K1EL PaddleStick Keyer/Paddle PS1B

Features

- Keyer speed range: 5 - 99 WPM
- Automatic touch sensitivity calibration
- Dynamically allocated message memory
- Keying Modes: Bug, Ultimatic, Iambic A or B
- Audio Frequency keying mode
- Adjustable Weighting: 25 to 75 %
- Adjustable Keying Compensation: 0 to 31 mSec
- Paddle swap command
- Continuously adjustable Sidetone frequency
- Speed control potentiometer
- Two User Configurations each with callsign
- Power Consumption: <1 ma
- HSCW and QRSS support
- Non-Volatile Message Memory: 240 letters in 12 Slots/dual banked with embedded commands.
- Integrated Touch Paddle Input
- 39 easy to use commands
- Supply Voltage Monitor
- Serial Number Generation
- Adjustable Letter Spacing: 25 to 75%
- Automatic letter space mode (Autospace)
- Beacon: Programmable interval: 1 to 99 seconds
- Sidetone Output: On board mini-speaker
- Key/PTT Output: Open collector up to 60VDC
- Push-button user interface
- Supply Voltage: 7-13.5 VDC (on board regulator)
- Backspace supported on message entry
- Rx and Tx Practice Modes
- Configure as keyer or paddle

Description

The PS1B is a dual function device that can act as a simple touch paddle or a full function iambic keyer with touch paddle input. Optimal touch paddle sensitivity is maintained by an auto calibration algorithm that runs continually. PS1B is implemented in a Microchip PIC16F1825 microcontroller and utilizes the K1EL K16 keyer core (K16-PS) which provides a wide range of features. A single jumper configures the device in paddle or keyer mode. In keyer mode, setup commands are directly entered on the paddles in Morse code. All settings and messages are stored in nonvolatile memory so that settings are preserved when the keyer is turned off and on. The K16 keyer core has many original features not found in other keyers:

- **Supply Voltage Monitoring**

The K16-PS has a unique feature that is useful in battery powered applications. It can accurately monitor its supply voltage and provide an indication when battery voltage is low. Normally the K16-PS will respond with an ***R*** when entering command mode. If the battery voltage is approaching the minimum operating limit, it will respond with an ***L*** instead. This tells the operator that the batteries need to be replaced. The actual supply voltage can be read out in Morse by using the **V** command in the extended command set. See page 21. Note that a voltage regulator maintains the keyer supply voltage at five volts until the power supply drops below approx. 6 volts.

- **Dual User Configuration**

The K16-PS provides storage for two complete configuration setups. For example, one setup could be used for contesting while the other for casual operating. Or, when two operators share the same keyer, each user can have their own setup profile. The extended command **U** is provided to select one configuration or the other. All K16-PS settings are included in each profile including a stored callsign. (page 21)

- **Dual Message Banks**

The K16-PS has two message banks of six slots plus two callsign slots. Total message storage is 240 bytes. While this does not seem like a lot of message space, due to the K16-PS's dynamic memory allocation scheme, it turns out to be more than adequate for most users. It is very easy to swap message banks with **E** command. This is the shortest command sequence and allows you to swap banks quickly. There is also a buffered message command **/E** that swaps message banks. (page 25)

- **Stored Callsigns**

A special memory slot is provided to store the operator's callsign. In fact there are two callsign slots provided, one for each user. The callsign is programmed by using a special callsign load command in the extended command set. The callsign can be embedded in a message with the **/M** buffered command. The callsign slot works like any other message slot, you can call other messages, embed commands, and there is no practical limit to the length of the string. (page 25)

- **Wide range of embedded message commands**

Please refer to the list on page 25.

- **Sidetone Frequency**
The K16-PS sidetone can be set to any frequency between 300 Hz and 2000Hz. (page 20)

- **Fast Message Interruption**
The K16-PS will stop a message immediately upon paddle press, stopping in mid-letter if need be.

- **Practice Mode**
Both send and receive practice are included. The user can select practice content by letter group so that easier letters can be mastered first followed by progressively more difficult groups. A very good pseudo-random letter generator is provided which generates a varied, ever changing letter order. (page 18)

- **Message Stacking**
Up to 10 messages can be queued to be sent in the order requested.

- **Simplified Beacon Formatting**
For example, this is all that is required to setup a repeating 15 second beacon: **/B15 K1EL BCON**

- **Easy Beacon**
Any message slot can be turned into a beacon without having to add the special **/B** embedded command. The **B** command allows 'on the fly' beaconing without embedded commands. (page 16)

- **PTT Lead In and Tail Settings**
The K16-PS adopts the WinKeyer scheme for PTT control. Both the lead in delay and tail delay can be specified in milliseconds as well as speed dependent hang delay for paddle operation. (page 21)

- **Dit/Dah Ratio Control**
The timing of dits vs. dahs can be customized. A ratio of 1:3 is standard but this can be altered to suit different tastes. (see Y command on page 20)

- **Improved Cut Number Selection**
The K16-PS allows serial number cuts to be used for 0, 9, both, or neither. (page 23)

- **Tuning Duty Cycle Selection**
Tune can be set to generate either a 50% or 100% key down duty cycle. (see G command page 16)

- **Contest Word Spacing**
The K16-PS allows a shorter inter-word spacing to be selected. This is intended to speed up exchanges during contests. Standard word spacing is 7 dits while contest mode word spacing is 6 dits. (page 24)

- **Keyer Lock**
The K16-PS can be locked by command and it will stay locked until both paddles are pressed at the same time for eight seconds. While locked, the K16-PS will ignore any input and stays in a very low power sleep mode. This is useful for traveling or to prevent "accidental" keying while connected to a radio. (page 26)

- **Fixed Speed Setting**
The K16-PS supports both a variable speed control with a fixed "favorite" speed setting. It is very easy to switch between them. The fixed speed setting is set by the **S** command. (page 18)

- **Speed Pot Range Setting**
The upper and lower limit of the speed pot is set with a new extended command; **R** for range. Two values are entered the lowest speed pot setting followed by the highest speed pot setting. (page 21)

- **Paddle Serial Number Decrement**
A fast way to decrement the serial number is very useful during contests. The K16-PS allows this with a simultaneous command pushbutton and paddle press. (page 24)

- **First Element Extension**
This is another command that is brought over from the WinKeyer command set. It allows the first dit or dah of a transmission to be elongated to allow for receive to transmit relay delay. (page 20)

- **Command Response Time Adjustment**

The K16-PS will enter command mode when the command pushbutton is pressed for about 2 seconds. This may be too long for some operators. A new extended command **F** has been added that allows the delay to be shortened to about 1.3 seconds. (page 20)

- **Full Time Speed Pot**

The K16-PS responds to speed pot changes without delay, even while sending messages.

Paddle Stick Functional Block Diagram

Figure 1 is a block diagram of the PaddleStick (PS1B) board. You can configure the operation of the PS1B with a single two pin jumper. When the jumper is in place, the PS1B will act as a simple touch paddle that can be attached to a radio that has a built in keyer. In other words, PS1B takes the place of an iambic paddle set. With the jumper out, PS1B operates as a standalone keyer that supports a speed control pot, four message pushbuttons, and a powerful, self-contained, Morse keyer. One of the push buttons is dual purpose, press and hold to enter commands or quick press to play a message. Also included on the PS1B board is a sidetone speaker and two open collector output buffers that provide either Key/PTT outputs or Left/Right paddle outputs. The paddle sensors are integrated into the PS1B circuit board which provide a very compact keyer/paddle set in one. The PS1B can be mounted in one of two ways. Two right angle brackets and hardware are included so that the PS1B can be mounted on the bottom or front.

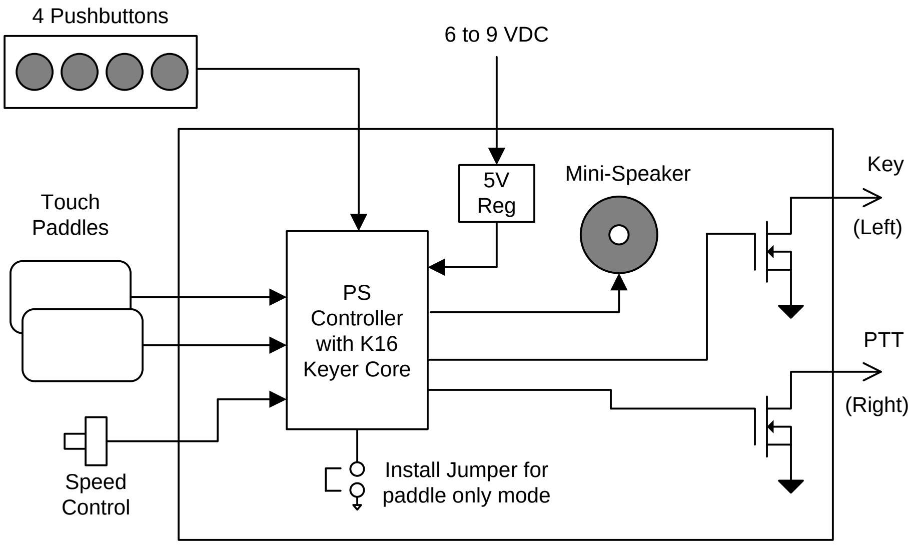

Figure 1 – PaddleStick Block Diagram

Touch Paddle Configuration

The PS2B scans and adjusts paddle sensitivity automatically based on current conditions, however, due to process variations in PIC microcontrollers, a baseline calibration must be run once when the kit is complete.

PaddleStick Kit Introduction

This kit consists of a printed circuit board, a K16-PS IC, sidetone speaker, keying output drivers, voltage regulator, speed pot interface, and a multiple pushbutton interface. The kit can be powered in one of two ways with or without the on board 5 volt regulator enabled. If the regulator is not used, it must be insured that the external power supply voltage does not exceed 5 volts.

PaddleStick Kit Assembly

Parts Inventory

U1	– K16-PS 14 pin DIP IC (16F1825)
VR1	– LM7805 TO92 5.0V regulator
Q1	– PN2222A NPN TO92
Q2, Q3	– 2N7000 Transistor TO92
R2	– 2.2KΩ 1/8 watt (red red red)
R3, 4,	– 470 1% 1/8 watt (violet yel brn)
R5, 6	“ “
C1, 5	– .1 µF ceramic disk capacitor 104
C6	– .47 µF ceramic disk capacitor 473

C3	– .01 uF ceramic cap 103 .2” spacing
C2, 4	– .001 uF ceramic capacitor 102
1 pc	– 14 Pin DIP Socket
1 pc	– PaddleStick R01 PC board
SP1	– Mini speaker
HW1	- Two right angle 4-40 brackets
HW2	- Four 4-40 by ¼” screw
HW3	- Two 4-40 plastic washers

PCB Assembly

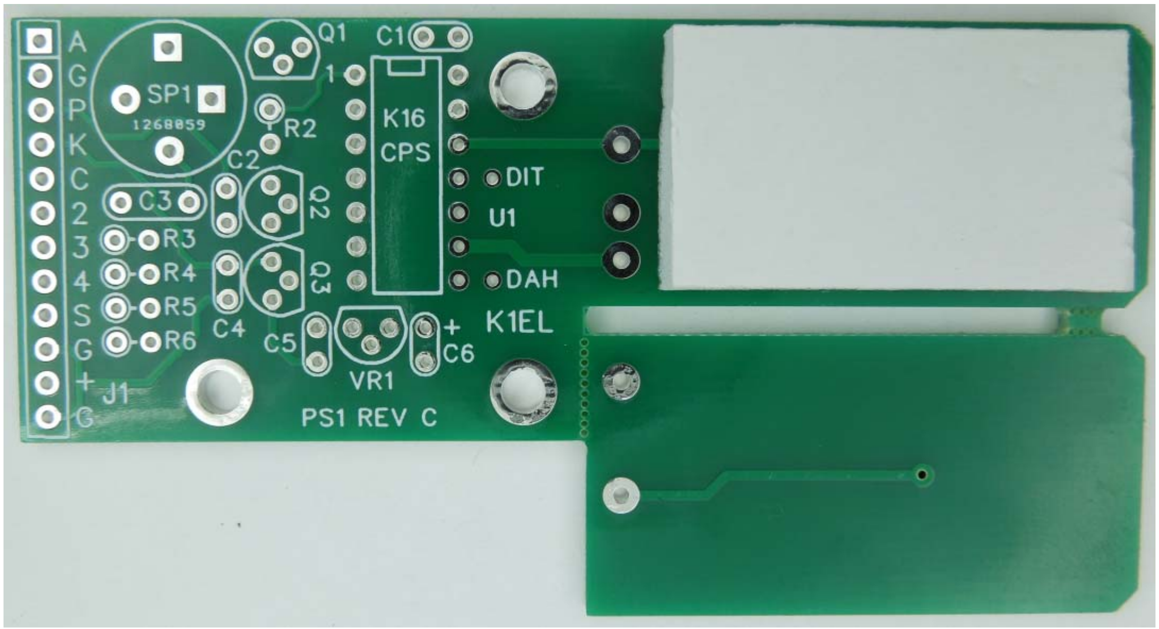

Figure 2 – PaddleStick1 PC Board before assembly

Use a pair of wire cutters to cut through the paddle separator holes, the perforations make it easy.:

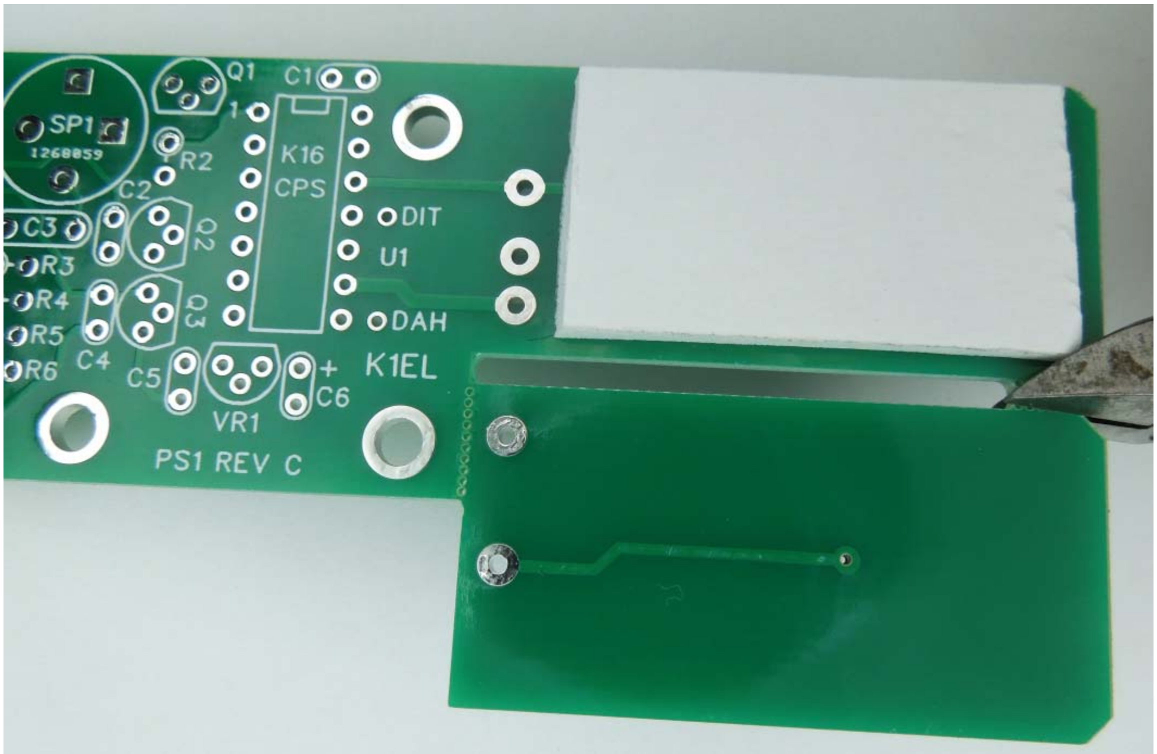

Figure 3 – Cut paddle separator

Bend the paddle section to break it free. Trim off separator and use sandpaper to remove burs.

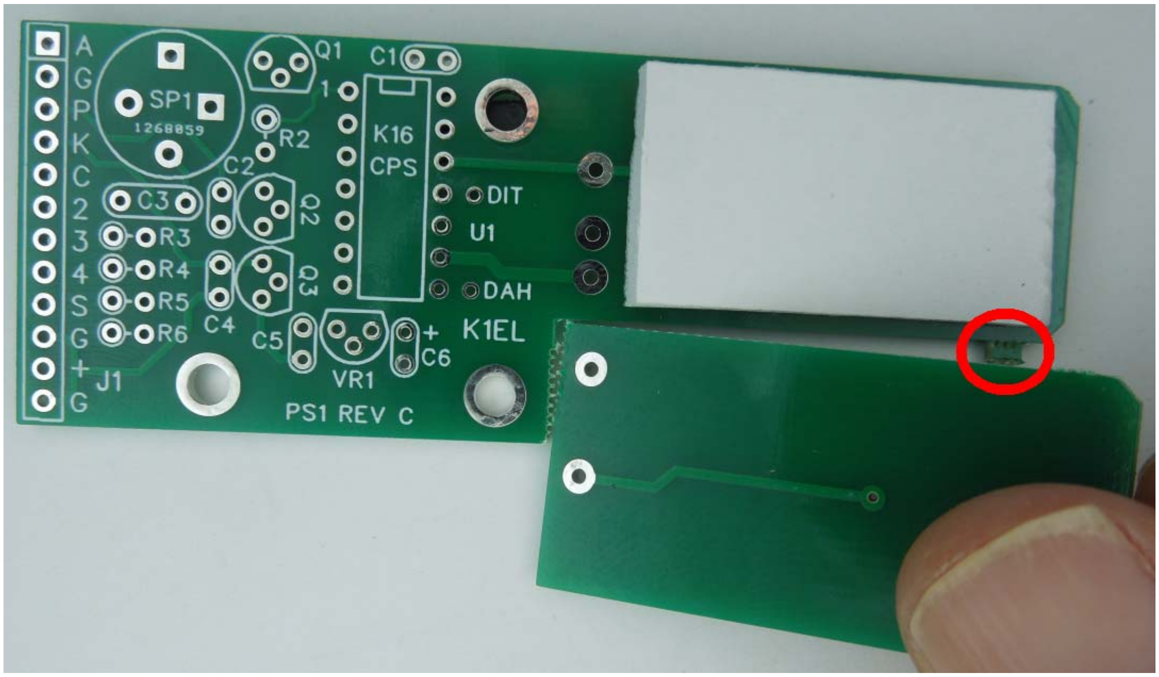

Figure 4 – Remove the paddle piece and trim off separator remainder

Using Figure 5 below as a guide, install and solder capacitors: C1 through C6. Then install and solder the 14 pin DIP socket with dimple adjacent to C1. Bend two pins on opposite corners to hold it in place while you solder the socket.

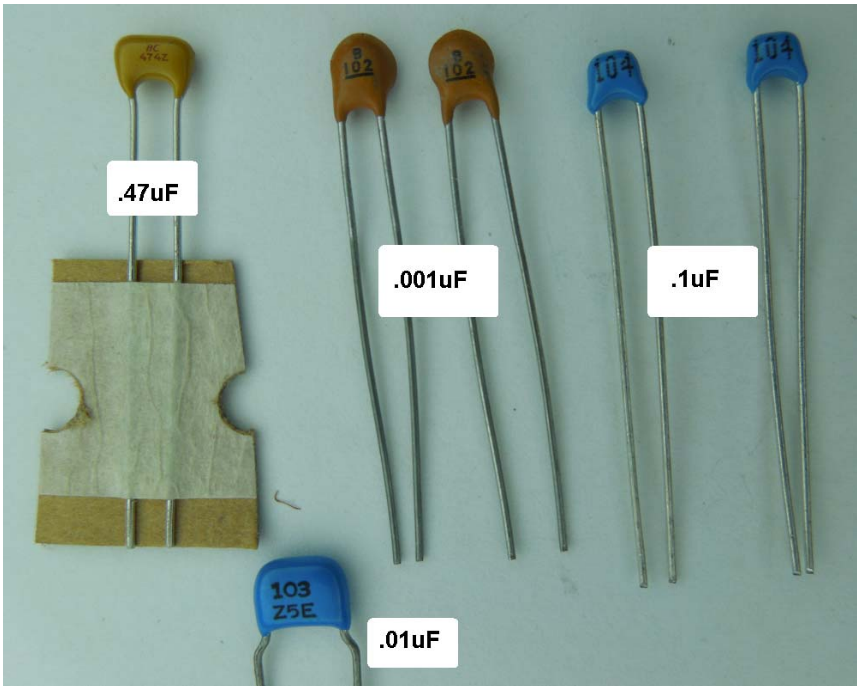

Figure 5 – Capacitor details

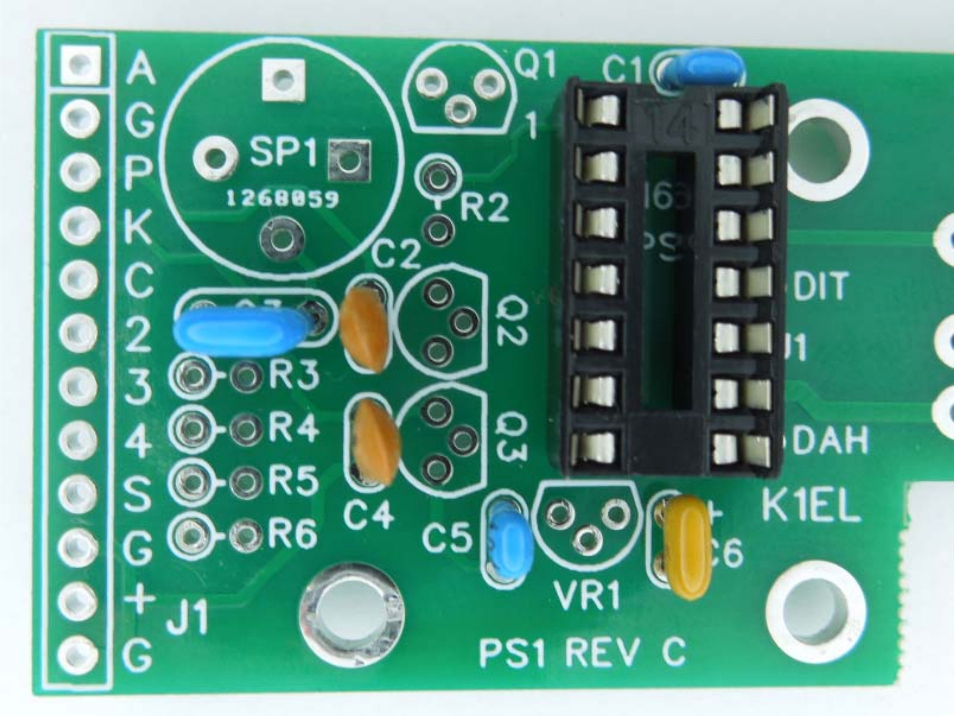

Figure 6 – Install Capacitors and 14 pin socket

Install all four TO92 parts as shown in Figure 7. Match the part numbers to the labels in the figure. Make sure to align the flat side of the parts with the silkscreen.

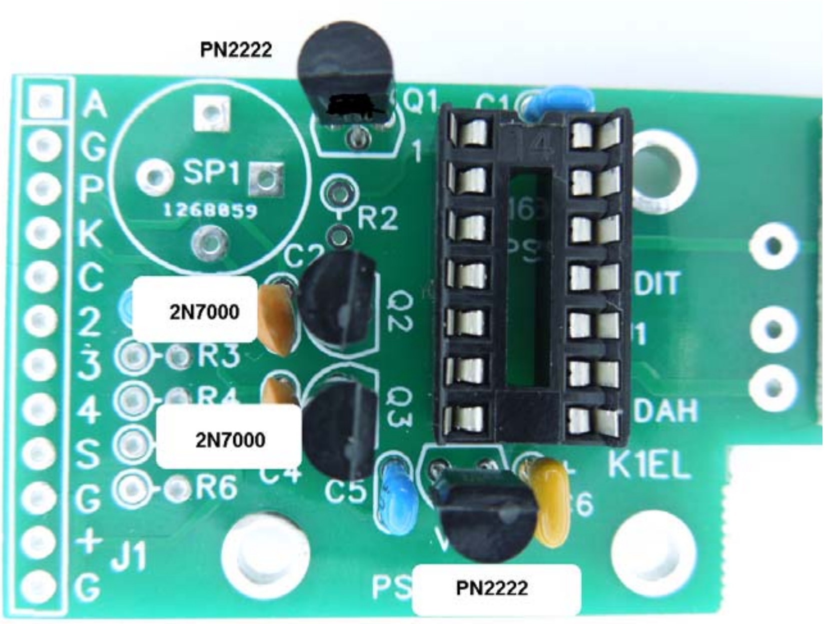

Figure 7 – Install Transistors and Voltage Regulator

Install and solder five resistors using the bill of materials to identify each resistor by color code. Note that the resistors are installed standing up. Placement is shown in Figure 8. Then install and solder the mini speaker, with plus pin into the square hole. Note that there are two sets of mounting holes to accommodate an alternate speaker pinout. You can remove and discard the protective white film speaker cover.

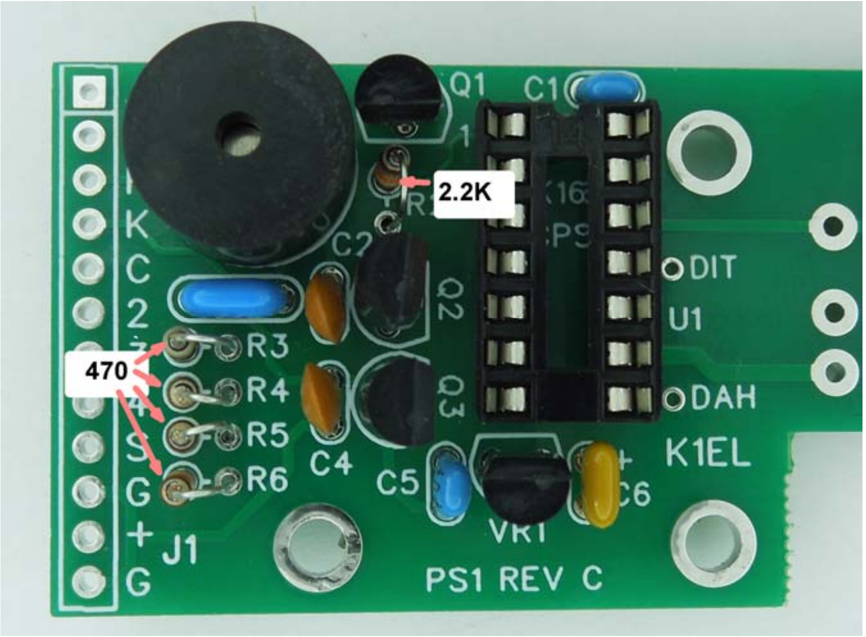

Figure 8 – Install Resistors and Speaker

Now it's time to install U1 (K16-PS). Be careful to get pin 1 in the right place. There is a dimple in the IC that must align as shown below in Figure 9.

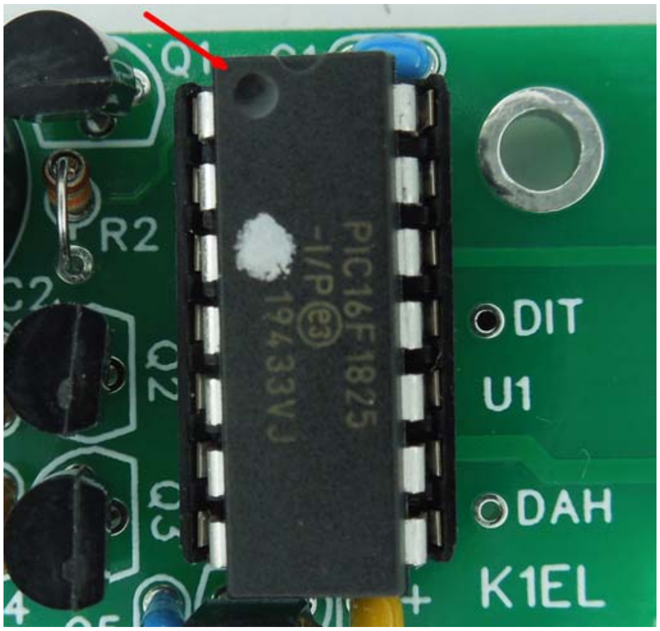

Figure 9 – Install U1, orient pin 1 as shown

Now we will assemble the touch paddle pieces. Basically we will remove the adhesive tape backing and carefully place the free paddle piece to make up a dual paddle. If desired you may double or triple up the double sided tape stack to increase the space between the paddle halves. The keyer will adjust for the spacing during the calibration procedure.

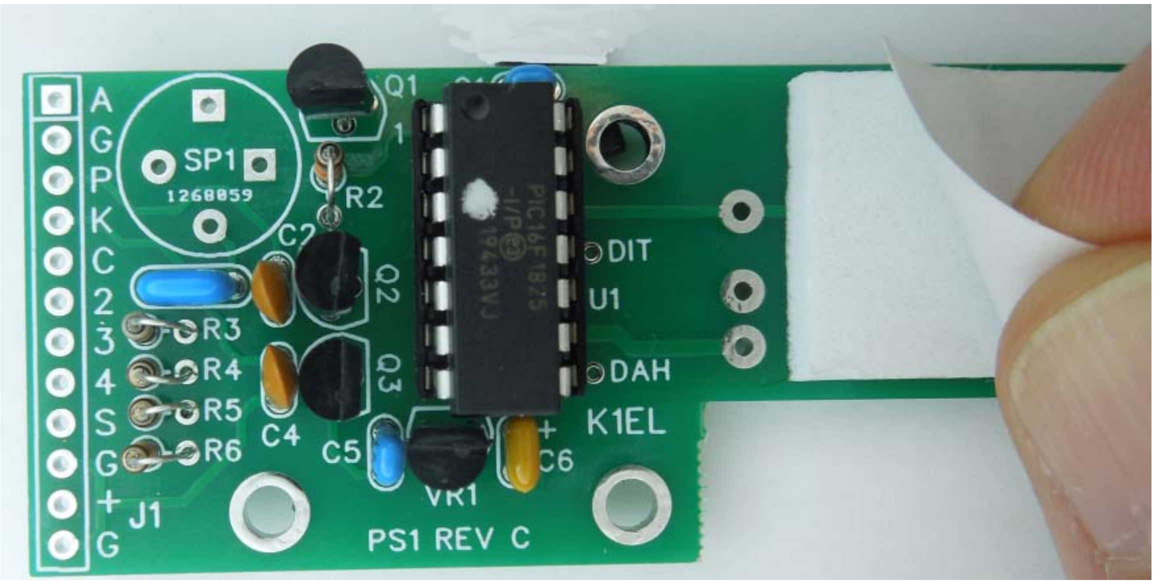

Figure 10 – Remove tape film to expose adhesive pad

Attach the free paddle piece to the main paddle board. Make sure you attach it to the correct side exactly as shown below. Take your time with this step to make sure that the two holes in each half line up perfectly then press them together making one assembly.

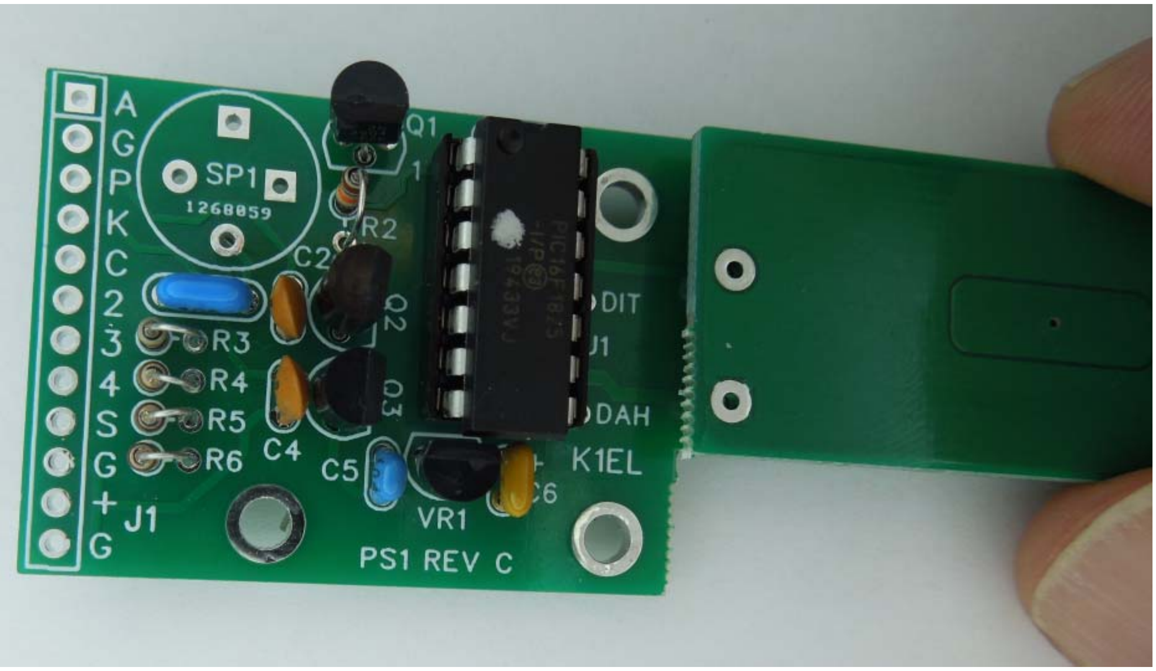

Figure 11 – Join free paddle to main paddle board

Insert two component lead scraps into the paddle interconnect holes and solder both halves.

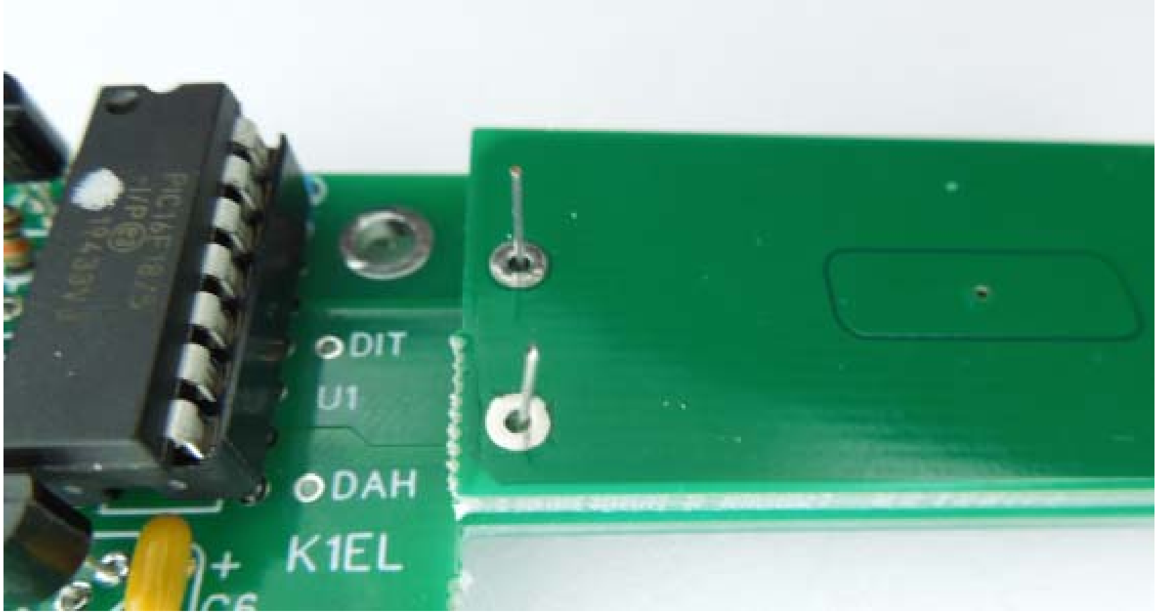

Figure 12 – Detail Insert and solder two resistor lead scraps

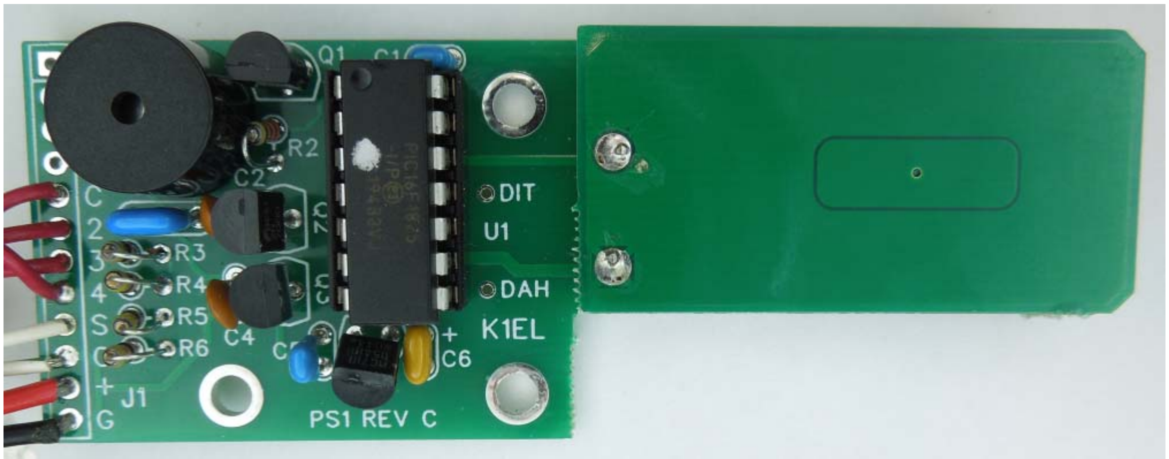

Figure 13 – Completed assembly, power and control leads attached.

How to wire up your PaddleStick1B

All external connections are made to the 12 pin array of pads marked J1 on the back edge of the PC board. The main signal groups are power/ground, pushbutton, dit/dah outputs.

Starting from the top, the connection points are:

A – Sidetone Audio
G – Ground
P – PTT or Dah paddle output
K – KEY or Dit paddle output
C – Command/MSG1 pushbutton
2 – Message 2 pushbutton
3 – Message 3 pushbutton
4 – Message 4 pushbutton
S – Speed Pot
G – Ground
+ – Plus power supply
G – Ground

Figure 14 illustrates the various connections to the PS1B. There are many options available. Not all pushbuttons are required, PS1B will work fine with a single pushbutton tied to the command (C) input. Alternatively, 2, 3, or 4 message pushbuttons can be connected. The more pushbuttons, the more messages can be accessed. A speed pot is not a requirement, if you don't want to use one simply tie the **S** input to ground, this will tell the K16-PS to operate in fixed speed mode. The speed then is changed using the S command. If you do want a speed pot, find a 10K linear taper potentiometer. Wire it up so that the bottom of the potentiometer goes to ground and the wiper goes to the PS1B **S** input pad.

By default the PS1B is set up to use the on board speaker for sidetone output. If desired an additional speaker can be wired between the **A** pad and ground.

The key and PTT outputs are open collector which means they acts like a switch to ground. The key output can be directly connected to a transmitter key input. Beware that the Key output can only switch voltages up to 60V DC. It is not capable of directly keying a vacuum tube transmitter.

When configured for pass through, the Key and PTT outputs directly follow the touch paddles. The internal keyer is disabled and the PS1B can be used as a substitute for a set of iambic paddles.

Power Connections and the On/Off Switch

The PS1B requires a power on/off switch because it does not go into a low power sleep mode when idle like other K1EL keyer ICs do. It uses minimal power when idle but if you leave the power on, the batteries will drain in a few days. So always remember to turn power off when not in use.

Be sure the positive lead goes to the pad marked **+** while the negative lead goes to the pad marked **G** for ground. If you haven't decided whether to use a speed pot yet For now wire a temporary jumper between pad **S** and **G**. The optimal supply voltage is 8 to 9 volts but higher voltages up to 13.5 volts will also work fine.

Command Pushbutton

Before testing you will need to at least attach one pushbutton switch between the **C** input pad and ground. The switch must be a normally open (NO) type. You don't have to attach any other pushbuttons to test the board but if you do they would be the same NO type.

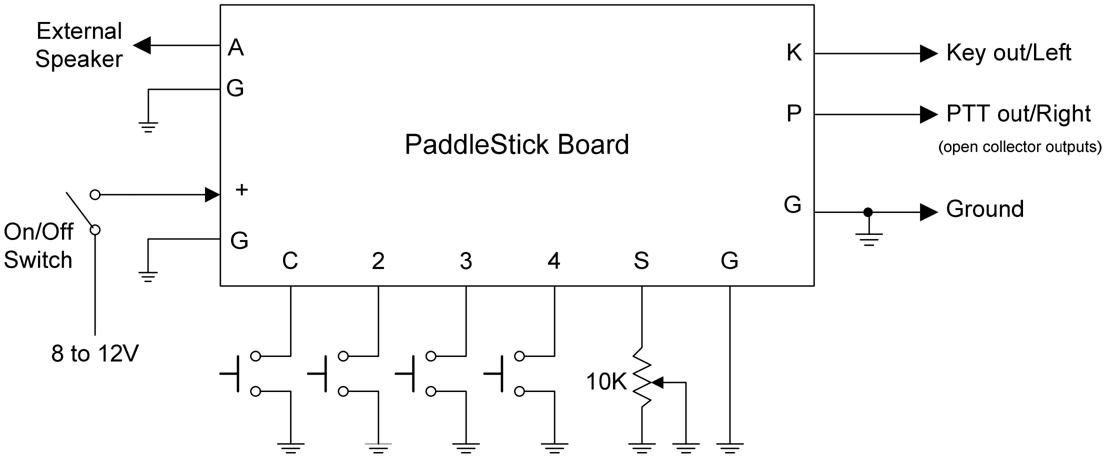

Figure 14 - PaddleStick Connection Diagram

Test Procedure

We need to run a baseline calibration to compensate for process variations in the PIC microcontroller. Here is the procedure to do this:

1. Make sure the PS2B power switch is off then attach power.
2. Press and hold the command PB while you turn the power switch on.
3. The keyer will send an AR followed by an L, release the cmd PB.
4. Press the left paddle as you normally would and wait for the keyer to send an R
5. Then press the right paddle until the keyer sends an SK followed by a normal startup R.

After the start up "R" press and hold the command button until the keyer responds with an R. Release the button and after a few seconds the keyer will respond with a "?" A quick press and release of the command button will cause the keyer to send an MT which signifies that the message slot is eMpTy. Paddle presses will cause dits and dahs to be sent. If you have an ohmmeter, measure resistance between the **K** output pad and ground. When you press the paddle you should see the meter move with Morse letters. Now move to the **P** output pad you will see the meter go to a low reading during the time the keyer is actively sending.

Now the rest of the pushbutton array will be tested. Attach a short length of wire to power supply ground. Strip and tin the other end so that it can be used as a test lead. Momentarily ground pads 2, 3, or 4 and the keyer will respond by sending MT. Again, this is shorthand for "e**M**p**T**y message slot"

If you don't get any of these tests to work carefully check the board for miswires or solder shorts. Refer to the images of the solder side and silkscreen to aid in your debugging.

Next we will look at ways of mounting the PS1B assembly and wiring up connectors and pushbuttons.

Keyer Mounting

There are two mounting options; base mount or front panel mount. Two right angle brackets and hardware are included with the kit. In front panel mount, the paddle portion of the board would extend out of the front of an enclosure. A slot and two holes must be provided in the enclosure for this. In base mount, PS1B sits on a base and does not have to be in an enclosure. A weighted base works best since PS1B is very light and will move around if not weighted down. Since most base mount applications will require a power supply, batteries may provide enough weighting. Provisions can be made to mount the speed pot and pushbuttons.

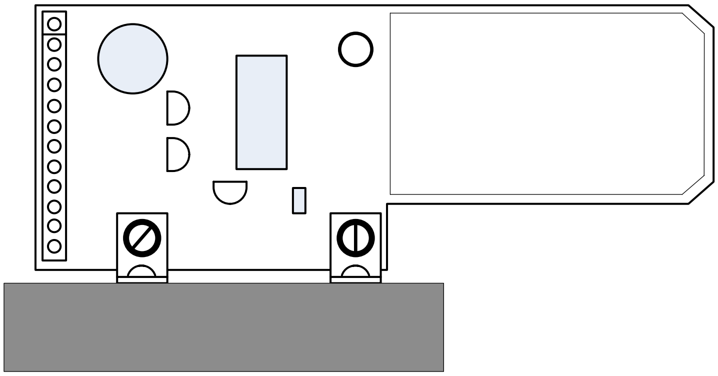

Figure 15 – Base mount illustration

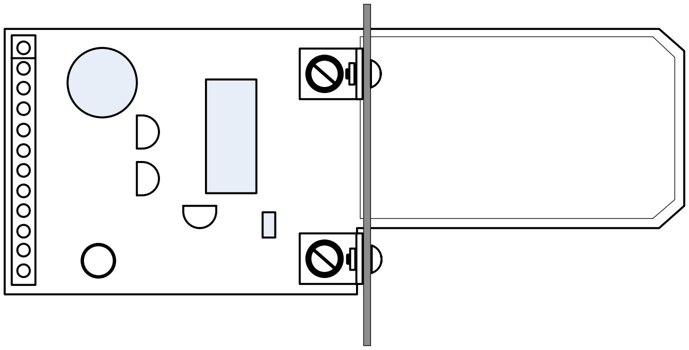

Figure 16 – Front panel mount illustration

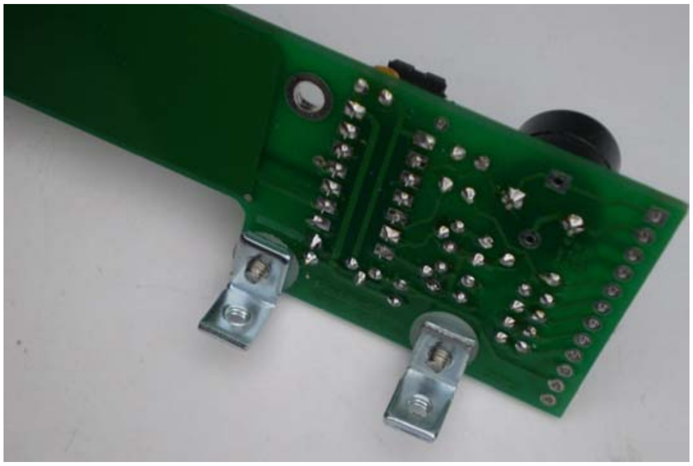

Figure 17 – Picture of brackets installed

Keying Considerations

PS1B outputs are low true open drain using 2N7000 MOSFETs. These provide a very low on resistance so the PS1B will be able to key virtually any solid state transceiver. These outputs are capable of sinking 60 milliamps. The highest voltage that the PS1B can safely switch is 60 VDC so it would not be suitable for keying vacuum tube transmitters that utilize grid block or cathode keying. Solid state or reed relays are good solutions for keying these types of transmitters.

Input Considerations

Capacitive sensing pads are integrated into the PS1B printed circuit board. While these inputs have built in ESD protection, the safety margin can be increased by applying a layer of plastic tape to the paddles.

Command and Message Push-buttons

The PS1B requires at least one normally open push-button control, this switch is referred to as the command push-button and is connected to pad **C**. It serves two functions, command entry and message record/playback. Three additional message push-buttons can be added at pads **2**, **3** and **4** to provide a total of four direct access messages. Be sure to use normally open switches for the push-buttons. Two additional messages are accessed by pressing two pushbuttons in a specific sequence, see page 26 for more info.

Speed Pot

The speed pot is sensed by the same mechanism that reads pushbutton presses. The PS1B continuously monitors the speed pot position and pushbutton matrix state. The value of the speed pot must be 10K ohms, no other value may be substituted. If you choose not to use a speed pot, be sure to tie the S input to ground, to force the K16-PS to operate in fixed speed mode. When operating the K16-PS in this mode, speed changed can be done easily with the Fast WPM paddle feature.

PaddleStick Kit Schematics

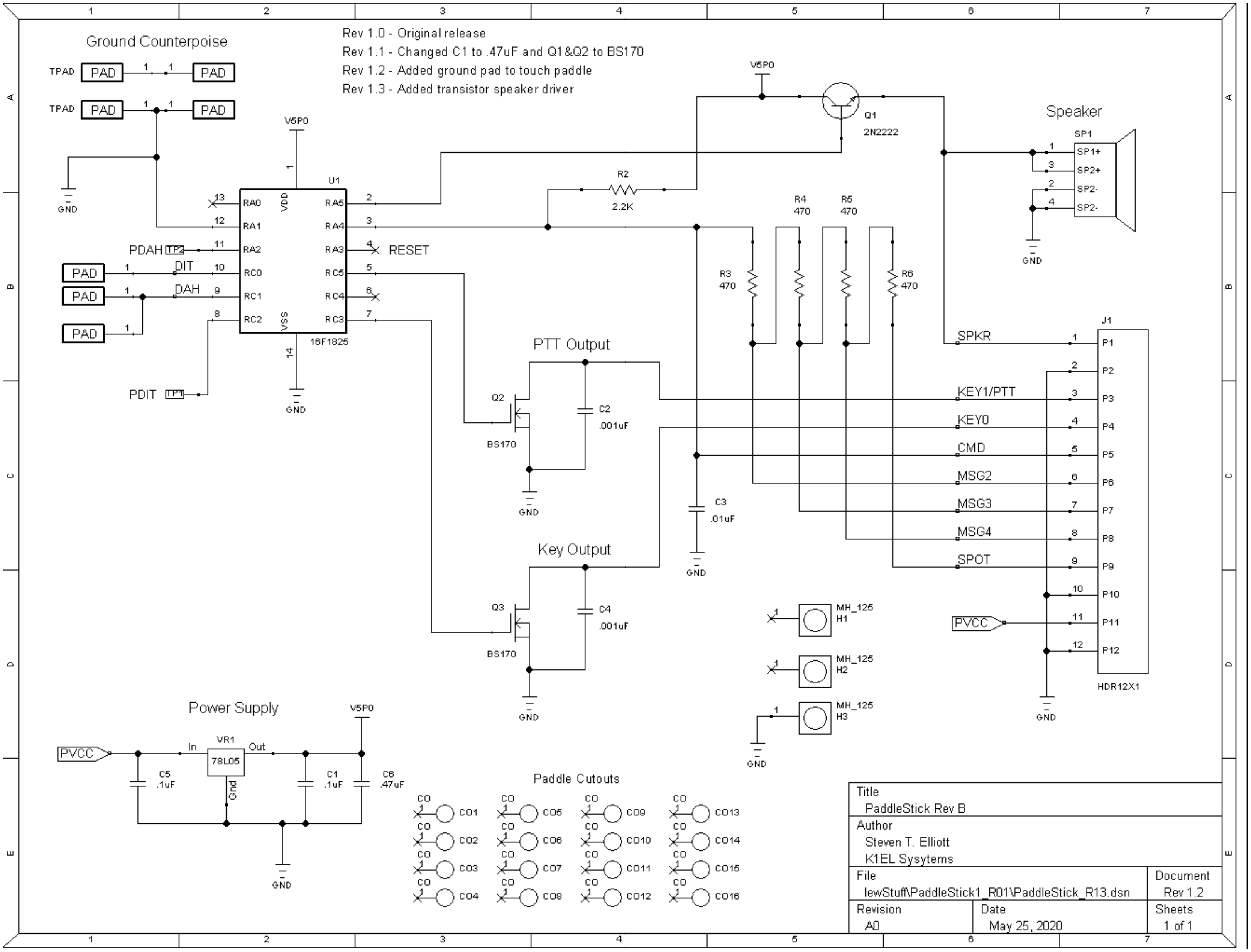

Figure 18 – PaddleStick Schematic

Operating the PS1B Keyer

The PS1B incorporates the K16 keyer core so it shares the same functionality as the K16. Presented here is the K16 documentation for reference.

Command Mode

Changes to the PS1B's configuration are made by entering values on the paddles. Before doing this, the PS1B must be put into command mode.

If the command push-button is pressed and held, the K16 will respond after about two seconds with the letter ***R*** in sidetone. This means the K16 is ready to accept a command. Simply enter the command letter in Morse on the paddles and the command will be executed. Some commands require additional parameters. In this case, the PS1B will prompt you with the letter ***E*** (for enter). When the PS1B is in command mode, the KEY and PTT outputs are de-activated. All commands provide some sort of feedback to tell you if the command was understood and executed properly. If an illegal command or parameter is entered, the PS1B will respond with a question mark.

Important Note ! In command mode, transmitter keying is disabled and replies are sent in sidetone only. If sidetone had been disabled with the **A** command, it will be re-enabled temporarily during command mode.

Command Toggles – Many settings such as Paddle Swap and Transmit Mute have just two states, on or off. These settings are turned on or off like a toggle switch. Issuing the command will change the state back and forth between off and on. When a toggle command is turned off, the PS1B will echo an ***N*** for "Not enabled" Likewise when a toggle command is turned on an ***A*** is echoed for en**A**bled.

K16 Command List

In the following command descriptions, the letter displayed in **BOLD** is the command and ***BOLD ITALIC*** is PS1B response. **[pb]** means that the PS1B will wait for you to press one of the message pushbuttons.

A - Sidetone enable is a toggle command. Sidetone should be disabled when using a transceiver's built in sidetone. The PS1B will acknowledge this command by responding with an ***A or N***. Note: If sidetone is disabled, it will be temporarily re-enabled when entering command mode.

B [n,dd] - Easy Beacon: Any message in the current bank can be repeated at a specified rate. After entering **B**, the user is prompted to enter a single digit message number **n** (1-6) and then prompted to enter a two digit beacon cycle time **dd** in seconds (01-99). A beacon can be interrupted by hitting either paddle. The beacon is timed from start of beacon to start of next beacon. For example if you set a delay time of 10 seconds, the beacon will start every 10 seconds regardless how long the message is. If the message is longer than delay time, then there will be no gap between messages.

C [nn] – Command WPM: The PS1B uses different speeds for command transactions and keyed transmit. Changes in transmit speed will not affect command speed. After the **C** command is issued enter the speed **nn** in WPM (05-99). If the speed is valid the PS1B responds with an **R**, otherwise a **?** *See the* ***S*** *command for details on setting transmit Morse speed.*

D - Decrement serial number by 1, PS1B responds with an ***E***

E - Swap message banks: The PS1B has two separate message banks, six messages each. In response to this command, the PS1B will respond with an ***E*** for bank one or an ***I*** for bank two.

F [nn] - Set Farnsworth Speed: This is a used primarily for code practice. Letters are sent at the Farnsworth speed while maintaining the default code speed. For example, if Farnsworth is set to 25 WPM and the operating speed is set to 7 WPM, individual letters will be sent at 25 WPM while the spacing between letters remains at a 7 WPM rate. To disable Farnsworth mode, set it to zero.

G - Toggle 50% tune duty cycle: The default tune duty cycle is 100% key down. This command allows either 100% or 50% duty cycle to be selected. Some folks prefer a 50% tuning duty cycle to reduce power dissipation thereby protecting transmitter finals and/or a linear amplifier. An ***A*** is echoed when 50% is enabled, an ***N*** is echoed when set to 100%

H [n] - Set Transmit PTT Hang Delay Time: Sets a PTT delay that is proportional to sending speed. The delay begins after paddle sending stops. You can select one of four delays:

HangTime = 0: wait 1 wordspace + 1 dit before ending PTT
HangTime = 1: wait 1 wordspace + 2 dits before ending PTT
HangTime = 2: wait 1 wordspace + 4 dits before ending PTT
HangTime = 3: wait 1 wordspace + 8 dits before ending PTT

After entering the command letter, you will be prompted with an **E** to enter the desired hang time as a number 0 to 3 as indicated in the table. Hang delay is different than PTT tail delay in that it is proportional to code speed while PTT delay is a primarily a fixed delay time. This means you don't have to change the PTT delay every time you change sending speed.

I [nn] - Set Letterspace Adjustment: nn is a value 0 to 31 that specifies an additional letterspace delay to be applied between letters. Multiply **nn** by two to arrive at the actual adjustment percentage. For example a value of 7 applies 14% additional letterspace between letters. The maximum adjustment is 62%.

J [nn] - Paddle Sample Delay: normally the PS1B waits one dit time after a paddle press has been sensed before latching a second paddle press. The **J** command allows this delay time to be adjusted longer or shorter than one dit. If the delay is set too short, the keyer may send unwanted dits or dahs, if there is too much delay it can make sending a bit more tedious. From the formula provided below, delay time can be set to be greater or smaller than one dit time. The default value is 50 which specifies one dit time. Value of 99 doubles the delay time while a value of 25 halves the delay. A value of 55-60 gives a more relaxed feel. **If the paddle sensitivity is set to zero, both dit and dah paddle memories are disabled.** The delay, which tracks sending speed, is calculated with this formula:

DELAY_TIME = (**nn**×DIT_TIME)/50 where Switchpoint is a value between 01 and 99.

K - Set Keying Mode: There are six different keying modes supported by the PS1B: Iambic mode A, Iambic mode B, Straight Key/Bug, Ultimatic, Dit priority mode, and Dah priority mode. In either iambic mode, alternating dits and dahs are sent while both paddles are held closed. In mode B an extra alternate dit or dah is sent after both paddles are released. In straight key/bug mode a dah paddle press will key the transmitter for as long as the paddle is pressed and dits will be generated automatically when the dit paddle is pressed. In Ultimatic mode when both paddles are pressed the keyer will send a continuous stream of *whichever paddle was last pressed. Hold dah then press dit->sends dits. Hold dit then press dah -> dahs are* sent. Ultimatic dit and dah priority mode will generate dits and dahs automatically in response to single paddle presses, but when both paddles are pressed either dit or dah has priority.

After the **K** command is issued the current mode is set by entering a single letter:

Iambic B:	Enter ***B***
Iambic A:	Enter ***A***
Ultimatic:	Enter ***U***
Straight Key:	Enter ***S*** (This is also the Bug setting)
Dit Priority:	Enter ***E*** (Ultimatic with dits always taking priority when both pressed)
Dah Priority:	Enter ***T*** (Ultimatic with dahs always taking priority when both pressed)

L [nn] - Set PTT Lead In Time to a value between 0 and 99 milliseconds. See the Set PTT Lead/Tail description on page 21 for more information.

M – Mute Transmit: This is a toggle command which turns keying output on and off. Mute transmit when you want to use the PS1B as a Code Practice Oscillator (CPO) When muted, the PS1B will send CW in sidetone only. In response to this command, the PS1B will echo an ***A*** when mute is turned on and an ***N*** when mute is turned off.

N [nnnn] - Load 4 Digit Serial Number: All four digits must be entered including leading zeroes. The serial number is played by inserting a play message token **/N** into a message. The serial number is automatically incremented after playing. See *Embedded Command* section for more details.

O - Swap Key Output Port: In dual output mode, this command will swap keying outputs. In other words, each time the **O** command is issued, the key port will toggle between key port 1 and key port 2. Command response is one dit for port 1 and two dits for port 2. In single output mode, the K16 will respond with an ***X***. Refer to extended command **O** (page 23) to learn about output options. The ability to change keying outputs if useful if you have two transmitters, it frees you from moving cables around when you want to switch the PS1B keyer from one radio to another.

P [m,d] - Start Practice Mode: A dual mode multi-level code practice program is built into the PS1B.There are two styles of practice, receive only and echo (receive/respond) practice. There are four levels of practice organized by easy to difficult letter groups. The four levels are:

Level 1:	E T A N I M W S G D U K O R	
Level 2:	C Q P J F B V Y H X Z L	including level 1
Level 3:	1 2 3 4 5 6 7 8 9 0	including level 1 & 2
Level 4:	? / , . AR SK BT AS	including level 1 & 2 & 3

The syntax for entering a practice mode is:

P m d where m is **R** for receive or **E** for echo practice and d is a single digit **1** to **4** to select difficulty level.

P R 2 selects Level 2 receive practice
P E 4 selects Level 4 echo practice

Receive Practice Description: Random characters from the selected level are sent in groups of five. Practice will continue until the command pushbutton is pressed.

Echo Receive/Transmit Practice Description: The PS1B will send a random character from the selected level and you must respond by echoing the character back on the paddles. If you get it right the PS1B will repeat the first character followed by a new character. Now you must echo back both characters. The PS1B will continue to add characters until a set of five characters has been completed successfully. After that it will start over with a new set. If you miss a character the PS1B will respond with an ***X*** and start over with a new sequence of characters.

When you want to end practice, either respond with di-dah-di-dah or press the command pushbutton. By default practice will be sent on the active output key port, enable transmit mute (**M** command) to inhibit this.

Q - Query PS1B Current Settings: PS1B will respond with current settings sent in the following format:

WPM	is sent first
N	followed by Serial Number-1
M	followed by free msg memory space in letters available
C	followed by command WPM
W	followed by weight
L	followed by lead time
T	followed by tail time
E	followed by 1st extension (this parameter described in host mode section)
V	followed by key compensation
F	followed by Farnsworth WPM
I	followed by Letterspace adjustment
J	followed by Paddle Sample Adjust
Y	followed by dit/dah ratio
B	followed by speed pot min WPM
T	followed by speed pot max WPM
REV	followed by K16-PS firmware revision denoted by a single letter; A or B or C… etc.

You can abort this command at any time after the first parameter is sent by pressing the Command and PB4 pushbuttons together or holding either the left or right paddle until the listing stops.

R [pb] - Review a message without transmitting: After the **R** command is entered the PS1B will respond with an ***E***. Press the message button of the message you wish to play. The message will be sent in sidetone only. If you try to play an empty slot, the PS1B will respond with ***MT***. Embedded commands will be sent without expansion. In other words /S10TEST will be sent as: ***DAH-DI-DI-DAH-DIT S10TEST***

S [nn] - Set Fixed Speed in WPM: One value ***nn*** is entered in WPM (05-99). This speed is activated when the speed pot is turned fully counterclockwise. The speed pot will act normally above this setting.
Enter a zero to disable fixed speed which will allow full speed pot range.

T [nn] - Set PTT Tail Time: The PS1B provides a transmitter PTT output that can be used to switch a transmitter or linear amplifier over to transmit mode in advance of actual CW keying. You have control over the time delay between when PTT is asserted and when CW keying will start, this is lead-in. You also have control over how long the transmitter will stay in transmit after keying has stopped this is tail delay. The tail delay is handled differently for CW sent by paddle and CW sent by message. Paddle delay is controlled by the Hang Time setting while message PTT delay is controlled by the Tail setting. The formula to calculate tail time is:

Tail Delay = Three Dit Times + (Tail Setting *times* 10 milliseconds)

Examples:

At 20 WPM, Tail set to 7, Tail Delay = (3x60)+(7x10) = 250 mSec
At 40 WPM, Tail set to 7, Tail Delay = (3x30)+(7x10) = 160 mSec
At 20 WPM, Tail set to 0, Tail Delay = (3x60)+(0x10) = 180 mSec
At 15 WPM, Tail set to 55, Tail Delay = (3x80)+(55x10) = 790 mSec

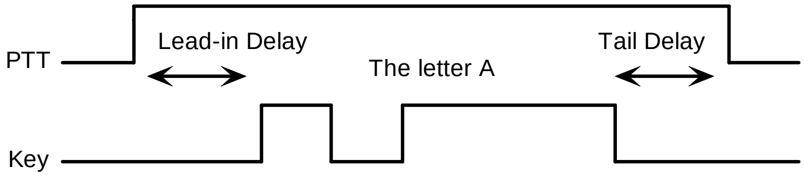

Figure 32 – PTT Lead-in and Tail Example

In general we want a very short tail time when sending messages and we want PTT to stay asserted between letters while sending with a paddle set. That's the reason the delay is dictated by two mechanisms.

U - Toggle Autospace Mode Off and On: When autospace is enabled, the PS1B will automatically force correct inter-letter space between letters. When the **U** command is issued, the PS1B will respond with an ***A*** for autospace enabled or an ***N*** for autospace disabled.

Here is how autospace works: If you pause for more than one dit time between a dit or dah PS1B will interpret this as a letter-space and will not allow the next the next dit or dah to be started until the proper letter-space time has been met. The normal letter-space is 3 dits however this can be increased by using the **I** command. PS1B has a paddle event memory so that you can enter dits, dahs, or squeeze both during the inter-letter space and PS1B will send them as they were entered. With a little practice, autospace will help you to send near perfect Morse.

V [nn] - Keying Compensation: specifies a fixed amount of time to be added to the length of all dits and dahs. QSK keying on modern transceivers can cause shortening of these elements which is especially noticeable at high speeds. The PS1B allows the length of the elements to be increased uniformly to compensate for this. The adjustments can be made in one-millisecond steps. The maximum adjustment is 31 mSecs. Key compensation is very similar to Weighting in that any adjustment added to the dits and dahs is subtracted from the spacing so the resulting speed is not changed. The difference between weighting and keying compensation is that compensation is independent of speed, so if 10 mSec of key compensation is selected, 10 mSec will be always be added regardless of speed. So be careful, using large values of keying compensation at high speeds may result in dits and dahs being run together with no spacing at all.

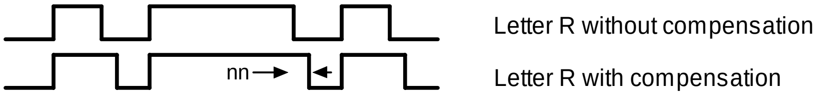

Figure 33 – Key Compensation

W [nn] - Key Weighting: can be adjusted in percentage from 25% to 75%. When set to 50 % the dit time is equal to the inter-element time, which is normal. Values less than 50 reduce weighting while values greater than 50 increase weighting. Note that weighting does not affect sending speed because any increase in keyed time is subtracted from spacing time. Reduction in weighting results in a thinner sound while increased weighting results in a heavier sound. Since weighting tracks speed, a given weighting will sound the same at all speeds.

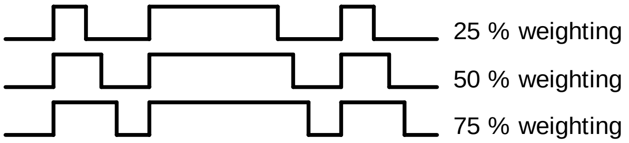

Figure 34 – Key Weighting

X – Extended Keyer Commands

An additional set of commands are located in a sub menu which control settings that not changed very often. Extended commands require two entries, an **X** followed by a sub command. Here is the procedure in detail:

Press and hold the command pushbutton and the PS1B will respond with an ***R***
Enter an **X** and the PS1B will respond with an ***E*** (command request)
Enter desired Extended Command with additional parameters, if required.

A list of extended commands is provided in the next section.

Y [nn] - Set Dit/Dah Ratio: nn ranges from 33 to 66. Entering ***Y 50*** sets the standard 1:3 ratio. For example a value of **33** selects a dit/dah ratio of 1:2 while a value of **66** selects 1:4. The ratio formula is:

Ratio of 1:N where N = (nn * 3)/ 50 example nn = 40 give a ratio of 1:((40*3)/50) = 1:2.4

Z - Change Sidetone Frequency: After this command is entered the sidetone oscillator will be keyed at a steady rate with transmit muted. Pressing the paddles will raise or lower the frequency. The range varies nearly continuously from 300 Hz at the low end to 2000Hz on the high end. It takes a while to sweep through the whole range. Pressing the command pushbutton will end this command and store the new sidetone frequency. Like all settings, use the Preserve Settings extended command to save the new sidetone setting in EEPROM.

Extended Command List

An additional set of commands are located in a sub menu which control settings that not changed very often. Extended commands require two entries, an **X** followed by a sub command.

A – Pushbutton Input Diagnostic: is used to verify the correct operation of the switch network connected to PS1B input pin 7. This design allows four switches and a potentiometer to share a single pin on the PS1B. The state of the network generates a unique numeric value which is then handled appropriately, either as a pushbutton press or speed pot change.

After the Extended **A** command is issued, the numeric network state will be sent in Morse sidetone. For proper operation the input values must fall within the following ranges:

Command PB	0 to 11
PB 2	12 to 31
PB 3	32 to 57
PB 4 5	8 to 89
Speed Pot	90 to 205 (approx)

The PS1B will remain in this diagnostic state until power is cycled.

C - Toggle Contest Spacing: When contest spacing is enabled, word space is set to 6 dit times as opposed to the normal 7 dit times. An *A* is sent when CT space is enabled, an *N* is sent when it is turned off.

E[nn] - First Element Extension: Forces the first dit or dah of a transmission to be elongated to allow for receive to transmit delay. Enter a value between 0 and 99 mSecs for nn.

F - Toggle Fast Command Response Time: Normally the PS1B will enter command mode when the command pushbutton is pressed for 2 seconds. This may be too long for some operators. When fast response is enabled, the delay time is reduced to 1.3 seconds.

M - Load Callsign: Use this command to load a stored callsign. It works just like a message entry and the destination is the currently enabled user slot. Each user slot has one unique callsign. Since the callsign is treated like any other message, embedded commands can be included if desired. The only way to play back a callsign is by embedding the **/M** command in a message.

N - Select Cut Number for number 9: When enabled, an N will be substituted for the number nine when sending a serial number. Command response: an A is sent when enabled, an N is sent when disabled.

O – Set Output Mode: This is used to set the keyer output configuration. After the command is entered the K16 will prompt you for a configuration setting:

Enter **E** to select single output mode with key output locked to port 1 and PTT locked to port 2.
Enter **I** to select dual output mode. Keying can be routed to port 1 or 2 with the **O** command (page 20)
Enter **P** for paddle pass-through mode to use PS1B as a touch paddle only with an external keyer.

If the toggle port command **O** is issued in single output mode, PS1B will respond with an ***X*** to remind you that it is not allowed. ***Known Bug:*** When the **I** command is first issued, both keying outputs are enabled at the same time, please use the **O** command to select a single output 1 or 2. In pass-through mode, PS1B's internal keyer is disabled and outputs are asserted in the same manner that the paddles are pressed. Use this feature if you want to use the PSB as a touch paddle only with your radio's internal keyer.

R [nn nn] - Set Speed Pot minimum and maximum: After the **R** is entered the PS1B will prompt for two values, the minimum WPM and the maximum WPM. An error will be flagged if the minimum value entered is greater than the maximum, if the minimum value is less than 5 WPM. Maximum WPM allowed is **99.**

S - Preserve Settings in EEPROM: will respond with a letter ***R*** to signify that settings were saved successfully.

T - Select Cut Number for Zero: When enabled, a T will be substituted for the number zero when sending a serial number. An ***A*** response means this cut is enabled, an ***N*** response means it is disabled.

U - Swap Users: The PS1B provides two complete user configurations, each with a unique callsign. The two message banks are shared between users. This allows a universal set of messages to be created that will work with either user. For example a message like CQ CQ CQ DE /M /M K will send the selected user's callsign. In response to this command a single dit is echoed when user 1 is selected and two dits when user 2 is selected.

V - Voltage Readout: The PS1B will measure the current supply voltage and send it in Morse sidetone. For example a voltage of 4.52 will be sent as ***4R52*** with the r indicating the decimal point.

X - Toggle paddle swap (Exchange dit/dah inputs): PS1B will respond with a letter ***A*** to signify when paddle swap is enabled and an ***N*** when turned off.

PTT Functionality

PS1B's PTT output is normally used to control an accessory device in addition to normal CW transmitter keying. In most cases this device is a linear amplifier but it could be an antenna relay or the PTT input of a transmitter. In all of these cases there are delay requirements that must be met to insure that the accessory device is switched on before transmission begins and is held on until transmission completes. This prevents damage to the accessory device due to hot switching. The PS1B provides three independent PTT delays to meet this requirement; Lead In, Tail, and Hang Delay.

Lead-In delay initiates a keying event. PTT will be asserted first and then, after Lead-In expires, the key output will be asserted. Lead-In can be set to a value from 0 to 990 milliseconds in 10 mSec steps (0 to 99).

Tail Delay specifies the amount of time PTT will be released after Key is released. Like Lead-In delay, it is adjustable from zero to 990 milliseconds in 10 millisecond steps. Tail delay is the sum of two delays, Tail setting times 10 milliseconds plus three dit times.

> Tail Delay = Three Dit Times + (Tail Setting *times* 10 milliseconds)
> *note: one dit time = (1200/WPM) mSec*

Examples:

At 20 WPM, Tail set to 7, Tail Delay = (3x60)+(7x10) = 250 mSec
At 40 WPM, Tail set to 7, Tail Delay = (3x30)+(7x10) = 160 mSec
At 20 WPM, Tail set to 0, Tail Delay = (3x60)+(0x10) = 180 mSec
At 15 WPM, Tail set to 55, Tail Delay = (3x80)+(55x10) = 790 mSec

In setting tail delay it is desirable to set the delay long enough to prevent hot switching. The PS1B will hold PTT between letters for messages and then PTT will timeout after the last letter of a message is sent.

For paddle sending, most ops want PTT to be held just long enough to prevent drop out between letters. An issue arises in that Tail delay is not solely proportional to sending speed. This is problematic when someone sets a comfortable tail delay at a slow speed and then increases the speed to a much faster rate. At the faster rate, the tail delay will hold too long after keying stops. Alternatively, if a comfortable delay is set at a faster WPM rate, PTT will then drop out between letters at a slower speed. Since it is very time consuming to constantly adjust the tail delay with sending speed, a different delay method is used for paddle sending, namely Hang Time.

Hang Time is adjustable in four steps and is measured only in wordspace and dit times rather than fixed milliseconds. This means that the delay will track sending speed. In other words it will decrease automatically as sending speed increases and vice versa. The four settings for Hang Time are:

HangTime = 0: wait 1 wordspace + 1 dit before ending paddle insertion
HangTime = 1: wait 1 wordspace + 2 dits before ending paddle insertion
HangTime = 2: wait 1 wordspace + 4 dits before ending paddle insertion
HangTime = 3: wait 1 wordspace + 8 dits before ending paddle insertion

To sum up, Tail delay is set to provide just enough delay to prevent hot switching for machine sent CW while hang delay is designed to hold PTT between letters independent of sending speed. PTT will automatically be held between machine sent letters and words but will drop out quickly after a message has been sent as long as there is no trailing wordspace. When entering a message be sure to end the message with the di-dah-di-dah (**AA**) character to prevent the PS1B from automatically appending a wordspace.

Shortcuts and Speed Ups

The PS1B design goal was to streamline command entry, here are some notable improvements:

Fast Command responses – PS1B uses ***A*** for positive responses instead of an ***R*** or ***Y***

Cut Numbers on Command Entry – When entering numeric values use cut numbers to save time. For example when changing the command speed to 19 WPM, use **C A N** instead of **C 1 9**
These are the command cuts used in the PS1B: T=0, A=1, U=2, V=3, 4=4, 5=5, 6=6, B=7, D=8, N=9

Single digit number entry – If you are entering a parameter that usually requires two digits but you only need to enter one, just enter the single digit and the PS1B will figure out that there is only one. For example instead of entering **T 0 7** you can simply enter **T 7**.

PS1B will respond with an ***E*** or ***I*** when swapping users, message banks, or output ports. Think of it as a single dit for 1 and a double dit for 2. This is much faster than responding with a Morse 1 or 2.

Fast Message Entry – Just press the command button till you get an R then simply press the message button you want to load. To stop load mode, either press the command button or enter di-dah-di-dah.

Fast Tune Mode – Press and hold pushbutton 4 and then press the command button to start tune. Press the command button to end tune.

Fast Fixed Speed Change – Press the command button and then press either paddle to increment or decrement the fixed speed setting. The PS1B echoes a single dit after each speed change.

Fast Command Response – If you think the PS1B takes too long to respond to the command button, enable fast command reply mode which halves the delay time. This is the extended command **F**.

Command Prompts – The PS1B will respond to commands that require additional input with an ***E***. The E stands for "Entry Required" and is fast and efficient. For example if you enter the Weight command **W**, the PS1B will respond with an ***E*** to let you know it is waiting for the value.

Speed Potentiometer Configuration

Turning the speed control will change the speed and update the WPM rate with minimal lag. The entire sweep of the speed pot is called the speed pot range and it can be modified with the extended **R** command which sets the upper and lower speed limits. This allows you to tailor the speed control to an area that you prefer. The minimum acceptable value for speed bottom is 5 WPM. If you want to set an exact speed, the easiest way to do this is to turn the speed control fully counter clockwise and set the fixed speed to whatever you want using the **S** command. You can determine the current speed control setting with the **Q** (query) command. Turning the speed pot fully counterclockwise will select the fixed "favorite" speed.

Message Functionality

Messages are loaded by holding the command button until PS1B responds with an ***R***, and then pressing the message pushbutton of the memory slot you wish to enter. When PS1B is ready to accept a new message it will respond with an ***E***. If you wait too long, PS1B will respond with a ***?*** and you will have to start over. Since only four pushbuttons are provided, messages 5 and 6 are accessed by pressing two pushbuttons in the following sequence after the ***R*** is echoed:

Press and hold either message button 2 or 3. (for message 5 or 6 respectively)
Press the command pushbutton.
Release both push buttons.

Message 5 and 6 can be played in a similar manner by first pressing and holding pushbutton 2 or 3, then pressing the command pushbutton, and finally releasing both. Don't forget that there are also two separate message banks each containing six slots bringing the total number of unique messages to 12.

After PS1B responds with an ***E***, a new message is entered directly on the paddles at a steady rate, making sure to leave proper space between letters. To insert a word space simply pause for longer than a word space and PS1B will respond with an ***E*** to signify a word space insertion. You can force a wordspace insertion by entering di-di-dah-dah (**<u>IM</u>**). This allows you to put a wordspace at the beginning of a message or insert more than one wordspace in a row. A ½ letterspace pad character can be inserted by entering di-di-dah-dah-dit (**<u>IG</u>**).

If a mistake is made while entering a message, press and hold the command pushbutton and PS1B will backspace through the letters that have been entered. When you reach the position you want, release the button and new letters can then be added starting at that position. If the message memory becomes full while entering a message, PS1B will stop further loading, respond with an ***F***, and then return PS1B back to non-command mode. When a new message has been completely entered, press the command push-button, or enter di-dah-di-dah (**<u>AA</u>**), and PS1B will respond with an ***R*** to signify that the message was accepted and stored. There are 232 letters in message memory that can be distributed in any way between 14 message slots. The length of the individual message slots is not fixed. This means, for example, you could have one message of 80 characters, one message with 5 characters, and a third with 10 characters and still have 141 locations left to split among the remaining three slots. Keep in mind that each word space occupies one memory location.

What if you want to insert one of the message controls (**<u>IM</u>**, **<u>IG</u>**, **<u>AA</u>**) into a message ? Simply precede them with a ***/*** (**<u>DN</u>**) and it will not be acted on as a control code.

Usually when you end a message, PS1B will append a wordspace before you have a chance to press the command pushbutton. There are cases when you do not want a wordspace at the end, especially if you are using PTT to key an amplifier. This is because PS1B will hold PTT during that added wordspace. The best way around this is to end a message with the di-dah-di-dah (**<u>AA</u>**) control code inserted immediately after the last letter in the message. This will terminate the message without a trailing word space.

If you are having problems loading messages into PS1B, make sure you leave adequate space between letters and are not sending much faster or slower than current command speed. If, for example, you enter an ***A*** followed by a ***T*** and end up with a ***W***, you are not allowing enough space between letters. It's a fine line though because if you allow too much space PS1B will interpret that as an intentional pause and insert a word space. Temporarily lowering the command speed (see command **C**) can help while you learn how the process works.

To play a message back, simply press the desired message button, release, and that message will be sent. If you press a pushbutton that does not have a message loaded, the PS1B will respond with an ***MT***, short for e**M**p**T**y. If you want to review the message without keying the transmitter, use the **R** (review) command. Note that review will ignore control codes and send them as entered. To abort a message, press the command and PB4 pushbuttons together or press and hold one of the paddles and PS1B will stop transmission immediately.

Gap (Extra Space) Insertion

In messages, PS1B interprets the **IG** prosign (di-di-dah-dah-dit) as a ½ dit delay time. The **IG** character can be included in a text string to add extra emphasis to similar sounding sequences. An example is W1OMO, sending it as W1**IG**O**IG**M**IG**O makes it easier to copy. To insert an **IG** prosign in a message without translating it to a gap, enter it as **/IG**.

Word Space Insertion

In messages, PS1B interprets the **IM** prosign (di-di-dah-dah) as a 7 dit wordspace delay time. The **IM** character can be included to add a small amount of delay and is easier to use than a delay command. To insert an **IM** prosign in a message without translating it to a wordspace, enter it as **/IM**.
'Two Press' Message Button Functionality

Two Press Message Button Functionality

As previously mentioned above, you can trigger message 5 and 6 directly with the following sequence:
1) Press and hold PB2 for message 5 or PB3 for message 6
2) Press the command PB (you now have two PBs pressed)
3) Now release both pushbuttons and selected message will play.

Quick Tune Command

If you use the sequence outlined above but start with PB4 instead, tune mode is turned on. This keys your transmitter until you press one of the paddles or two press PB1+PB4. Use the **G** command to select either a 100% or 50% tune duty cycle.

Quick Serial Number Decrement

Sometimes during contest operation, a serial number has to be reissued. Since the serial number is automatically incremented when it's played, we need a way to decrement the serial number. This can be done by using the **D** paddle command. After the serial number is decremented, PS1B echoes a single dit.

There is a second way to decrement a serial number, that is with a **/D** command embedded in a message. A message can be built that predecrements the serial number before sending it. For example the following two messages can be created:

Message 1: 5NN /N QSL ?
Message 2: /D/N QSL ?
Message 3: /N/D /N

Message 1 is the initial exchange, if the serial number needs to be resent, message 2 would be sent. The second message pre-decrements the serial number before sending it. Both of these messages leave the serial number incremented after it is sent. Message 3 will send the serial number twice in one message.

Embedded Message Command List

It is an easy procedure to embed commands in a message. The format is the fraction bar ***DN*** (D and N sent together as one letter) followed by the desired command letter. If you want to insert the DN prosign into a message but don't want it to be interpreted as a command simply enter DN twice.
Example: **K1EL/1** would be entered as **K1EL//1**

Embedded message command table

/Bnn Set a beacon cycle time of nn seconds (nn=00 to 99). Put this at the beginning of a message to set the beacon period.
/Cn Call message in slot n (1-6), return and resume current message.
/D Decrement serial number.
/E Toggle message banks
/Hn Set HSCW speed. See table below for determining n.
/Inn Increase letterspacing within a message, nn is a value from 0 to 31 percent times 2.
/Knn Key transmitter for nn seconds. (nn=00 to 99)
/M Play user callsign.
/N Play Serial Number with auto post increment.
/On Select key output port; 1 for port 1 or 2 for port 2.
/P Pause and wait for paddle entry and then continue after one word space time. The pause is ended three ways 1) paddle entry 2) Press a msg PB (2-6) or 3) Press the cmd PB to cancel.
/Q Set QRSS speed. See table below for determining n.
/Snn Set a speed change within a message. (nn=WPM, 5 to 99)
/Un Turn PTT on or off. PTT is turned on when n = 1 and off when n=0.
/V Send the current voltage in Morse, useful for beacons.
/Wnn Wait for nn seconds. (nn=00 to 99)
/Xn Cancel speed override, for example cancel HSCW, QRSS, or /Snn speed.
/Yn Force a relative speed change up. Add **n** to the current WPM. n=(0-9)
/Zn Force a relative speed change down. Subtract **n** from the current WPM. n=(0-9)
/1 Jump to message 1 **/2** Jump to message 2
/3 Jump to message 3 **/4** Jump to message 4
/5 Jump to message 5 **/6** Jump to message 6
AA End message load immediately **(DI-DAH-DI-DAH)**
IG Insert ½ letterspace pad **(DI-DI-DAH-DAH-DIT)**
IM Insert wordspace pad **(DI-DI-DAH-DAH)**

Rate Table

n	HSCW Rate	QRSS Rate
0	1000 lpm (200 wpm)	3 sec dit
1	1500 lpm (300 wpm)	6 sec dit
2	2000 lpm (400 wpm)	10 sec dit
3	3000 lpm (600 wpm)	12 sec dit
4	4000 lpm (800 wpm)	30 sec dit
5	6000 lpm (1200 wpm)	60 sec dit

Embedded Command Examples:

/B60BCON DE K1EL BEDFORD NH will send BCON DE K1EL BEDFORD NH every 60 seconds
UR RST IS /P QSL will pause to allow the user to enter the RST then resume automatically
/K05 /W10 VVV DE K1EL will key down for 5 secs, wait 10 secs, and then send VVV DE K1EL
CQ CQ CQ DE /M /M /M will send a 3x3 CQ using the user callsign
/H2CQ CQ DE K1EL K1EL K1EL/S15 DE K1EL will send 1st part at 1500 lpm and the 2nd at 15 WPM
CQ CQ CQ DE K1/I10TMT/I00 K will send message with 20% extra space in TMT. A more manageable way of doing this would be to load **K1/I10TMT/I00** in the callsign slot to get this spacing any time /M is used.
CQ CQ CQ DE /Z4K1EL K1EL K1EL/Y4 K send the callsigns 4 WPM slower then return to normal WPM.
QTH IS /E/C1/E NAME IS STEVE Will play the QTH from message bank 1 and then return for the name.
/Q2EL /1 will continuously send EL at QRSS10 speed (this message is in slot 1). Avoid inserting a space between the QRSS command and the start of text: /Q2 EL unless you want a long delay at start of message.
/B10K1EL BCON/W2/VVOLTS sends K1EL BCON, wait 2 secs, send XrXX VOLTS repeat every 10 secs

SOM/E/C3/E/U1/W5/U0/S50K1EL//1/XEOM Send SOM, swap to msg bank 2, call msg 3, swap back to msg bank 1, turn PTT on for 5 seconds, change speed to 50 WPM and send K1EL/1, cancel 50WPM send EOM.

Preserve Settings

PS1B setting changes are not automatically copied into permanent storage. That means the settings will be lost if power is cycled. To save the settings permanently, use extended **S** command. Press and hold the command PB until the ***R*** and enter an **X** followed by a **S**. This will save current settings in nonvolatile memory so that all settings will be retained on power cycling. Note that messages are always saved directly into nonvolatile memory so the **S** command is not required to preserve messages.

Restore User Defaults (Warm Restart)

It's possible that a command could get entered by accident and put the PS1B into an undesired state. An easy way to restore user default settings is to power off and on.

Restore Factory Defaults

If you want to restore the PS1B to original "factory" settings, turn the PS1B off, squeeze both paddles, and then turn the PS1B on. After about 2 seconds, release both paddles and the PS1B will send a ***C*** signifying a cold reboot. This erases all settings and messages and then restores factory settings. Baseline paddle calibration is not changed by a cold reboot.

Factory Defaults are:

Fixed WPM: 15	Command WPM: 15	Sidetone: 800Hz	Weight: No adjustment
KeyComp: 0	Interchar Spacing: Normal	SampleAdjust: None	KeyMode: Iambic B
Sidetone: On	Autospace: Off	OutputMode: KEY/PTT	Serial Number: 0001
TX Mute: Off	User: 1	Message Bank: 1	Messages: All Erased
Speed Pot Min: 5	Speed Pot Max: 35	First Extension: 0	Farnsworth: Off
Dit/Dah Ratio: 1:3	Sidetone: On	Tune Duty Cycle: 100%	Extra Letterspace: None
Output: Key0/PTT			

Keyer Lock

A lock feature is provided to disable paddle input and message pushbuttons. This is useful when you want to pack up a battery powered keyer and insure that it stays off with batteries still connected. It is also handy to lock the keyer paddles to keep little hands from sending 'messages'. To lock the keyer, press the command pushbutton, wait for the ***R***, and then enter a period (di-dah-di-dah-di-dah). The PS1B will respond with an ***L*** to let you know it is now in a locked state. To unlock the keyer, press and hold the command pushbutton for about 8 seconds and the PS1B will wake up and send an ***R***.

Straight Key Operation

If you want to take a break from the touch paddle and use a straight key, it's recommended to not feed this through the PS1B. Instead, wire the straight key directly across the PS1B keying output. Since the PS1B outputs are open drain, the two devices happily coexist.

PS1B Command Cheat sheet

Immediate Command List:

A	Toggle sidetone on/off	N	Load 4 digit serial number
B	Easy Beacon	O	Output port configuration
C	Set Command Speed	P	Start Practice Session
D	Decrement Serial Number	Q	Query: Report current settings
E	Swap Message Banks	R	Review message with transmit muted
F	Set Farnsworth Speed	S	Set Fixed Speed
G	Toggle Tune Duty Cycle	T	Set PTT Tail Delay
H	Set PTT Hang Delay	U	Toggle Autospace On/Off
I	Set Letterspacing	V	Set Keying Compensation
J	Set paddle sensitivity	W	Set Keying Weight
K	Select keyer mode	X	Enter Extended Command Mode
L	Set PTT Lead-In Delay	Y	Set Dit/Dah Ratio
M	Toggle Transmit Mute	Z	Select Sidetone Frequency
AA	Set tune on	.	Lock paddles (period)

Extended Command List

A	Analog Input Diagnostic	R	Set Speed Pot Min and Max WPM
C	Toggle Contest Spacing	S	Preserve settings in EEPROM
E	Set 1st Element Extension	T	Toggle Number 0 cut
F	Toggle Fast Command Response	U	Swap Users
M	Load Callsign	V	Voltage Readout in Morse
N	Toggle Number 9 Cut	X	Swap Paddle Inputs (left to right)
O	Set output Mode		

Embedded Message Command List

/Bnn	Set a beacon cycle time	/Un	Turn PTT On/Off (n=0 or 1)
/Cn	Call message (n=1-6)	/V	Send Voltage reading in Morse
/D	Decrement Serial Number	/Wnn	Wait for nn seconds (n=0-99)
/E	Swap message banks	/X	Cancel speed override
/Hn	Set HSCW Speed (n=0-5)	/Yn	Relative WPM change up (n=0-9)
/Inn	Set Alternate Letterspacing (n=0-31)	/Zn	Relative WPM change down (n=0-9)
/Knn	Key down for nn seconds (n=0-99)	/1	Jump to message 1
/M	Play user callsign	/2	Jump to message 2
/N	Play Serial Number	/3	Jump to message 3
/On	Select Key Output Port (n=0 or 1)	/4	Jump to message 4
/P	Pause and Wait for Paddle	/5	Jump to message 5
/Qn	Set QRSS Speed (n=0-5)	/6	Jump to message 6
/Snn	Set Sending speed in WPM (n=0-99)	AA	End message load
IM	Insert Wordspace (DI-DI-DAH-DAH)	IG	Insert Gap (DI-DI-DAH-DAH-DIT)

Rate Table for H and Q Commands

n	HSCW Rate	QRSS Rate
0	1000 lpm (200 wpm)	3 sec dit
1	1500 lpm (300 wpm)	6 sec dit
2	2000 lpm (400 wpm)	10 sec dit
3	3000 lpm (600 wpm)	12 sec dit
4	4000 lpm (800 wpm)	30 sec dit
5	6000 lpm (1200 wpm)	60 sec dit

PS1B Tutorial

Start with power on:
After power is applied, the PS1B will output the letter ***R*** to let you know it's ready. Touching the paddle will generate dits and dahs both in sidetone and keyed output. If you press any of the message pushbuttons, the PS1B will send an ***MT*** meaning the message slot is e**M**p**T**y. Even though the keyer uses a small amount of power when idle, be sure to turn the keyer off when not in use to prolong battery life.

Command Entry:
A command cheat sheet can be found on page 30. There are three command types, immediate, extended, and embedded message. The first commands to look at are the immediate commands.

Immediate Command Entry:
The leftmost pushbutton is the command pushbutton (CMD). Press and hold this until the PS1B answers with an ***R***. Then without hesitation. Release CMD, and then enter an immediate command letter on the paddles. Try the **Z** command which allows the sidetone frequency to be changed. The PS1B will output a continuous tone and you can adjust the frequency by touching the paddles. When you are finished, press the command button to return to normal operation.

If the PS1B does not understand a command, or you are too late in entering a command, the PS1B will respond with a question mark.

Some commands require additional parameters; a good example is setting the command speed. Press CMD, wait for the **R**, and then enter **C**. The PS1B will respond with an **E** telling you it's waiting for you to enter the new speed in WPM. Enter a 1 followed by a 0. You have changed the command entry speed to 10 WPM. Try 10 again but this time use a **T** for the zero. This is a handy shortcut. If this command speed is too slow, repeat the command with a more comfortable speed.

Change Keyer Mode:
If you enter the **K** command, the PS1B will prompt you for a keying mode. **A** sets Iambic A while **B** sets Iambic B, there are many other choices, all covered on page 20. No matter what mode you set, the PS1B will respond with an ***A*** to let you know it acknowledged the command or **?** if an illegal mode was entered.

Other keying parameter commands:
The sample adjust command **J** adjusts the paddle timing to respond the way you prefer. (a value of 55 will come close to another well known keyer). Setting sample adjust to zero will disable the dit and dah paddle memories. Weighting, Keying compensation, and letterspace are a few other ways to adjust the way Morse is generated. These commands are covered in detail on pages 19 through 22.

Entering Extended Commands:
Since we have more commands than letters in the alphabet, we added extended commands. They work just like immediate commands with the exception that you have to enter two letters. An often used extended command is the 'save settings' command **S** . Press CMD, wait for the ***R,*** and in response enter an **X** for extended command, wait for the ***E***, then enter **S** for save. The PS1B will save the current settings to nonvolatile memory so that when you power off and on your custom settings are preserved. Messages are automatically saved in memory when entered but settings have to be saved by the Save command. It works this way since most users make temporary changes settings but always want to go back to their favorite settings when they are done. It's easy to restore default settings, just turn the PS1B off and then back on again. Another interesting extended command is **V** which tells the PS1B to report the current keyer supply voltage. It plays it in this form: ***4r35*** which in this case is 4.35 volts.

Messages:
Now let's play with messages. Review the procedure for message loading on page 26. The PS1B has two unique features associated with message loading. The first is backspace, if you make a mistake while entering a message, just hold the command button down and the PS1B will back up letter by letter. Just release CMD when you are done backing up. The second feature is a variable message slot size; if you only use two bytes in slot one, only two bytes of message memory are used up, not an entire slot.

To start, we will load a message into slot 1. Press and hold CMD, wait for the ***R,*** release CMD, and then momentarily press CMD again. This tells the PS1B you want to load a message into slot 1. The PS1B responds with an ***E*** to let you know it is ready to accept the message. On the paddles enter **CQ CQ TEST**. Pause after entering the first CQ and a word space will be inserted. You will hear a dit in sidetone when this happens. To end the message entry, either enter **AA** (DI-DAH-DI-DAH) or press the CMD PB. Now when you press CMD your message will be sent. All 6 message slots are loaded in the same manner except slots 5 and 6. The procedure for those are described on Page 27 (*Two Press … Functionality*)

Embedded Message Commands
Follow the procedure you learned in the previous paragraphs and enter the following message in slot 2:

/S10SLOW /S25FAST where / is the DN prosign (DAH-DI-DI-DAH-DIT)

The letter(s) following a **DN** are the embedded command. This message has two embedded speed change commands which happen while the message is playing: ***SLOW*** will be sent at 10 WPM and ***FAST*** at 25 WPM. (make sure to not allow a space to be inserted between **DN** and **S)** After this message ends, the operating speed will be returned to what it was before the message was sent.

Embedded Beacon Command: It's easy to compose a beacon command. First, we will load msg slot 2. Enter**: /B60/K05 BCON DE K1EL NH**
The beacon starts when you press MSG2, first a key down for 5 seconds, then ***BCON DE K1EL NH*** is sent. **/B60** specifies that the beacon will be repeated every 60 seconds. To cancel a beacon simply press CMD and PS1B will stop the loop and respond with an ***X*** to let you know the beacon was cancelled.

More embedded commands with Serial Numbers:
Next we will test out serial numbering. First enter a starting serial number using the immediate **N** command. You need to enter all four digits including leading zeroes. A serial number is sent by inserting the **/N** embedded command in a message.You may want to select the way PS1B will send 0s and 9s in a serial number through the use of the extended commands **N** and **T**. (see page 24).

Here is an example of a message that will play a serial number incorporating the **/P** pause command:

In slot 1 enter: **CQ DE K1EL/P UR NR /N QSL?/P**.
In slot 2 enter: **UR NR /D/N QSL ?**

PB1 will send CQ and then pause to let you listen for a reply. If there is no reply, hit PB1 to repeat the CQ. If there was a reply, enter the station's callsign and the PS1B will send the serial number and pause again. If the station needs a repeat of the callsign, press PB2. Since the serial number is incremented after an **/N** command you need to pre-decrement it with **/D** to send the correct serial number.

In software terms, the **/P** command is a three-way branch: First branch: *paddle something to continue*, Second branch: *hit a msg button (other than CMD PB),* Third branch: *hit the CMD PB to cancel the message*. Since MSG1 = CMD PB you can't use slot one as a 2nd branch choice.

HSCW and QRSS: The PS1B supports two alternate sending rates. They are selected by putting embedded commands in a message. QRSS is extremely slow CW for VLF operation, while HSCW is extremely fast CW typically used for QSOs via meteor scatter. Here are examples of each:

QRSS: **/K10 /Q2EL/2** Key down for 10 seconds followed by ***EL*** at QRSS6 rate, repeat.

HSCW: **/H3K1EL K1EL K1EL K1EL K1EL K1EL** the callsign K1EL is repeated six times at 3000 LPM

INDEX

Paddle Stick Functional Block Diagram 3
Figure 1 – PaddleStick Block Diagram 3
Touch Paddle Configuration 3
PaddleStick Kit Introduction 4
PaddleStick Kit Assembly 4
Parts Inventory 4
PCB Assembly 4
Figure 2 – PaddleStick1 PC Board before assembly 4
Figure 3 – Cut paddle separator 5
Figure 4 – Remove the paddle piece and trim off separator remainder 5
Figure 5 – Capacitor details 6
Figure 6 – Install Capacitors and 14 pin socket 6
Figure 7 – Install Transistors and Voltage Regulator 7
Figure 8 – Install Resistors and Speaker 7
Figure 9 – Install U1, orient pin 1 as shown 8
Figure 10 – Remove tape film to expose adhesive pad 8
Figure 11 – Join free paddle to main paddle board 9
Figure 12 – Detail Insert and solder two resistor lead scraps 9
Figure 13 – Completed assembly, power and control leads attached. 10
How to wire up your PaddleStick1B 11
Figure 14 - PaddleStick Connection Diagram 12
Test Procedure 12
Keyer Mounting 12
Figure 15 – Base mount illustration 13
Figure 16 – Front panel mount illustration 13
Figure 17 – Picture of brackets installed 13
Keying Considerations 14
Input Considerations 14
Command and Message Push-buttons 14
Speed Pot 14
PaddleStick Kit Schematics 15
Figure 18 – PaddleStick Schematic 15
Operating the PS1B Keyer 16
Figure 32 – PTT Lead-in and Tail Example 19
Figure 33 – Key Compensation 19
Figure 34 – Key Weighting 20
PS1B Tutorial 28
INDEX 30
Revision History .... **Error! Bookmark not defined.**
Appendix B - A Note About Safety 32

Appendix C - Soldering Basics... 33

The PS1B is fully warranted to the original purchaser by K1EL Systems against defects in materials and workmanship for one year after purchase. This warranty does not cover damage caused by accident, improper assembly, or lightning damage. Please contact us before returning your PS1B for repair and we will issue an RMA. Please submit questions by e-mail to k1el.kitsinfo@gmail.com

Watch our website for latest updates and new products: http://www.k1el.com

While every effort has been made to insure that the PS1B design is as complete and safe as possible, it is still possible to cause equipment damage or incur personal injury if:

1) **The PS1B kit is not used as intended.**
2) **Is connected incorrectly.**
3) **Safety guidelines outlined in this document are not followed.**
4) **The PS1B kit is modified in any way.**

K1EL Systems LLC cannot be held responsible in these or other similar events

Steven T. Elliott K1EL
43 Meadowcrest Drive
Bedford, NH 03110 USA

or e-mail: k1el.kitsinfo@gmail.com

Watch the K1EL Website for latest updates and new product offerings: http://www.k1el.com

Revision History

PS1B Data Sheet

A.1 Initial release

PS1B PIC Firmware Revision

Rev A Original Release

Appendix A - Kit Construction Hints

1. Find a good workspace.

It is essential that you have a good place to work on your kit,

You will need room to spread out your parts and have access to tools. Good lighting and ventilation is essential. A magnifying glass or visor is highly recommended.

2. Have the proper tools.

At a bare minimum you will need:

Small side cutters, flush cutters are a plus.

Small needle nosed pliers

Small flat blade & Philips head screw drivers

A good quality, 40-60Watt, temperature controlled Soldering Iron. The price has come down on these lately, look for a Weller WLC100 40W soldering station it has adjustable power control for under $40.

3. Read the Instructions First.

Read through the assembly instructions completely and have everything on hand before you start. Inventory the kit parts and make sure you have ALL of them.

4. Follow the assembly instructions in order.

Although not always obvious, the order in which parts are added to a board is important and should be followed. Sometimes sections are installed and tested in order or there could be a mechanical consideration.

5. Keep your Workplace Clean and Orderly.

Nothing spoils a kit building experience more than lost parts. Second to that is stray bits of dirt and metal that get into a printed circuit board assembly. Our PC boards are nicely plated and accept solder easily. There is no need to clean the board with steel wool before starting. A good rosin core solder will work fine, avoid organic core unless you have the capability to clean the board after assembly. Lead free solder is recommended for obvious health reasons.

6. Take your time.

There is no need to rush, enjoy the process and the end result will be much better. Moving too quickly or working when you are tired often leads to big mistakes which could be difficult if not impossible to fix.

Appendix B - A Note About Safety

Burns to your skin can be very painful and can lead to serious injury.

Burns to your eyes can be catastrophic.

Toxic fumes can cause serious harm.

Flying objects such as wire ends etc. can cause painful and serious injuries.

When building your kit please remember that Soldering Irons and Solder are used at High Temperatures !

Soldering Irons can remain hot for many minutes after being turned off. Never touch the tip to see if it is hot.
Touch the tip to a wet pad to test for temperature.
Wear safety glasses to protect your eyes from flying objects.

Appendix C - Soldering Basics

1. Insert component leads into PCB holes and bend them back slightly to hold the part in place. You can either trim the lead now or wait till after the joint is soldered. I usually install several parts at one time and then solder and trim multiple leads.

2. Place a hot and clean iron tip against both the lead and pad as in Fig. C1.

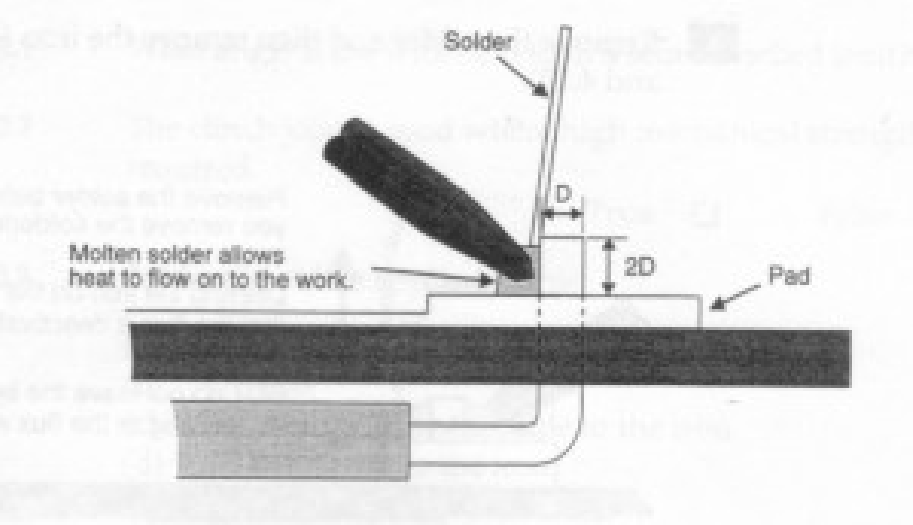

Fig. C1 - Form a heat bridge

3. Create a heat bridge between the lead, the PCB pad and the iron by placing a small amount of solder on the tip.

4. Apply solder around the outside edge of the pad as in Fig. C2. If the pad and lead are at the correct temperature, the solder will flow around the connection.

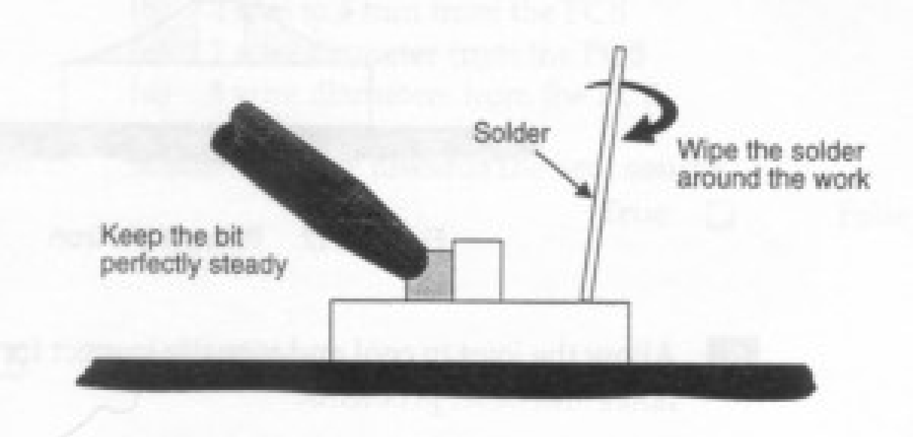
Solder
Wipe the solder around the work
Keep the bit perfectly steady

Fig. C2 - Spread solder around the work

5. Remove the solder and then remove the iron.

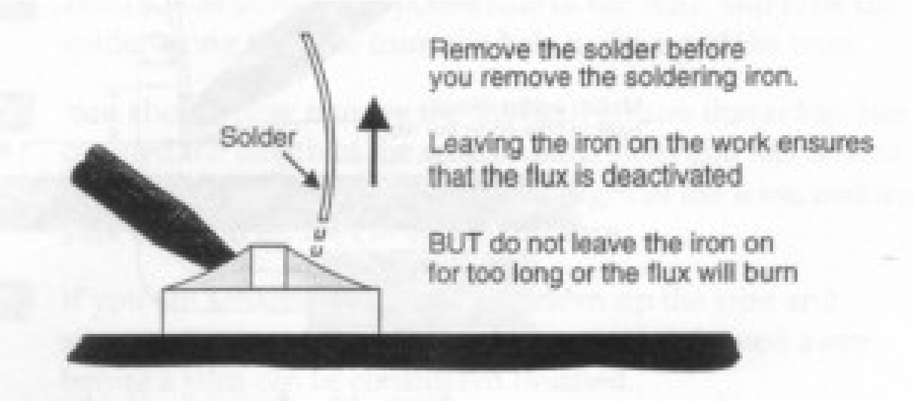
Solder
Remove the solder before you remove the soldering iron.
Leaving the iron on the work ensures that the flux is deactivated
BUT do not leave the iron on for too long or the flux will burn

Fig C3 - Remove the solder

6. Allow the joint to cool and visually inspect for defects or other problems. You should have a solder joint with a bright shiny finish and a profile like that shown in the middle picture below. Make sure you use enough heat so that solder flows around both the lead and pad. A good connection will always look like a tent, if it looks like a round ball, then odds are, the solder did not bond to the PCB pad.

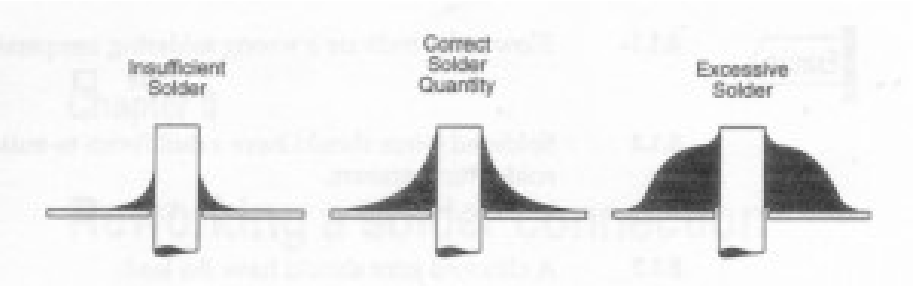

Fig. C4 - Solder quantity comparison

7. To avoid cold solder joints, do not move the board or component lead while the solder is cooling. Keep your iron tip clean, contamination can cause poor solder joints.