

The Morse Code Trainer

Reaching the pinnacle of CW Operations!

Finally an all in one tool for learning and increasing Morse code operations. The Morse Code Trainer enhances the learning experience by immersing the user in word sounds, and how to send words correctly. It also contains the smoothest and most responsive Keyer available and the one and only tool all experienced CW operator must have to enhance their proficiency and operating skills. The Morse Code Trainer will put the DX world, Contesting, and Rag Chewing at your fingertips!

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Read Me First:

Before ordering or starting the kit build, please review the **KIT OPTIONS** on page 6, to help select the level of build to meet your needs. Also take a look at the instructions for building an MCT II version, which has been written for the Novice and beginning builder! This kit has some unique features such as using the **Printed Circuit Board (PCB)** as a drill template to insure proper mounting and alignment of all Board mounted Switches.

If you're interested in the MCT II, we recommend down loading this *Manual* and *Faceplate Template* from the web site for use in the build process. <http://www.qsl.net/k5bcg/Kits/Kits.html>

Preface:

We would like to thank **Rob Brownstein (K6RB)** and the **CW Ops CW Academy** for their support and approval in allowing us to utilize and modify the Character sequence created for the CW Ops CW Academy. For group training classes please search **CW Ops** then select **CW Academy** (<http://www.cwops.org/cwacademy.html>) to sign up for Level 1, 2, or 3 Classes. Level 1 is for new hams or hams that have been away from CW for a while. This level will teach all the Letters, Numbers, and Prosigns. Level 2 will take the student to 25 WPM and start training for head copy and cover the basics of contesting. Level 3 will complete the Head Copy process and take the student to 30 WPM, and work on contest excellence.

We would like to acknowledge all the people in Amateur Radio who have put items on the internet or contributed in one form or another where we've utilized there information in the development and/or documentation of this product to bring people into this great hobby of Amateur Radio.

A great thank you to **Jim's** restaurant at 9091 Research Blvd, Austin, TX 78758 for:

- 1) Letting us use their location to chow down every week.
- 2) Allowing us to use their facility to meet for hours on end to have our discussions to formulate our thoughts and challenges.

Last but not least, we would like to acknowledge and thank everyone who has purchased a **Morse Code Trainer**. By doing so, it supports this great language of Morse code, and its method of communications. We also express our greatest wishes and success to those using this device to learn or enhance their CW operating skills. We believe the features, functions, and training method used in this device is a totally new paradigm for the present as well as next generation of Amateur Radio Operators.

Thank you,
The Team

Quick start: (Windows users: hold down the "Ctrl" key and Left Mouse click the selection)

For [Kit Option Summary](#), go to page 6, **Section 1: Introduction / Operations**

For [Using the MCT Keyer](#), go to page 11 - **Section 1: Introduction / Operations**

For [MCT II Complete Assembly Instructions](#), go to page 16, **Section 2: Assembly**

For [MCT III Assembly Tips](#), go to page 38, **Section 2: Assembly**

For [Learning Morse code](#), go to page 41 – **Section 3: Training**

For [Enhancing Skills and Proficiency](#), go to page 52 - **Section 3: Training**

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Section 1: (Introduction / Operations)

Introduction:

Welcome and thank you for your interest in the **Morse Code Trainer (MCT)**. We believe this product is a major breakthrough in the process of learning Morse code. It not only teaches Morse code to the beginner at their speed, and Life constraints, but it's also the **A to Z in a box for CW!** It includes an exemplary Keyer, with the capabilities to enhance the skills and proficiency of the most experienced CW operator.

To be very CLEAR! This is not a Heathkit, Red Hot 20 Kit, or a complete Kit containing every part to complete the build! However it is a simple **board level kit** that includes everything to build the circuit board including all external components that allows the builder to install the kit in the box of their choosing.

If you're new to CW and/or Kit building, and already ordered the **MCT II** kit with the **standard Push Button Switches**, or haven't made up your mind yet, may we recommend the **MCT II** kit as detailed in the **Assembly** section of the manual? We also recommend printing the whole manual, following the step-by-step instructions, and assembling it in the recommended enclosure. Then after the kit is finished, move on to **Section 3** (page 41) to use the trainer to learn this great language of **Morse code**, then move on to the **Keyer features** on page 11. See **Quick Start** (page 2) for the different sections.

Or, if you're an experienced builder and need no help in the build process and your goal is to build one of the Kit Options (see page 6) in an enclosure of your choosing, may we recommend a different idea and some tips that are identified on page 38 - 40. **NOTE:** Prior to assembly, review the board layout to the schematic; there are connections on the **PCB** which may help when connecting external devices that are not shown on the schematic. When you're finished, please review **Section 3** to learn how to use the trainer and Keyer features of the device. See page 41 for **Learning Morse Characters**, page 52 for **Enhancing Skills and Proficiency**, or page 11 for **Using the MCT Keyer**.

In keeping the new kit builder in mind, we understand the assembly of **Surface Mount Technology (SMT)** and its difficulties in hand soldering. So there have been measures taken in the board layout to maximize and ensure easy soldering. Like having the major chips already mounted on the board, and larger component pads for discrete components. We also assume that some initial care will be taken in the assembly and setup of this kit. As you'll soon find out, **not everything is spelled out!** That's because the Kit is also a training tool in learning how to build from scratch. We want you to not only just put parts together, but also learn the process of how to assemble a partial Kit into an enclosure of your choosing and finishing it to your expectations.

Also, by learning to use some basic tools like **PowerPoint** to create faceplates or templates to incorporate functional information will help in finalizing the product look, or by using the Printed Circuit Board for drilling holes to ensure alignment. These are just a few items that help in the learning processes in building a project. These are features of this kit which will expose the builder to all of these areas and supply a good knowledge base for future Home Brew projects utilizing board level projects and how to finish them.

Thank you again, and when your finished building the kit, we hope you find this new breakthrough in learning Morse Code and/or enhancing one's operating skills to be the most valuable tool in the shack, and everything that will ever be needed to take advantage of the great adventure in Morse code operations.

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History:

The **Morse Code Trainer** is a follow on to what was called the “**Code Buddy**”. The Code Buddy was an SMT Kit sold to new code enthusiast who wanted a small keyer that was simple to use, allowed good code sending at any speeds, and portable for practice.

The “**Code Buddy**” was available on the market for about 5 years. With the advent of Morse code no longer being required to pass the Amateur Radio license, the need for this device diminished.

Fast forward to today, and with the changes in licensing, it just so happened there’s a resurging interest in learning Morse code. However, the methods to learn this language today are antiquated and difficult to fit into today’s life style and hectic schedules.

So a group of hams from the Austin, Texas QRP Group, and a few local CW operators, got together and combined their knowledge and came up with the “**Morse Code Trainer**”. Well it didn’t start out with that name, but it evolved to this fantastic device. After a few iterations and lots of hardware and firmware changes. It became apparent to the team that this device is a major breakthrough in the Morse code learning process. This kit will give the builder an opportunity to build an SMT kit, learn Morse code, enhance their receiving and sending skills, and have a high quality Memory Keyer to use in the future.

The manual takes the new or experienced ham through an off-the-shelf box modifications, the Kit building process, debugging, then final assembly. Then depending on their needs, learning Morse code, enhancing their receiving and sending skills, and learning how to use the keyer.

For the new comer it exposes them to simple characters and immediately jumps into learning word sounds associated with the new characters. No more random character groups! We want you to bypass that stage and move right into hearing the characters as words! Also, as part of learning word sounds, it exposes the student to sending word sounds correctly using the internal Iambic Keyer with a dual lever Paddle to take advantage of the Iambic and Mode “B” operation of sending.

For the experienced ham this device allows them to work on their receiving skills of most commonly used and ham words in a database of over 1,000 words, to increase their ability to copy in their head. It also gives them the ability, like the new comer, to work on their sending skills in sending word sounds. Plus the device gives the experienced CW operator a fantastic Iambic Memory Keyer to use in everyday operations.

So this is a totally new paradigm in learning this great language of Morse code. One that allows the new ham or experienced CW operator to learn or enhance their CW skills without the pressures and stress of a classroom environment, study schedule to meet demands, or life’s interruptions. It’s the “**Morse Code Trainer**” on the users own schedule!

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Design Features:

The **MCT** contains unique features for the new ham to quickly learn this great language of Morse code, on their terms! At the same time, it has features for the experienced ham to enhance their CW skills and proficiency, and contains a Keyer with a unique sensitivity and responsiveness that will rival the most expensive Keyer's on the market, and will be the last Keyer any CW operator will ever need or want!

The **MCT** is set up for the convenience of the operator in four different sections:

Learning Mode – This section is setup for the **new person to Morse code**. First, it introduces them to numbers, then eight sessions, containing different character groups per session. Then quickly moves them to learn Word Sounds made up of the characters just learned in the session. How to set up and use a dual lever paddle to learn Iambic characters, and Mode “B” sending. Then it teaches them how to send those Word Sounds. Just like in the Enhancer Mode but the word groups in each session are made up of the characters learned.

Enhancer Mode – This section is setup for the **experienced CW operator** who would like to increase their skills and proficiency, and maybe break bad habits by learning Word Sounds and how to send Word Sounds correctly. It contains a large library of words and Ham abbreviations, from a single letter to seven letter words. It's setup to help the operator quickly reach that point of hearing the music of CW, copying in their head, and sending words and sentences with less mistakes!

General Setup – These are the unique functions that support both training modes and makes the difference in helping the new ham that has struggled in the past and helps them learn the language quickly without all the pit falls, plateaus, and bad habits previously encountered in trying to learn this language.

Iambic Keyer Mode – This is, as the user will soon come to realize, the finest sending device on the market today. With its eight (8) memories, easy to use responsive keyer containing the ability to Repeat and Link memories together, plus always knowing at what speed the device is set to while sending, will surely meet any user's requirements.

Features in a nut shell:

- **OLED** 4 lines **Display** of Menu items, Memory, Functions, etc.
- Adjustable **WPM** sending (5 – 100 WPM)
- Adjustable **PAUSE** between Words
- Adjustable **REPEAT** of words (1 – 50)
- Trains the beginner how to **Adjust a Paddle**
- Trains the beginner in **WORD SOUNDS**
- Trains the beginner how to **SENDING WORDS**
- Trains the beginner how to **SEND** Iambic characters
- Trains the beginner in an easy way to learn **NUMBERS**
- Trains the seasoned ham in **WORD SOUNDS** (head copy)
- Trains the seasoned ham in **SENDING WORD SOUNDS**
- Imbedded commands to **LINK** or **LOOP** memories together
- Low current drain (MCT II)
- Selectable **Mode A/B** Keying
- Adjustable **TONE** (100 – 4000 Hz)
- Adjustable **WORD LENGTH** (2 – 7 letters + ALL)
- Adjustable **TRAINING WORDS** (10 – 300)
- Smooth and responsive **KEYER**
- **MEMORY PROGRAMMING** via Paddle input
- **128 Character Memory capacity** per memory
- **Eight (8)** Programmable Non-volatile **MEMORIES**
- Saved memory **ERROR CORRECTION**
- **ON DEMAND** memory editing
- Complete memory **DELETION**
- Detailed **User** and **Assembly** manual (MCT II)

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Kit Options Summary: ([Back](#))

MCT I - there is no information in this manual describing the MCT I. Please follow the schematic in the kit.

MCT II - kit contains the basic board kit (Resistors, Capacitors, Transistors, and **Standard Push Buttons** for **Functions** and **Memories**, with the **Controller IC chip pre-soldered** to the **PCB**). External parts are one 2AA battery holder, three (3) stereo Jacks, a Piezo speaker, two (2) SPDT switches, and an OLED display. **Push Button Options** are available when ordering the kit in place of **Function** and **Memory** switches. See options below. (See Web Site for order details at <http://www.qsl.net/k5bcg/Kits/Kits.html>). This Kit **IS recommended for the first time builder** with step-by-step assembly instructions included in the manual.

MCT IIa - kit is configured **without the IC** soldered on the **PCB**, and for the experience **SMT** builder who has the capability to install the **IC**. This kit contains all the same parts as identified the MCT II, with the same **Push Button Options** available. *This kit **IS NOT** recommended for the first time builder, and may be assembled in the same box as the MCT II!*

MCT III - kit contains an enhanced Board Kit with parts for a sine wave audio amplifier, voltage regulator, **PCB** mounted volume control, and **Standard** push buttons for **Functions** and **Memories**, with **both IC's pre-soldered** to the **PCB**. External part are three (3) stereo Jacks, a one inch 8 Ohm speaker, two SPDT switches, one 3AA battery holder, and an OLED display. **Push Button Options** are also available. This kit is recommended for the **Intermediate** builder and requires a **larger box** then the MCT II. See **Tips** on page 38.

MCT IIIa - kit like the MCT IIa, is configured **without the IC's** soldered on the **PCB**. It's for the **Experience SMT** builder who wants to solder the **IC's** to the **PCB**. This kit contains all the same parts as identified in the MCT III, with the same **Push Button Options**. *Also **NOT** recommended for the first time builder!*

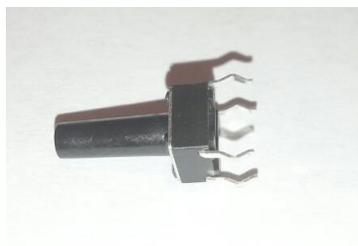
Push Button Option 1:

This option is for containers (boxes) with wall thicknesses of greater than 3/32" thick or requiring the **PCB** to be mounted on standoffs which would require a longer stem on the switch. The switch has a stem which protrudes 9mm or ~3/8" from the top of the switch body which will allow for various mounting schemes with the switches mounted on the **PCB**. The switch mounting is the same as the **STANDARD** Push button switch with a 4mm or ~1/8" stem protrusion from the top of the switch used in containers (boxes) with wall thicknesses of 3/32" or less.

Standard Button



Button Option 1



Button Option 2



Push Button Option 2:

This option is for a panel mounting push button of up to 3/16" wall thickness, and/or where more space is required for button access. This button will require the wires to be soldered between the switch contacts and switch contact location on the **PCB**.

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Theory of Operations:

Firmware:

John Fisher, K5JHF, created the firmware which uses a LPC824 Chip that contains all the functions, data, and **proprietary** code and intellectual properties for all the functions and operations of the **MCT**.

Hardware:

Kees Talen, K5BCQ, developed the Hardware and board layout configuration to allow all this magic to have a human interface. He also manages the Web site, kitting, and distribution.

Features:

Steve Sparks, WK5S, instrumented the features and participated in developing the circuit to produce an amplified sine wave side tone. He also manages the assembly for installing the IC's.

Functions:

The **MCT** is a Kit, utilizing Surface Mount Technology (SMT) to create a functioning device with the ability in the Firmware to enable a unique State-of-The-Art training process. It contains the ability to learn Morse characters, learning word sounds, and how to send word sounds using an external paddle. In part of the firmware is a sensitive-to-the-touch responsive Iambic Keyer, containing Memories to enhance the Keyer's operations. The memory function contains unique imbedded commands which makes it a world class Keyer. One of the unique and major features of this Keyer is that it will maintain its sensitivity and responsiveness at **ALL** speeds from 5 to 100 WPM.

Audio: (Option)

If Kit 2 is selected, it contains the hardware for the audio string to create a sine wave side tone for listening. The audio from the chip (which is a square wave) is sent to RC filters to remove the multiple frequencies and to pass a sine wave tone which is amplified using the NCS2211D audio amplifier. This circuit replaces the Piezo speaker having no amplifier. The headphone Jack is a user convenience which allows for the redirection of audio from the Speaker or Piezo when the headphones are used for quiet listening.

Output Keying:

Output keying is accomplished by driving a 2N7000 to key all modern direct keyed transmitters.

Manual: (by Bill Sepulveda, K5LN)

The manual has been written by a ham with a passion for **CW** in support of a different learning process to help eliminate the traditional problems encountered in learning Morse code, with steps to help the new comer build a Kit!

The **new Ham** who has never taken a journey in building a project will be taken through a process that will allow them to jump right in and build a kit by **READING** and **FOLLOWING** the detailed instruction. In the process, they will be given options in some cases, and step-by-step instructions like building of an MCT II, and in the Training Sections. As part of the build process, they will also be a little challenged in putting together their final configuration (Packaging). Even though the instructions spell out a complete kit with the box for the MCT II, the included example is to help the individual open their imagination in the process to create a one of a kind unique package for their kit.

So for those who are **experienced builders** and already know CW, please bear with us, but be careful not to miss the details. You're on your own in building and packaging the MCT III, and soon find out what a fantastic device this is.

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Menu:

The **MCT** contains sixteen (16) items which are accessible by pressing the Up and Down push buttons and pressing the Left and Right push buttons to change the value in the selected Menu Item. The **Seed** (center button) button is used to change the random order of words in some sessions.

Menu Overview:

1) IAMBIC KEYER

The “IAMBIC KEYER” is initiated when power is applied to the device. In this mode the Keyer functions may be used to key the transmitter, practice sending, and is the launch point for the Enhancement sessions (WORD SOUNDS and SEND WORDS).

2) WORD SOUNDS*

“WORD SOUNDS” is the first Enhanced session for the advanced operator to practice WORD SOUNDS to help increase head copy comprehension.

3) SEND WORDS*

“SEND WORDS” is the second Enhanced session for the advanced operator to practice sending WORD SOUNDS to help increase sending skills.

4) KEYER WPM

“KEYER WPM” will change the speed at which the Iambic keyer and learning sessions are regulated. The value (speed) may be changed from 5 to 100 WPM. The keyer function may also be used when this menu item is displayed.

5) MODE

“MODE” is a Keyer function to select between Mode “A or Mode “B”. Explanation of this function will be covered later.

6) # WORDS*

The “# WORDS” menu allows the learning of words in groups of ten. Its value can be changed from 10 to 300. This sets up the “WORD SOUNDS” and “SEND WORDS” sessions to extend the users vocabulary, which contains over 1,600 most commonly used words, Ham Abbreviations, and “Q” signals.

7) REPEAT*

The “REPEAT” function allows the user to change the number of times a word is sent in the “WORD SOUNDS”, “SEND WORDS”, “SESSION WORDS”, and “SESSION WORD+KEY” sessions, and allows the word to be repeated between 1 to 50 times before changing to another word.

8) PAUSE*

The “PAUSE” function allows the user to change the time between the word being repeated to help hear and recognize the word being sent, and can be change from 0 to 5000ms.

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9) # LETTERS*

The “# LETTERS” function allows the user to change the number of characters used in the makeup of the words used in the “**WORD SOUNDS**” and “**SEND WORDS**” session, and may be changed from 1 to 7 to practice words of a selected number of letters. If “**ALL**” is selected, all the database words from one to seven characters in length are used in both sessions and sent randomly.

10) TONE HZ

When “TONE” is viewed in the window, the Left and Right buttons may be used to change the frequency of the Side Tone from 100 to 4000 Hz.

11) SESSION (X)*

“SESSION (X)” allows for the selection of eight different training sessions for learning Morse code. This is where the Letters, punctuations, and Prosigns are learned.

12) SESSION LETTERS (X)*

“SESSION LETTERS (X)” allows the selection of an individual letter within a session to be learned.

13) NUMBERS

“NUMBERS” is a training session for the beginner to learn Numbers, and is the launch point for the Learning sessions (SESSION LETTER, SESSION WORDS, and SESSION WORD + KEY).

14) SESSION LETTER

“SESSION LETTER” allows for the learning of each unique letter/character sound by continually repeating the selected letter.

15) SESSION WORDS*

“SESSION WORDS” is where all the letters learned in a session are brought together in word sounds.

16) SESSION WORD + KEY*

“SESSION WORD + KEY” is where the new comer learns how to send words correctly from the characters learned in the session.

Memories

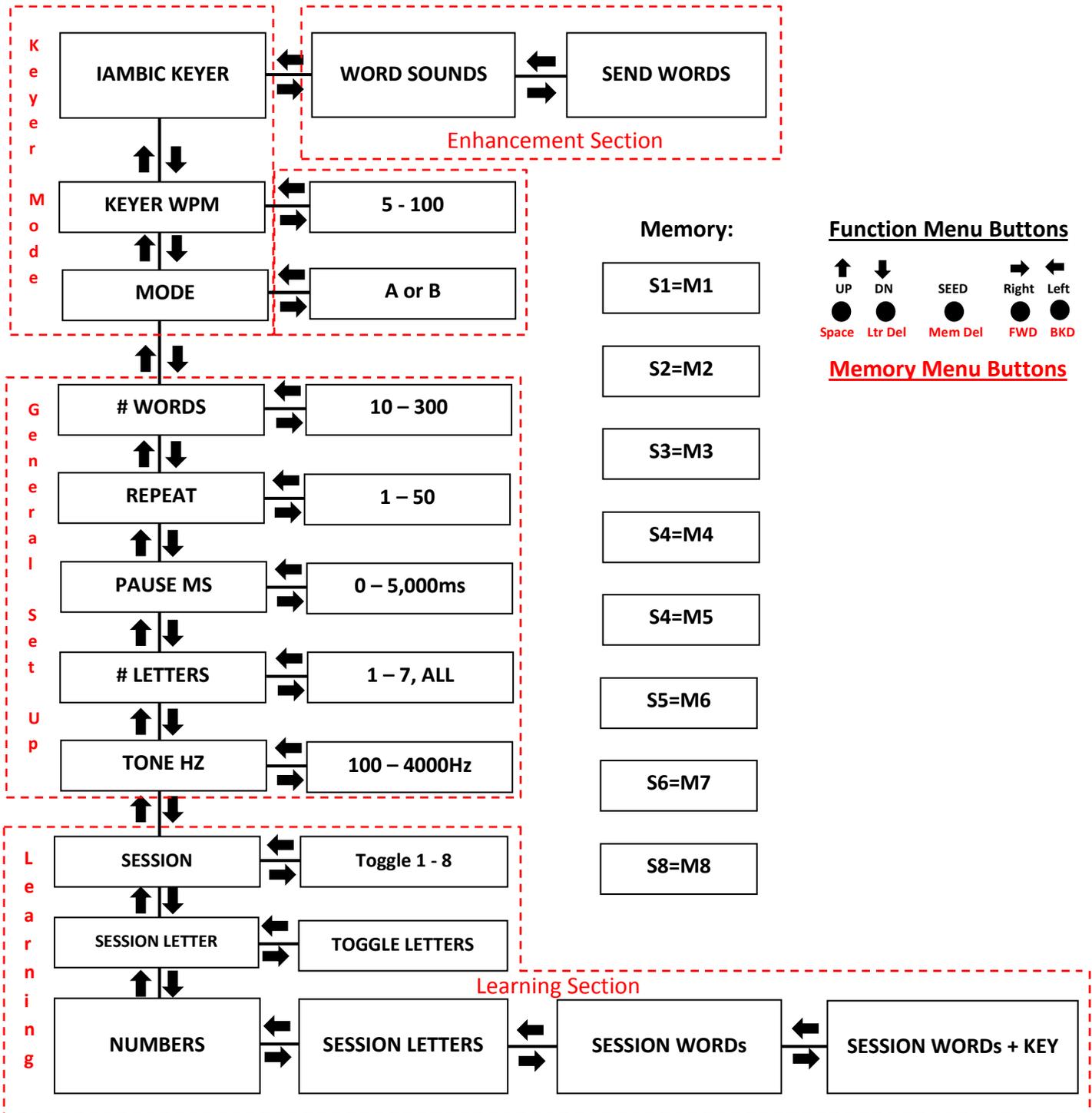
Memories (1 – 8), are for user convenience with each memory capable of looping to itself when using an embedded command or linking and looping to another memory using the embedded commands. Each memory has the capacity of 128 characters.

*These are features and functions which make this device unique and different than any other process used in learning the language of Morse code or Enhancing one skills.

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Menu Map / Flow Chart:

The map shows how to step through the different menu items to access the different function within the device. Use the **Up** (UP) and **Down** (DN) buttons to move from menu to menu, and use the **Left** and **Right** buttons to change the value in the selected menu. Also use the **Left** and **Right** buttons to move between training sections.



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Using the MCT KEYER: ([Back](#))

We recommend good quality tools such as **dual lever paddle** that will take advantage of all adjustment features. Please see **Appendix “A”** for paddle wire hook up, and connector recommendations. We also recommend reading and studying **“The secrets of Easy Morse Code Sending”**, to learn how to setup and use the paddle. The File can be found at <http://www.gsl.net/k5bcq/Kits/Kits.html>

Now that the paddle is adjusted and feels good in your hand, let’s start using the Keyer Function.

The **MCT** has the keying section (red dashed lines) grouped together for operator convenience (see the Flow Chart on page 10) which consists of the **IAMBIC KEYER**, **KEYER WPM**, and **MODE**.

The **IAMBIC KEYER** is the heart of the **MCT** because the **KEYER WPM** menu affects all the other training sections and is where the speed of the Keyer and training speeds are set. The **Keyer** function may also be used when either the **IAMBIC KEYER** or **KEYER WPM** menus are displayed.

When the device is in the **KEYER WPM** menu the speed at which the Keyer is set to will be displayed. This allows the user to always know at what speed the Keyer is set to. Very nice feature to have 😊

Mode “A” & “B”:

The **MODE** menu is where the type of keying is selected (see Appendix “E”). Mode “A” or “B” is selected based on the operator’s preference. Mode “B” is used in conjunction with lambic sending and will enhance the sending skills as the speed is increased.

Once you become comfortable with your sending skills you’ll quickly realize sending with this device is really easy, and the words just seem roll off the fingers. The keying design is proprietary and is what makes the Keyer function standout from all the others.

Set Up and Usage:

- 1) When the **MCT** is turned on it always comes up in the **IAMBIC KEYER** mode, and at the last Speed and Mode setting.
- 2) Press the **Down** button twice to select the **MODE** menu. Select which mode is preferable, “A” or “B”.
- 3) Press the **Up** button once to select **KEYER WPM** mode to display the keyer speed while sending, and make a change to the speed which feels most comfortable.
- 4) Plug in a cable from the output of the **MCT** to the direct keying of the transmitter and enjoy this fantastic responsive Keyer. Or start using it to learn **MORSE CODE** or how to **ENHANCE SKILLS AND PROFEICIENCY!**

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Using the Memory:

The Memory buttons (1 through 8) may be used to hold many different Terms, phrases, or information that's needed for a quick response like what's used in a Contest exchange, info for working a pile up, running a CW Net, or just to help in daily operations with the basic information as in the example below. Feel free to enter what meets your needs.

Examples:

M1 = (call sign) one time

M2 = **QSL 5nn TU** for those DX stations where your speed might be challenged, and using the memory to send the reply and signal report is much easier

M3 = **CQ CQ CQ DE (call sign) (call sign) K** a short CQ

M4 = **CQ CQ CQ DE (call sign) (call sign) CQ CQ CQ DE (call sign) (call sign) K** a long CQ

M5 = **RST 559 559** low signal report

M6 = **RST 579 579** medium signal report

M7 = **RST 5nn 5nn** strong signal report

M8 = **QTH IS (city, & state.) (city, & state.) NAME or OP (name) (name) SO HW CPY? AR DE (call sign) K**

Because this device can send up to **100 WPM**, it may be utilized in the category of high speed burst communications by setting the **KEYER WPM** to **100**, loading a memory and or linking multiple memories with data and just pushing the appropriate memory button to deliver the message.

How to program Memory: (setting up a short CQ)

- 1) Set the **KEYER WPM** to **20**. Slower if need be, but **no faster than 20 WPM!**
- 2) With the **MCT** in either the **IAMBIC KEYER** or **KEYER WPM** menu, press the **M3** memory button and hold it down until a double beep is heard. Then release the button after the double beep. The **MCT** is now ready to receive data into the memory.
- 3) Using the paddle, enter **CQ** and pause. As the letters are entered, the **MCT** will display each character. After the pause, the **MCT** will move the cursor to the right one more time which automatically enters a **word space**.
- 4) Enter a second **CQ** and pause, again as the letters are entered, the **MCT** will again display the letters and will insert another **word space** after the pause.
- 5) Enter a third **CQ** and pause, again the **MCT** displays the letters and will insert another **word space**.
- 6) Enter **DE** and pause, the **MCT** displays the letters and will insert another **word space**.
- 7) Enter (**your call**) and pause, and wait for the **word space** to be added.
- 8) Enter (**your call**) again and pause, and wait for it.
- 9) Enter the Letter "**K**" and pause, to allow the **MCT** to add the **word space** after the "**K**" is entered.
- 10) Now press and release the **M3** memory button, a beep will be heard and the display will return to the setting prior to entering the memory information. This signifies the message has been stored.
- 11) Tap the **M3** memory button to hear the **MCT** send the short **CQ** message.

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Unique Memory Requirement:

Using a Forward Slash (/) in a call sign to identify a different location, will require two slashes (//) when loaded into memory.

Example:

For the memory to play WA4ZFP/5, it will have to be entered in to the memory as WA4ZFP//5.
Or SP5/WA4ZFP will have to be entered into the memory as SP5//WA4ZFP.

How to correct a mistake while entering a message in a Memory:

If a mistake is made while entering the data into the memory, it may be corrected by pressing the **Backward (BKD)** button to move the cursor back to the mistake (see **Memory Menu Button definition**).

Then press the **Letter Delete** button and re-enter the correct letter.

Then using the **Forward (FWD) button** to move the cursor to the right one space, to continue entering the rest of the message.



Remember after the message is completed, press the memory button until a beep is heard, then let it go.

How to correct or edit a message after it has been saved:

- 1) Press and hold the memory button requiring the edit until a double beep is heard. The **MCT** may or may not start playing the message, just keep holding the memory button down until a double beep is heard then release the button. The message will show up in the screen after the double beep.
- 2) Using the **Backward (BKD)** button (see button definition), move the cursor back to the locations requiring the correction, and use the **Letter Delete (Ltr Del)** button to remove the incorrect character(s) then enter the correct character. If the issue is that a space needs to be added in the message, use the **Backward (BKD)** button to move to where a space is to be added and press the **Space** Button to insert the space.
- 3) Press and hold the memory button until a beep is heard and release the button, to save the message.
- 4) Tap the memory button to play the message and listen to the message to make sure it was corrected.

How to write over existing information in a memory:

To change a message already in a memory with a different message, hold down the memory button until a double beep is heard. After the memory is displayed press the **Memory Delete** button (see Memory Menu button definition) and the existing message will be cleared and a blank screen will be displayed.

Enter the new message and correct any mistakes as identified previously. Hold down the memory button after the message has been entered to save the new message.

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Using Embedded Commands:

There are two embedded commands utilized in the **MCT** to help in the daily operations and use of memory.

“/” – The Forward Slash is utilized as the **Definer** to setup the following characters as an embedded command.

/D(#) – When the letter **“D”** is used after a Forward Slash it becomes the **Identifier** for a **Delay**. A number (**#**) from 1 to 9 added after the **“D”** will set the delay in seconds before the memory continues with whatever is to follow in the memory.

/M(#) – When the letter **“M”** is used after a Forward Slash, it becomes the **Identifier** for a **Memory Location**. A number (**#**) from 1 to 8 added after the **“M”** will activate the identified memory.

A great use for these two embedded commands is when a general call (**CQ**) is created. This way you don't have to constantly be sending the **CQ** manually. But it's good to practice! 😊 Remember you want to be able to send the long **CQ** in your sleep without any mistakes!

Example 1:

- 1) Press and hold the **M4** button down until a double beep is heard.
- 2) Enter the following into the memory. **“CQ CQ CQ DE (call sign) (call sign) CQ CQ CQ DE (call sign) (call sign) K /D9 /M4”**. Note the spaces: **“K” (space) /D9 (space) /M4**.
- 3) Press the **M4** memory button down until a beep is heard, than release the button.

Pressing the **M4** button after it has been programmed will start sending the information in the memory as stated above. **“/D9”** will add a nine second delay before the next imbedded command. The **“/M4”** command tells memory four to start sending. This condition will continue to loop the long **CQ** information in memory every nine seconds, until it's interrupted with the push of either paddle lever. Give it a try. You'll be pleasantly surprised. 😊

Example 2:

This next example will require two different steps, and will link two memories together.

Step 1:

- 1) Press and hold the **M8** button down until two beeps are heard, than release the button.
- 2) Enter the following into memory, **“QTH IS (city, state.) (city, state.) NAME IS (name) (name) SO HW CPY? DE (Your call) K”**. Don't forget the Comma and Period in the City and State.
- 3) Press and hold the **M8** button down until a beep is heard, than release the button.

Step 2:

- 1) Press and hold the **M7** button down until a double beep is heard, than release the button.
- 2) Enter the following into memory, **“RST 5nn 5nn /M8”**.
- 3) Press and hold the **M7** button down until a beep is heard, than release the button.

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Now press **M7** and listen to what happens. If programmed properly, **M7** will send the signal report of 599 (abbreviated), then **M8** will start sending what was entered for the initial information transfer.

TEST TIME:

Now go back and update Memory three (**M3**) using the Edit features to add a delay of five seconds, and add the embedded Link command to repeat the short CQ.

Really neat useful stuff, and with all these memories there is no limit to what can be done with Delays and Linking. Enjoy!

This completes the detailed review and instructions on how to use the Keyer section of this device. We hope you're satisfied with the **MCT** and that your configuration of the kit has surpassed your greatest expectations. We hope you enjoy it so much that you'll tell others about it and show off your handiwork. We also wish you many years of enjoyable operating with the "**Morse Code Trainer**".

The Team,

K5BCQ

K5JHF

WK5S

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Section 2: (Assembly)

MCT II Complete Assembly Instructions: ([Back](#))

Before assembling this device, please be aware that 98 % of **issues** with SMT kit building are due to poor solder connections and misaligned parts. Because of the small size of the Resistors and Capacitors, the pads have been enlarged to aid in hand soldering. However, it's important to educate oneself in the basics of SMT assembly prior to jumping into building any SMT device.

This is like anything else, and with a little preparation and the right tools, the new comer to the hobby and SMT assembly will be prepared and feel like a pro after a few projects. But first, we recommend visiting a few of the many sites on the Internet which will give clear step-by-step instruction on how to assemble and solder individual SMT components.

Tools:

It's recommended that a fine point temperature controlled soldering iron be used when soldering SMT devices. Or an SMT rework station that includes a hot air gun.

It's also important to have a good set of hand tools which includes a good set of **Non-magnetic pointed metal tweezers**, and an X-acto Knife like the one shown below.

Also don't forget to have a Head Magnifier with LED lighting.



Because of the size and small leads of the controller (LPC824) and amplifier (TDA8541) IC's, they will come already installed on the **PCB** as defined in different Kit Options.

If you're experienced in assembling SMT parts and interested in packaging this kit in a different box other than the one shown in the step-by-step instructions, go ahead and start, but don't forget to use the board as drill template for the switches and board mounting holes! Then start by soldering all the Resistors to the **PCB**, followed by all the small and large capacitors. Followed by soldering all the through-hole parts and wires in position as outlined in the schematic and go ahead and put the

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assembly in the box of your choosing. Make sure to determine the mounting of the **PCB** before installing the transistors, push button switches, and display! See MCT III Tips on page 38.

If interested in building the **MCT II** kit as defined in the manual, there are some requirements before starting to build the kit and putting it in the box.

First, and to take advantage of time, order the recommended Box from Mouser (**P/N: 546-RL6215**).

Second, inventory the parts in the kit to the Bill of Material included in the Kit to make sure everything is there. Make sure to put the parts back in the bag after inventory. See page 23 for SMT part identification.

Third, make sure your Ham tool box contains the tools for SMT assembly:

- Temperature controlled Soldering Iron, or SMT rework station with small pointed tip (1/16")
- Small Needle Nose Pliers
- Wire Strippers
- X-acto Knife (See reference above)
- Small Solder (1/32" Dia.) 60/40 or equivalent (available on-line or from Fry's Electronics)
- A holding device such as a 2.5 inch table vice, Helping hands, or something to hold the board in place
- A set of head magnifiers with LED lights to help see the parts (also at Fry's)
- A medium size serving tray with raised edges as a containment working area
- A Drill Motor or Drill Press.
- A 5/64", 1/8", 3/16", 1/4", and 1/2" **Bullet type** drill bits or **Stepped Drill Bits** (either set is a great addition to a Ham tool box)
- Countersink Drill bit (available at hardware store)
- 1/2" wide Rough File (available at hardware store)
- Small Wire Cutter
- **Pointed Non-magnetic Metal Tweezers**
- Flux Pen (Available from Fry's or on-line)
- Masking Tape



Required parts not included in the Kit:

- 4-40 x 1/2" Flat Head Screws (Qty 5)
- 4-40 Nuts (Qty 10)
- 4-40 Flat washers (Qty 10) (4-40 Screw and Nut combo are available at local Hardware stores or Fry's). If available, **2-56 X 3/16" Flat Head** screws will allow a nice finish with screws hidden under the Template. In place of the 2-56 hardware **Hot Melt Glue** or **RTV** may be used to hold the Display.
- 2-56 X 1/4" Round Head Screws (Or Hot Melt Glue, or RTV)
- 2-56 Nuts (Qty Screw and Nuts = 4)

While acquiring the extra parts, please check the material list to finish the final assembly to get all the parts at the same time. [See Page 31](#).

This is as good a place as any to talk about Power Tools and drilling into soft plastic: 1) Please be careful when using any power tool! Also note the recommended drill type used in creating the holes. **Bullet** type drill bits start with a small hole like having a pilot hole, then follows with the larger part of the bit. This drill bit makes it easier to drill into soft plastic with less grabbing. If Bullet drill bits are not available, try the **Stepped** drill bits to drill the holes! 2) Make sure to clamp the box in a vise or clamp it to a table before drilling, then let the weight of the hand drill do the work! The weight of the drill motor is enough pressure to cut the hole. Let the drill do the work and don't force it! **SAFETY FIRST!!!**

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Now that all the tools and extra parts are available, let's get started preparing the box. Please understand building a Kit of this nature will take **WORK!** But when finished it will be something you have built with your own two hands and something to be proud of because it wasn't just putting parts together but you actually created the box configuration. So be **patient**, have fun, and **follow the instructions!**

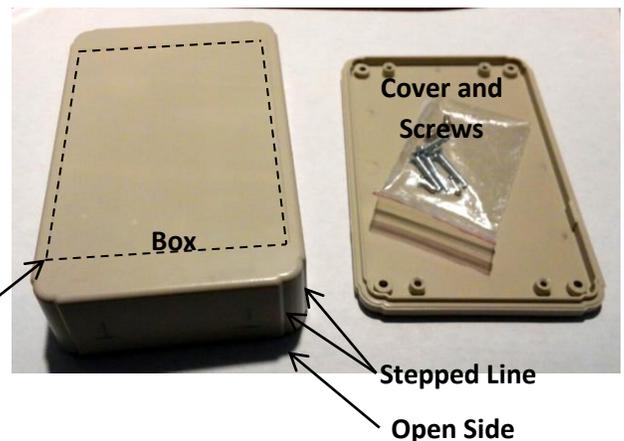
Box Modifications and Mounting holes:

Before soldering parts on the **Printed Circuit Board (PCB)**, we recommend using the **PCB** in the kit as a drill template for all the mounting and Push Button switch holes. The board has been designed with this feature to ensure the holes are in the right location once the board is assembled and mounted.

Please follow the instructions and drawing/picture associated with each step and check off the each steps as you go. Read each step multiple times to insure you understand what needs to be done! It's like measure three times and cut once. 😊

Box and PCB Orientation:

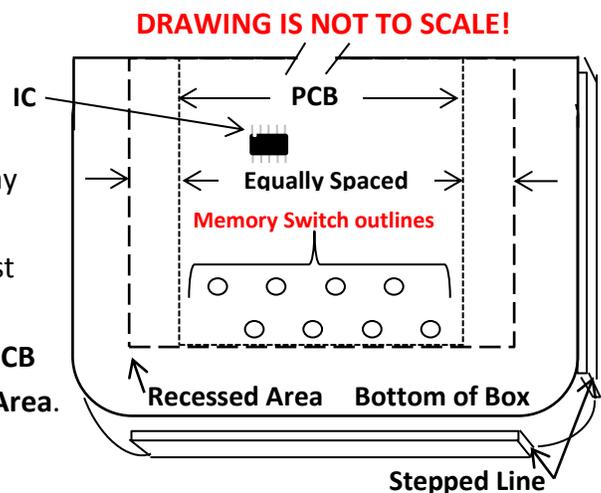
- [] Remove the box from its shipping bag and set the cover and mounting hardware aside.
- [] Place the box on a flat surface so the opening is toward the flat surface.



Reference Terms:

- **Recessed Area** – A stepped down area in the Front and Cover.
- **Stepped Line** – A raised sections on the sides of the Box.
- **Open Side/Back** – is the **Back** of the Box where the Cover goes.
- **Top** – The end of the Box where the Paddle & TX Jacks mount, and just above the five (5) Function Switches.
- **Bottom** – The end of the Box where the Headphone Jack is mounted.

- [] Remove the **PCB** from the Kit bag.
- [] Position the **PCB** so the side with the **IC** is up, and the **Memory switch holes** are toward the **Bottom**, and lay the **PCB** in the **Recessed Area** of the box.
- [] Align the bottom edge **of the PCB** so it's sitting against the **Bottom edge** of the **Recessed Area**.
- [] Align the **PCB** so the distance from each side of the **PCB** is **Equally Spaced** to the side edges of the **Recessed Area**.

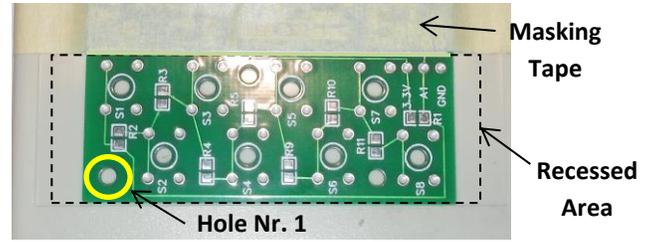


NOTE: Before drilling holes in soft plastic, make sure the box is in a clamp or vise, and if using a hand drill, drill the hole at medium speed and do not apply downward pressure. Hold the motor firmly and let the weight of the drill do the work. If this is the FIRST TIME drilling holes please get help! USE CAUTION AND REMEMBER SAFETY FIRST!!!

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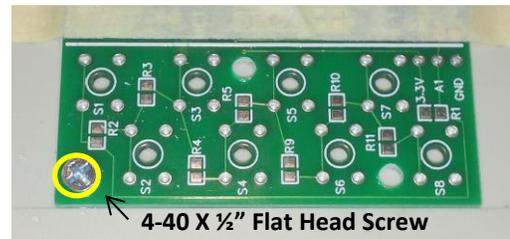
Drilling mounting hole Nr. 1:

- [] Using Masking Tape, tape the **PCB** in position to hold it in place on the box. Double Check the space to the recessed area for centering.
- [] Using an 1/8" drill bit, drill the Mounting Hole identified as **Nr. 1** in the picture to the right.



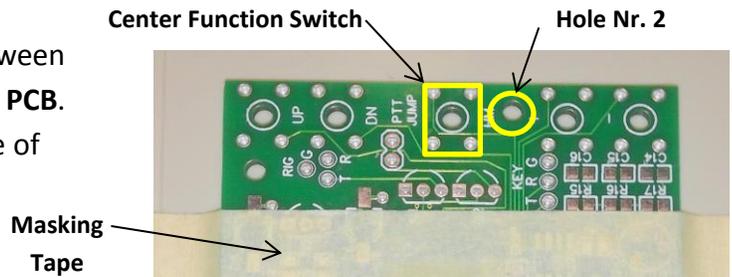
Installing Guide Screw:

- [] After the first Mounting Hole is drilled, insert a **4-40 X 1/2" Flat Head** screw in hole **Nr. 1**.

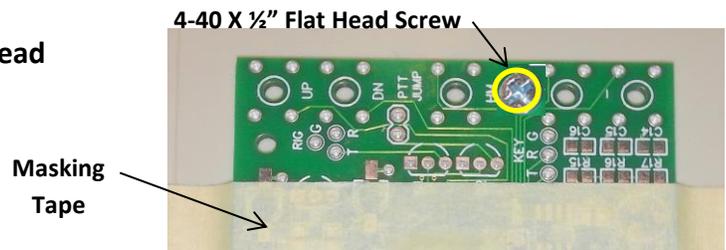


Drilling mounting hole Nr. 2:

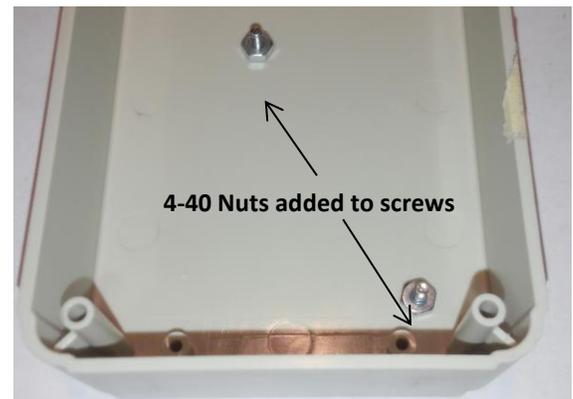
- [] Drill the hole identified as **Nr. 2** located between the five Function switches at the top of the **PCB**. **NOTE:** Hole **Nr. 2** is located to the right side of the **Center Function Switch** mounting.



- [] After the hole is drilled, insert a **4-40 Flat Head** Screw in hole **Nr 2**.



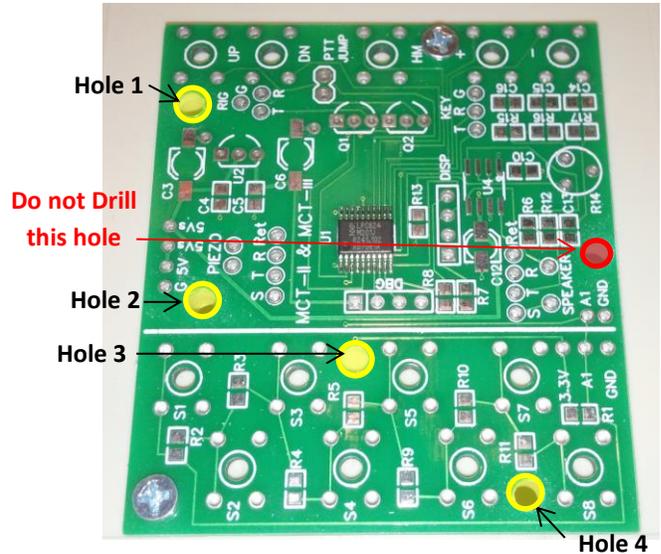
- [] Apply a **4-40 nut** on each screw inside the box, and Tighten. This will help hold the board in place for the drilling of the remaining holes.



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- [] Remove the Masking Tape.
- [] Drill four (4) remaining **PCB Mounting Holes** highlighted in **Yellow**.

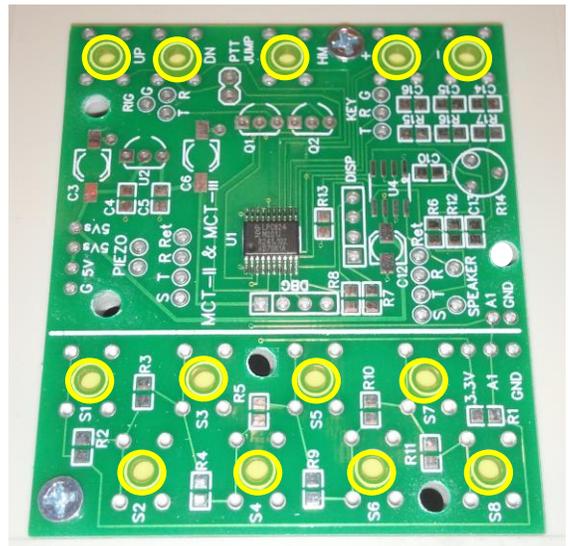
NOTE: In this assembly the mounting hole identified in red will not be drilled!



Creating the Push Button access holes:

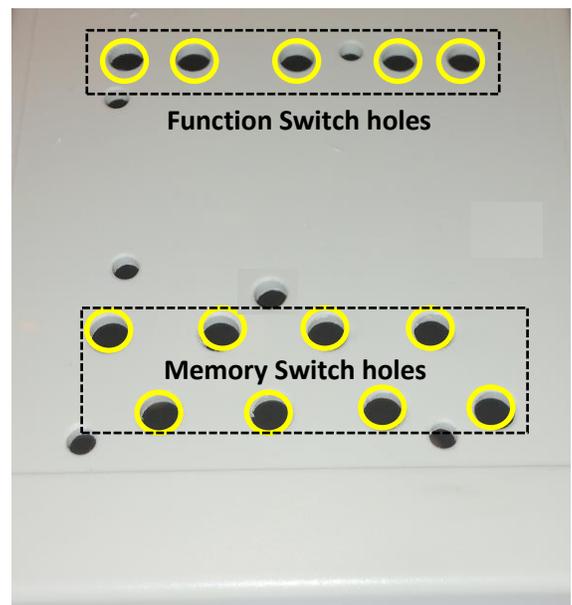
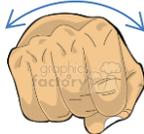
- [] Using the same drill bit used to create the **PCB Mounting Holes**, and using the holes in the **center of the Push Button** switch outlines as a drill guide, drill the holes in the box for all **thirteen (13) Push Button** access holes highlighted in **Yellow**.

- [] Remove the Screws, nuts, and **PCB**.



- [] Using a 3/16" drill bit, re-drill **ONLY the Push Button holes** highlighted in **Yellow**. This will allow easy access around the stems on the Push Buttons.
 - [] Using a 1/2" drill bit in your hand, deburr both sides of all the **Switch** and **Mounting** holes by rotating the 1/2" bit in the holes by hand.
- NOTE: Rotate the drill bit with a twisting back and forth motion of the wrist while holding the drill bit against the hole.**

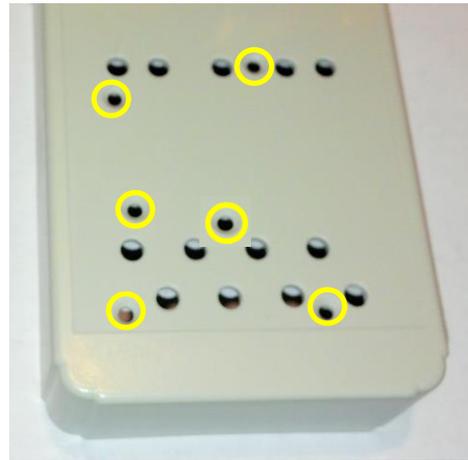
twisting back and forth motion



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Counter sinking the mounting holes:

- [] Using the Drill motor and a **Counter Sink** bit.
Carefully create the counter sink for each **MOUNTING HOLE** identified in **YELLOW**.
NOTE: Use a 4-40 X 1/2" Flat Head Screw to check the depth of the counter sink. Remove the material slowly and check the depth as you drill using the Flat Head Screw to make sure the flat on the screw is flush or just below the surface.



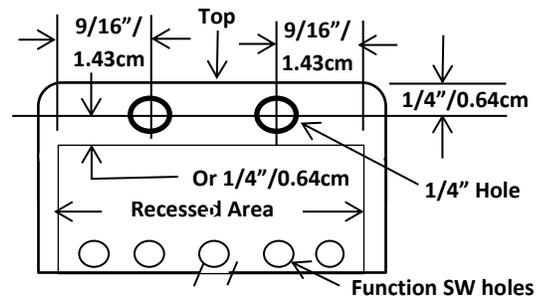
Please NOTE:

The following hole locations are not critical! Well within reason that is! Though close counts.

Switch Mounting Holes:

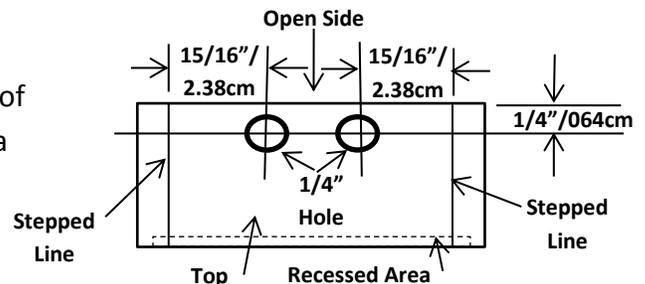
- [] Measure from each side of the **Recessed area** 9/16" and make a mark to position the center of each hole.
- [] From the Top Edge of the box measure down 1/4" and make a mark for the center of each hole. See diagram to the right.
- [] Using a 1/4" drill bit, drill two Switch Mounting holes (**Bold Circles**) on the **Top** front of the box as shown.

DRAWINGS ARE NOT TO SCALE!



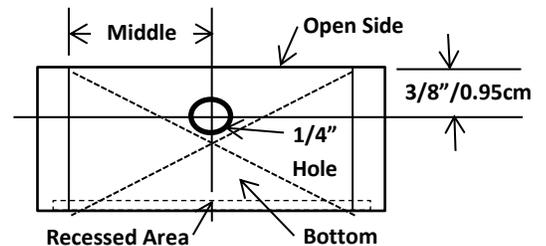
Paddle & Transmitter (TX) Jack Mounting Holes:

- [] Using a 1/4" drill bit, drill two holes in the **Top End** of the box about 15/16" from the **Stepped lines** and a 1/4" down from the **Open Side** of the box.



Headphone Jack Mounting hole:

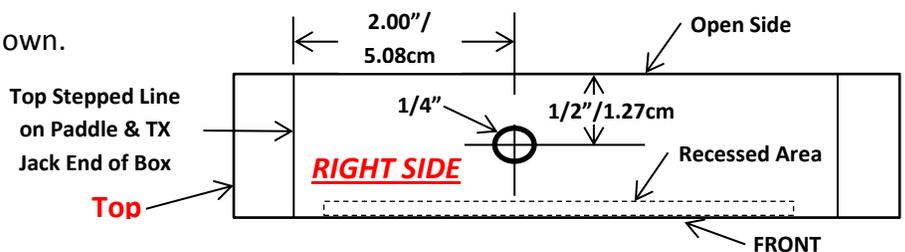
- [] Using a 1/4" drill, drill a hole in the location as shown in the **Bottom end of the box** for the Headphone Jack. To find the middle just draw a line from one corner to the next. See dotted lines. Then measure from the **Open Side** of the box 3/8" and mark the spot to drill the hole.



Piezo Speaker Hole:

- [] Add a 1/4" hole in the location shown. This will be used for the Piezo speaker hole.

NOTE: Speaker hole is on the RIGHT SIDE of the box.



-- Display Mounting Hole:

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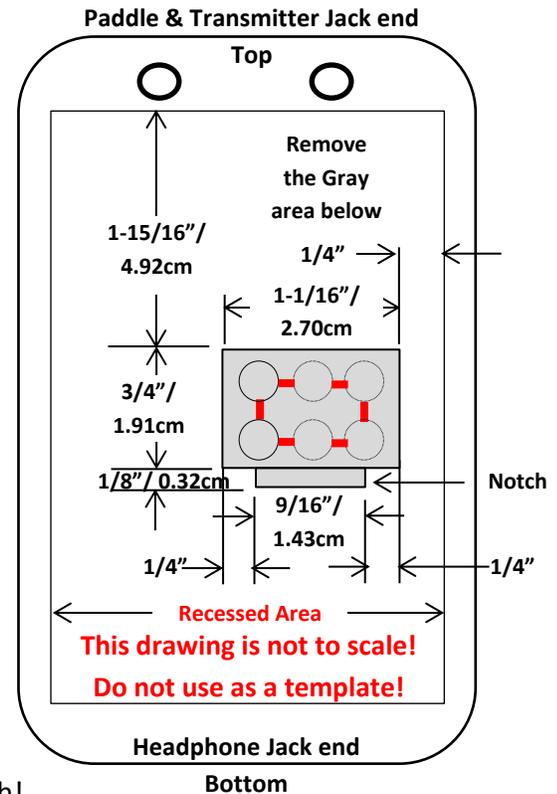
Please read all of the instructions before proceeding!

- [] With the **Box opening** facing down, draw a rectangle as shown for the **Display** mounting. **Or**, cut out the **Display Template**; apply **3M REMOVABLE** Double Sided tape on the back. Position the label in the **Recessed Area** and use the Template as a guide to cut out the rectangle.

Make sure the Template match the dimensions!

(See **Applying the Final Template** on page 31)

- [] Using a 1/4" drill, drill holes in the inside area of the rectangle. Make sure not to drill on the lines of the rectangle. See view for approximate hole locations.
- [] After multiple holes have been drilled in the area, use the small wire cutter to cut through the plastic material between the holes and remove the center part of the plastic. See **RED** lines on view to cut between holes.
- [] Using a file, file the edges to the outline of the opening. Try to make the opening straight and rectangular. Don't rush!
- [] File the 1/8" by 9/16" **Notch** in the bottom of the rectangle.
- [] Remember to clean the edge of the opening with the file so the display PCB fits flush against the inside Surface of the box. **NOTE: The Display opening in the box is made a little larger than the Display.** On close inspection of the Display a flat ribbon cable connected to the front surface of the Display can be seen. FYI, it's not good to apply pressure with a sharp bend against a flat ribbon cable. The **Notch** in the bottom of the Display rectangle will allow the **Display PCB** to sit flush to the back surface of the Box without interfering with the Flat ribbon cable.



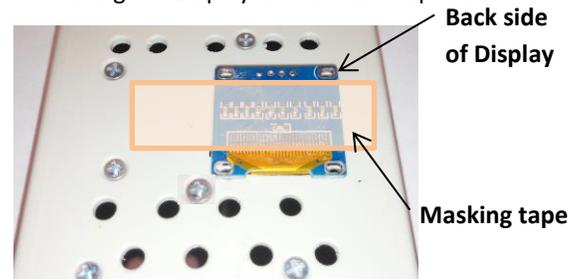
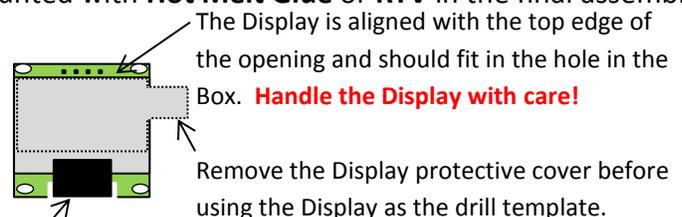
Alternate Display mounting: Display may be mounted with **Hot Melt Glue** or **RTV** in the final assembly.

If using Screws, continue with the following:

- [] Place the display in its mounting hole with the display facing down in the hole.
- [] Apply Masking tape across the back to hold it in place.
- [] Using a small drill the size of the display mounting holes and using the Display as a template, drill four (4) mounting holes in the center of the slotted hole.

Be careful when using Electrical Tools!

- [] Remove the Display, and put it back in its bag.
- [] If 2-56 X 3/16" **Flat Head Screws** are available, countersink the mounting holes in the same manner as the 4-40 screws so the screws are not visible after the front template is installed. **OR, use Hot Melt Glue or RTV to hold the display in place.**



This completes the Box preparation. Place the Box aside and let's get started building the **PCB**.

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Tool reminder Tips prior to PCB Assembly:

- 1 – Make sure to use a **Serving Tray** with raised edges as the work area to help contain parts in case they fall off the **PCB** during assembly.
- 2 – Do not apply too much pressure when picking up a part with **Tweezers**. Applying too much pressure will most likely cause the part to disappear, and be ricocheted around the room to never be seen again! So be careful when picking up parts with the **Tweezers**! Apply very light pressure!
- 3 – When removing the part from its holder, remove the part over the **PCB** so the part drops onto the **PCB**. This way it will be easy to just slide the part into position on the **PCB** rather than picking it up.
- 4 – Use an **X-acto Knife** or **Tweezers** to rotate a part that has fallen upside down. Remember to not apply very much pressure on the side of the **SMT** part!



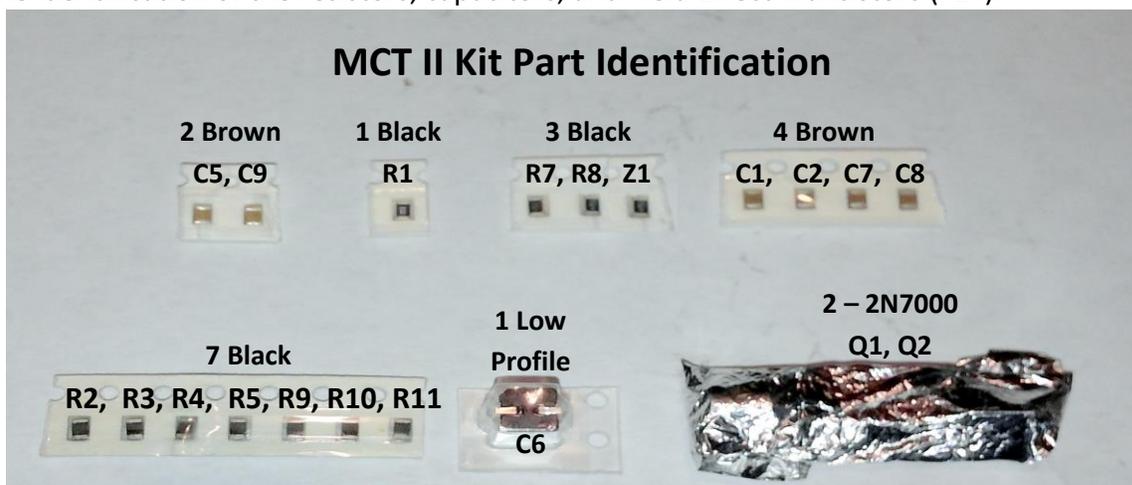
5 – Use a Vise, Helping Hands or some device to hold the **PCB** flat when installing the parts.

6 – Soldering Procedure:

When soldering an SMT capacitor or resistor, first apply a small amount of solder to one pad, and then re-touch the soldering Iron tip to the pad with the solder to re-melt the Solder. Then with the Tweezers holding the sides of the part with **LIGHT PRESSURE**, slide the part to the pad with the melted solder. First remove the soldering Iron, and then release the Tweezers. Then solder the other side of the part to the other pad. If a Rework station is used please follow the supplied instructions for soldering parts.

Part Identification for MCT II:

Here's the identification of the resistors, capacitors, and Field Effect Transistors (FET).



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PCB Assembly:

Please use the check off boxes in assembling the PCB. First, all top side parts will be installed on the PCB, followed by all the bottom side parts. Then the through hole parts on the bottom and so on. **Parts to be installed in each step are highlighted in YELLOW.**

Prior to soldering any parts on the PCB, clean it by using a clean cloth and Isopropyl Alcohol 91%.

If **Solder Flux** is used, please make sure not to apply too much on each pad. Use a small metal pad and apply the Flux to the pad, than use a **Tooth Pick** to collect a smaller amount of Flux on the tip of the **Tooth Pick**, and spreading it on the component pad should be sufficient.

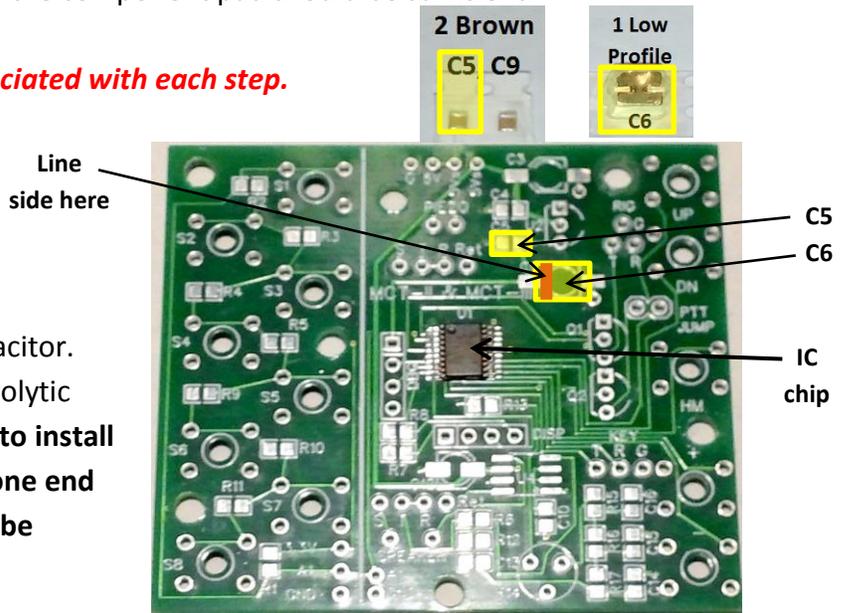
Please review the drawing/picture associated with each step.

Top Side of the PCB:

The **Top Side** of the PCB is the side with the **IC chip** on it.

Capacitors:

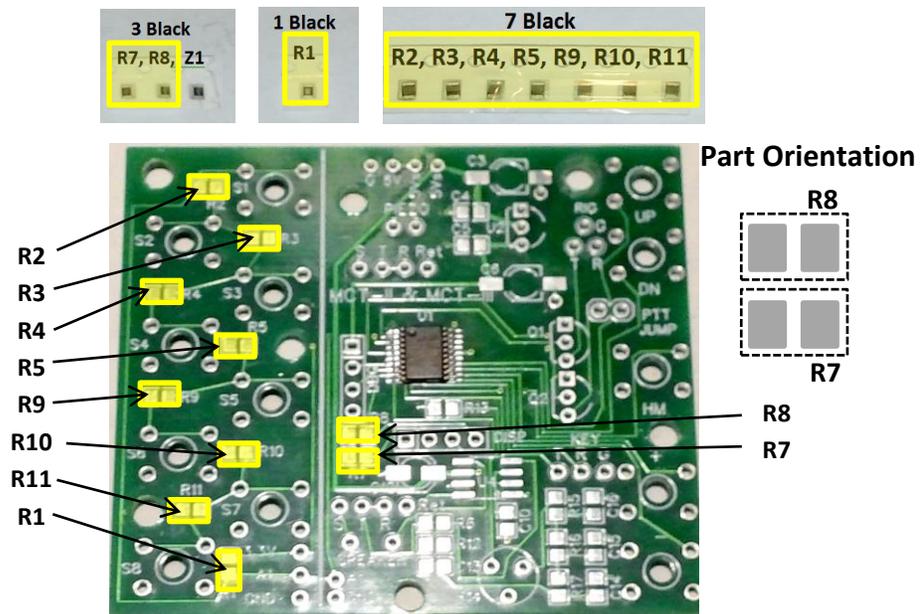
- [] Install and solder **C5** (100nF) Capacitor.
- [] Install and solder **C6** (10uF) Electrolytic Capacitor. **NOTE: It's important to install C6 correctly! There is a line on one end of the part (+). This part should be oriented as shown.**



Resistors:

Top Side of the PCB:

- [] Install and solder **R7** (4.7K Ohm)
- [] Install and solder **R8** (4.7K Ohm)
- [] Install and solder **R1** (10K Ohm)
- [] Install and solder **R2** (1K Ohm)
- [] Install and solder **R3** (1K Ohm)
- [] Install and solder **R4** (1K Ohm)
- [] Install and solder **R5** (1K Ohm)
- [] Install and solder **R9** (1K Ohm)
- [] Install and solder **R10** (1K Ohm)
- [] Install and solder **R11** (1K Ohm)

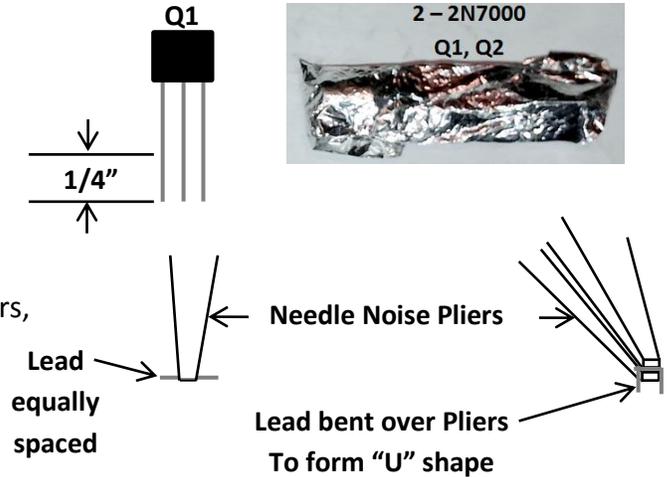


NOTE: Make sure R7 and R8 are soldered to the correct pads!

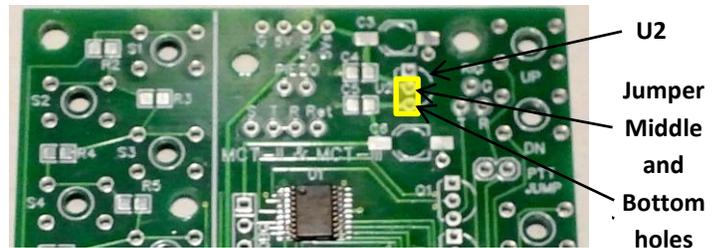
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Top Side of the PCB: (U2 Jumpers)

- [] Remove one FET from the Tin Foil wrap.
- [] From one legs of this FET which we will now call **Q1**, remove a 1/4" of lead.
- [] Using the **small Needle Nose Pliers**, set the **Lead** about 1/16" from the end of the Pliers.
- [] Set the **lead** equally space on each side of the Pliers, and form the **lead** into a "U" shape to create a **Jumper**.



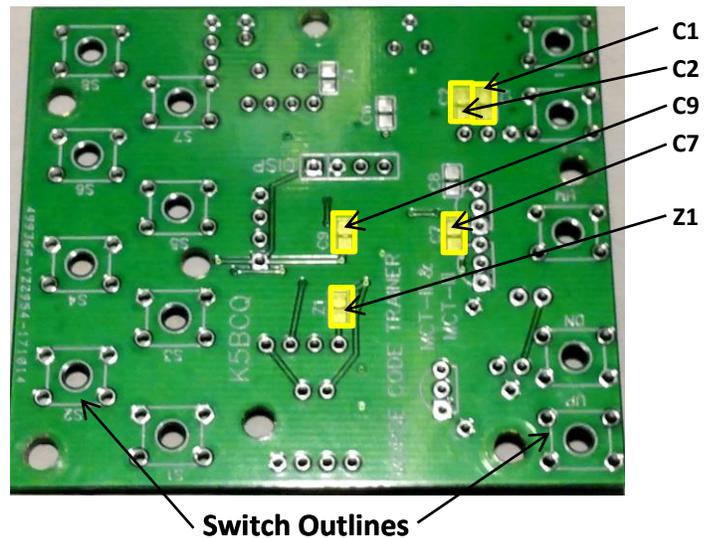
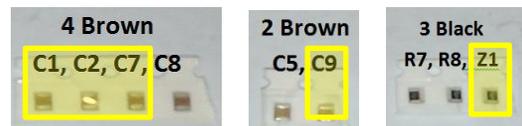
- [] Install and solder the **Jumper** into the **MIDDLE** and **BOTTOM** holes of **U2** as shown.
- [] Put **Q1** back in the **Tin Foil** wrap.



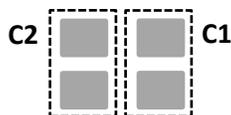
Bottom side of the PCB:

- [] Rotate the **PCB** in the holder so the bottom side of the **PCB** is now up. Also position it so the **Switch Outlines** are as shown.
- [] Install and solder ***C1** (10nF)
- [] Install and solder ***C2** (10nF)
- [] Install and solder **C7** (10nF)
- [] Install and solder **C9** (100nF)
- [] Install and solder **Z1** (4.7K)

***NOTE: Make sure C1 and C2 are Soldered to the correct pads!**

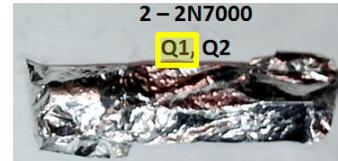


Part Orientation



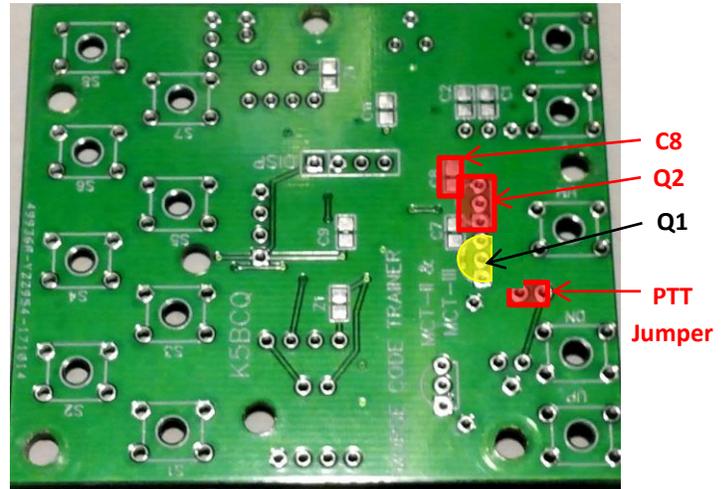
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Through Hole Parts:



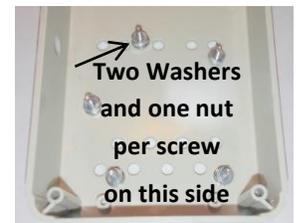
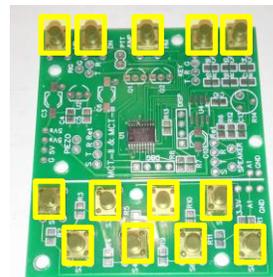
Bottom side of the PCB:

- [] Remove **Q1** (w/short lead) from the **Tin Foil**.
- [] Install **Q1**, so its body outline matches the outline on the **bottom side of the PCB**, and it's spaced off the **PCB** about 1/8".
NOTE: the orientation of the part is different on the bottom. Just install it to match the outline shown on the bottom.
- [] Solder the leads on the **Top** side of the **PCB** and trim the leads flush to the surface.

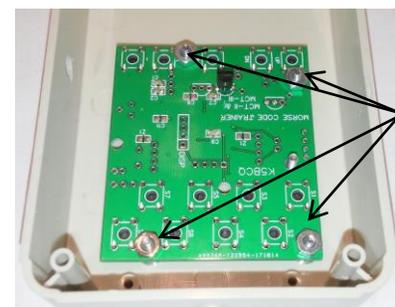


NOTE: The PTT function of Q2 is not installed in this assembly. If that function is required, please see the schematic for wiring connections and create the "PTT Jumper" from one of the legs of Q2, just as it was done with Q1 and solder it in place. Then solder C8, Q2, and trim the leads on Q2.

- [] Install all **13 Push Button Switches** to the **Top** side of the **PCB**. **NOTE: after installing each Switch, bend the leads of the switch contacts over to hold the switch in position.**
- [] After installing all the switches, install the **five 4-40 X 1/2" Flat Head** mounting screws from the front of the box and secure with **two 4-40 Flat Washers** and a **nut** on the inside on each screw.
- [] Position the **PCB** in the mounting locations so the **Push button Stems** protrude through the holes in the box.
- [] Secure the **PCB** in place with **four 4-40 nuts** on the mounting screws on the back side of the **PCB** to hold the switches flat against the **PCB** and box.
- [] Solder all switch contacts on the back side of the **PCB**, and double check to make sure all contacts are soldered!
- [] Remove the four nuts and **PCB** from the Box, but leave the mounting screws in place.



Bend Leads over on back side of PCB



Secure with Four nuts

This process was used to ensure that all the switches are mounted flat on the PCB.

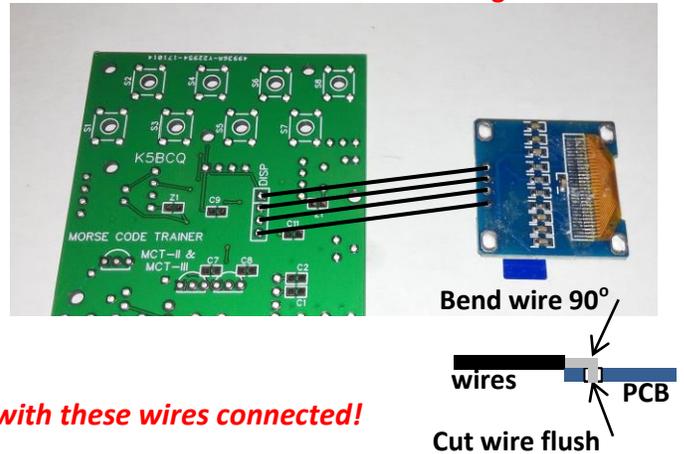
NOTE: "S1" = Memory 1, "S2" = Memory 2 and so on.

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Display connection:

- [] Cut four (4) pieces of hook up wire 3"/7.62cm Long and strip the ends about a 1/8"/0.32cm.
- [] Install and solder the four wires to the **bottom** side of the **PCB** from the "**DISP**" holes.
- [] Install and solder the leads as shown to the **back** of the **OLED Display** and trim the excess leads flush with the **PCB** on the Display.

NOTE: PCB orientation has changed!



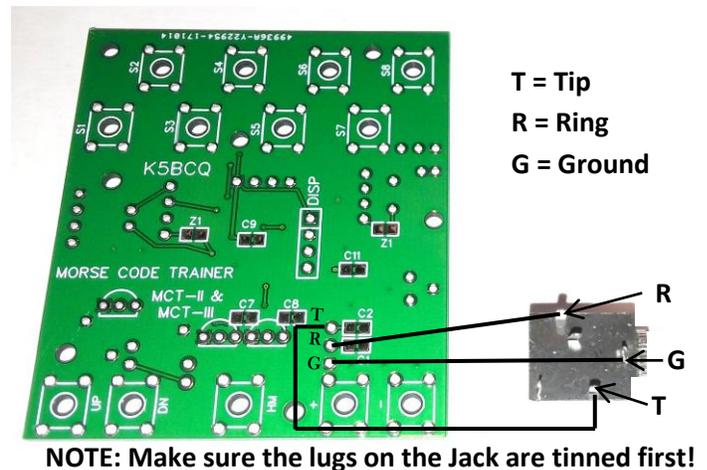
Care should be taken while handling the assembly with these wires connected!

Paddle connections:

- [] Cut three (3) pieces of hook up wire to 4"/10.16cm long, strip the ends about a 1/8"/0.32cm.
- [] Install and solder the three wires on the bottom side of the **PCB** in the positions identified on the **Top** as **KEY "T", "R", "G"**.

NOTE: On the Jack, the wires come off the side of the lug! So make a hook on the end of the wire to hold it on the lug before soldering.

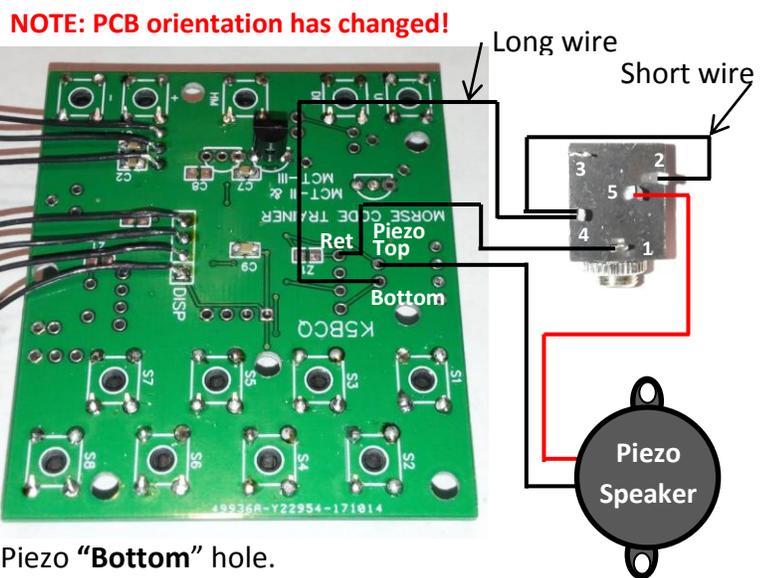
- [] Install and solder the wire from "**T**" to the **TIP** Lug of one of the supplied Stereo Jacks.
- [] Install and solder the wire from "**R**" to the **RING** Lug of this Stereo Jack.
- [] Install and solder the wire from "**G**" to the **Ground** Lug of this Stereo Jack.



NOTE: Make sure the lugs on the Jack are tinned first! Do this on all Jacks before soldering wires!

Piezo Speaker & Headphone connections:

- [] Cut one (1) piece of hook up wire 1" / 2.54cm long, strip the ends a 1/8"/0.32cm.
- [] Cut one (1) piece of hook wire 2 – 1/2" / 6.35cm long, strip the ends a 1/8"/0.32cm.
- [] Twist one end of the **short** wire with one end of the **long** wire and solder together.
- [] Solder the end of the two wires soldered together to **Lug 4** on a new Stereo Jack.
- [] Solder the other end of the **short** wire to **lug 2** of this Stereo Jack.



- [] Solder the other end of the **long** wire to the Piezo "**Bottom**" hole.
- [] Cut another piece of hook up wire 2 – 1/2" / 2.54cm long, and strip the ends a 1/8"/0.32cm.
- [] install and solder one end of this wire to the "**Ret**" hole as shown.
- [] Solder the other end of this wire to **Lug 1** of this Stereo Jack.

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- [] Solder the **Black** wire from the **Piezo Speaker** to the Piezo **“Top”** hole.
- [] Solder the **Red** wire from the **Piezo Speaker** to **Lug 5** on this Stereo Jack.

Caution: Be careful not to short the Lugs on the Stereo Jack.

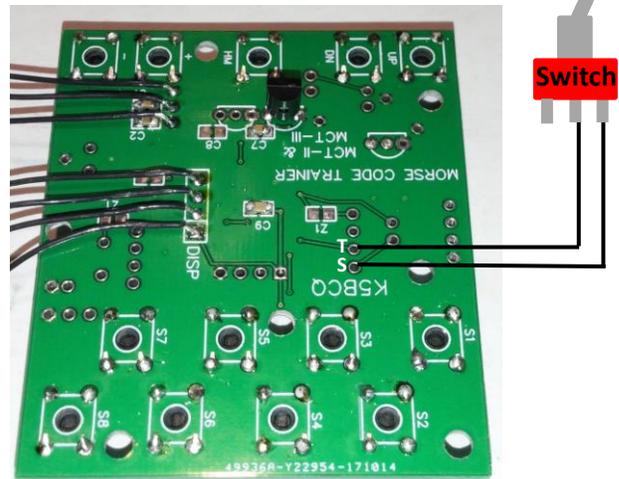
NOTE: Set switch in position as shown!

Speaker (SPKR) Switch connections:

All wires are installed from the bottom of PCB.

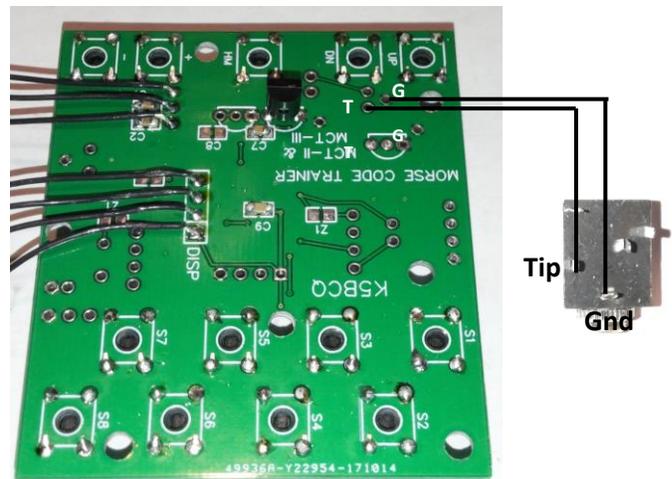
- [] Cut two (2) piece of hook up wire 6 – 1/2” / 16.51cm long, strip the ends a 1/8”/0.32cm.
- [] Solder one end of a wire into hole **“S”**.
- [] Solder one end of the other wire into hole **“T”**.
- [] Solder the other end of the wire from **“T”** to the center lug on one of the supplied Switches.
- [] Solder the other end of the wire from **“S”** to The right lug on this Switch.

NOTE: Switches may vary as suppliers change.



Transmitter (TX) Jack connection:

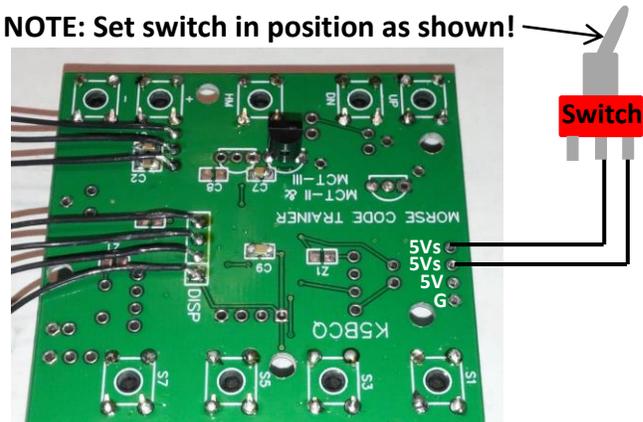
- [] Cut two (2) piece of hook up wire 3 – 1/2” / 8.89cm long, strip the ends about a 1/8” / 0.32cm.
- [] Install and solder on the bottom side of the **PCB**, one wire to **RIG** contact **“T”** as shown.
- [] From the bottom side of the **PCB**, install and solder the other wire to **RIG** contact **“G”** as shown.
- [] Trim the leads on the **top** side of the **PCB**.
- [] Connect the other end of wires as shown to another Stereo Jack.



NOTE: Set switch in position as shown!

Power (PWR) Switch connection:

- [] Cut two (2) piece of hook up wire 3 – 1/4” / 8.26cm long, strip the ends about a 1/8” / 0.32cm.
- [] From the back of the **PCB**, install and solder the two wires from the **“5Vs”** connections as shown, and solder the other ends of the wires to the second switch as shown.

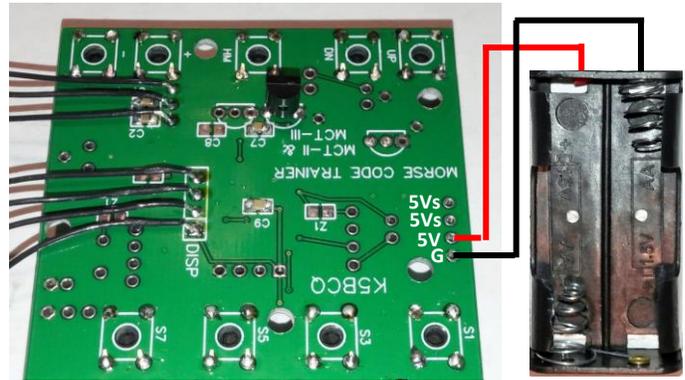


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Battery Holder connections:

- [] From the back side of the **PCB**, install and solder the wires from the **Battery Holder** to “**G**” and “**5V**” connections as shown.
- [] Trim leads on the top side of the **PCB**.

NOTE: The **Red** wire goes to **5V**!



Visual Inspection:

Triple check, and closely inspect all the solder joints don't be afraid to retouch any legs of the resistors, capacitors or through Hole Parts that may look suspicious. Reheat the pad or hole in question with a clean tip of the Soldering Iron to allow the solder to reflow and add solder if necessary.

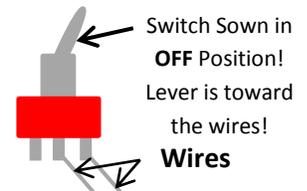
Caution: Do not touch the leads on the preassembled IC! It has been tested and loaded with firmware, so there are no problems with it being soldered properly.

Please move on to the next page and start the **Initial Power up and Test**.

Morse Code Trainer

Initial Power up and Test:

- 1) Now that you have a rats nest in front of you, make sure the **ON/OFF Switch** is in the **OFF** position!
- 2) Install the batteries into the Battery Holder.
- 3) While watching the display, turn on the **MCT**. If assembled correctly, the unit will display the **device name** and **number**. Then the display should change to **IAMBIC KEYER**, meaning the Display section and initialization is working!
- 4) Turn the speaker switch to the **On** position.
- 5) Plug a Paddle into the Paddle Jack and squeeze the paddles together. Listen to the device for alternating Dits and Dahs. If alternating Dits and Dahs are heard, **Congratulations**. The Keyer and Piezo sections are working.
- 6) Now use the **Down Button** to move the menu to **KEYER WPM**, and use the **Left** and **Right** buttons to change the speed setting. The display should show the number changing. This means the Menu is working.
- 7) Next press and hold the **M8** button and listen for a double beep. If a double beep is heard and the display goes blank, press the **M8** button again and a single beep should be heard, and the display should again show **KEYER WPM**. If this occurs, the Memory string is working.
- 8) Now plug in a set of **Headphones** and press the paddles together to check that the tone is now heard through the Headphones and not through the Piezo speaker.
- 9) Turn the **MCT** off, and move to the next page for the **Final Assembly**.



Function Menu Buttons



If the unit **does not** comply with each step above, turn the unit off and double check all the solder joints and proper assembly of all the parts and wiring.

Correct any concerns and re-apply power to the unit and repeat all the steps above. If the unit meets all the steps above, go to the next page for **Final Assembly**. If not, something was missed. Refer to page 62 for the different [Trouble Shooting Tips](#) associated with each Test.

Again, **CONGRATULATIONS** and now let's put this stuff in the box.

Morse Code Trainer

Final Assembly: (Packaging)

If using **2-56 X 3/16" Flat Head** screws, go ahead and install the screws in place for the Display mounting and secure with nuts.

Using the Mouser P/N: 546-RL6215 box & Kit 1 or 2 (MCT II):

When using the **Final Template**, make sure the template is aligned exactly in the recess on the box.

Required Materials and Tools: (Back 4)

- A color printer (your choice, Black and White will work too)
- White 20 Lbs. bond paper (inexpensive type) (wherever you get paper)
- Scissors
- A role of 3M Scotch **REMOVABLE** Double sided Tape (available at Office stores)
- A roll of 3M Scotch **PERMANENT** Double sided Tape (available at Office stores)
- 1/2" wide Scotch **Matte Finish Magic^{MT} Tape** (again available at the Office Store)
- **Con-tact** Brand - **Transparent Mat** (available at hardware store in the Kitchen section)
- X-acto Knife



Using the Faceplate files:

NOTE: THIS IS VERY IMPORTANT, NOT ALL PRINTERS ARE CREATED EQUALLY!!!!!!

Make sure your printer will print a one-to-one template to match the layout!

Applying the Final Template:

- [] From the Web Page <http://www.gsl.net/k5bcq/Kits/Kits.html> , find the **Mouser Box Final Template** file under the **Morse Code Trainer** kit information and copy the file to your computer.
- [] Open the file and print the **Final Template** using an available printer.
- [] Prior to mounting the **Final Template**, check to make sure all the mounting screws are installed in the box. If not, install the five (5) **4-40 X 1/2" Flat Head** Screws into the Box for the **PCB Mounting** holes, and secure in place with two **4-40 Flat Washers** and a **4-40 nut** on each screw. The same with the **2-56 X 3/16" long Flat Head** screws and just secure with nuts, **no washers**.
- [] After printing the **Final Template**, remove it from the sheet by **carefully cutting around the outer edge** of the outline of the template. Double check the fit of the template in the recessed area. Trim if necessary.
- [] Lay the template in the **recessed area** on the box, and position the box over a light source; like a small flashlight, to see the light shine through the holes in the box. Check the template for text alignment with their corresponding holes. If misaligned, there may be different things affecting the alignment. Maybe the **PCB** was not in the middle of the **recessed area** when the holes were drilled, or Printer scaling. Since we don't know every printer on the market this is where we need your help to take care of this situation. The **PowerPoint** file may be altered by **Left Mouse clicking** over the text to highlight it, than hold the "**Ctrl**" key down, and us the Up, Down, Left, or Right keys to move the text to make up for the difference. Then try it again with the new changes. Once it's okay lets continue.

Morse Code Trainer

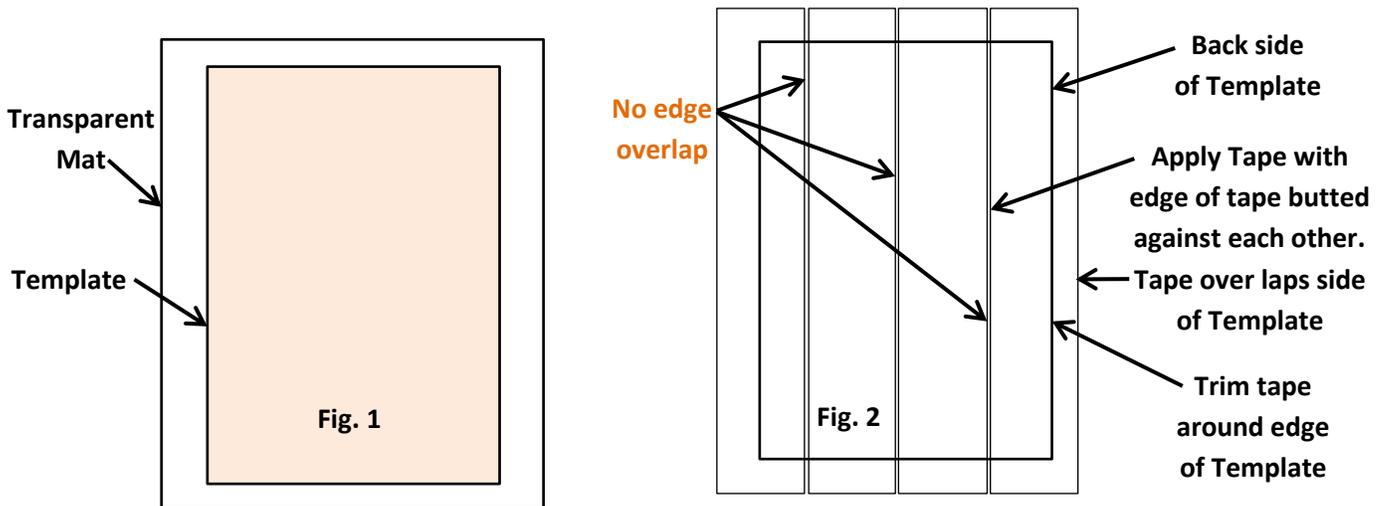
Template Assembly Options:

There are two options to assemble the Template. **Option 1** is where the Template is completely assembled with the **Mat** on the front and the **double sided tape** on the back of the Template. Then it's applied to the box and the areas covering the holes are removed (cutout). The **Template** with **no circles** for switch location is used in this application.

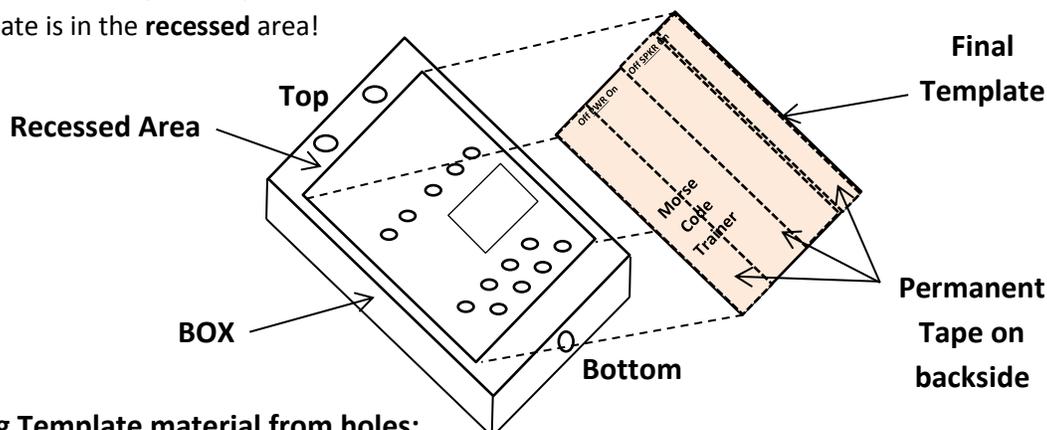
Option 2 is where the **Mat** is installed on the front of the Template and trimmed. Then the **double sided tape** is applied in the recessed area of the box, with the excess tape removed from the edges of the recess, and the tape covering the switch holes is removed. Then the Template is installed in the recessed area. This Template does not allow for the switch buttons to be seen through the holes and give the feel of a membrane switch. This **Template** is the one **with the circles** in the switch location. It's your choice which one to use.

Template Assembly (Option 1):

- [] Once a **Final Template** is to your liking, cut a piece of **Con-tact Brand - Transparent Mat** larger than the **Final Template**. Remove the backing on the **Mat** and roll the **Mat** on the **top side** of the **Final Template** and rub it into the paper to remove any uneven areas or bubbles. **Caution:** apply the **Mat** smoothly so there are no wrinkles or bubbles. See Fig 1



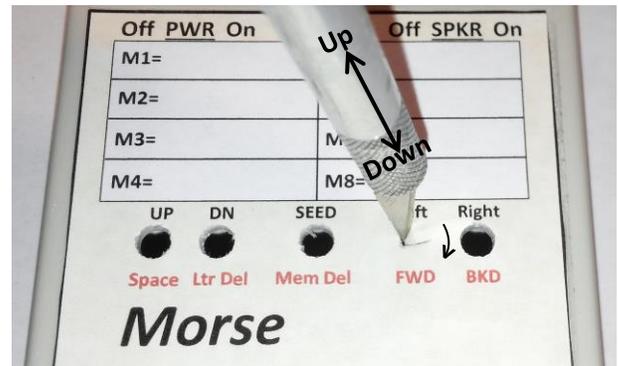
- [] Carefully apply four (4) strips of **3M Scotch PERMANENT Double Sided Tape** side-by-side on the **BACK** side of the template, and **without any edge overlap of the pieces of tape**. Make sure the tape extends over the sides as well as the top and bottom of the template. See Fig 2
- [] Remove the excess **Tape** and **Mat** by cutting around the Template edges with scissors.
- [] Place the **Final Template** in position in the recessed area of the Box. Be careful to ensure the alignment of the Template is in the **recessed** area!



Removing Template material from holes:

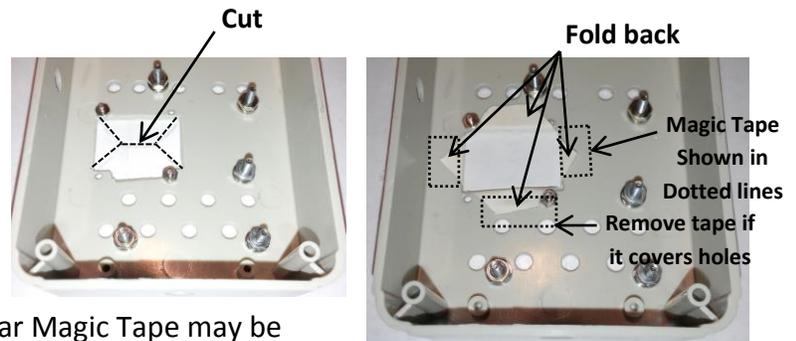
Morse Code Trainer

- [] Using a sharp X-acto Knife, gently push the knife edge down into each hole and follow the edge of each hole to remove the template material from all the round holes in the **Final Template**. Use an **Up and Down motion** to move the knife around the hole. This will create a clean hole and allow proper clearance for switch access.



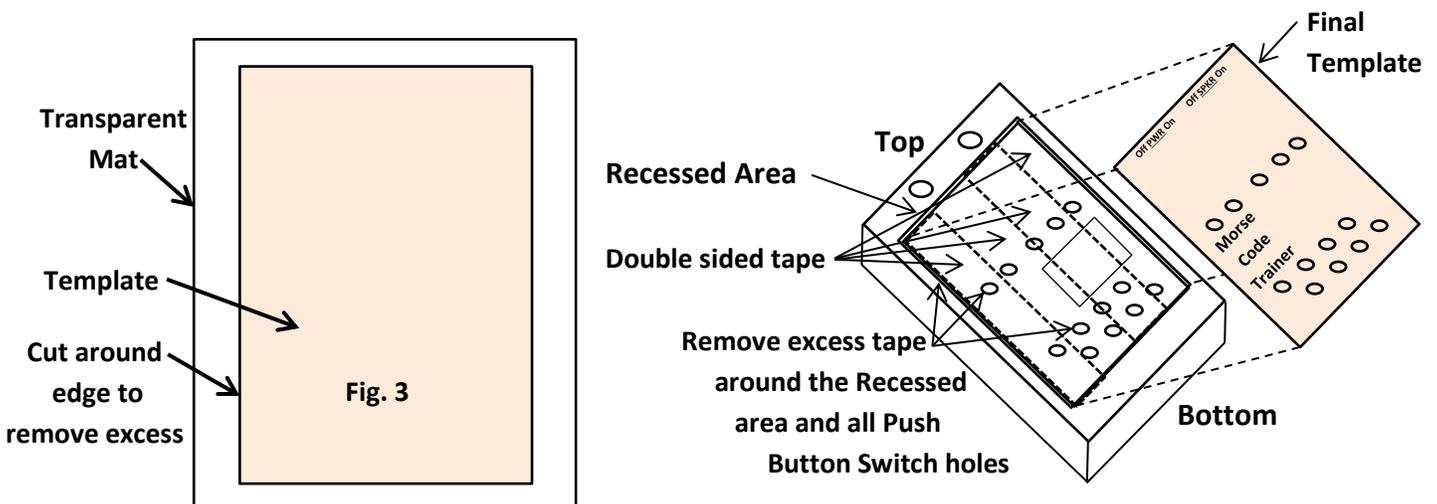
Display Area Prep:

- [] Turn the box over to look down into the Display opening.
- [] Using the X-acto Knife carefully cut on the imaginary dashed lines as shown.
- [] Fold the cut part of the template back to create a smooth edge around the Display opening as shown. Some small pieces of clear Magic Tape may be used to hold the folded pieces down. Don't forget to remove the tape if it covers a hole!



Template Assembly (Option 2):

- [] Once a **Final Template** is to your liking, cut a piece of **Con-tact** Brand - **Transparent Mat** larger than the **Final Template**. Remove the backing on the **Mat** and roll the **Mat** on the **readable side** of the **Final Template** and rub it into the paper to remove any uneven areas or bubbles. **Caution:** apply the **Mat** smoothly so there are no wrinkles or bubbles. Cut around the Template edges to remove excess **Mat** material, See Fig 3
- [] Apply the **3 M Scotch PERMANENT Double Sided Tape** side-by-side inside the recessed area in the Box.
- [] Using a sharp X-acto knife, remove the **excess Tape** around the edge of the **recessed area** and around the **switch holes**. Move the knife up and down around the hole outline to make a clean cut.

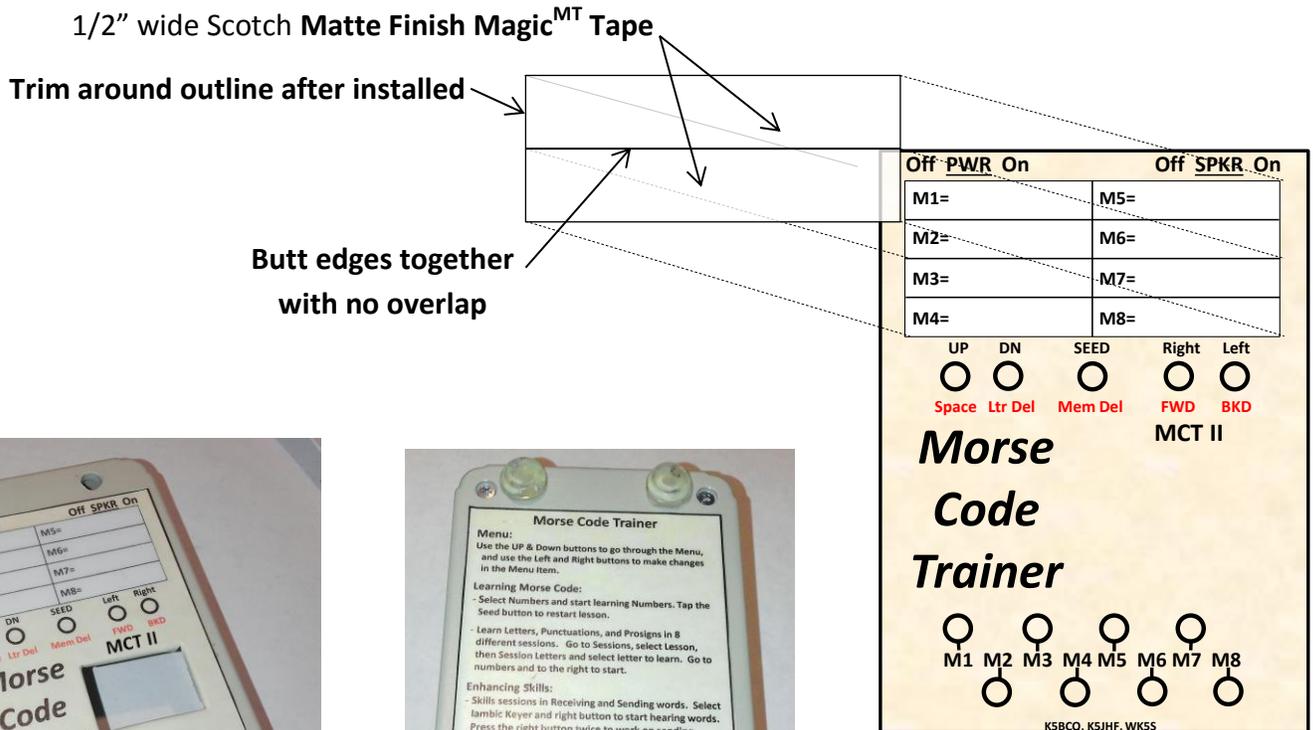


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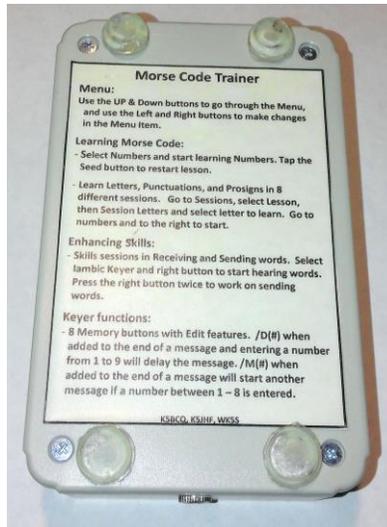
- [] After removing the tape from the switch holes, carefully align and apply the **Template** into the recessed area in the box.
- [] Using the fingers, rub the template onto the tape to ensure a good bond.
- [] See the **Display Area Prep** on page 33 to make the opening for the **Display mounting**.

Applying Transparent tape to Options 1 or 2:

- [] Apply two (2) strips of **Scotch 1/2" wide Matte Finish Magic^{MT} Tape** over the white area on the template and gently trim around the edge using the X-acto Knife. Try not to overlap the edges of the tape. Adding this tape will allow for information to be written into the different Memory blanks with a **pencil** which can be erased for changes to help remember what's in each memory.



Finished Cover Template



The rear Information label may also be added to the Cover, by using the same process of applying the matt and double sided tape to the Label, and placing it in the recessed area in the Cover.

Clean looking finish and no screws showing when using Flat Head Screws under the Template!

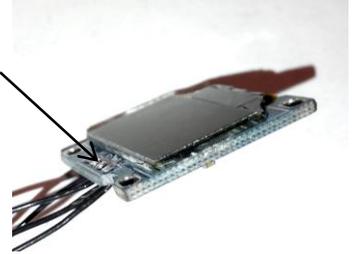
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Final Assembly of the Mouser 546-RL6215 box & Kit 1 (MCT II):

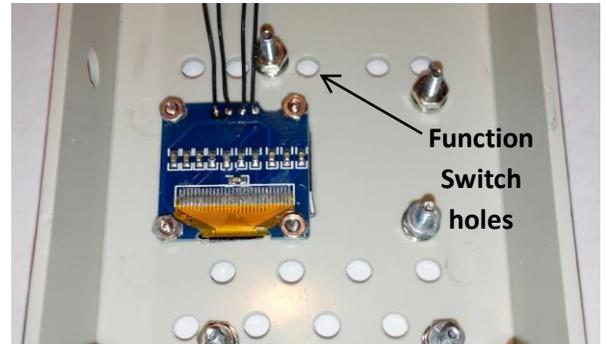
Display mounting:

- [] Prior to mounting the Display, make sure the ends of the wires sticking through the holes have been cut flush with the front side of the Display board.

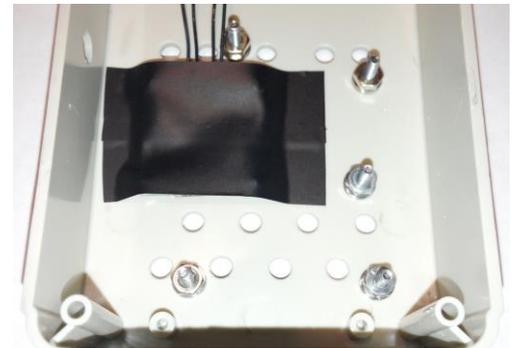
Wires cut flush!



- [] Using four (4) **2-56 X 1/4" Round Head** or **2-56 X 3/16" Flat Head** screws and nuts, mount the display in place. Be careful not to break the wire connections. If the **Flat Head** screws are used, remove the nuts and mount the Display in position with the wires toward the **Function switch holes**, and secure in place with the nuts that were removed, or add the nuts if the Round Head screws are used. Or use **Hot Melt Glue** or **RTV** applied in the corners to hold the Display in place.



- [] After the Display is mounted and before installing the **PCB**, apply two pieces of Electrical Tape 2"/5.08cm long across the back of the display. This is just a precaution just in case tolerances are not the same and this will add some protection between the **PCB** and **Display hardware**.



PCB mounting:

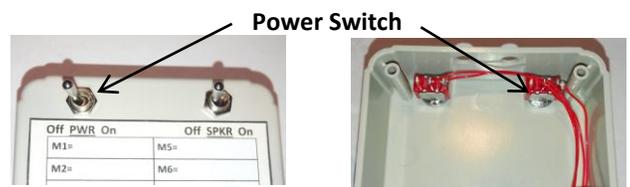
- [] Gently move the display wires to the side and ensure they are not pinched between the switch mounting surface and box.
- [] Gently install the **PCB** onto its mounting screws.
- [] Secure the board in position by adding a 4-40 Nut on each mounting screw. **Do not over tighten!**



Power and Speaker Switch Mounting:

- [] Install **two** switches to the front panel with the body of the switches mounted Parallel to the top edge of the box, and route wires as shown.

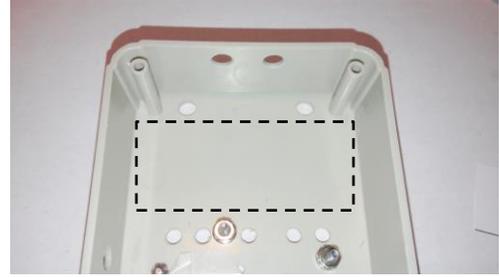
Power switch is the one with the shorter wires.



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Battery Holder mounting:

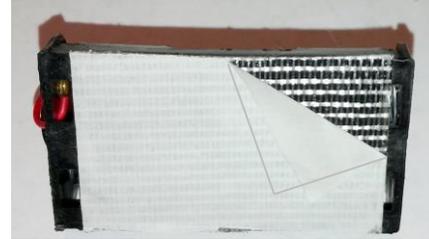
- [] Inside the box, wipe the area with a clean cloth between the **Switches** and **PCB** where the battery is to mount (dashed outline in photo).



Removing Paper backing from Battery Holder:

- [] Remove the paper backing from the tape on the back side of the battery holder.

NOTE: The physical size and tape type may not match the picture as the material may vary over time.



Installing Battery Holder:

- [] Position the **Battery Holder** in position as shown.
- [] Apply downward pressure to the **Battery Holder** to ensure the Tape grabs. **NO Batteries installed yet!**

NOTE: Insure the battery wires are on the right side As shown in the view to the right.

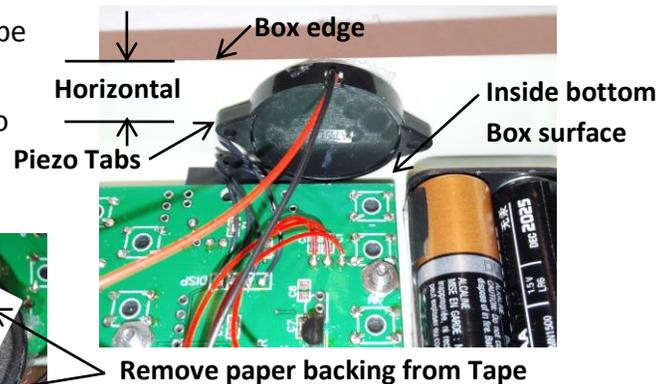
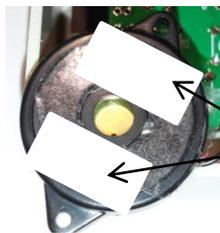


Batteries wires to the right side

Piezo Speaker mounting:

- [] Remove the paper backing from the Double Sided Tape already installed on the Piezo speaker. Make sure the **Piezo mounting tabs** are **horizontal**, so the round part of the speaker edge sits on the **inside Top surface** of the box, with the wires up.

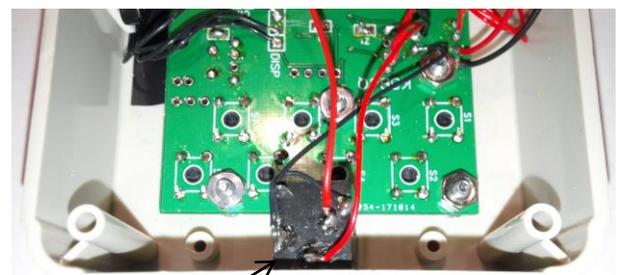
- [] **Carefully** align the hole in the **Piezo** to the hole in the **right** side of the box and then press it against the side wall to hold the Piezo Speaker in place.



Remove paper backing from Tape

Headphone Jack mounting:

- [] Remove the mounting nut on the **Stereo Headphone Jack** and mount the **Headphone Jack** in the bottom single hole, and reattach the nut and secure.



Headphone Jack

Mounting Nut

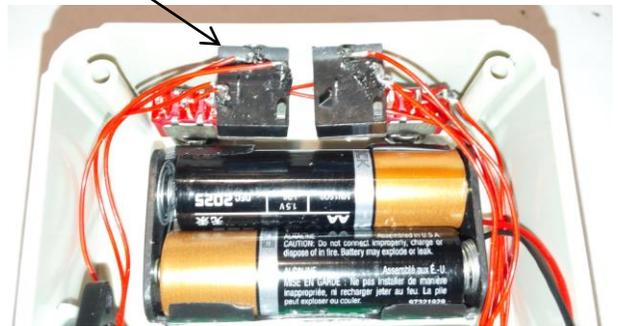
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Paddle Jack mounting:

- [] Remove the mounting nuts on the **Paddle Stereo Jack**, and mount the **Jack** to the **left hole** as shown above the “**SPKR**” switch.

NOTE: The Paddle Jack is the one with three (3) wires on it. Also route the wires as shown. This will keep them out of the way when the Batteries have to be changed.

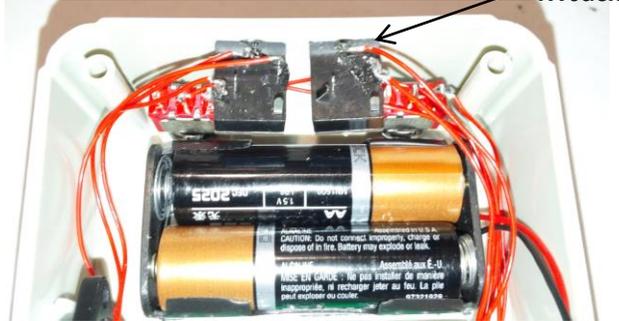
Paddle Jack



Transmitter (TX) Jack mounting:

- [] Remove the mounting nut on the last **Stereo Jack** and mount the **Jack** in the hole to the right of the **Paddle Jack**, and reattach the nut.
- [] Set the “**PWR**” switch to the off position!
- [] Install the batteries into the battery holder.

TX Jack



Bottom Cover assembly:

- [] Before installing the bottom cover, take one final look at all wire connections and make sure all connections are still in place, and make any corrections if you feel a wire needs to be altered.
- [] Place the box with the open end down on a flat surface and turn the **MCT** on. If the display comes up with the correct information, pat yourself on the back for a job well done!
- [] Turn the **MCT** off, and install the bottom cover and secure it with the screws supplied with the box. Rubber feet may also be added to the bottom cover to keep the bottom from scuffing.

This completes the assembly of the **MCT II Kit** into one Box configuration. Congratulations on completing the kit!

If this is your first project and if you're a new comer to Morse code, **GREAT JOB** and a **GREAT ACCOMPLISHMENT!** Now it's time to move to **Section 2; [Learning Morse code Characters](#)** (page 41) and start learning this great language on your terms. Make sure to follow the instructions, it's important in the learning process!

If you're an experienced CW operator and looking to use the Keyer, go ahead to the section on **[Using the Keyer](#)** (page 11) and get acquainted with this great Keyer and its abundance of memories and functions. Then connect the keyer to the rig and start using it to see how well the Keyer responds. If you would like, try the section on enhancing skills, go to the section on **[Enhancing Skills and Proficiency](#)** (page 52).

Whatever your situation, have fun and enjoy this great product you just built! It's something to be very proud of!

Morse Code Trainer

MCT III Assembly Tips: [\(Back\)](#)

FIRST, there are no step-by-step instructions to build the MCT III, it's for the experienced builder! Since the MCT III has more parts, and **MAY** require a larger box than the MCT II, please review the following **Build Tips**. The Tips are there to save steps! Also see the features on the following pages that may be added in the box for added functionality for a nice looking thought out package. **Note this is not a Kit with everything included!**

Build Tips:

- Use the **PCB** as a **drill template** for **PCB** and **Push Button** mounting holes. (see page 17 – 20)
- Use an **1/8" drill bit** to create the **PCB** and **initial Push Button** mounting holes. (see page 17 – 20)
- Use a **3/16" drill** to add clearance for the **Function** and **Memory Push Button** switches. (see page 20)
- It is recommended to install the **Transistor type** devices on the Bottom side of the **PCB** (Q1, Q2, U2).
- Please note that the **stripe** or **line** on the Electrolytic Capacitors is the **Plus (+)** side of the capacitor (C3, C6, C12, and C10). Check from "**G**" or "**Gnd**" on the **PCB** to the each side of capacitor mounting pads to identify the negative side of each capacitor to insure correct mounting of the Electrolytic capacitors.
- **By the way the "PTT" Function is not supported in Firmware! Do not install the "PTT" Jumper!**
- For a clean looking front panel use 4-40 Flat Head screws to mount the **PCB**. (see page 21 "**Counter sinking Mounting holes**")
- For **Speaker On/Off switch** connections, connect the wires from the switch to points "**S**" and "**T**" which are located next to the "**SPEAKER**" connections on the **PCB**.
- For the **Headphone Jack** and "**SPEAKER**" connections reference page 27, "**Piezo Speaker & Headphone connections:**", but make sure the *wiring connections are to the same reference points on the "**SPEAKER**" **connection side of the PCB**.
- Reference page 22 for **Display** mounting hole dimensions, and mounting. **Or use Hot Melt glue or RTV.**
- Reference page 27 for **Display** connections and *wiring. Note the **top** of the Display is where the wires are connected.
- Reference page 27 for **Paddle Jack** connections and *wiring.
- Reference page 28 for **TX Jack** and **Power Switch** connections and *wiring.
- Reference page 29 for **Battery** connections and *wiring.
- A Lithium Polymer (LiPo) Battery similar to the one shown maybe be used in place of the 3AA battery Holder. This will supply longer life, and may be recharged through a standard USB connection.



- * Wire lengths will be different in the **MCT III** based on the different part locations and Box size used to house the components! The wire lengths will have to be determined by the builder when assembling the kit, and may require more wire than supplied in the kit.

The following pages will show "**Alternate Assembly Ideas**" for a different packaging scheme and "**Extra Functionality**" to add features to support different equipment.

If the alternate box and layout is used as shown on the next page, with the speaker mounted in the middle of the Push Buttons, then **Option 1 Push Button switches** (See Options) are required so the **PCB** may be spaced from the surface to add clearance for the Speaker. But since the **MCT III** is for the **experienced builder**, please go ahead and use your **experience** and **imagination** and create **your version** of the **MCT III** in the **Box of your choosing**.

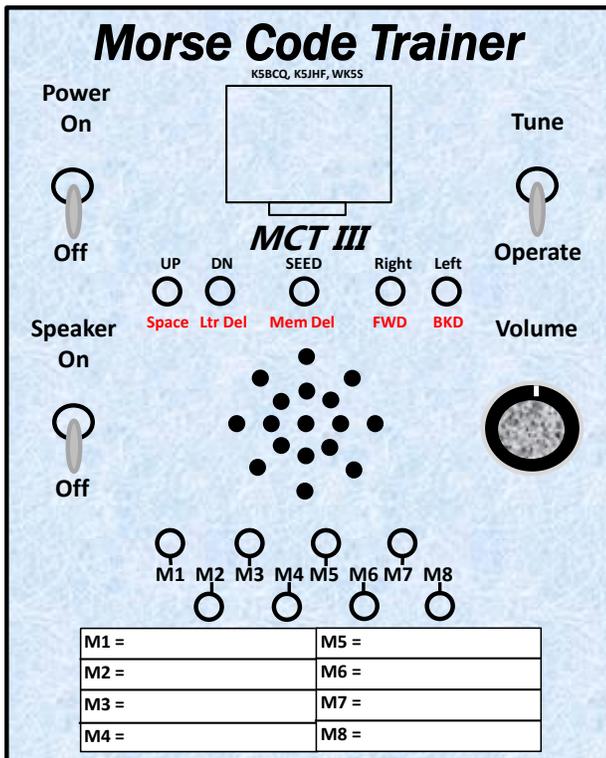
Morse Code Trainer

Alternate Assembly Ideas:

Here's an example of a different package of the Morse Code Trainer: The template was made using **Microsoft PowerPoint** to create that professional look of a project, and have something on the table that will have visitors asking where did you purchase that product, and you'll proudly say with the hairs on your arms standing up and with goose bumps, I made it!

The Faceplate layout below is an example of a template created to fits the **SERPAC A31, BK** plastic box, and again it's just an example of what can be done. It incorporates the **option 1 Push Buttons** that may be used as direct replacement for the **standard Push Buttons** switches.

This box size was selected because optional functions to drive different classic transmitters, by adding an "Alternate Keying" circuit as show in the following section called **Extra Functionality**. The size was also selected to hold the **MCT III** because of the larger Battery, Speaker and an alternate external Pot for volume control. Plus the addition of a switch on the top for a Tune/Operate functions.



NOTE:

Please remember this is just an Idea/example. It's up to you to create the version in the box you wish.

However, if you decide to use an alternate box, please create your own layout and use this example and learn how to use **PowerPoint** as a faceplate template tool. It comes in handy in all types of projects.

The example is not to scale!

The Push buttons are the **Option 1 Longer PCB Mount switches** mounted on the top side of the PCB with the PCB spaced away from the inside surface of the box by **3/8"** to allow the speaker to fit between the PCB and box. See the file on line for details!

"Template for SERPAC A31, BK box"

Using the Faceplate file:

NOTE: THIS IS VERY IMPORTANT, NOT ALL PRINTERS ARE CREATED EQUALLY!!!!!! Make sure your printer will print a one-to-one template to match the Push Button layout.

If using the SERPAC A31, BK box or other configuration:

It's highly recommended to check the print out of the template to make sure the printer is delivering a one-to-one layout. One layout may be a drill template and the other the final template without showing the locations for the holes drilled in the box. Refer to the detail instructions on pages 31 - 34 for ideas.

Morse Code Trainer

Extra Functionality:

Please understand the **MCT** is not competing in the Keyer market. This is an educational device, which there is nothing out there like it today that also contains a fantastic keyer. Since the Kit has been created to pass along a great value for all Amateur Radio operator, not every function found in the higher priced Keyer's has been included. Plus most of those functions are never used because of the advent of computer programs which contains every type of contest configuration imaginable.

Tuning Function:

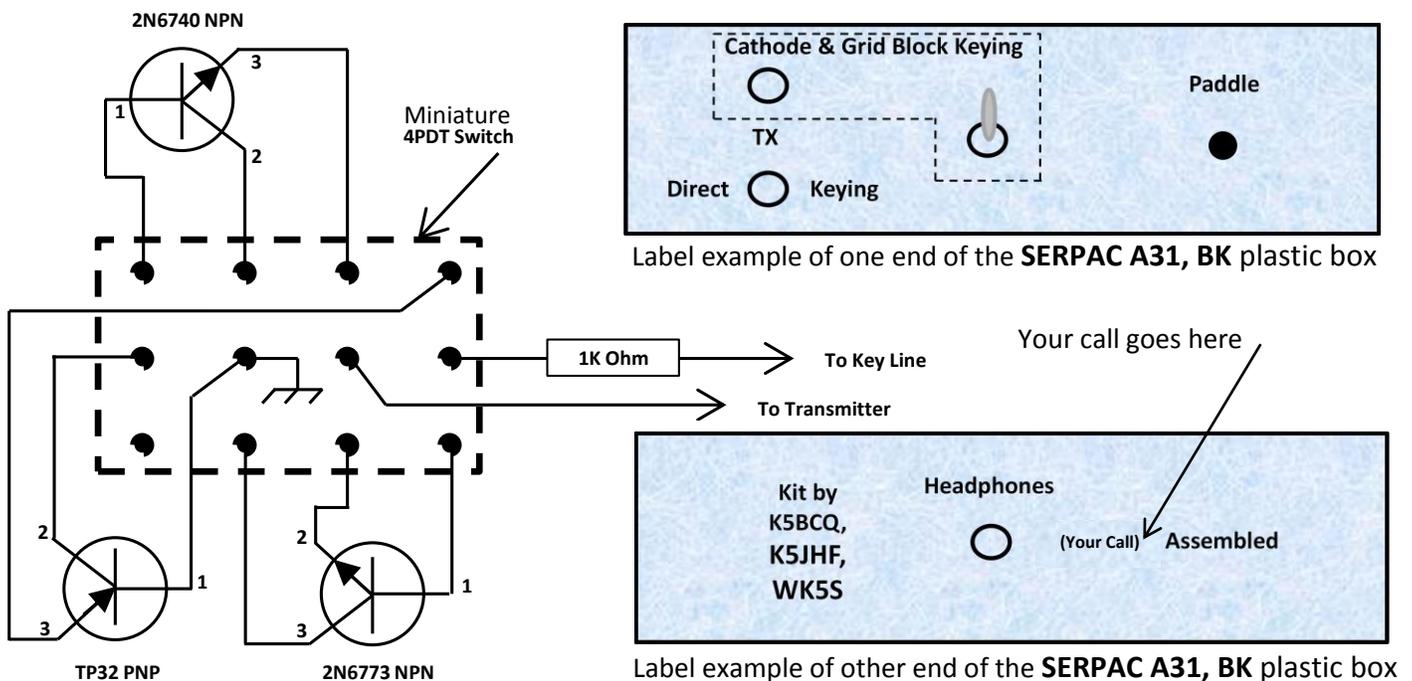
For instance, a "**Tune**" function in firmware is not available in this device. So if you're one of the lucky ones still using Classic equipment, may we recommend adding an extra switch wired in parallel with the key jack and use that as a simple way to key the transmitter for tuning? Like in the example face plate.

Alternate types of Keying:

Since this device is not competing in the Keyer market, there is only one type of transmitter keying. The **MCT** has been equipped with components to key direct keying transmitters (most modern rigs).

If tube type (**Cathode** or **Grid Block**) keying is required, may we recommend adding another switch and keying jack in your individual configuration to be able to switch between the two? If a direct keying transmitter (modern Radio) needs to be keyed, add one cable going from the **direct keying output to that radio**, and the other cable going to either the **Cathode** or **Grid Block** keying transmitter.

Here's one example of how to do the **Cathode** and **Grid Block** keying arrangement using a Four Poll Double Throw Switch (4PDT), a few power transistors and a 1,000 ohm 1/4W resistor.



Morse Code Trainer

Section 3: *(Training)*

Learning Morse Characters: [\(Back\)](#)

First, **CONGRATULATIONS** on finishing the assembly and having a working “**Morse Code Trainer**”. But before starting the learning process of this great language, let’s review and set some expectations.

Please excuse the directness, but it has to be **SAID** up front! **THIS IS NOT A VISUAL LANGUAGE!!!** Doing so will **STOP** the learning process! **THIS IS AN AUDIBLE LANGUAGE!!!** Which will require listening, and at first recognizing the character sounds, then quickly moving to word sounds to eliminate bad habits. **Please understand this will take time!!!**

With that said, the **Characters**, **Punctuations**, and **Prosigns** will be learned and at varying speeds from 18 to 23 words per minute (WPM).

Things to learn:

- 1) Learning the individual Characters, Numbers, Punctuations, and some Prosigns
- 2) Learning how to recognize Word Sounds
- 3) Learning how to send Iambic Characters
- 4) Learning how to Send Words with Iambic Characters
- 5) Learning hand and finger position for relaxed sending
- 6) Training the finger and Thumb muscle memory
- 7) Learn how to send from ones thoughts
- 8) Learning head copy (recognizing Word Sounds)
- 9) Learning CW operating procedures
- 10) Learning the different parts to a CW QSO and how to carry on a conversation

Required Tools:

- 1) The “**Morse Code Trainer**”.
- 2) A good quality **Dual Lever Paddle** with all the adjustments to make the paddle feel comfortable.
- 3) A **cable to connect the Paddle** to the “**Morse Code Trainer**”.

Please understand that the biggest issues today in learning this language are the **availability of time** to learn the language, and **time to practice the individual lessons**. This tool allows the flexibility to **manage time, learn at a desired availability** without any **stress**, and work around **Life’s interruptions**. But don’t take too many or long breaks between learning sessions or **PRACTICE!** Like anything else; **IF YOU DON’T USE IT, YOU LOSE IT!**

This tool has been equipped with a Character set configuration that has been proven to bring the new ham up to speed quickly with minimum effort. The settings will start out with the easiest letters first, and works up to the more difficult letters, Punctuations, and Prosigns.

Morse Code Trainer

It's recommend that no more than 15 minutes be spent on each learning section of each session, and spend a week on each session before moving on to the next session. Don't become lax, stick with it!!!

Each learning session is made up of three sections:

Section 1) Learning new Characters

Section 2) Learning Word Sounds

Section 3) Learning how to Send Words

The learning Groups will be in the following sequence:

Session 1 – T, E, A, N

Session 2 – R, O, S, I

Session 3 – H, D, L, U, Period (.)

Session 4 – C, M, W, F, ?

Session 5 – Y, P, G, B, /

Session 6 – V, K, J, X

Session 7 – Q, Z, Comma (,)

Session 8 – SK, BT, BK, AR, AS

Each group of characters will have **Word Sounds** associated with them which are made up of the characters learned. This will allow the letters to be learned in the sounds of words. No more random Letter exercises!!

As the sessions are increased and more characters are learned, the words will be based on the total characters learned up to that session. So as the characters are increased, the words will also increase immediately to start learning the sounds of the most commonly used words incorporating the newly learned characters.

“Q” signals **will not** be covered in the training material. See Appendix “H” for the details of the most commonly used “Q” signals. These will come as the skills are increased.

Some of the most used **Prosigns** are covered in **Session 8** of the learning process. These will become more familiar as on air operations occur. The underscore in these characters indicates that the letters are sent as one letter. Such as the sound of SK which is send as didididahdidah. Not as the individual letters “S” and “K”, dididi space dahdidah!

Prosign Definitions:

SK = Is used only at the **END** of *your* last transmission of a QSO. Meaning; you're done and will no longer respond.

BT = **A pause or a separator**. Most times used in place of a Comma or Period in a sentence or phrase

BK = **Back To You Over.....** Is used as a break in a transmission when a quick reply is expected from the other station without going through the station ID.

AR = Used at the **end of transmission** and before the call signs when the conversation is sent back to the other station. It's like saying **OVER**, but in CW.

AS = **Wait**. Telling the other person to please standby, I'll be right back

See Appendix “F” for more common Prosigns and applications.

Morse Code Trainer

It's highly recommended to start each session by reviewing the NUMBERS prior to reviewing previous or learning new characters!

Learning Numbers:

Please read through the complete lesson plan / process before starting the lessons. Please read up to "Detour". Then come back and start the **Numbers Session** followed by **Session 1**. We want you to understand the different nuances of the device, and know what to expect from each function and step in the learning process. Also please pay close attention to all **NOTES** covered in the process.

Learning numbers is a totally different process because of the length of each number, and they will be learned at a speed of 30 WPM. Don't panic, this process has been proven to work for everyone, **if** the instructions are actually followed! 😊 With that said, the numbers will be sent at a rate of 30 WPM, with a 22 WPM space between the numbers, thus 30/22. The different speed timing between the letters will allow just enough time to say the number quickly in your head before the number is sent again.

Numbers Learning Process:

Once the **MCT** starts sending numbers, close your eyes, relax, and say the number immediately after the number is sent. Keep repeating the process until it's completed. The session will start with the number 1 and go up to 0 (Zero) in succession. Then back down to number 1. The numbers will be sent multiple times before going to the next number. So when it starts and the number is sent say **ONE quickly in your head** right after you hear the number sent. Continue saying it after you hear the number and until you hear a different sound. That will be the next number and now you say **TWO (2)** each time you hear that sound, and so on (111..... 222..... 333..... and so on to Zero, and back down to One). If you get lost, you can always look at the display to see the number being sent. But....

Steps:

- 1) Turn ON the **MCT** and press the Up button once to select **NUMBERS** from the main menu.
- 2) Now sit back and follow the process explained earlier.
- 3) After the **MCT** goes through one pass of the numbers, **FINISHED** will be displayed and it will stop. Pressing the **Left** or **Seed** button will restart the session.

Review the **Numbers** a minimum of one time before starting each learning or practice session. However, reviewing them two times will help get the mind use to the speed, help in preparing for the character learning session, as well as learning the numbers.

Now go back to the **Steps:** and follow the process and start learning Numbers.

After you're done with the **Numbers** session, start with **Session 1** to learn the first set of characters. But don't forget to do the numbers before each learning session or practice!

Morse Code Trainer

Session 1: ([Back](#))

In this session **T**, **E**, **A**, and **N** will be the first characters learned.

Prior to starting the session some items need to be pre-set:

- 1) Turn ON the **MCT**, and press the Down button to select **KEYER WPM** from the menu, and use the Left or Right button to change the speed to **20**.
- 2) Press the Down button several times to select **SESSION** from the menu, and use the Left or Right button to select **SESSION "1"**.
- 3) Press the Down button again to select **SESSION LETTER** from the menu, and use the Left or Right button to select **"T"**.

Learning Letter "T":

- 1) Press the Down button to select **NUMBERS**, and quickly press the Right button to select **SESSION LETTERS**.
- 2) The **MCT** will start sending the character **"T"**. After the character sound is heard, quickly say it in your head (not out loud). **Focus on the sound!** Continue this for about a minute.

NOTE 1: Do not picture the character as a letter after it's sent! This is not a picture language, it's an audible language, and you want to recognize the **SOUND** of the characters!

NOTE 2: The device will continue to send the selected character continuously until the device is moved from this menu setting. **So limit the time for learning each character to about a minute.**

- 3) Press the Left button **one time** to move the **MCT** back to **NUMBERS** then press the Up button to move to **SESSION LETTERS**, and take a short break. If you're slow on moving to **SESSION LETTERS**, the device will start sending numbers. If this happened, just press the Up button to move the menu to **SESSION LETTERS**. You'll get used to it, and zip right through the button selections quickly.
- 4) After a short break repeat steps 1) though 3) for three more times until you feel comfortable hearing the character sound for **"T"**.

Learning Letter "E":

- 1) With the **MCT** in the **SESSION LETTER** mode, use the Right button to select the next character **"E"**.
- 2) Press the Down button to select **NUMBERS** and quickly press the Right button to select **SESSION LETTERS**.
- 3) The **MCT** will start sending the character **"E"**. After the letter sound is heard, quickly say the letter in your head (just like before). **Focus on the sound!** Continue this for about a minute.
- 4) Press the Left button **one time** to move the **MCT** back to **NUMBERS** then press the Up button to move to **SESSION LETTERS**, and take a short break.
- 5) After a short break repeat steps 2) though 4) for three more times until you feel comfortable hearing the character sound for **"E"**.

Morse Code Trainer

Learning Letter “A”:

- 1) With the **MCT** in the **SESSION LETTER** mode, use the Right button to select next character “**A**”.
- 2) Press the Down button to select **NUMBERS** and quickly press the Right button to select **SESSION LETTERS**.
- 3) The **MCT** will start sending the character “**A**”. After the letter sound is heard, quickly say the letter in your head. **Focus on the sound!** Continue this for about a minute. **Focus on the sound!**
- 4) Press the Left button **one time** to move the **MCT** back to **NUMBERS** then press the Up button to move to **SESSION LETTERS**, and take a short break.
- 6) After a short break repeat steps 2) though 4) for three more times until you feel comfortable hearing the character sound for “**A**”.

Learning Letter “N”:

- 1) With the **MCT** in the **SESSION LETTER** mode, use the Right button to select next character “**N**”.
- 2) Press the Down button to select **NUMBERS** and quickly press the Right button to select **SESSION LETTERS**.
- 3) The **MCT** will start sending the character “**N**”. After the letter sound is heard, quickly say the letter in your head. **Focus on the sound!** Continue this for a minute.
- 4) Press the Left button **one time** to move the **MCT** back to **NUMBERS** then press the Up button to move to **SESSION LETTERS**, and take a short break.
- 7) After a short break repeat steps 2) though 4) for three more times until you feel comfortable hearing the character sound for “**N**”.

Continue the above procedure until you feel comfortable hearing and recognizing the new characters.

NOTE: Any character maybe selected at any time during the session to focus on a specific character sound.

Learning Word Sounds:

Learning words is nothing new. It’s what experienced CW operators wind up doing after many years of CW operation, and where their skills and proficiency have increased to where they hear the music of CW and start copying in their head! Today’s experienced CW educators have also realized this and now immediately immerse the CW student into learning **Word Sounds**, rather than teaching random letters as a part of the introduction to characters. This shortens the time from years to only months to hear the word sounds. This way the new ham doesn’t have to go through 10, 20, or 30 years of CW operations before they can hear and send words, or finally hear the music of CW and start copying in their head.

But! Don’t take this too lightly and don’t expect it to happen overnight or by osmosis! It requires continuous **EFFORT, DEDICATION**, and sorry to say **HARD WORK!!!** Oh, and did I forget to say lots of **PRACTICE!!!!!!** Plus getting on the air and having multiple QSO’s per day for 6 months after learning the language will engrain the language so it’s not completely lost and becomes second nature.

Morse Code Trainer

You have a huge benefit over others by having this great tool to help you avoid all the pitfalls, plateaus and headaches of learning this great language called Morse code! Just take it with you everywhere you go.

Just in case someone asks, “Why are you learning the code at 20 WPM, isn’t that too fast?” You can inform them 20 WPM has been proven to be the right speed to learn Morse code to eliminate all the pit falls, plateaus, and bad habits encountered at slower speeds. At this speed it allows the proficiency to be increased much faster to where it’s not boring to send and receive Morse code, and it doesn’t take 20 to 30 years to hear the music. Also in your case you’re learning it with a great tool you made with your own two hands! How great is that!

Now that the first group of characters has been reviewed and their sounds are starting to become familiar. It’s time to jump right into learning **Word Sounds** made up of those characters.

Process:

Please read through the whole process before starting the lesson.

- 1) Prior to learning word sounds, press the Up or Down button to select **REPEAT**. Use the Left or Right buttons to change the number of times each word will be repeated. Set the number to “5”.
- 2) Press the Down button once to select **PAUSE**. Use the Left and right buttons to select “500ms”.
- 3) Press the Down button to select **NUMBERS** and quickly press the Right button **two times** until **SESSION WORDS** is visible in the screen.
- 4) Sit back and listen to the word sound being sent. Try to make out the word being sent and once the sound is understood, say it in your head each time it’s sent. Listen closely to recognize the **Word Sound**. You may want to sneak a peek at the screen to see the word if you cannot figure it out. But first, work hard to listen to the **Word Sound** and figure out what’s being sent. At first there’s a tendency to listen to each character sent to figure out the word. That’s okay for starters, but once the **Word Sound** is understood, then focus on listening to the **Word Sound**! Remember to say the word in your head.
- 5) The **MCT** will continue to send the words as long as it’s in this setting. So don’t spend more than 15 minutes on the session.

Pressing and holding the **Seed** button for two seconds will change the order the words are sent.

If there’s a concern with only being able to hear the word repeated five times as in step 1). Go back to the **REPEAT** menu and select a higher or lower number of times the word is repeated, depending on what it takes to recognize the sound before the word is finished being repeated. If you’re getting the word before it’s sent five times, then change the “**REPEAT**” to 4 or 3 times and try again. If you’re not getting the word after the fifth time then increase the time the words are repeated. However, don’t stay at this setting too long! The goal is to recognize the word the first time. Well maybe the second time. 😊

Now that you’re feeling comfortable with hearing the **Word Sounds**, let’s work on learning how to send words.

Morse Code Trainer

Learning how to Send Word:

Prior to using the paddle to start sending words, please review "[Using the IAMBIC KEYER](#)" section (page 11) of this manual to become familiar with how the paddle and Keyer work.

Process:

Again please read through the whole process before starting the lesson.

- 1) Plug in the paddle.
- 2) From the **NUMBERS** menu, push the right button **three times** to put the **MCT** into the **SESSION WORDS + KEY** menu.
- 3) After the word is sent, the **MCT** will pause for two seconds. This pause is the time for you to send the **WORD SOUND** you just heard. If the unit does not detect any key action after two seconds it will send the word again as many times as it was setup in the **REPEAT** menu. So after the word is sent, send the **word sound** to **MIMIC the sound exactly!**
- 4) Continue this until you become familiar with the words being sent and you're able to **MIMIC** the word **EXACTLY** as it was sent.

NOTE: It is recommended that the **WORD SOUND** be sent more than just one time after the word is heard. If the word is sent multiple times, the **MCT** will wait until there's a two second pause, then it will send the word again and pause. So send the word about **five times** in quick succession after the word is heard and work hard to **MIMIC** the **exact sound!** Then pause and listen for the word sound again and do it again 5 times. Listen closely when the **MCT** sends the word! Keep doing this until you feel you're sending the word just as it's sent. If need be, send the word more than five times to become familiar with the **WORD SOUND**, and feel comfortable sending the **WORD SOUND** without any mistakes or spaces between the letters in the word.

Once you become familiar with the word, strive to be able to send the word without thinking of the each letter. Send the **WORD SOUND** in rapid succession as mentioned in the **NOTE** without thinking of the word. It's like the thumb and finger are being trained from your thought (which is called Muscle Memory) and you're sending the words while you're talking to someone else at the same time about something totally different. 😊 This is where you want to be, and if learned as outlined, you'll find yourself eventually sending word thoughts and sentences to where the muscle memory of the thumb and finger of the sending hand just take over and send the words. Yahoo!!!! You have got to be kidding, you say! No, it's true; **BUT**, it's up to you and your individual goals!!! How bad do you want to do it?

Sending is the most important part of the learning process, and the **MCT** will give you the needed practice and training on how to **Send Words correctly!** This will later pay dividends once you get on the air and start sending sentences made up of word sounds with the correct spacing between the words. Once you achieve this ability, the person on the other end of the QSO will love to listen to your sending. Why, because it will be so easy to copy in their head. Which we should all strive for, but many miss out because they don't have this great tool to help them!

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Remember this will not happen overnight. It will take time to learn, but by using the **MCT** you're learning it the right way, and it will help you get there faster! Also being able to send the **WORD SOUNDS** will also help in your comprehension and copy speed, which will get you to head copy quicker.

Once the new characters and words in session 1 become familiar, move on to Session 2, and follow the same process used in Session 1, and continue the process until **all eight sessions** have been covers with at least a 70% comprehension and proficiency with all the words. However, when moving to each new session, check for **Iambic Characters** as identified below to learn how to send the characters as they show up in the lessons.

Iambic Characters:

As the **Iambic** letters show up in the different sessions. Please Reference **Appendix "B"** for each formation of the **Iambic** character, and take advantage of all the **MCT** features and capabilities.

Practice Iambic characters slowly at first, to turn the thought from the mind to a muscle memory in the thumb and finger. Then increase the speed back up to **20 WPM** and practice at speed. **Practice a lot!**

<u>Session</u>	<u>Iambic Ltr</u>	<u>Session</u>	<u>Iambic Ltr</u>	<u>Session</u>	<u>Iambic Ltr</u>
2	R	4	C, F	6	Q, K
3	L, Period (.)	5	Y	8	<u>SK</u> , <u>AR</u> , <u>AS</u>

Please note that Morse code in Amateur Radio isn't about 100% copy!!!!!!

It's about understanding what the other person is saying, and you don't need 100% copy to do that!

Now go back to "Learning Numbers" and come back to this spot after completing all eight sessions.

Detour:

Congratulations on completing all eight sessions to learn the Morse characters, Numbers, and some Prosigns, with a basic level of understanding of word sounds and how to send those words correctly. By now things should start making sense and you should start feeling comfortable with your sending. So let's take a little detour for a different kind of practice, and before getting into **"What makes up a QSO"**. Let's start sending written words from a magazine or book to work on sending sentences and information from what you see on paper. So open a book and look at the first word, then think what the word is and send it from your thought as a word. This will start out slowly at first, but the more you practice you'll find yourself recognizing the word quickly and the words winds up rolling off your fingers. Remember, if you have trouble at **20 WPM**, slow down to **17 or 18 WPM**, and after it gets better, increase the speed to **20 or 23 WPM**. But don't go too fast at this time. The speed will come soon enough.

FYI, sending words will become easier to do then recognizing words! The normal tendency is to send faster than you can receive. So work at matching your **sending speed** with your **receiving speed**.

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After you feel comfortable with sending from printed words, start sending made up sentences from your thoughts. Such as:

Hi John hw r u doing today? I hpe everything is wl wid u es ur family. Use appendix "D" "Ham Abbreviations" to make sending easier. Use the abbreviations as much as possible. Using Ham abbreviations will allow you to say more in less time.

Then, start sending from your thoughts; "what did you do today, and do you have plans for tomorrow." This is a great way to get in some really good practice. Now remember it's going to be *slow going at first*, but like anything else, the more you do it the better you get. IT'S ALL UP TO YOU!!!!!!

The above will help to send sentences with fewer mistakes. At first you'll find yourself thinking and sending letters with the words being a little erratic. But the more you practice, you'll quickly find out your training is paying off because you've been trained to **hear** and **send words**, and it will soon change. You will find yourself sending words from your thoughts and sentences will be smoother and easily sent. But do a lot of sending (**PRACTICE**) from your thoughts, because that's how you'll be communicating in this mode (CW).

WHAT MAKES UP A QSO:

Okay, now that you're able to send from a written document and from your thoughts, let's get into "**What makes up a QSO?**" Let's start by discussing the different parts of the **QSO**.

There are three parts to a **QSO**:

- 1) **Initial Information** transfer of the **QSO**
- 2) The **Body** of the **QSO**
- 3) The **Termination** or **Exit** of the **QSO**

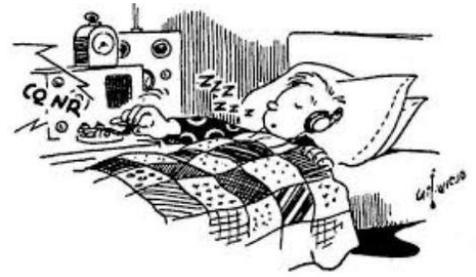
But first there's a little thing known as a **CQ**. It's the initial call to let people know that you're looking for someone to talk to.

There are two methods recommended for **HF** CW use. First is the **short CQ**, and second is the most common, the **long CQ**.

Short CQ = CQ CQ CQ DE (your call) (your call) K

Long CQ = CQ CQ CQ DE (your call) (your call) CQ CQ CQ DE (your call) (your call) K

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Practice sending the **long CQ** until you can send it in your sleep with **NO mistakes!** It's a muscle memory thing, and be aware of the timing between words. It's another second nature thing and every time you do it, it just comes out right. Well that's the goal. 😊

Initial information transfer:

This section of the **QSO** is the first interaction with the other station and starts with a salutation like; ***"nice to meet you for the first time"***, or ***"great to QSO again (Name)"*** followed by the transfer of basic information; such as **his signal report (RST)**, **your City & State (QTH)**, **your name (Op)**, and sending it back to the other station with proper identification.

But first, please read Appendix **"C" "Basic CW Operations"**! It's important to understand some basic aspects of a QSO and why things are done in a certain way. Some who **have not** been Elmered in the art of CW will disagree and they will be the ones having the most trouble communicating not only in CW, but in all other modes. We are supposed to be communicators, and learning the basic process pays off in the long run to deal with any communications situation that may arise.

Also see Appendix **"G"** to see the example of how a basic **QSO** is organized.

Appendix **"G"** is made up in two parts for each **QSO** exchange.

- 1) The first example is an exchange between two stations, **Tim (NB8I)** and **Mark (N9PUZ)**.
- 2) Then the same example follows with blanks in the areas where you insert your information.

The Second Exchange is also between **Tim** and **Mark** and is shown in the same manner to give a basic example of the formatted information to follow starting the **Body** of the QSO. Also, below that example is the formatted information with the blanks for your information to be inserted.

So review and practice sending all the different exchanges to become familiar with the process so it becomes second nature and just rolls off your fingertips. Also see **"Morse Code - An Overview"**.

YouTube videos: [part 1](#), [part 2](#), [part 3](#) and [part 4](#), and go back often to review the information.

The exchange examples in Appendix **"G"** may be used when starting out on the new adventure of your first few CW **QSO** exchanges. Just make a copy of the example, insert your information, and send from what's on the paper. This should work pretty well because you have already been sending from a written document. Don't forget; leave a little extra space between words!

As time goes by, and you start feeling comfortable in your skills and comprehension, feel free to rearrange the exchanges any way you wish that feels good to you. But don't forget the basics; there is nothing wrong with identifying at the beginning and end of each exchange. It's just good hamming and you don't have to worry about the ten minute ID rule. 😊

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Oh, and don't forget to end each exchange in the body with a question to the other person! This is how you find a niche you both have in common to carry on an interesting and meaningful **QSO**. I guess we all have to learn how to interview people to find the others interests. It also makes for a great conversationalist and something that's missing in the world today. It appears people don't talk anymore. 😊

Okay it's time TO GET ON THE AIR! Yes I know what you're thinking. NO NO NO !!!!! I'm not ready! Is what's going through your head right now? It's like anything attempted for the first time, and it's all in your head, not in your skills, you already have them. It's just that proverbial first time doing anything syndrome, jitters, queasy stomach, stage fright, or whatever you want to call it, and as they say, "Don't worry about it!" 😊 It's part of experiencing the thrill of that first CW **QSO**! Where the sweat will be pouring from your forehead, your hands will be clammy and shaking to the point where you'll make a ton of mistakes. But just push through it, you're not the first one to feel this way. Every CW operator has gone through it ever since the beginning of communications. If you think about it, it's like a self-inflicted initiation into CW operations. It's like that first time you talked on the microphone or anything you've done for the first time in front of people. 😊 Oh and while you're at it, it doesn't hurt to let the other person know that they're your first **QSO**, and make sure you ask them for their QSL card.

So pick a frequency in the middle or top end of the CW section of the bands and call CQ. Or, find someone that you feel comfortable copying, **and adjust your sending speed to match theirs**. But don't go to slow either. Your skills will take over once you get started. Also for the time being stay away from any CW contests! Let's first work on feeling comfortable with your skills and comprehension. There will be time for contesting later as your confidence grows.

Don't give up after the first **QSO**! It does get better the more you do it. Plus, you're a giant step ahead of every other new CW operator because you have learned the basics and have been trained with a great CW Elmer (**MCT**). Now you can look forward to using this great Keyer, and you'll soon be sending like those folks that took 30 years to develop their skills to where you are.

To further increase your skills and comprehension, go through the section on "[Enhancing Skill and Proficiency](#)". Start out using two letter words and work yourself up to five letter words. **But most of all get on the air and make as many QSO's as you can every day to really experience the quick growth you'll encounter.**

Also don't forget to review "[Using the Memory](#)" to learn the memory features of this great device.

Now, go have fun and enjoy your new skills. We hope you soon hear the music of CW, because it's an awesome way to communicate! Also, please share your experience with others and let them know about you CW Elmer (the **Morse Code Trainer**).

The Austin, TX QRP Group (AQRG)

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Enhancing Skills and Proficiency: [\(Back\)](#)

Please read through the whole process before starting each practice session.

The **MCT** is perfect for the experienced CW operator who would like to increase their comprehension of **Word Sounds**, and **Sending Skills**, and will help them to go beyond their greatest expectations. *If* continually applied in the practice session! It will also take time to break bad habits of hearing letters!

Each session consists of two skill sets. **WORD SOUNDS** and **SEND WORDS**. Both should be practiced sequentially in one session, with no more than 15 minutes spent on each skill. More is up to you. 😊

Before we get started, we assume you're already proficient at some level of receiving and sending Morse code and using a Paddle. We will not try to get you to use a different paddle, but if you're not already sending words and phrases with minimal mistakes, we will share with you some great training on how to copy in your head by recognizing **WORD SOUNDS**, and to increase your sending skills by learning to send **WORDS SOUNDS** correctly to build finger and thumb muscle memory, and the rest will follow quickly.

Building WORD SOUNDS as a standalone function:

This section requires five Pre-sets (**KEYER WPM, # WORDS, # LETTERS, REPEAT, PAUSE**).

- 1) Turn on the **MCT**, and make sure the speaker is on, and/or plug in the headphones.
- 2) In the menu adjust the **KEYER WPM** to **five WPM** over what you're comfortable with. Or try **30** or **40 WPM**. Your trying to hear words sounds not letters!
- 3) Adjust **# WORDS** to **10** for starters.
- 4) Adjust **# LETTERS** to **2**. Now if you're experienced and competent at those words, just adjust the number of letters to where you'll be challenged.
- 5) Adjust **REPEAT** to **5** or **7** for the number of times each word is to be sent. Depending on the skill level this may be change to what feels a little more challenging, or where the word is understood.
- 6) Adjust the **PAUSE** to **500ms** or a comfortable time between words. This can be changed at any time during the practice session.
- 7) From the **IAMBIC KEYER** menu, press the Right button one time so the display shows **WORD SOUNDS**. Sit back and start listening to the words sent. If there's a problem recognizing the word after it has been sent five times. Look at increasing the **REPEAT** number to hear the words sent more times. Or change the **KEYER WPM** to a slower speed until words are recognizable and you're able to recognize the **WORD SOUND** every time it's sent. But don't go **below 18 WPM!** You want to hear the **WORD SOUND** and it's harder to hear words at slower speeds. You want to **RECOGNIZE** the **WORD SOUND!** *Not listen to each letter to configure the word in your head!* That was the old way of doing it, and a habit that needs to be broken, or it will limit your growth.
- 8) After the word group is recognized at the present settings. Change the **REPEAT** to reduce the times a word is sent. As you get better, change the **KEYER WPM** to **18**, to see if you still recognize the words. You should find it harder to hear the words. Then Increase the speed of the **KEYER WPM** to a higher speed. Between 20 and 30 WPM is a good speed to continue practicing at varying speed. Also change the **REPEAT** to **1** to hear the word only once. This helps with the best level of comprehension. Set the speed to 40 WPM and see how you do. You want to hear words, right!

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Pressing and holding the **Seed** button for two seconds will change the order the words are sent.

CAUTION: Do not get stuck at copying at one speed, because that's all you'll be able to do! It's important to constantly vary the speed!

- 9) It's recommended to only **practice 15 minutes** per session. Doing more is up to you. Remember this is supposed to be enjoyable and fun. 😊
- 10) Also change the **# WORDS** to increase the vocabulary, and change **LETTERS** to increase the number of letters in the words. Be careful when trying to head copy more than five letter words. Copying long words comes with understanding what's being said in the sentence and it winds up just being understood. The funny part when this happens is you wind up getting so excited because you understood what was said, that you wind up missing the next five words. 😊
- 11) Afterwards you may want to try "**ALL**" from the "**# Letters**" selection to copy random word lengths.

The whole idea is to create the **DESIRE** to push ones-self to increase comprehension and skills to where you're able to hear the music and easily copy good CW in your head at any speed. There's not much we can do about the folks who don't send good code, but maybe by sending good code to them, they'll hear the difference and want to sound like you! YES!!! Well, we can always hope. 😊

This is what makes this device so unique, special, and worthwhile having. Where else can you get this kind of great help! So go back and start the process, and after 15 minutes start with **SEND WORDS**.

Building Sending Skills SEND WORDS as a standalone function:

Use the same initial menu set up as in the **WORD SOUNDS** session.

We highly recommend reading "**The secrets of Easy Morse Code Sending**", which may be found at the Web site where you found this kit (<http://www.gsl.net/k5bcq/Kits/Kits.html>). It will give you some insight on how to setup and use a paddle. **How to setup and use a paddle will not be covered in these instructions.** We also recommend a good **Dual Lever Paddle** that has the adjustments to fit your hand. But if a **Single Lever Paddle** is use, that's okay too. As was mentioned before, we don't want to change something you're comfortable with, we just want to help you do it better.

If you use to a **Single Lever Paddle** don't worry about any Iambic functions or Mode "B", and please set the **MCT** to **MODE "A"**, and skip step 3 below.

- 1) Plug in the paddle, and turn the **MCT** on.
- 2) In the menu adjust the **KEYER WPM** to **five WPM** over what you're comfortable with. I found **25 WPM** is a good speed to start sending word sounds. But don't go too slow!
- 3) Now depending on which Mode of Iambic keying your accustomed to, it may be selected by changing the menu to **MODE** and using the Left or Right buttons to either select **Mode "A" or "B"**. Your preference. We recommend **Mode "B"** for Iambic sending.
- 4) From the **IAMBIC KEYER** menu, press the Right button **two times** so the display shows **SEND WORD**. After the word is sent, the **MCT** will pause for two seconds. This pause is the time for you to send

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the sound of the word which has been sent. If the **MCT** does not detect any key action after two seconds, it will send the word again as many times as it was set to **REPEAT** the word. So after the word is sent, send the word sound to **MIMIC** the sound **EXACTLY!** See the **NOTE** Below.

- 5) Continue this until sending each word become second nature and **MIMICING** the word sound **EXACTLY**.
- 6) Then change the # **WORDS** to increase the vocabulary, and/or change **LETTERS** to increase the number of letters in the words sent up to 7. Or use "**ALL**" and use it to send random letter words.

NOTE: It's recommended that the **word sound be sent more than just once after the word is heard**. If the word is repeated multiple times, the **MCT** will wait until there's no key action for two seconds, and then it will send the word again and pause. So send the word about **five times** or more after the word is heard and work hard to **MIMIC** the **exact sound!** Then pause and listen for the word sound again and do it again multiple times. Listen closely when the **MCT** sends the word! Keep doing this until you feel you're sending the word just like you heard it. Remember no spaces or wrong timing between the letters in the words! You want to just think of the word and the Muscle Memory takes over and all you hear is the word sound! Don't think of each letter as the word is sent!

This is a very important part of the learning process, and will give the needed practice and training on how to **SEND WORDS** correctly. This will pay dividends in every conversation (Rag Chew) on the air when sentences are made up of word sounds with good word spacing. You'll also find out that the amount of mistakes will greatly diminish and sentences will flow smoothly. What's really happening when learning how to send words correctly is that the muscle memory in the thumb and index finger are being trained to respond to the word thought, and eventually the thought of the word is just sent and the character configuration of the word is no longer necessary! Once this level is achieved, the person on the receiving end will love to listen to your sending. Why, because it's so easy to copy in their head! Which is what we should all strive for, but many miss out because they don't have this great tool to help them! 😊

Come back and practice this section often, and you'll find yourself starting to recognize words and making fewer mistakes. It works, but like anything else, it takes a **DESIRE** and **PRACTICE**. 😊

Best wishes and we hope you enjoy using the "**Morse Code Trainer**", and use the "A to Z in a box for CW" as the only tool you'll ever want to meet your needs in communicating in this great language of Morse code!

The Team:

K5BCQ

K5JHF

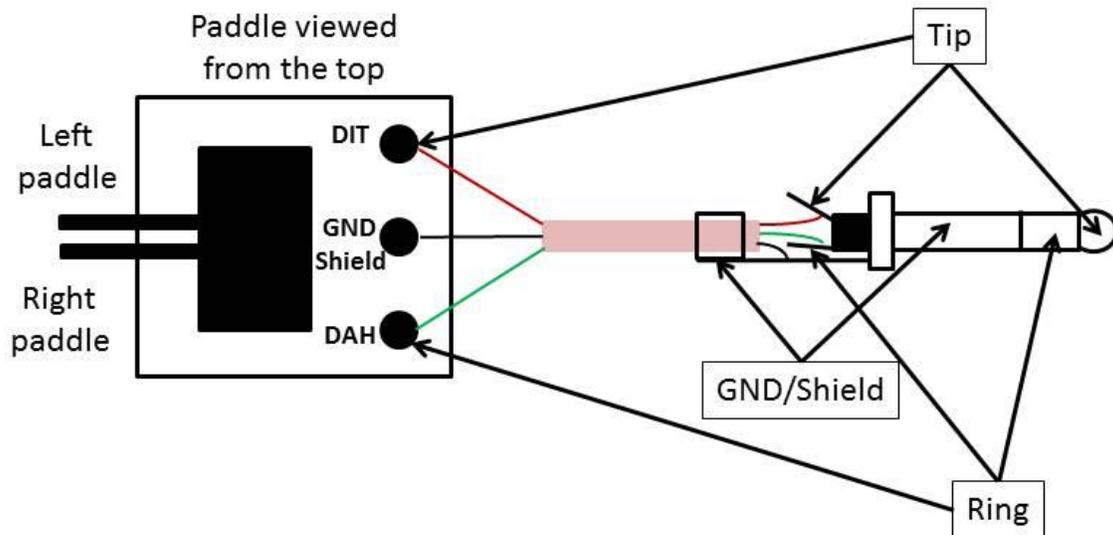
WK5S

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Section 4:

Appendix "A"

Cable connection for Paddle and Jack



It is recommended that a shielded cable be used to connect the Paddle to the Jack.
Use a miniature 1/8 inch Stereo Jack on the end of the cable.
Use a miniature to 1/4 inch adapter when connecting to a larger connection.

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Appendix “B”

Iambic Characters

Iambic operation is useful for sending characters that have alternating patterns;
C, Y, Q, K, R, F, L, AR, SK, AS, KN, and period (.).

Sequence of Iambic Characters:

- “C” – Squeeze the DAH paddle first and hold it, then squeeze the DIT paddle and hold it until the DAH and DIT are sent again (or twice), then release both paddles. **DAH DI DAH DIT**
- “Y” – Squeeze the DAH paddle first and hold it, then tap the DIT paddle and release it quickly, after the second DAH release the DAH paddle. **DAH DI DAH DAH**
- “Q” – Squeeze the DAH paddle first and hold it, after the second DAH tap the DIT paddle and release it quickly, then release the DAH paddle. **DAH DAH DI DAH**
- “K” – Squeeze the DAH paddle first and hold it, then tap the DIT paddle and release it quickly, then release the DAH paddle. **DAH DI DAH**
- “R” – Squeeze the DIT paddle first and hold it, then tap the DAH paddle and release it quickly, then release the DIT paddle. **DI DAH DIT**
- “F” – Squeeze the DIT paddle first and hold it, then after the second DIT tap the DAH paddle and release it quickly, then release the DIT paddle. **DI DI DAH DIT**
- “L” – Squeeze the DIT paddle first and hold it, then tap the DAH paddle and release it quickly, then release the DIT paddle after the second DIT. **DI DAH DI DIT**
- “.” – Squeeze the DIT paddle first and hold it, then squeeze the DAH paddle and hold it until the DIT and DAH repeat two more times. Then release both paddles. **DI DAH DI DAH DI DAH**
- “AR” Squeeze the DIT paddle first and hold it, then squeeze the DAH paddle and hold it until the second DAH, and then release both paddles. Then release the DAH paddle before the DIT paddle.
- “SK” Squeeze the DIT paddle first and hold it for 3 DIT's, then squeeze the DAH paddle and hold it. Then release the DIT paddle before the DAH paddle during the DIT in the letter “K”. **DI DI DI DAH DI DAH**

Picture the sending sequence for the **AS** and **KN** and practice sending them until you can send them easily at 20 WPM. Do it slowly to start with, then build up the speed as you become comfortable sending the characters. Remember, Prosigns do not have a space between the two characters, the two characters are sent as one.

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Appendix "C"



1. **When making the initial domestic call to another station, always send their call at least once followed by a "DE" and your call sign twice.** Why, because you don't know their receiving condition. Just because they're 10 over S9 on your "S" meter doesn't necessarily mean you're the same at their QTH.
2. **In the initial contact segment of the QSO, send your information twice.** It's the important information for the log and you want them to get it right. After that, you can send everything once. Not everyone uses a computer log.
3. **When sending the QTH spell it out.** Don't use East Texas, or Eastern PA. Again you want them to get it right for the log.
4. **Always start and end a transmission with the call of the other station followed by your call. Or, at least your call sign followed with a "K"!** We are supposed to identify every 10 minutes as stated in Part 97 anyway, and it's just a good habit to get into.
5. **Prior to calling CQ, check for a clear frequency by sending QRL? at least 3 times with a 5 to 10 second pause between QRL's.** There might be a station in your dead zone that you may not hear. Or the band conditions aren't right for the antenna direction.
6. **Never respond to a station calling CQ at a slower speed than they're sending!** There are plenty of other frequencies where people will be sending at your speed, and just maybe, that station wants to practice at their sending speed. So show a little respect and crank up the speed to match theirs.

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Appendix “D”

CW Abbreviations

AA	All After	GE	Good Evening	SASE	Self-addressed stamped envelope
AB	All Before	GESS	Guess	SED	Said
ABT	About	GG	Going	SEZ	Says
ADEE	Addressee	GM	Good Morning	SGD	Signed
ADR	Address	GN	Good Night	SIG	Signature, Signal
AGN	Again	GND	Ground	SINE	Personal initials or nickname
AM	Amplitude Modulation	GUD	Good	SKED	Schedule
ANT	Antenna	GV	Give	SRI	Sorry
BCI	Broadcast Interference	HH	Error sending	SS	Sweepstakes
BCL	Broadcast listener	HI HI	Laughter	SSB	Single Sideband
BCNU	Be seeing you	HR	Hear, Here	STN	Station
BK	Break in	HV	Have	SUM	Some
BN	Between, Been	HW	How, Copy?	SVC	Service
BTR	Better	LNG	long	T	Zero
BTU	Back to you	LTR	Later	TFC	Traffic
Bug	Semi-automatic key	LID	Poor operator	TMW	Tomorrow
B4	Before	MA, MILLS	Mill Amperes	TKS, TNX	Thanks
C	Yes, Correct	MSG	Message	TR, TX	Transmit, Transmitter
CFM	Confirm, I confirm	N	No, Nine	T/R	Transmit/Receive
CK	Check	NCS	Net Control Station	TT, TTS	That, That is
CKT	Circuit	ND	Nothing Doing	TU	Thank you
CL	Closing Station, Call	NIL	Nothing; I have nothing for you	TVI	Television interference
CLBK	Callbook	NM	No More	TXT	text
CLD	Called	NR	Number, Near	U, UR, URS	You, You're, Your, Yours
CLG; CLD	Calling; called	NW	Now	VFB	Very Fine Business
CNT	Can't	OB	Old Boy	VFO	Variable Frequency Oscillator
CONDX	Conditions	OC	Old Chap	VY	Very
CPI, CPY	Copy	OM	Old Man	W	Watts
CQ	Calling any station	OP, OPR	Operator	WA	Word After
CU	See you	OT	Old Timer	WB	Word Before
CUD, CULD	Could	PBL	Preamble	WD, WRD; WDS	Word; Words
CUL	See you later	PKG	Package	WRK, WKD	Work, Worked
CW	Continuous Wave	PSE	Please	WKG	Working
DE	From, From this	PT	Point	WPM	Words per minute
DIFF	Difference	PWR	Power	WL	Well; will
DLD, DLVD	Delivered	PX	Press	WUD	Would
DN	Down	R	Received, Roger, Are	WX	Weather
DR	Delivered	RC	Ragchew	XCVR	Transceiver
DX	Distance	RCD	Received	XMTR	Transmitter
EL	Element	RCVR, RX	Receiver	XTAL	Crystal
ES	And	REF	Refer, Reference	XYL, YF	Wife
FB	Fine business	RFI	Radio Frequency Interference	YL	Young Lady
FER	For	RIG	Station Equipment	YR	Year
FM	Frequency Modulation, From	RPT	Repeat	73	Best Wishes
GA	Go ahead, Good afternoon	RPTR	Report	88	Love & Kisses
GB	Goodbye, God Bless	RTTY	Radio Teletype		
GBA	Give better address	RST	Readability Strength Tone		
GD	Good	RX	Receive, receiver		

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Appendix "E"

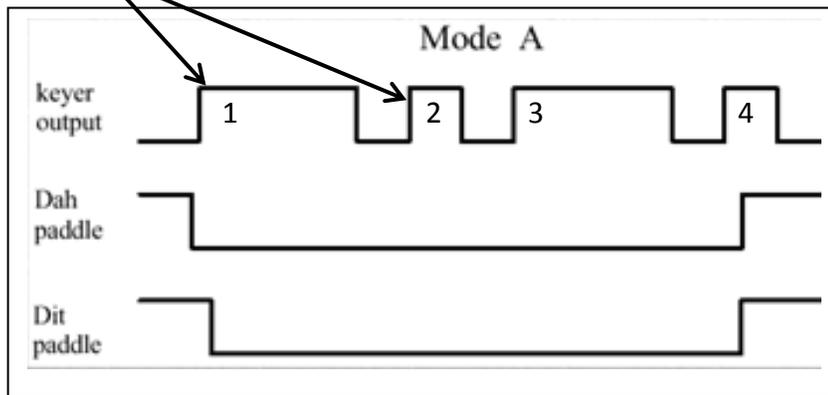
Mode "A" & "B"

The difference between mode "A" and Mode "B" lies in what the keyer does when both paddles are released.

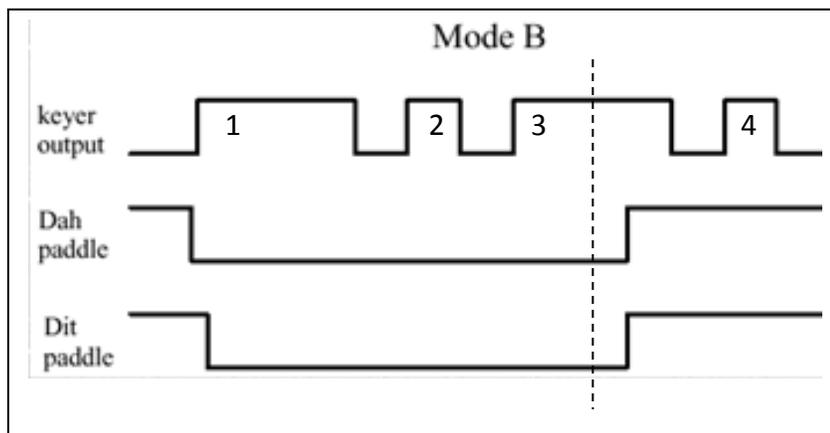
Example for Letter "C":

In **Mode "A"**, the paddles are released during any part of the last element and sending stops.

Character Elements



In **Mode "B"**, the keyer sends an additional element opposite to the one being sent when the paddles are released. Note the keyer output is the same, but the paddles are released much sooner. For the last element to be automatically sent to complete the letter "C", both paddles need to be released during the **last half of the third element**. If the paddles are released any time during the last half of the second element or the first half of the third element, the letter "K" will be sent.



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Appendix "F"

Prosigns

Prosign	Answer or Advice	Example
<u>BT</u>	A pause or a separator. Sometimes used in place of a Comma or Period in a sentence or phrase.	NAME HR IS LARRY BT QTH IS
<u>AR</u>	Used at end of transmission and before the call signs when you are sending it back to the other station. It's like saying OVER .	BTU BOB AR W3BBO DE W2LJ KN
<u>SK</u>	used only at the END of your last transmission of a QSO.	TNX QSO BOB BT 73 ES GN AR W3BBO DE W2LJ SK
BK	Back to you over..... Used as a break in a transmission, when you expect the other station to reply quickly without going through the station ID.	(W3BBO sends) WHAT RIG U USING? BK (W2LJ replies) RIG HR IS K2
K	Go ahead over. Use this when you are turning it over to the other station. You also use this at the end of a CQ.	HOW CPY NOW BOB? AR W3BBO DE W2LJ K CQ CQ CQ DE W3BBO K
<u>KN</u>	Almost the same as K; but used only when you want a specific station AND NO ONE ELSE to come back to you. This can be useful when you're in a multi-op roundtable QSO.	W3BBO DE W2LJ KN
<u>CL</u>	Use this only when you intend this to be your last QSO and you will be turning off your equipment or leaving the frequency. A good way to let other ops know that you will not respond to any further calls.	NICE QSO BOB BT 73 ES GN CUL SK W3BBO DE W2LJ CL

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Appendix "G"

What makes up a QSO

Example of First QSO exchange with Tim replying to the call:

Calling CQ:

CQ CQ CQ DE N9PUZ N9PUZ CQ CQ CQ DE N9PUZ N9PUZ K (Tim is calling CQ)

N9PUZ DE NB8I NB8I k (Mark answering the CQ)

Tim replying to the new call:

NB8I DE N9PUZ BT TNX FER THE CALL BT UR RST IS ^{or 5NN 5NN} 599 599 BT MY QTH IS SPRINGFIELD, IL. SPRINGFIELD, IL BT MY NAME IS TIM TIM BT SO HW CPY AR NB8I DE N9PUZ K

The other station (Mark) replying back:

N9PUZ DE NB8I R R GUD CPY TIM ES TU FER THE RPTR BT UR RST IS 579 579 BT MY QTH IS PARMA, OH. PARMA, OH BT MY NAME IS MARK MARK BT SO BTU TIM AR N9PUZ DE NB8I K

Calling CQ:

CQ CQ CQ DE Your CALL here twice CQ CQ CQ DE Your CALL here twice K

Answering a CQ:

Their CALL once DE Your CALL here twice k

Replying to the new call:

Their CALL DE Your CALL BT TNX FER THE CALL BT UR RST IS ^{or 5NN 5NN} 599 599 BT MY QTH IS Your QTH city & State Your QTH City & State BT MY NAME IS Your name here twice BT SO HW CPY? AR Their CALL DE Your CALL K

The other station replying back:

Their CALL DE Your CALL R R GUD CPY Their NAME ES TU FER THE RPTR BT UR RST IS 599 599 BT MY QTH Your QTH City & State Your QTH City & state BT MY NAME IS Your name here twice BT SO BTU Their NAME AR Their CALL DE Your CALL K

Example of Second exchange:

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This is Tim replying back to Mark:

NB8I DE **N9PUZ** BT TNX FER RPTR **MARK**. WX HR IS SUNNY ABT 80 DEG. RIG HR IS A FT 857, PWR IS 100 WTS, ANT IS A DIPOLE UP 25 FT. SO HW ABT U **MARK?** AR **NB8I** DE **N9PUZ** K

This is Mark replying back to Tim:

N9PUZ DE **NB8I** BT TNX **TIM** ES STILL GUD CPY HR. WX HR IS CLOUDY ABT 82 DEG. RIG HR IS A TS 850, ANT IS A VERTICAL UP 15 FT. SO **TIM** ARE U STILL WRKING OR RETIRED? BTU AR **N9PUZ** DE **NB8I** K

Replying back with your information:

Example replying back:

Their CALL DE **Your CALL** BT TNX FER RPTR **Their NAME**. WX HR IS Sunny, Cldy, Raining,
Whatever your WX is add it in this space ABT Temp DEG.
RIG HR IS A Add your rig here, PWR IS Pwr Hr WTS, ANT IS A Add your Ant here UP Height FT.
SO HW ABT U **Their NAME?** AR **Their CALL** DE **Your CALL** K

Their CALL DE **Your CALL** BT TNX **Their NAME** ES STILL GUD CPY HR. WX HR IS Sunny, Cldy, Raining,
Whatever your WX is add it in this space ABT Temp DEG. RIG HR IS A Add your rig here, ANT IS A Add your Ant here UP Height FT. SO **Their NAME** ARE U STILL WRKING OR RETIRED? BTU AR **Their CALL** DE **Your CALL** K

Example of Third exchange:

What do you think the third exchange should be? Write it down below.

Remember be personnel, thank them for the QSO, and exit with 73 hope to QSO again, than like before give "their call" first followed by a DE then "your call" followed with the Prosign SK. Remember what SK means?

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Appendix "H"

Commonly used Q-Signals

Sign	Meaning
QRH	Does my frequency vary? Your frequency varies.
QRI	How is the tone of my transmission? The tone of your transmission is ____ (1-Good, 2-Variable, 3-Bad.)
QRL	Are you busy? I am busy, please do not interfere
QRM	Is my transmission being interfered with? Your transmission is being interfered with ____ (1- Nil, 2-Slightly, 3-Moderately, 4-Severly, 5-Extremely.) Or Man-made interference.
QRN	Are you troubled by static? I am troubled by static ____ (1-5 as under QRM.)
QRO	Shall I increase power? Increase power.
QRP	Shall I decrease power? Decrease power.
QRQ	Shall I send faster? Send faster (____ WPM.)
QRS	Shall I send more slowly? Send more slowly (____ WPM.)
QRT	Shall I stop sending? Stop sending.
QRU	Have you anything for me? I have nothing for you.
QRV	Ready to receive
QRZ	Who is calling me? You are being called by ____.
QSB	Are my signals fading? Your signals are fading.
QSK	Can you hear me between you signals and if so can I break in on your transmission? I can hear you between my signals, break in on my transmission. Or I am using full break-in
QSL	Can you acknowledge receipt? I am acknowledging receipt.
QSO	Can you communicate with ____ direct or by relay? I can communicate with ____ direct (or by relay through ____). Or an on-air-contact.
QSY	Shall I change to another frequency? Change frequency to ____.
QTH	What is your location? My location is ____.
QTR	What is the correct time? The time is ____.

NOTE: ANY Q-signal may be given an interrogatory meaning by following it with a question mark.

Example: **QRS** = Send Slower
QRS? = Shall I send slower?

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QN-Signals for Net Operation

Sign	Meaning
QNA*	Answer in prearranged order.
QNB*	Act as relay Between ____ and ____.
QNC	All net stations Copy. I have a message for all net stations.
QND*	Net is Directed (controlled by the net control).
QNE*	Entire net stand by.
QNF	Net is Free (not controlled).
QNG	Take over as net control.
QNH	Your net frequency is High
QNI	Net stations report in. I am reporting into the net. (Follow with a list of traffic or QRU)
QNJ	Can you copy me? Can you copy ____?
QNK*	Transmit message for ____ to ____.
QNL	Your net frequency is Low.
QNM*	You are QRMining the net. Stand by.
QNN	Net control station is _____. Who is net control station?
QNO	Station is leaving the net.
QNP	Unable to copy you. Unable to copy _____.
QNQ*	Move frequency to ____ kHz. and wait for ____ to finish handling traffic. Then send that station traffic for _____.
QNR	Answer ____ and Receive traffic for _____.
QNS*	Following stations are in the net.* (Follow with list.) Request list of station in the net.
QNT	I request permission to leave the net for ____ minutes.
QNU*	The net has traffic for you. Stand by.
QNV*	Establish contact with ____ on this frequency. If successful, move to ____ kHz. And send traffic for _____.
QNW	How do I route traffic for _____.
QNX	You are excused from the net.* Request to be excused from the net.
QNY	Shift to another frequency (or to ____ kHz.) to clear traffic with _____.
QNZ	Zero beat your signal to mine.

* - For use only by the Net Control Station (NCS).

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Notes on the Use of QN Signals

The QN signals listed above are special ARRL signals for use in Amateur Radio CW nets only. They are generally not for use in casual Amateur conversation. Other meanings that may be used in other services do not apply. Do not use QN signals on phone nets. Say it with words.

QN Signals need *not* be followed by a question mark, even though the meaning may be interrogatory.

Trouble shooting Tips: ([Back3](#))

These steps assume the user is capable of using a voltmeter to measure the voltages identified in the following Tips.

No Display: (Step 3 in Test steps)

- 1) With the **MCT** off, check that the **Batteries** are making contact in the **Battery Holder**. See Page 29 “**Battery Holder connections:**”, and check for approximately 3 plus volts from “**G**” to “**5V**” on the **PCB**. If not fix it!
- 2) With the **MCT** on, measure from “**G**” to the **Line side (+)** of “**C6**” for 3 plus volts. If no voltage check to see if **U2** has a jumper from the **middle** to the **bottom** hole. (See page 25, U2 Jumper). Check again, and if still no display move to step 3.
- 3) With the **MCT** on, there should be voltage on both sides of the resistor **PADS** on **R7** and **R8**. Measure from “**G**” to the **PADS** of **R7** and **R8** to make sure there is voltage on both resistor **PADS**. If not, turn the **MCT** off, and re-solder the side where there is no voltage. Turn the **MCT** on, and check to see if the information shows up on the display, and that there is voltage on both sides of **R7** and **R8**. If no display, and there’s voltage on both sides of the resistors pads, move to step 4.
- 4) See Page 27 “**Display connections:**”, check the wire connections and make sure the display is wired as shown in the picture. If not make the corrections. If wired incorrectly, the display may have been damaged, and a new display needs to be ordered. When a new display is available, please make sure it’s wired correctly!

Display comes on and moves to IAMBIC KEYER, but when squeezing the paddles, there is no Dits or Dahs heard from Piezo speaker: (Step 5 in Test steps)

- 1) Make sure the **Speaker switch** is turned on. See Page 29 “**Initial Power Up and testing:**” Switch position.
- 2) See page 27 “**Paddle connections:**” and check to make sure all the connections are as shown.
- 3) See page 27 “**Piezo Speaker & Headphone connections:**”, check the wiring for the Piezo speaker to make sure it’s connected as shown in the instructions.
- 4) Turn the **MCT** on and check for approximately 3 plus volts from “**G**” to each **PAD** of “**R1**” not the top of the resistor but the **PADS**. If there is only voltage on one side, re-solder the resistor contact on the other side and re-check to make sure there is voltage on both **PADS** of “**R1**”. This should resolve this situation.

Pressing the “Up” or “Down” buttons does not change the display: (Step 6 in Test steps)

- 1) Turn the **MCT** on and check for approximately 3 plus volts from “**G**” to each **PAD** of “**R1**” not the top of the resistor but the **PADS**. If there is only voltage on one side, re-solder the resistor contact on the other side and re-check to make sure there is voltage on both **PADS** of “**R1**”. This should resolve this situation.

There is no double beep heard in the Piezo speaker when holding down M8 Memory buttons: (Step 7 in Test steps)

- 1) First ensure when pressing the paddles the side tone is heard in the Piezo speaker. See steps above.
- 2) See page 24 “**Resistors Top side of the PCB:**” and re-solder all **PADS** on “**R2 – R5, R9 – R11**” and make sure there is continuity in the string of resistors. The problem is that the voltage divider is not connected through all the series resistors in the string when the memory buttons are pressed. This should resolve this situation.

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MCT II

The Austin, TX. QRP Group (AQRG)

<http://www.qsl.net/k5bcq/Kits/Kits.html>