WinKey USB Assembly and Operation Guide   Version 1.H   8/12/2010

This document describes the assembly, checkout, and hook up of the K1EL Winkey USB (WKUSB) Keyer Kit with a version D PCB. This design can be powered off a PC's USB port or internal batteries. When connected to a PC, there is no drain on the batteries. When running on battery power, it will go into power saving sleep mode when not in use. Because of this, a power on/off switch is not required. Two key output ports are provided which allow one of two rigs to be keyed from one keyer. The KEY/PTT outputs are optically isolated. A speed pot and four pushbuttons are also included.

WinKey PCB Bill of Materials

QTY	Ref Designator	Value	Description	Package	Chk
2	C4, C5	.01uF 10V (103)	Capacitor	Ceramic Disc	
6	C1, 2, 3, 6, 7, 9	.001uF 500V (102)	Capacitor	Ceramic Disc	
3	C10, 11, 12	.1uF (104)	Capacitor	Ceramic Orange	
1	C8	.0047uF	Capacitor	Mylar 10%	
4	D1, 2, 3, 4	1N4148	Silicon Diode	Glass DO35	
4	S1, S2, S3, S4	SPST	Pushbutton Switch	PC mount	
3	Plastic Push Cap		Pushbutton Cap	Black Square	
1	Plastic Push Cap		Pushbutton Cap	Red Square	
1	J1	1/8 phone jack	Connector	Paddle Input	
1	J2	4 way RCA Jack	Connector	Key/PTT Out	
1	J3	USB connector	Connector	USB_B	
1	L1	Inductor	Ferrite Bead	Axial lead	
1	Q1	2N2222A	Transistor	TO92	
1	R6	100Ω	Resistor	1/4 W 5%	
4	R7, 8, 13, 16	2.4KΩ (optocoupler) 620Ω (AQW relay) 470Ω (Clare relay)	Resistor	1/4 W 5%	
4	R9, 10, 11, 15	4.7KΩ	Resistor	1/8 W 5%	
5	R1, 2, 3, 4, 5	2.2KΩ	Resistor	1/8 W 5%	
3	R12, 14, 18	470Ω	Resistor	1/8 W 5%	
1	R17	10KΩ	Resistor	1/4 W 5%	
1	SP1	Piezo	Speaker	Plastic Can	
1	U2	PIC16F688	PIC Micro	14 pin DIP	
2	U1, U3	Toshiba TLP627 or NAIS AQW210EH or Clare LAA125	Optocoupler Solid state relay Solid state relay	8 pin DIP	
1	U4 (pre-mounted)	FT232RL	USB Interface	28 pin SSOP	
2		8 pin	Sockets	8 pin DIP	
1		14 pin	Socket	14 pin DIP	
1	RX1	10K	Potentiometer		
1	KX1	Knob	Speed pot knob		
1	WK-USB PCB	Rev D	PC Board		
2	WK_USB Enclosure		Aluminum Box		
1	Misc	3xAAA	Battery holder		
4	Screws	4-40 by ¼ inch			
4	Rubber Feet	Push in style			
1	Piece	Velcro Tape	Adhesive		
1	Cable	USB A to B cable			

Kit Assembly

1) Verify and check off all components against the bill of materials listed above. A resistor color code chart is provided below. If there are any shortages notify K1EL by email as soon as possible and we will send the missing parts to you. Note that the surface mount IC, U4, is pre-mounted on the board.
2) The WKUSB PCB has a solder mask but it is still easy to inadvertently bridge two pads together. Please solder carefully and use the checkplots on page 12 to resolve any connections in question. 95% of all kits returned for repair have had soldering errors.
3) Carefully check the PC board for any obvious defects.
4) Follow the silkscreen and carefully install all 18 resistors, then solder, and trim leads. Note that the value of R7, R8, R13, and R16 depends on the type of solid state relay or optocoupler provided with your kit, this is specified in the bill of materials.
5) Install and solder two 8 pin sockets and one 14 pin socket, make sure the alignment marking matches the silkscreen. Note that the 8 pin sockets are installed in reverse from the 14 pin socket. This will become important when you install the ICs.
6) Install the paddle connector J1, make sure it's flush and that the front of the connector is lined up with the front edge of the PC board. Hold it in place while you solder.
7) Install and solder the six .001uF (102) ceramic disc caps, C2 will be a tight fit against J1 so it may have to tilt away from J1 slightly. Trim leads.
8) Install and solder the three small orange .1uF ceramic caps: C10, C11, C12.
9) Install the four 1N4148 diodes, check that the band on the diode matches the silkscreen.
10) Install and solder the leaded ferrite bead L1.
11) Install transistor Q1 making sure that the flat side of the component body lines up with the silkscreen. Solder and trim leads.
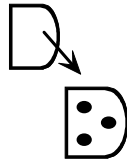

Fig 1 – Transistor Orientation

12) Install the USB connector J3. Bend over the holding tabs and make sure it is flush to the board before soldering. It helps to tack solder one of the tabs first to hold it in place. The signal pins on this connector are very easy to bridge together if you use too much solder.
13) Install and solder the two .01uF (103) ceramic disc caps C4 and C5. Trim leads.
14) Install and solder piezo speaker S1, observe polarity and align speaker + to silkscreen + Be sure to remove adhesive film covering the top of the speaker.
15) Install the .0047uF mylar cap C8, This may be a yellow "box" or dipped package. Solder and trim leads.
16) Now install the four-way phono connector block, make sure the connector is flush against the PC board before soldering in place. Trim the leads after soldering.

Resistor Color Code Chart
    100Ω   Brown Black Brown
    470Ω   Yellow Violet Brown
    620Ω   Blue Red Brown
    2.2K Ω   Red Red Red
    4.7K Ω   Yellow Violet Red
    10K Ω   Brown Black Orange
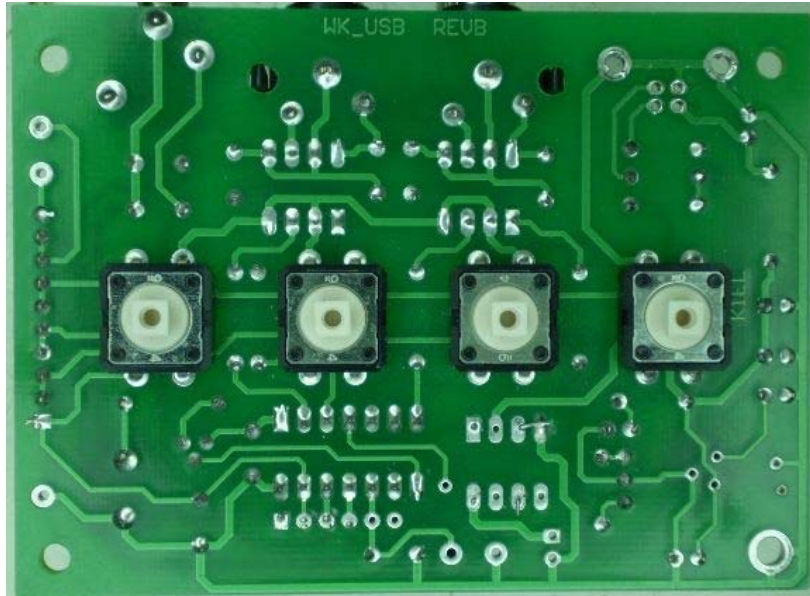
Install message pushbuttons on back of PCB !

17) Now install the pushbutton switches on the **!!!BACK!!!** side of the PC board as illustrated in the above picture. Make sure the switches are flush to the board before soldering. After soldering, attach the four square push-button caps. The red one goes on S1 which is the leftmost switch whn you hold the board upside down with the phono jacks away from you. Press firmly until they snap in place, only a small amount of force is required.

18) You can now wire the speed pot to the PC board, the center lug of the pot goes to PC board pad marked **W.** Cut two 7 inch lengths of wire. Looking at the pot from the back, the lug counterclockwise from the center goes to pad **G** while the center goes to **W**. If you don't plan on using the speed pot short PCB pads **W** and **G** with a scrap resistor lead.
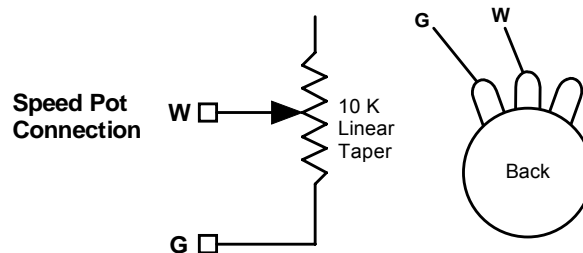

Figure 2 – Speed pot Connection

19) Don't install any ICs yet, we will do this as part of the kit bring up.

20) If you are using the battery option, wire the battery holder to the PC board. Be sure to connect the red wire to the square (+) pad of J4. The black wire goes to the round pad. Some battery holders have a switch, makes sure it is set to the on position.

21) That completes the circuit board assembly. Now proceed to bring up and final assembly.

Completed WKUSB Rev D PCB

Kit Checkout

Take a look at the Winkey USB PCB schematic on pages 9, 10, & 11 to familiarize yourself with the circuitry on the PCB. It is a fairly simple design. The WK PIC requires a positive power supply which is sourced either from a 4.5V battery pack or USB. Two diodes take care of selecting the right supply. Never use a battery supply greater than 5V. To insure that the power down mode current is as small as possible a voltage regulator is not utilized. The WK2 PIC is USB compliant in that it will go into a power down mode when the USB port goes into standby. The WK2 PIC monitors USB status by looking at the USB interface IC's SLEEP output pin.

The WKUSB keyer has two modes, host mode and standalone mode. In host mode, WKUSB is connected to a PC which has issued an open command from a running application. If WKUSB is connected to a host but the host has not issued an open command, WKUSB will stay in standalone mode. In standalone mode WKUSB will operate as a full featured keyer with message pushbuttons and a Morse command interface. In host mode WKUSB will not respond to Morse commands, instead it is under control of the PC. This is covered more completely in the WKUSB manual.

Getting back to WKUSB bring up, the first thing to do is test the USB interface. Before doing this you must install the USB driver on your PC. *Read the Quick Start guide before plugging WKUSB into your PC.* This document will describe how to install the driver. Make sure you do as instructed or the driver may not install correctly and WKUSB might not be detected properly. As part of the procedure you will eventually attach WKUSB to the PC USB port with the supplied USB cable. This will apply power to the USB interface IC, the WK IC does not have to be installed at this time. Once the driver is installed and WKUSB is attached, the PC will assign it a com port. You will need to know what that port number is when you get to the point of configuring applications to run with WKUSB. Here are the steps to follow to get the assigned com port:

Left Click on **START ->** right click on **My Computer** then select **Properties** this brings up the **System Properties** dialog box. Select **Hardware** then select **Device Manager.** Look for **Ports (COM & LPT)** and click on the + to the left of it. This will show all the communications ports installed. One of them will be **USB COM.** Write down the port number By clicking on that selection and clicking on **Advanced** you can change to port to a different value.

This is outlined with more detail in the *WKUSB Quick Start Guide* found on the CDROM.

If you ran into problems with the host not being able to recognize the WKUSB device, carefully recheck all components in the USB interface to make they were installed correctly. Double check that your solder connections are all there and that they look good. With WKUSB attached to the USB port, you should see +5V on the leads of the ferrite bead L1.

Once you have been able to get the PC to recognize WKUSB as a valid USB device, disconnect WKUSB from the PC and we will now test the keyer portion of the design. First install the 14 pin DIP U2 and then install the two 8 pin DIPs U1 and U3. For both ICs observe pin 1 as shown:
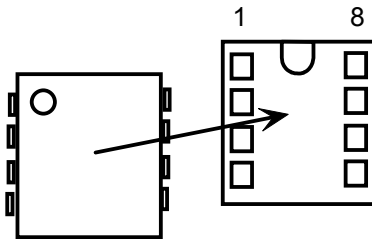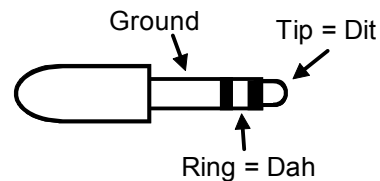
Fig 3 - IC Orientation   Fig 4 - Paddle Connector Pinout

Connect a paddle to J1, the expected paddle connections are shown above. If you have dit and dah reversed this is not a problem since the paddles can be swapped by software control. Install 3 AAA cells in the battery holder and WKUSB will wake up and send an R in sidetone. Attach a paddle set and you should hear dits and dahs on the sidetone speaker when you close the paddle contacts. Turning the speed pot will change the WPM rate. At this point the keyer is in standalone mode, press and hold the command button until WKUSB will responds with an 'R'. You can then enter a command on the paddles. An easy command to test is the paddle swap command **X**. All of the commands are covered in detail in the standalone keyer section of the Winkeyer2 datasheet.

WKUSB does not send an R when powered up:
Check the orientation of the WK IC to make sure it's not in backwards. Then measure the voltage between pin 1 and 14 on the WK IC. You should see about 4.0 volts or one diode drop less than the battery voltage. It's possible that the WK2 IC is functioning but the sidetone speaker circuit is at fault, look at driver transistor Q1 and associated circuitry.

WKUSB is not responding to paddle input or is sending out a continuous series of dits or dahs:
Check the paddle cabling, J1, and associated input circuit for shorts or opens.

*WKUSB periodically sends out an **R** followed by a **?** or an **MT**:*
You probably have a problem with the 2.2K pushbutton network (R1, R2, R3, R4, R5, R9).

WKUSB is completely unresponsive or just sends a single dit on power up:
This can be caused by a missing or miswired speed pot.

Here are instructions on installing the WK_USB assembly into the enclosure.

1) Using spray cleaner, clean the inside surfaces of the top and base enclosure halves to remove any dirt, grease, or metal filings.
2) With an Xacto knife, carefully scrape the paint from the inside edge of the USB connector opening. This will insure a good USB ground shield connection between the USB connector and the enclosure. Use care so to avoid accidentally scratching the back panel surface.

3) Attach speed pot to the single hole on the front of the enclosure.
4) A Velcro adhesive pad is attached to the bottom of the battery pack. Peel back the plastic film to expose the adhesive and carefully locate the holder as shown below. The adhesive is very difficult to remove so make sure you install the battery pack correctly with the wires oriented as shown. The battery pack needs to almost touch the speed pot.
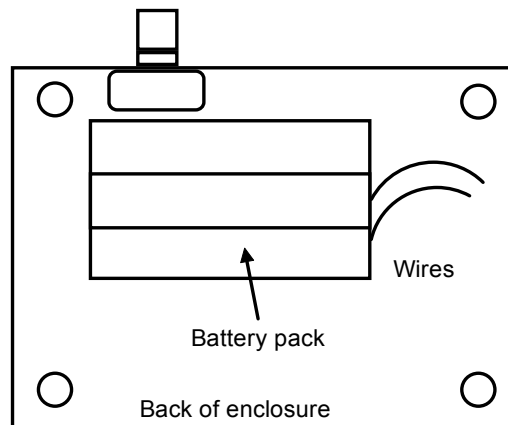

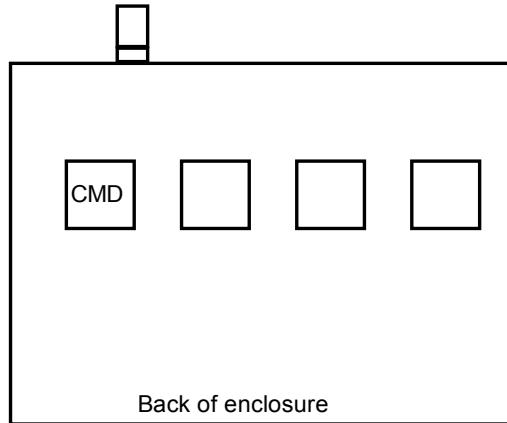Figure 12 – Installation of battery pack

Back of enclosure

Figure 13 – Command button location

5) Install the PC board in the top half of the enclosure using four 4-40 screws. Remember the pushbuttons protrude through the top of the case. It will only fit properly one way.
6) Assemble the two halves of the enclosure by tilting the top and inserting the connectors into their respective holes in the back panel of the bottom half.
7) It may be a tight fit and you may need to press firmly to make sure the paddle connector protrudes through the back panel. Also you may need to slightly adjust the position of the quad RCA jacks so that they are centered in the back panel holes. Install four 4-40 screws to hold the top cover in place.
8) This completes the assembly.

Now proceed to application checkout, at this point you will reconnect WKUSB to your PC's USB port so hopefully you have already installed the USB driver as described on page 4. The best application to use to check out the WKUSB kit is the K1EL WKtest Application. Although the interface is daunting at first look, there are only a few controls that need to be played with. A version is on the CD but here is a link to the application.

http://www.k1el.com/wktest_setup.exe

The quick start guide gives a step by step procedure to follow to get WKTEST connected and running with WKUSB. If you run into problems here are some debugging steps you can follow:

1) If the PC does not recognize WKUSB when plugged into the USB port: The first thing to do is double check all of the solder connections in the USB interface. There are a minimal number of components to look at. Verify that you see +5V on the ferrite L1 when plugged into the PC. It's possible, but not likely, that there is a USB controller pin connection problem. When all else fails check the pins for shorts or bad connections with a magnifying glass.

2) If you get the PC to recognize WKUSB and assigned it a comport but WKtest is unable to connect to WKUSB, WKtest will display one of two errors:
   Comport open error: You may have not have selected the correct port in WKtest or there is another device using that port.
   Echo or No Response error: The com port opened properly but WKUSB did not respond. This means there is probably a problem on the WKUSB PC board, proceed to Step 3.

3) At this point the USB interface and WKUSB standalone mode have been verified so if we can't get WKtest to connect, the problem must be in either the Rx/Tx serial or Sleep status connections between the USB IC and the WK2 IC. A good strategy at this point is to carefully go over the circuitry between the USB controller IC and the Winkeyer IC. Look for bad or missing solder connections, solder shorts, missing, or wrongly installed components. That is the most common problem at this stage. If you have a scope you can trace the receive data

path from the USB interface to WK IC pin 5. Click on WKopen while probing: a short burst of serial data is sent every time you click on WKopen. If you see it reach the WK IC, then look for the serial response burst from the WK IC pin 6 to the USB controller.

Precautions when connecting kit to a rig

NOTE !!! : WKUSB with solid state relays is capable of keying positive or negative voltages up to 300 volts. The maximum keying current is 100 milliamps. Before attempting to use WKUSB to key a vacuum tube transmitter please be absolutely sure that these limits are not exceeded.

Key port one output is the lower left RCA jack as you look at the connector from the plug-in side. The upper left is PTT one. Lower right is Key port two and upper right PTT two. You can change output ports in the Winkeyer2 app in the output setup dialog. In standalone mode the **O** command toggles the output port.

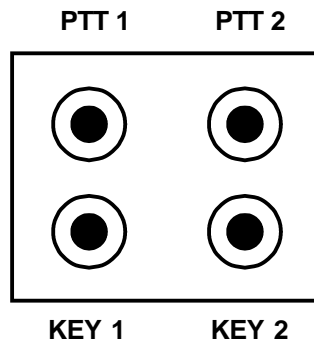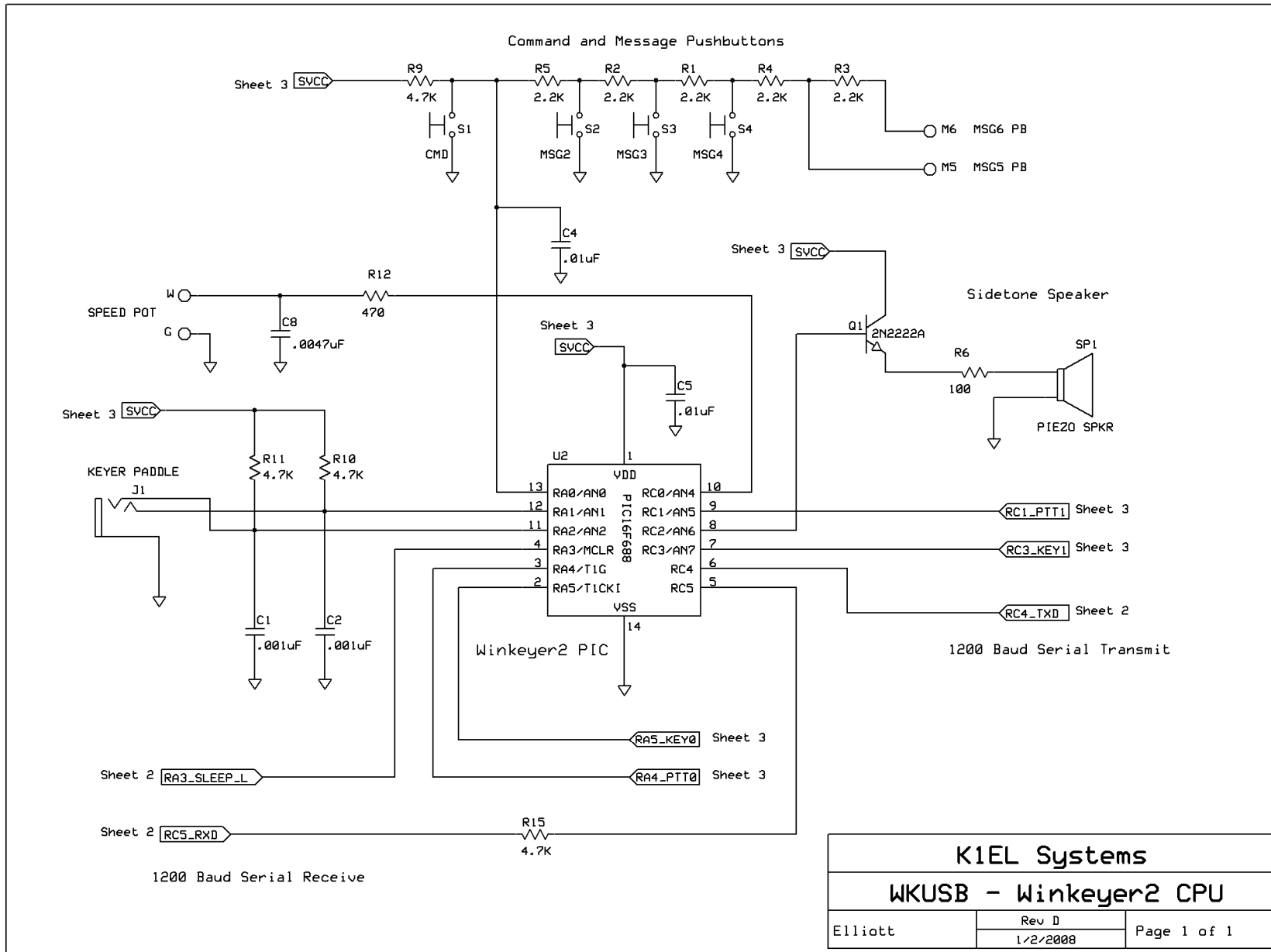**PTT 1**   **PTT 2**

KEY 1   **KEY 2**

Fig 6 – Back Panel View of Output Ports

There are several RF filter points included in the WinKey circuit design. Capacitors on the key and PTT lines shunt RF from coming back through those lines. C1 and C2 shunts any RF arriving over the paddle leads. C8 shunts any RF arriving over the speed pot leads. These components also reduce RF radiation from WinKey.

Even with good filtering the Winkey PCB is susceptible to problems caused by high RF potentials in the shack. Please observe standard RF grounding precautions to reduce RF at the operation position. This includes but is not limited to: multiple connection paths to a good earth ground, common grounding for all equipment, quarter wave stubs at particularly troublesome frequencies, and double checking all mechanical ground connections for oxidation.

Command and Message Pushbuttons

Sheet 3 SVCC — R9 4.7K — R5 2.2K — R2 2.2K — R1 2.2K — R4 2.2K — R3 2.2K

S1 CMD   S2 MSG2   S3 MSG3   S4 MSG4

M6 MSG6 PB
M5 MSG5 PB

C4 .01uF

Sheet 3 SVCC

Sidetone Speaker

SPEED POT
W
G

R12 470

C8 .0047uF

Sheet 3 SVCC

C5 .01uF

Q1 2N2222A

R6 100

SP1
PIEZO SPKR

KEYER PADDLE
J1

Sheet 3 SVCC

R11 4.7K   R10 4.7K

U2
VDD 1
13 RA0/AN0   RC0/AN4 10
12 RA1/AN1   RC1/AN5 9   RC1_PTT1 Sheet 3
11 RA2/AN2   RC2/AN6 8
4 RA3/MCLR   RC3/AN7 7   RC3_KEY1 Sheet 3
3 RA4/T1G   RC4 6
2 RA5/T1CKI   RC5 5
VSS
14

PIC16F688

RC4_TXD Sheet 2

1200 Baud Serial Transmit

Winkeyer2 PIC

C1 .001uF   C2 .001uF

RA5_KEY0 Sheet 3

Sheet 2 RA3_SLEEP_L

RA4_PTT0 Sheet 3

Sheet 2 RC5_RXD

R15 4.7K

1200 Baud Serial Receive

K1EL Systems		
WKUSB - Winkeyer2 CPU		
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L1

FERRITE

C11
.1uF

C12
.1uF

UVCC Sheet 3

J3
1
2
3
4

USB_B

Sheet 1 RC4_TXD

20   4
VCC   VCCIO

17 3V3OUT   TXD 1   RC5_RXD Sheet 1
                    RXD 5

16 USBDM   FT232RL

15 USBDP   RTS# 3   D3   RTS
                    CTS# 11   1N4148   1
                    DTR# 2   2   Sheet 3
19 RESET#   DSR# 9   RTS
                    DCD# 10
C10   RI#   6 U4   D2   DTR
.1uF   1N4148 1
27 XTIN   2
28 XTOUT   TXDEN 13   Sheet 3
                    TXLED# 23   DTR
                    RXLED# 22
8   NC1
24 NC2
                    PWREN# 14
26 TEST   SLEEP# 12   RA3_SLEEP_L Sheet 1

    AGND GND GND GND
    25   21 18 7   R17
                                   4.7K

Port 2 Key and PTT Interface

Sheet 1 | RA4_PTT0 | — R8 470 — | 1 AN1 | U1 | COL1 8 | — | J2-1 1 | **Port 2** Pin 1 = PTT
Pin 2 = KEY
Pin 3 = Ground

2 CA1 | EM1 7
Sheet 1 | RA5_KEY0 | — R7 470 — | 3 AN2 | COL2 6
4 CA2 | EM2 5

OPTOISOLATOR

C3 .001uF   C6 .001uF

RCA Jack

Note: Key Output ground is isolated from WKUSB Logic Ground

Port 1 Key and PTT Interface

Sheet 2 | RTS | — R18 470 —

Sheet 1 | RC1_PTT1 | — R16 470 — | 1 AN1 | U3 | COL1 8 | — | J2-2 1 | **Port 1** Pin 1 = PTT
Pin 2 = KEY
Pin 3 = Ground

2 CA1 | EM1 7
Sheet 1 | RC3_KEY1 | — R13 470 — | 3 AN2 | COL2 6
4 CA2 | EM2 5

Sheet 2 | DTR | — R14 470 —

OPTOISOLATOR

C7 .001uF   C9 .001uF

RCA Jack
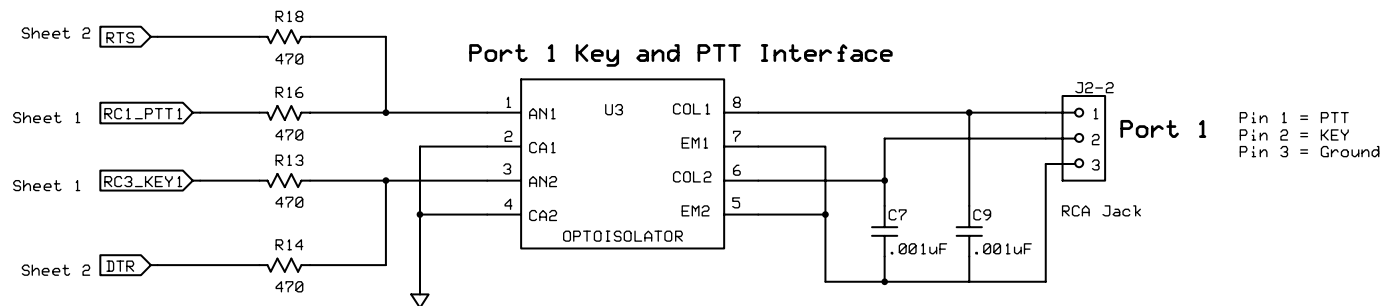
Note: Key Output ground is isolated from WKUSB Logic Ground

Battery Connector

4.5V PLUS   1 J4
4.5V GND   2

D1 1N4148 — SVCC Sheet 1

Sheet 2 | UVCC | — D4 1N4148 —
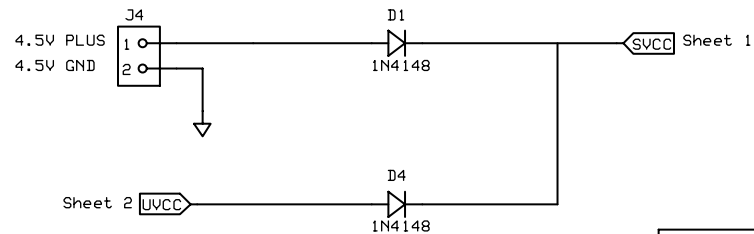
| K1EL Systems |
| Output Ports & Power Supply |

| Elliott | Rev D 8/18/2010 | Page 3 of 3 |

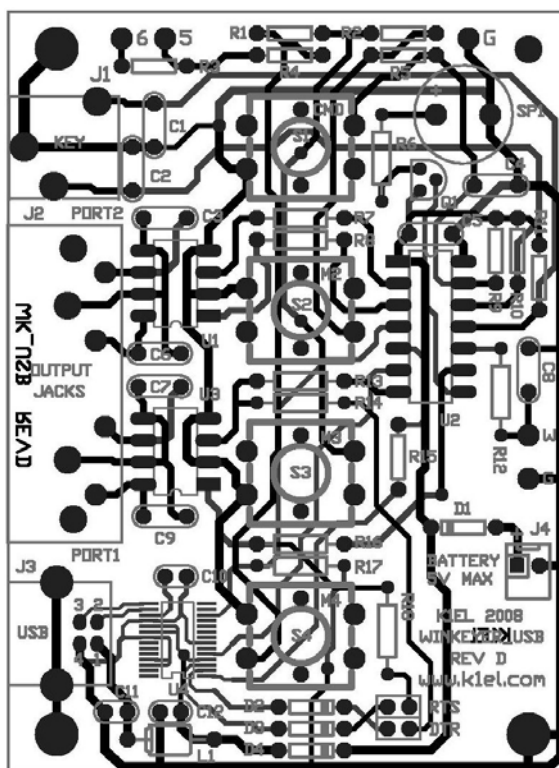**Winkey PCB Rev D Layout**

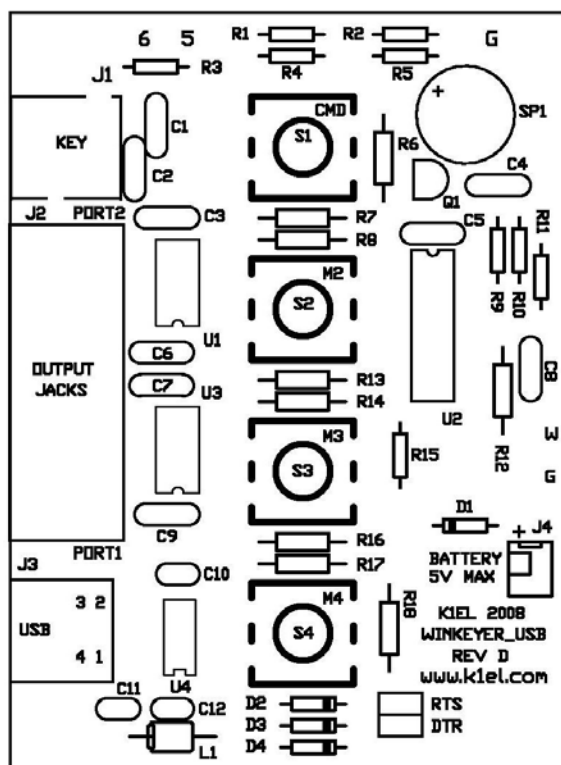Figure 8 – WinKey USB PCB Check Plot
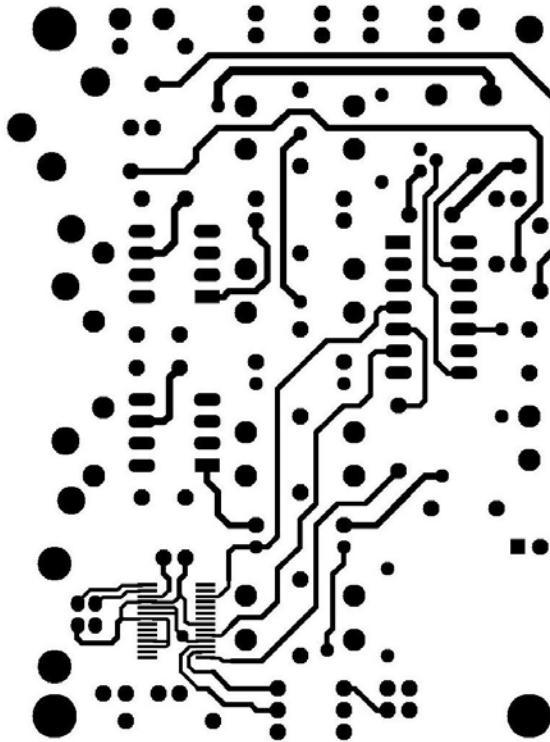

Figure 9 – WinKey USB PCB Silkscreen

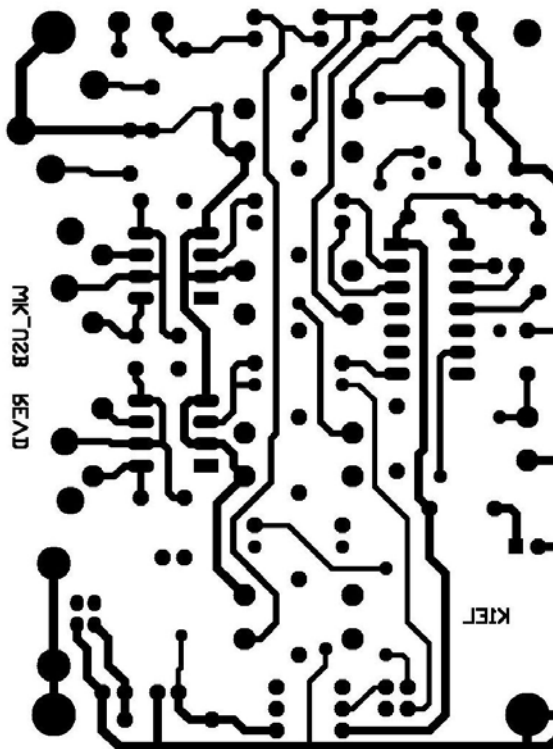Figure 10 - WinKey USB PCB Component Side

Figure 11 - WinKey USB PCB Solder Side

Standalone Considerations

Standalone operation adds a level of complexity to the system that didn't exist in WK1. Here's a list of things to know about standalone operation.

1) When WK_USB is powered up for the first time it loads a default set of standalone parameters.
2) These parameters can be modified through standalone paddle commands or by hooking WK_USB up to the Windows application WK2MGR.
3) If the user modifies parameters in standalone mode and wants to preserve them, they need to remember to save the settings with the standalone command **P**.
4) When WK_USB is connected to a PC's USB port, the PC recognizes the USB device and registers it but WK_USB remains in standalone mode until an application opens it. The only serial commands WK_USB will accept while in standalone are ADMIN commands.
5) WK2MGR works by directly reading and writing the EEPROM in the WK2 IC. The EEPROM contains all of the standalone settings and local messages. Since the EEPROM is accessed by ADMIN commands, WK_USB can remain in a closed state.
6) When an application opens WK_USB, WK_USB leaves standalone mode and will no longer responds to the command pushbutton making it impossible to enter paddle commands. This is as it should be since WKUSB is now under control of the application.
7) After opening WKUSB the host application overwrites the standalone settings with settings dictated by the host. This must be done to insure settings listed in the host application's dialog boxes are in sync with those in WKUSB.
8) You can not run WK2MGR when another application is connected to WKUSB.
9) When the host application closes WK_USB, standalone operation is restored, and the settings last stored in EEPROM are reloaded.