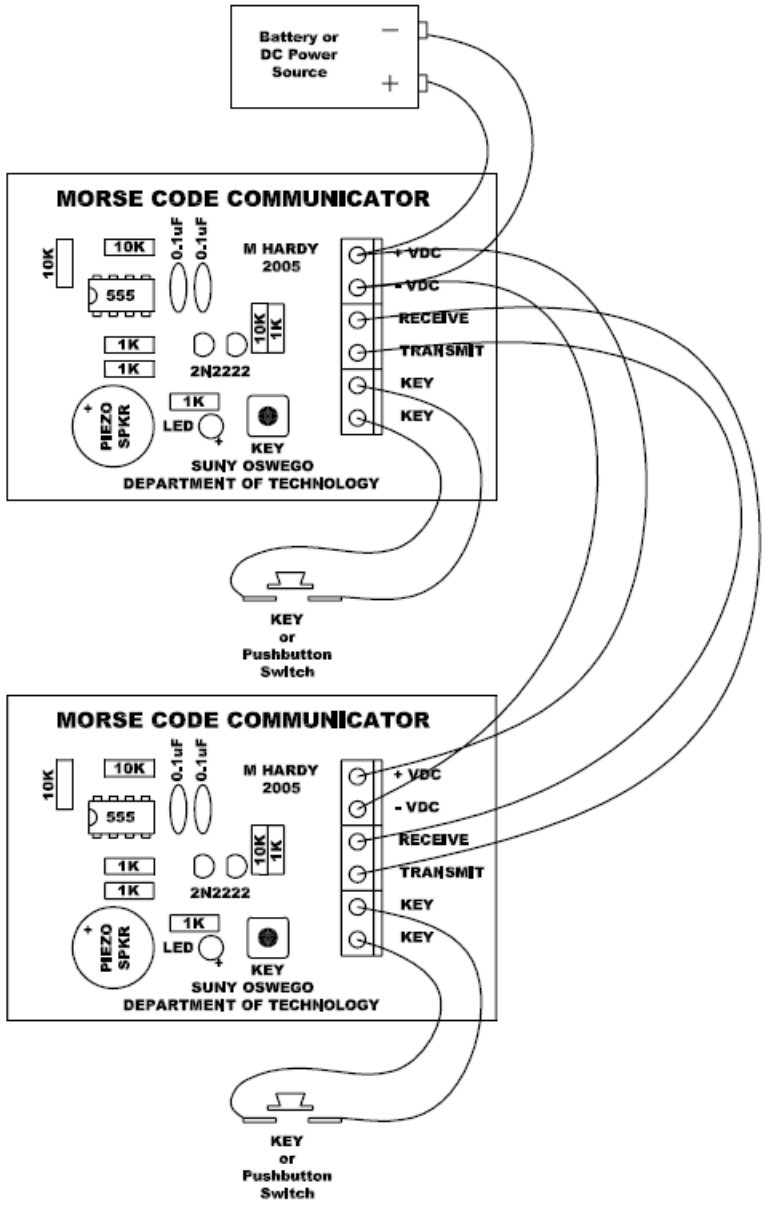
The circuit uses the RESET pin on the 555 timer to control the wave output. When the pushbutton is closed, the RESET pin is connected to positive, allowing the 555 to output a wave. When the switch is open, a 1K resistor pulls the RESET to ground, disabling the output.

The connections on the circuit board are as follows,

+ VDC	DC + Power Connection. The board will operate off of a voltage between 5 and 9 VDC.
- VDC	DC – Power Connection
RECEIVE	The receive connection connects to the transmit connection on a remote board. The input voltage should match the power voltage connected to the circuit board.
TRANSMIT	The transmit connection connects to the receive connection on a remote board. This is a direct, square-wave, digital output from the 555 timer. This could be used to drive external devices.
KEY	The two KEY connections can be directly connected to a normally open (NO) switch or external telegraph key.

Connecting Multiple Boards

The diagram below shows how two boards can be connected together to communicate between them.



Steps:

1. Connect + and – power on the first board to a battery or DC power supply. 5 to 9 VDC is recommended.
2. Connect + power to + power on each board.
3. Connect – power to – power on each board.
4. Connect the TRANSMIT on one board 1 to the RECEIVE on board 2.
5. Connect the RECEIVE on board 2 to the TRANSMIT on board 2.

Components List

Below is a list of components in the kit that will be assembled. Please identify and inventory your components kit to verify that you have the correct quantity and values for your components.

Component	Quantity	Cost Each	Total Cost
555 Timer Integrated Circuit	1	$0.24	$0.24
0.1µF Capacitor	2	$0.10	$0.20
Red LED	1	$0.08	$0.08
1 KΩ Resistor	4	$0.01	$0.04
10 KΩ Resistor	2	$0.01	$0.02
10 KΩ Potentiometer	1	$1.10	$1.10
2N2222 NPN Transistor	2	$0.05	$0.10
Pushbutton Switch	1	$0.14	$0.14
Terminal Block	3	$0.21	$0.63
Piezoelectric Speaker	1	$0.91	$0.91
Printed Circuit Board	1	$1.72	$1.72
TOTAL	19		$5.18

Sources:

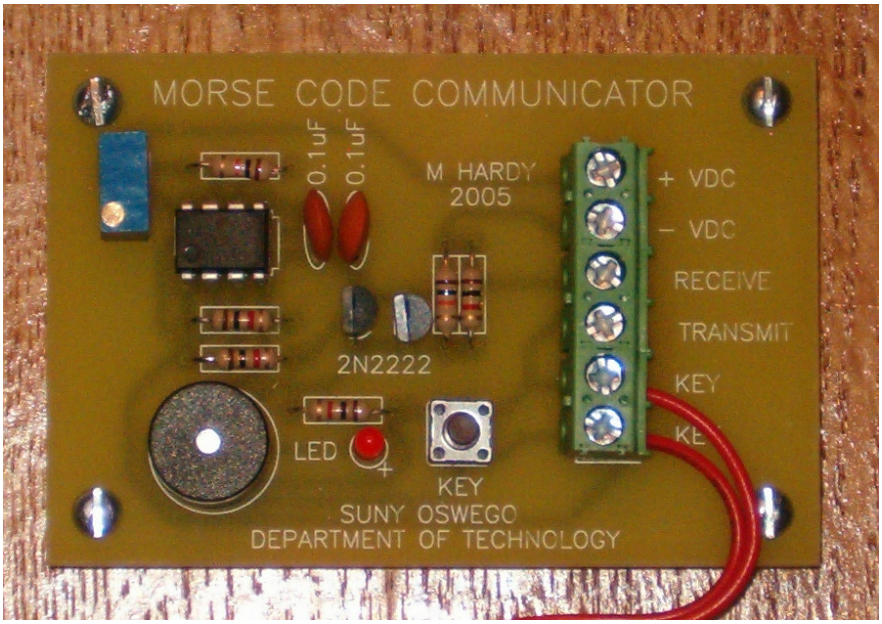
Electronics Components

Mouser Electronics
Mansfield, TX
www.mouser.com
Prices are based on purchasing in quantities of 100 parts

Printed Circuit Board
Northern Circuits
Syracuse, NY
www.northerncircuits.com
Price is based on purchasing 200.

Assembly Instructions

1. Identify and inventory the components in your kit and verify that you have the correct quantity of components. Please ask for assistance if you need help identifying components.



The finished circuit board.

2. Identify the 1KΩ, and 10KΩ resistors. Use the following chart to identify the resistors:

Value	Quantity	Color Code
1K Ω	4	Brown, Black, Red, Gold
10K Ω	3	Brown, Black, Orange, Gold

   Insert their leads into the board, solder in place, and then trim the leads. As a good practice, align the resistors such that the gold stripe is toward the top, such that the color code can be correctly read from the right edge of the board. Be careful and double check the resistor values to the different locations on the circuit board.

3. Identify the 0.1 microfarad capacitors. Insert the leads into the board, solder them, and trim off the excess. This capacitors do not have any polarity and do not require any specific orientation.

4. Insert and solder in place the LED. You need to make sure that the anode (longer lead) is toward the hole marked with a +. Trim off the excess leads after soldering them in place.

5. Identify the 555 Timer IC. Insert the pins into the holes in the circuit board being careful to not bend any pins over. The notch or dot identifying pin 1 should be toward the left of the circuit board and aligned with the notch on the block screen printed on the circuit board. Solder each of the pins in place. Be careful to avoid bridging solder between the pins.

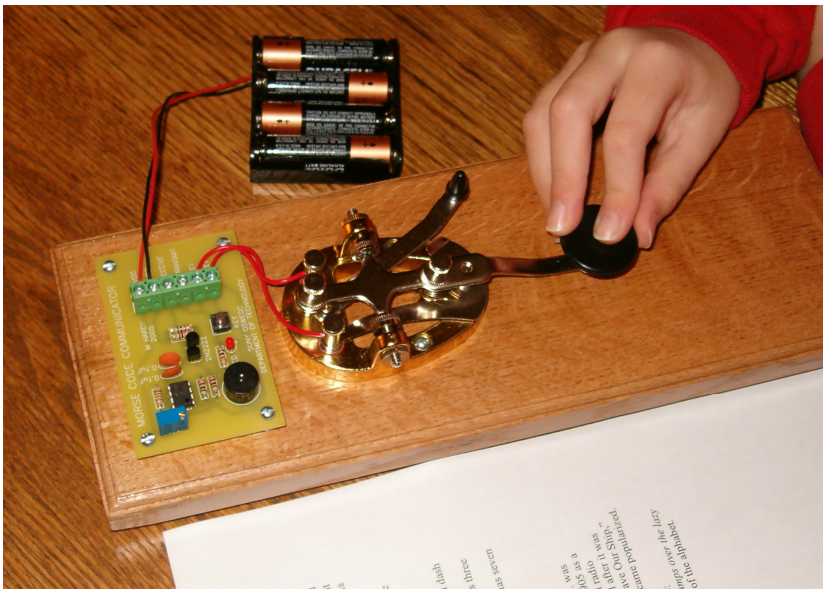
6. Identify the pushbutton switch and place it on the circuit board. Make sure that it sits flat on the printed circuit board. Solder the switch in place and trim the excess leads off.

7. Identify the Piezo Speaker. Place the speaker on the circuit board. The long lead should be oriented toward the Positive (+) mark on the board. Solder the speaker in place and trim the leads off.

8. Identify the 2N2222 Transistors. Note that there is a flat side on the resistor that must face toward the left as marked on the circuit board. Solder the leads in place and trim off the excess.

9. The remaining components to install are the terminal blocks. These blocks have dovetails on the side that allow them to be connected or "ganged" together. Connect the three blocks together and insert the pins into the circuit board with the screw terminal openings facing out of the board. Solder the pins in place. Due to the larger size of the pins, these will require additional heat to make a good solder joint.

This completes the assembly stage of the circuit board. Inspect the circuit for any bridged solder joints, cold joints, missed joints, or other imperfections and repair them.



Communicator circuit shown mounted to a wood base with a telegraph key.

International Morse Code

A	.-	N	-.
B	-…	O	---
C	-.-.	P	.--.
D	-..	Q	--.-
E	.	R	.-.
F	..-.	S	…
G	--.	T	-
H	….	U	..-
I	..	V	…-
J	.---	W	.--
K	-.-	X	-..-
L	.-..	Y	-.--
M	--	Z	--..
0	-----	Period	.-.-.-
1	.----	Comma	--..--
2	..---	?	..--..
3	…--	!	-.-.--
4	….-	@	.--.-.
5	…..		
6	-….		
7	--…		
8	---..		
9	----.		

The International Morse Code is comprised of a series of dots and dashes that represent the different letters, numbers, and symbols that we use.

When learning to send Morse Code, the following basic rules should be used:

1. A dot has one count.
2. A dash has three counts.
3. A space between the dot and dash has one count.
4. A space between letters has three counts
5. A space between words has seven counts.

Morse Trivia

The SOS distress call …---… was introduced in Germany in 1905 as a component of their national radio regulations. It wasn't until after it was created that the words, "Save Our Ship," or, "Save Our Souls," became popularized.

The following sentence:
The quick brown fox jumps over the lazy dog, uses every letter of the alphabet.

Morse Code Communicator Challenge:

TEL 240 - Electronics Technology Name:_____

Directions: Connect the Morse Code Communicator boards together as a pair. You and your lab partner will send a message back and forth to one another. Have the instructor provide you with a message, convert it to Morse Code, and then send it. Have the instructor check off the message for accuracy after it has been received.

Message to Send:

____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

Morse Code Message:

____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

Received Morse Code Message:

____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

Received Message:

____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

Instructor Approval: _____