WinKey USB SMT Assembly and Operation Guide   **Version 1.1   6/20/2014**

This document describes the assembly and testing of the K1EL Winkey USB Keyer Kit with a version 01 SMT PCB. In this new design, surface mount components were used where possible. These parts are pre-soldered to the PC board and tested at the factory. Assembly is fairly simple and consists of soldering a few switches, connectors, and two wires.

WinKey SMT PCB Bill of Materials

QTY	Ref Designator	Value	Description	Package	Chk
6	C1, 2, 4, 6, 7, 8, 10	.001uF 500V	Capacitor	Ceramic 0805	PLC
	X1, 2	.001uF 500V	Capacitor	Ceramic 0805	N/U
6	C3, 9, 11, 12, 14, 15	.1uF 16V	Capacitor	Ceramic 0805	PLC
1	C5	.0047uF 16V 10%	Capacitor	Multilayer 0805	PLC
1	C13	4.7 uF 16V	Capacitor	0805	PLC
4	DA1, 2	BAV70LT3G	Dual diode array	SOT23	PLC
4	S1, S2, S3, S4	SPST	Pushbutton Switch	PC mount	THS
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	THS
1	J3	4 way RCA Jack	Connector	Key/PTT Out	THS
1	J6	USB connector	Connector	USB_B	THS
1	L1	Filter - 220 ohm	Ferrite Bead	0805	PLC
1	Q1	MMBT3904	Transistor	SOT23	PLC
1	R1	68Ω	Resistor 1%	0805	PLC
4	R2, 3, 5, 13	4.7KΩ	Resistor 1%	0805	PLC
3	R7, 9, 11	2.2KΩ	Resistor 1%	0805	PLC
1	R4, 6, 8, 10, 12	470Ω	Resistor 1%	0805	PLC
1	SP1	Piezo	Speaker	Plastic Can	THS
1	U2	PIC16F1825	PIC Micro	14 pin SOIC	PLC
2	U1, U3	NAIS AQW210EH or Clare LAA125	Solid state relay	8 pin SOIC	PLC
1	U4	FT232RL	USB Interface	28 pin SSOP	PLC
1	RX1	10K	Potentiometer		OB
1	KX1	Knob	Speed pot knob		OB
1	WK-USB SMT PCB	Rev 01	PC Board		
2	WK_USB Enclosure		Aluminum Box		
1	Misc	3xAAA	Battery holder		OB
4	Screws	4-40 by ¼ inch			OB
4	Rubber Feet	Push in style			OB
1	Piece	Velcro Tape	Adhesive		OB
1	Cable	USB A to B cable			

PLC = Pre-Placed on Board,   N/U = Not used, OB = Off Board,
THS = Through hole soldered by builder

Kit Assembly

1) All of the surface mount components are pre assembled and tested so all that remains for the builder to do is add several connectors and a mini speaker. Then the battery holder and speed pot are wired to the board followed by enclosure assembly.

2) The WKUSB PCB has a solder mask but it is still easy to inadvertently bridge two pads together. Please solder carefully. Virtually all kits returned for repair have soldering errors.
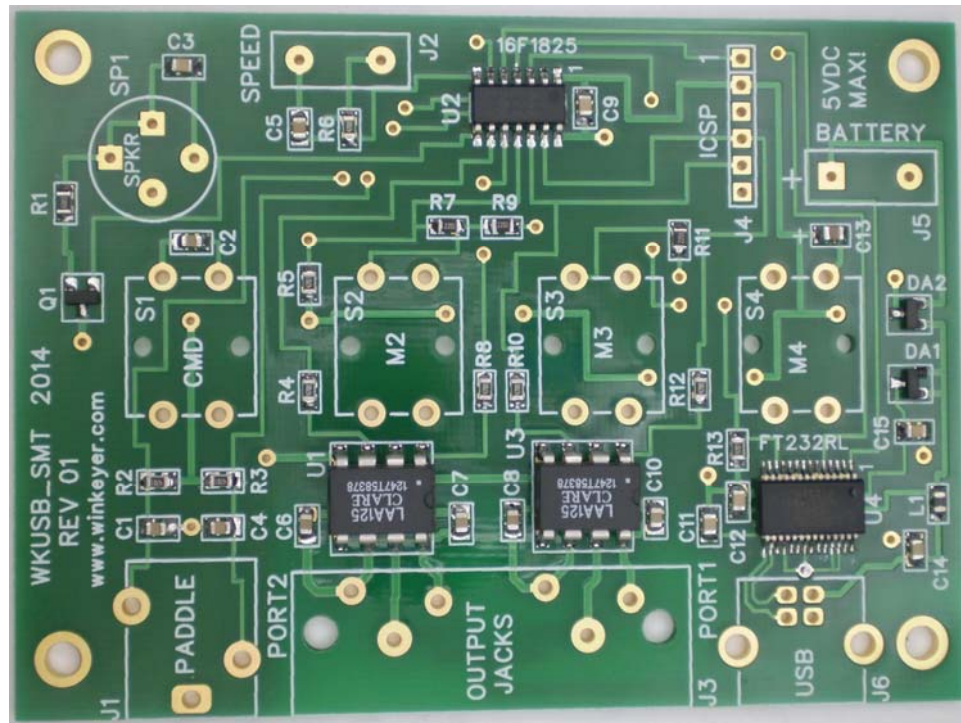

Figure 1 – WKUSB PCB as shipped with kit

3) Install the paddle connector J1, make sure it sits flat on the PCB and that the front of the connector is lined up with the front edge of the PC board. Be sure to hold it in place while you solder.

4) Install the USB connector J6. 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.

5) Install and solder piezo speaker SP1, observe polarity and align speaker + to silkscreen + There are four holes, two pairs with different spacing. Rotate the speaker to find the pair that fits. Peel off the protective film covering the top of the speaker.

Figure 2 – J1, J6, and SP1 installed

6) Now install four pushbutton switches on the **!!!BACK!!!** side of the PC board as shown in figure 3. Make sure the switches are flush to back of the board before soldering from the front of the board. After soldering, attach the square push-button caps, red on S1 which is to your left when the phono jacks are away from you, switches facin up. Press firmly until they snap in place, just a small amount of force is required.
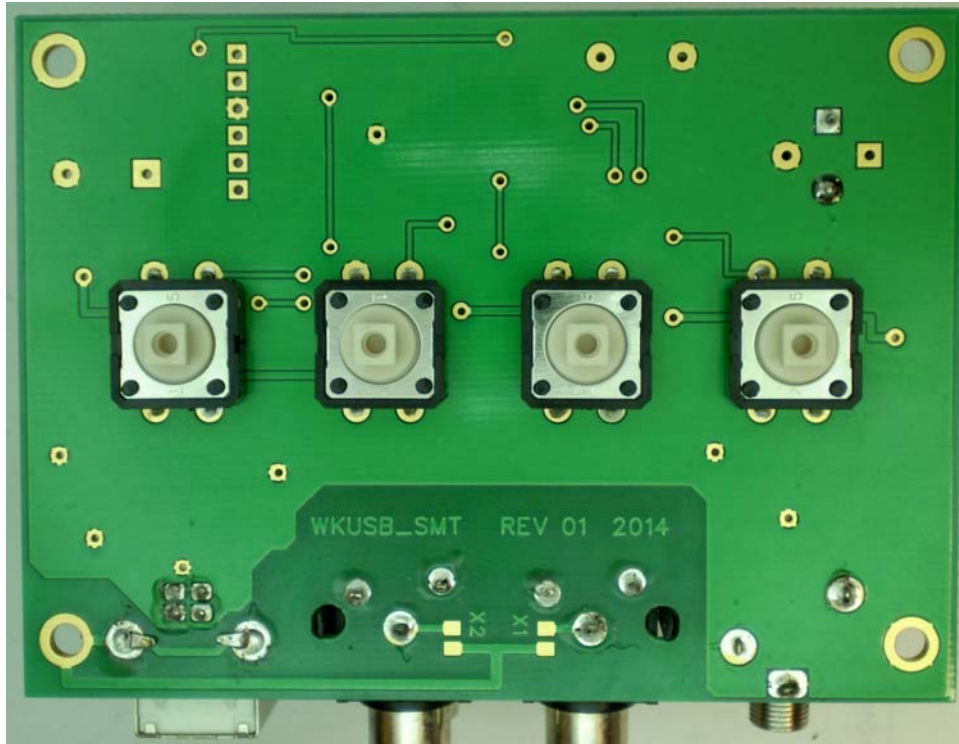

Figure 3 – Pushbutton switches in place

SWITCHES MOUNT ON THE BACK OF THE PCB !!!

7) Now install the four-way phono connector block at J3. Make sure the connector is flush against the PC board before soldering in place. Trim the leads after soldering.

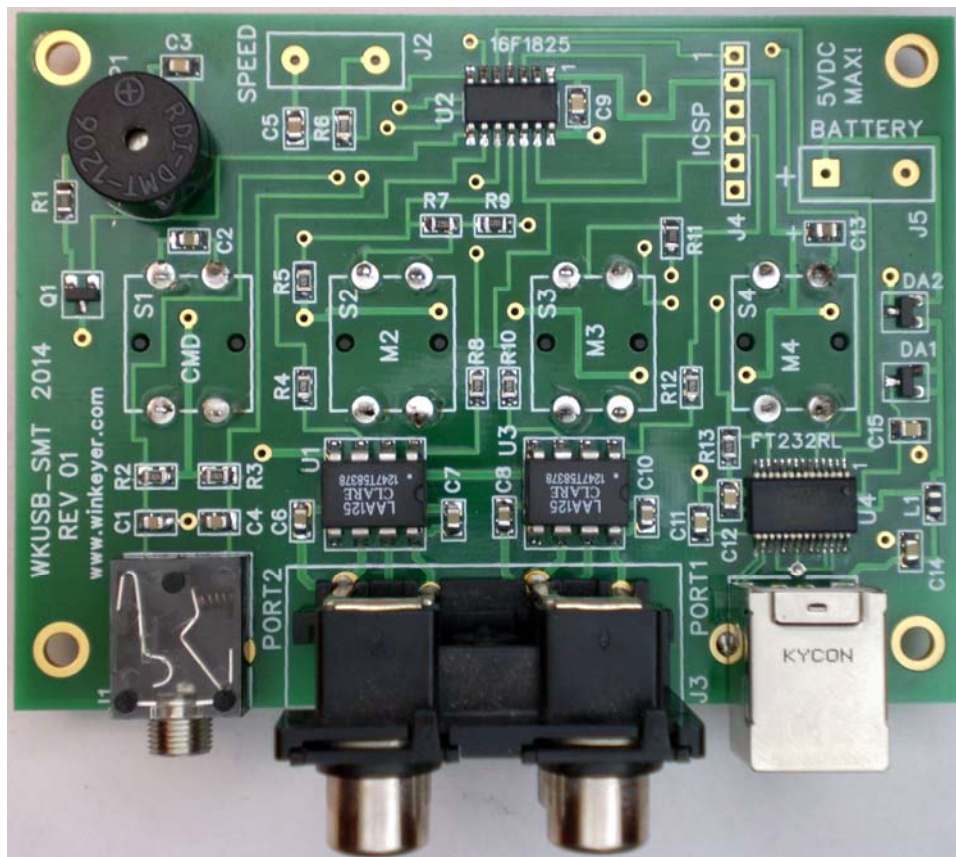8) That completes the circuit board assembly. Now on to add the speed pot and battery holder.

Figure 4 - Completed WKUSB-SMT Rev 01 PCB

9) Now wire the speed pot to the PC board as shown in figure 5. Cut two 7 inch lengths of wire and attach to J2. If you don't plan on using the speed pot short the two pads of J2 with a short piece of resistor lead.
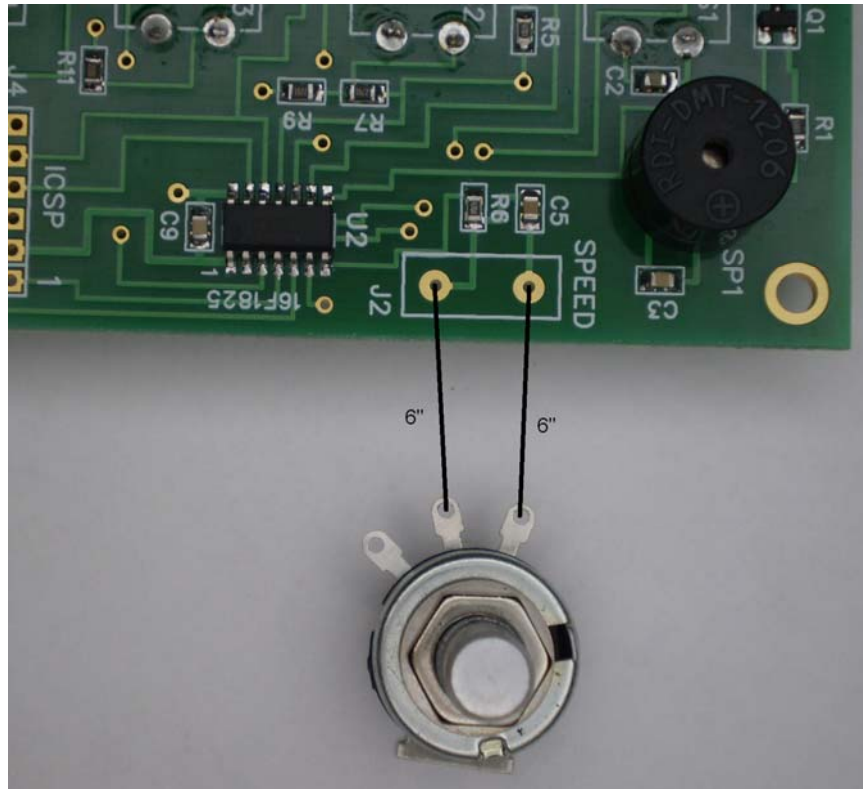
Figure 6 – Speed Pot Connected

10) Wire the battery holder to the PC board. Trim the red and black wires to 5" and connect the red wire to the square (+) pad of J5 and the black wire to the round pad as shown.
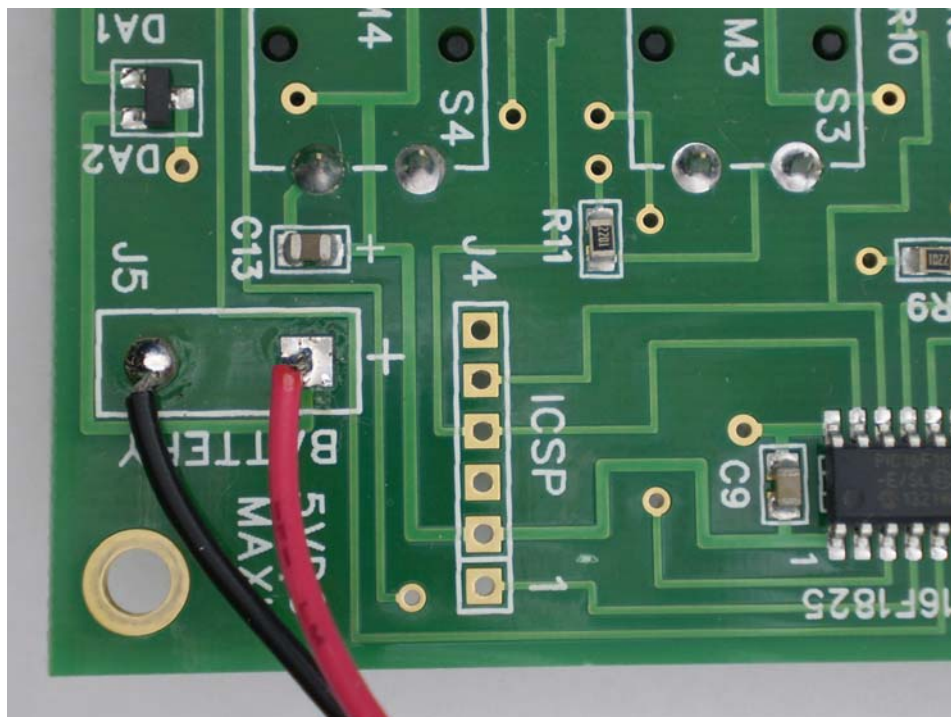

Figure 7 – Battery Wiring

Kit Checkout

Warning: Please do not use WKUSB3 with the WK2CFGMAC application or with Ham Radio Deluxe (HRD/DM780) releases earlier than 6.2.

Review the Winkeyer USB PCB schematic on pages 11, 12, & 13 to familiarize yourself with the circuitry on the PCB. It is a fairly simple design. There are two ICs, a WK3 PIC microcontroller and a FT232RL USB interface. The WK3 PIC is powered either from a 4.5V battery pack or USB port. Two diodes select the active supply. When WKUSB is plugged into a USB port, the internal battery pack is electrically disconnected. (Never use a battery supply greater than 5V) To insure that power down mode current is as small as possible, a voltage regulator is not utilized. The WK3 PIC is USB compliant in that it will go into a power down mode when the USB port goes into standby. The WK3 PIC monitors USB status by checking the FT232RL'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 is under control of the PC and will not respond to pushbutton commands. This is covered more completely in the WK3 Datasheet (WK3_Datasheet_v1.pdf)

The WKUSB-SMT circuit board is assembled and tested at the factory which makes it easy to get it going. As a first test, install three AAA batteries and WKUSB should come alive and send an 'R' on the sidetone speaker. You should get an MT when you press each message pushbutton, this signifies that the messages slots are e**M**p**T**y. Now press and hold the red pushbutton and after a few seconds WKUSB will respond with a R. Release the button and after a few more seconds it will send a question mark. If you have a paddle set handy, plug it in and check that WKUSB will send dits and dahs. Turning the speed pot will change the WPM rate. The keyer is in standalone mode so you can enter paddle commands. Read the standalone keyer section of the WKUSB manual for complete information on that procedure.

Now for host mode testing, we have to consider a USB driver. Almost all WIN7 and WIN8 PCs now ship with the FTDI FT232RL USB driver preinstalled. So in those cases you can just plug WKUSB in and go. If you do need to install a USB driver, carefully follow the instructions found on the WKUSB CD in the USB_DRIVER directory.

To start host testing, attach WKUSB to the PC's USB port with the supplied USB cable. This will apply power to the USB interface IC and the PC will detect it and assign it a com port. You will need to know what the port number is in order to configure applications to run with WKUSB. Here are the steps to follow to find 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.

WK3demo is a good application to use to test out WKUSB host mode. It can be found on the WKUSB CD in the WK3DEMO directory. Install the application and start it up. With WKUSB attached, set the com port by clicking on setup. Only the active com ports are shown which makes port selection easy. After entering the comport click "Open". After a second or two a connect message will be displayed along with the WK3's firmware revision. If this does not happen, there are two possible errors that you may encounter:

openCom: Open Failed: Invalid or non existent com port

openCom:Success Attach WK: No Echo: There is a problem with the USB interface. This can also happen if the speed pot is not connected.

It's very unlikely that you will see the second error since the USB port is tested at the factory. If you do, check that the USB connector is soldered correctly and that there aren't any shorts between the four signal connectors. Check that the USB cable is properly inserted at both ends.

Once you get WK3demo connected you can enter letters into the lower window and they will be sent by WKUSB. You can experiment with different settings by clicking on "Setup". Now it's time to assemble the enclosure.

Possible Problems:

WKUSB does not send an R when powered up:
Measure the voltage between pin 1 and 14 on the WK3 IC. You should see about 4.0 volts or one diode drop less than the battery voltage. It's possible that the WK3 IC is functioning but the sidetone speaker circuit is at fault.

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 (R5, R7, R9, and R11).

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

WKUSB responds to command pushbutton press with an L instead of an R: Low battery voltage

Here are instructions for installing the WKUSB-SMT 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) Attach the speed pot to the single hole on the front of the enclosure.
3) 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.
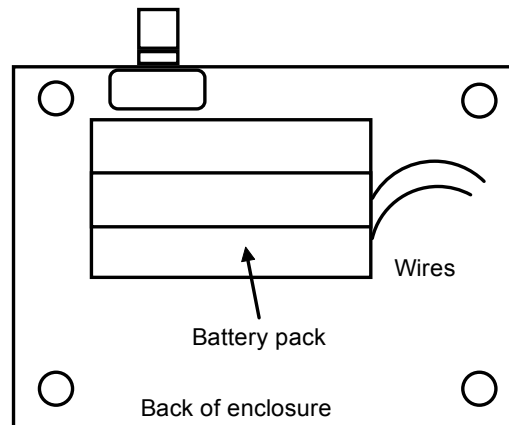

Figure 12 – Installation of battery pack
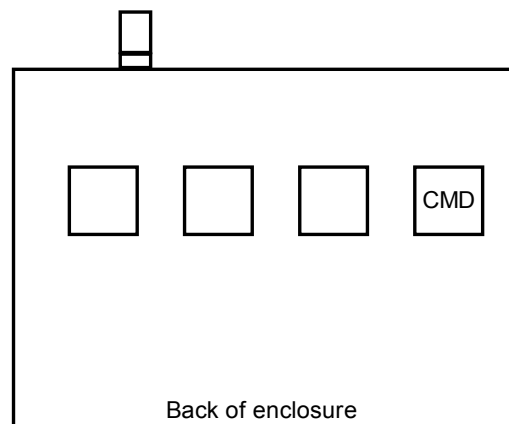
Figure 13 – Command button location

4) 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.
5) 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.
6) It is 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.
7) This completes the assembly.

Precautions when connecting kit to a rig

NOTE !!! : WKUSB uses solid state relays which are 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**
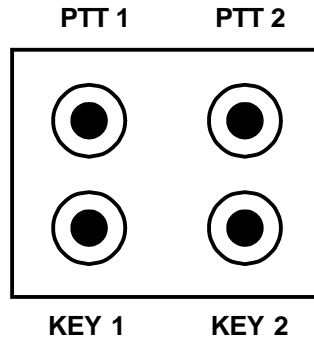
Fig 6 – Back Panel View of Output Ports

There are several RF filter points included in the WKUSB circuit design. Capacitors on the key and PTT lines shunt RF from coming back through those lines. C1 and C4 shunts any RF arriving over the paddle leads. C5 shunts any RF arriving over the speed pot leads. These components also reduce RF radiation from WKUSB. The RCA jack block is electrically isolated from the WKUSB circuitry. This is for both safety and RF interference reasons. In some installations it may be necessary to provide an AC path from the RCA jack block ground to the enclosure ground. Two capacitor locations X1 and X2 are provided for this purpose. Be sure to use capacitors with a rating of 250V or higher to prevent shorting due to very high potentials.

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.

Speaker

VCC

Q1
MMBT3904

R1
68

C3
.1uF
50V

GND   GND

SP1
1 SP1+
3 SP2+
2 SP2-
4 SP2-

ICSP Connector

VCC

J4
1 VPP
2 VDD
3 GND
KEY1   4 ICSPDAT
PTT1   5 ICSPCLK
        6 AUX

GND

Speed Pot Connector

R6
470

C5
.0047uF
10%

GND

J2
1 SP1
2 SP2

GND

C2
.001uF
50V

GND

PB_NET

C9
.1uF
50V

GND

VCC

Winkeyer3 IC

U2
PTT1 13 RA0   VDD   RC0 10 PTT2
KEY1 12 RA1   RC1 9   KEY2
PB   11 RA2   RC2 8   ST
TIP   4   RA3   RC3 7   SP
USB   3   RA4   RC4 6   TX
RING 2   RA5   VSS   RC5 5   RX

16F1825

14

GND

SLEEP_L

CMD_TX

R4
470
KEY_2

R8
470
PTT_2

R10
470
KEY_1

Paddle Connector

J1

VCC

R2
4.7K
1%

R3
4.7K
1%

tip
ring
shell

GND

C1
.001uF
50V

C4
.001uF
50V

GND

R12
470
PTT_1

CMD_RX

Title
WKUSB_SMT - Keyer PIC

Author
Steven T. Elliott
K1EL Systems

File		Document
F:\NewStuff\WKUSB_SMT\WKUSB_SMT.dsn		R0077

Revision	Date	Sheets
01	July 15, 2013	1 of 3

USB Connector

Mounting Holes

Battery Connector

USB Interface

BAV70LT3G

VCC_USB

L1
1uH

C14
.1uF
50V

C12
.1uF
50V

DA1

C15
.1uF
50V

CMD_TX

CMD_RX

J6   USB_A

USB A

VCC	1
USBDM	2
USBDP	3
GND	4

SHIELD 5
SHIELD 6

GND

CHAS

MH_125 H3
MH_125 H2
MH_125 H1
MH_125 H4

GND

U4   FT232RL

4   VCCIO
20 VCC

16 USBDM
15 USBDP

8   NC
19 RESET_L
24 NC
27 OSCI
28 OSCIO

17 3V3OUT

TXD   1
RXD   5

RTS_L   3
CTS_L   11
DTR_L   2
DSR_L   9
DCD_L   10
RI_L   6

CBUS0   23
CBUS1   22
CBUS2   13
CBUS3   14
CBUS4   12

25 AGND
7 GND
18 GND
21 GND
26 TEST

C11
.1uF
50V

GND

SLEEP_L

R13
4.7K
1%

GND

GND

BAV70LT3G

VCC

FILTERED_USB_VCC

J5

| POS | 1 |
| NEG | 2 |

DA2

C13
4.7uF
16V

GND

GND

| Title |
| WKUSB SMT - USB I/F |
| Author |
| Steven T Elliott |
| K1EL Systems |
File		Document
F:\NewStuff\WKUSB_SMT\WKUSB_SMT.dsn		R0077
Revision	Date	Sheets
01	July 15, 2013	2 of 3

KEY_2

PTT_2

U1
1 AN1   COL1 8
2 CA1   EM1   7
3 AN2   COL2 6
4 CA2   EM2   5
AQW210EH

Optically Isolated
Dual Solid State Relay

GND

C7
.001uF
250V

C6
.001uF
250V

X1   Populate for RFI reduction
.001uF
CHAS

J3
1 PORT_A_SIG
2 PORT_B_SIG
3 PORT_AB_GND
4 PORT_C_SIG
5 PORT_D_SIG
6 PORT_CD_GND
RCA_4_BLOCK
4 Way RCA Jack

KEY_1

PTT_1

U3
1 AN1   COL1 8
2 CA1   EM1   7
3 AN2   COL2 6
4 CA2   EM2   5
AQW210EH

Optically Isolated
Dual Solid State Relay

GND

C10
.001uF
250V

C8
.001uF
250V

KEY & PTT OUTPUTS

X2   Populate for RFI reduction
.001uF
CHAS

VCC

R5
4.7K
1%

PB_NET

S1
CMD

S2
MSG2

R7
2.2K 1%

S3
MSG3

R9
2.2K 1%

S4
MSG4

R11
2.2K 1%

GND

PUSHBUTTON SWITCHES

Title
WKUSB SMT - I/O
Author
Steven T. Elliott
K1EL Systems
File
F:\NewStuff\WKUSB_SMT\WKUSB_SMT.dsn
Document
R0077
Revision
01
Date
July 15, 2013
Sheets
3 of 3

Winkey SMT PCB Rev 01 Layout
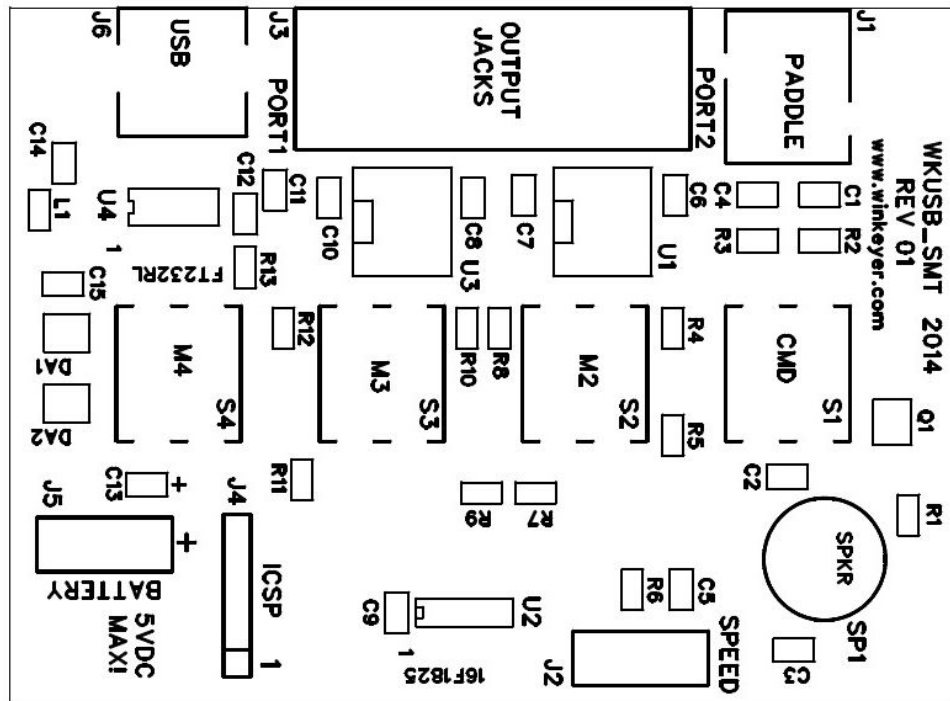

Figure 8 – WinKey USB SMT PCB Check Plot

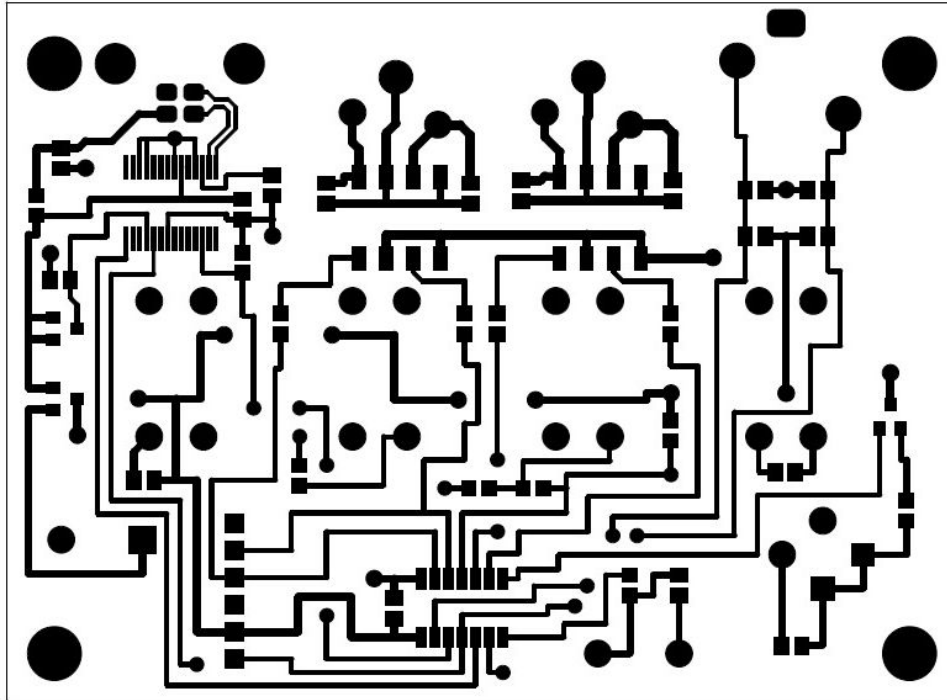Figure 9 – WinKey USB PCB Silkscreen
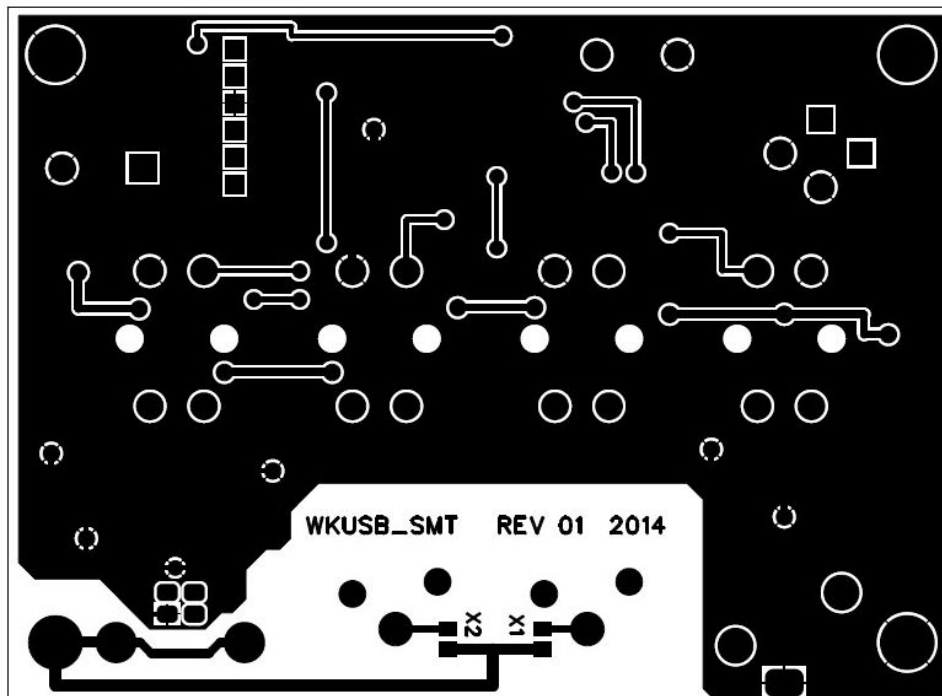
Figure 10 - WinKey SMT USB PCB Component Side

Figure 11 - WinKey USB PCB Solder Side

Standalone Considerations

Here's a list of things to know about standalone operation.

1) When WKUSB 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 WKUSB up to the Windows application WK3MGR. This is on the CD in the WK3MGR directory.
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 **P** command.
4) When WKUSB is connected to the USB port, the PC recognizes the USB device and registers it but WKUSB remains in standalone mode until an application opens it. The only serial commands WKUSB will accept while in standalone are ADMIN commands.
5) WK3MGR works by directly reading and writing the EEPROM in the WK3 IC. The EEPROM contains all of the standalone settings and local messages. Since the EEPROM is accessed by ADMIN commands, WKUSB can remain in a closed state.
6) When an application opens WKUSB, WKUSB leaves standalone mode and will no longer responds to the command pushbutton making it impossible to enter paddle commands.
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 WK3MGR when another application is connected to WKUSB.
9) When the host application closes WKUSB , standalone operation is restored and the EEPROM settings are reloaded.