

USB Warbler

Build this interface and operate your radio from a single USB port

The majority of new laptop computer manufactures' have abandoned serial and parallel ports in favor of one or more USB ports. This presents a problem for the digital mode operator who is accustomed to using a serial port to control the radio's PTT function. The amateur is faced with either discarding his old interface or buying one of the new USB interfaces. However, building a USB adapter is not as hard as you might think.

How It Works

This project describes how one USB port can provide all of the signals necessary to operate a transceiver in digital mode (excluding CAT control) from a Windows XP computer. By making use of low cost "Plug & Play" adapters the cost is kept to a minimum. First, a four port USB hub splits the incoming USB signal. A USB to serial adapter plugged into one hub output provides the necessary PTT switching between transmit and receive. A USB audio adapter (which contains a 16 bit soundcard) is plugged into a second hub output. The audio adapter's input and output are then isolated and attenuated to present the transceiver with optimum signals. As a bonus, this setup frees the computer's internal soundcard to do other tasks.

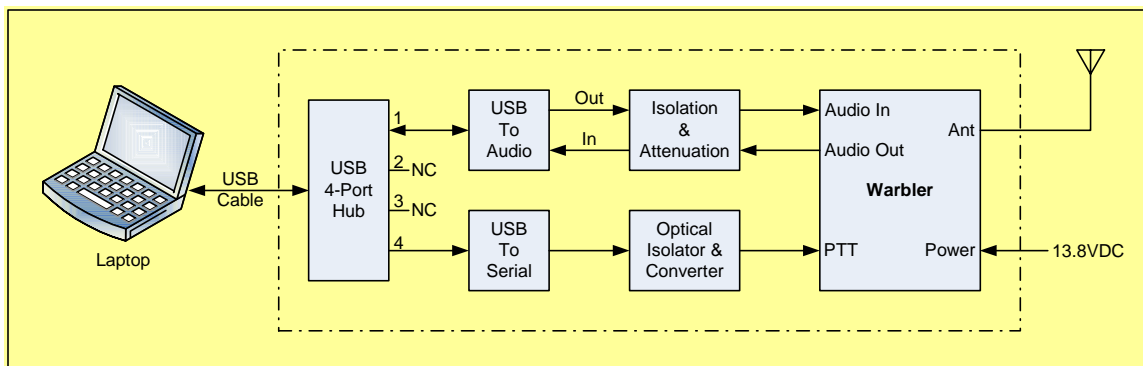


Figure 1

The PSK-80 Warbler¹ is a great kit and I enjoyed putting it together. After completing the kit I decided to add this USB interface and place the assembly in one enclosure. To prevent any Warbler modifications, connectors were used for all inputs and outputs as well as a special circuit for the serial interface. The result is a stylish but larger than normal enclosure.

One important point in favor of the Warbler is that it uses a dedicated serial line to switch the radio from receive to transmit. This is much more dependable than the VOX method which will trigger the radio's PTT when *any* sound is present.

4-Port USB Hub

A 4-port hub² was chosen because the 2-port versions are getting hard to find. The hub was modified by first removing and discarding the plastic case. Next, the captive pigtail USB cable was unsoldered and replaced with a USB-B jack. This action allows the use of a standard USB cable, with a USB-A plug on one end and a USB-B plug on the other, (see Figures 2A, 2B, and 2C). The hub is then attached to the enclosure mounted perf board with the jack protruding out of the rear panel. A plastic 2-56 x 1/4" screw and nut secures the hub and will not short out any of the traces on the hub circuit board.

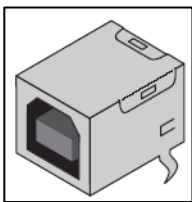


Figure 2A
USB-B Jack



Figure 2B
USB-A Plug

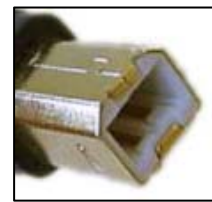


Figure 2C
USB-B Plug

USB Serial Adapter

Two different brands of USB serial adapters were tested with mixed results. The first was a GUC232A from IOGear which worked flawlessly. Before plugging in the adapter, install the driver from the included CD or from the manufacturer's website. The second adapter was a much cheaper version obtained through a popular on-line auction site. The adapter worked but had a COM port assignment problem. After installing the driver using the included CD, the adapter was plugged into each of the laptop USB ports to check the COM port assignments. Previous COM port assignments would remain even though the device was unplugged. These unused assignments did not clear until the laptop was rebooted.

If you plan on using DigiPan³ software there is one caveat that needs addressing. DigiPan supports serial ports COM1 through COM9⁴. Selection of the COM port depends on which USB hub output the serial adapter is plugged into. On my 4-port hub, output-1 came up as COM9, with the next three outputs assigned to COM10, 11, and 12, respectively. Therefore, the serial adapter was plugged into output-1 and DigiPan configured to use COM9. MixW⁵ does not have this limitation as it supports ports COM1 through COM31.

A female DB9 connector (J4) is mounted on the perf board to accept the USB serial adapter plug. A single conductor shielded cable wired to the circuitry on the perf board terminates in a female plug (P5) which plugs into the Warbler.

USB Audio Adapter

Two different brands of USB audio adapters were tested with mixed success. The first was an Altec Lansing adapter that came with their USB headset (AHS304usb). This adapter worked well, although some inherent noise was visible on the waterfall at regularly spaced intervals. Fortunately, the noise level is low and does not interfere with operation. This adapter uses the C-Media CM108 chip.

The second adapter (from a popular on-line auction site) labeled “3D Sound” did not perform as well. Reduced volume levels and considerable distortion was observed on the audio output. This was especially true when only one side (left or right) was selected via the Windows volume balance slider. It is possible that a different driver is needed but the adapter did not include a driver CD. This adapter uses the ELAN EKA85 series chip. Choose an adapter that comes with a driver CD for Windows XP to ensure compatibility.

A shielded cable with two 1/8” stereo plugs was cut in half and used to interface the audio adapter to the isolation and attenuation circuitry mounted on the perf board. A similarly cut cable makes the connection from the perf board circuitry to the Warbler audio input and output jacks.

Audio Isolation, Attenuation, and PTT Isolation

The circuitry to provide audio isolation/attenuation and PTT isolation is based around the KK7UQ Interface Model II⁶. Included in this design is a small speaker to monitor the outgoing signal. Speaker volume is controlled via the Windows Soundcard WAV balance control, and toggle switch S2 switches the speaker on and off.

The Warbler is designed to accept a true RS-232 signal with approximate receive and transmit levels of -10V and +10V, respectively, between the RTS and Ground pins. The USB Serial Adapter is powered from the USB port and is limited to 5V signals. First, isolation is provided by running the USB serial signal through a 4N33 optical isolator which inverts the polarity at its output. An RS-232 driver/receiver (MAX232) is then used to invert the signal from the optical isolator and convert it to a Warbler compatible bipolar signal. LED2 indicates transmit mode and will turn on when the PTT level is +7V (see Table 1).

Warbler PTT Interface					
USB Serial Output		4N33 Output		MAX232 Output	
Rx	Tx	Rx	Tx	Rx	Tx
0V	5V	5V	0V	-7V	+7V

Table 1

Power Supply

An external 13.8VDC supply powers the Warbler and associated circuits. A low current 5V regulator (LM78L05) is used to power the MAX232.

Warbler Mounting

In an effort to allow room for the interconnecting cables, the Warbler circuit board is mounted beneath the top of the enclosure using 1-1/8" nylon standoffs with 4-40 hardware. A right-angle BNC connector with a short length of RG-8X coax connects the Warbler antenna output to an SO-239 connector mounted on the rear panel.

Initial Setup

Ensure that all USB adapter drivers have been installed. Connect the computer and USB Warbler using a standard USB-A to USB-B cable. Allow some time for Windows to detect and load the USB hub, USB audio, and USB serial drivers. When this is complete run DigiPan and click on Configure. Under PTT Interface, select the appropriate COM port (in this case, COM9) and OK. Under Sound Card, ensure that the sound card selected for digital mode use is the USB audio adapter.

Initially, set the Windows volume control microphone input and wave output to mid level, then use the Waterfall Drive and Transmit Drive controls to fine tune these levels.

Testing

A coax-fed 80 meter dipole was used for initial testing. The antenna was trimmed to resonate at 3.580 MHz to minimize losses. Using a QRP wattmeter, the output was observed to peak at about 4 watts. The Transmitter Drive control was then adjusted to the point where the RF output just stopped increasing and then backed down slightly. This minimized IMD distortion but also reduced the output to 3 watts.

I was happy to learn that 3 watts was enough to establish several contacts. Contacts ranged from 30 to 200 miles with good signal reports.

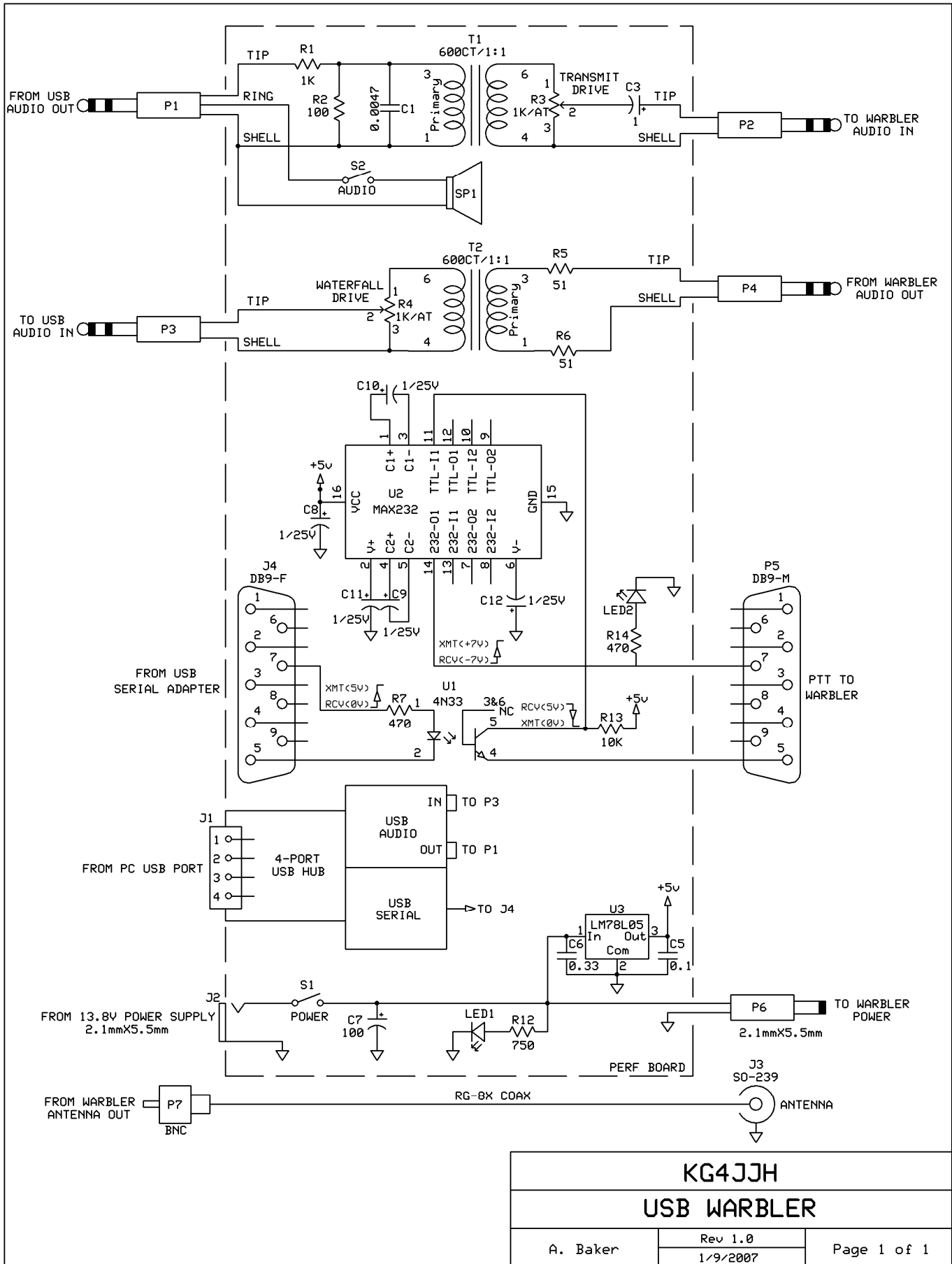
Wrapping Up

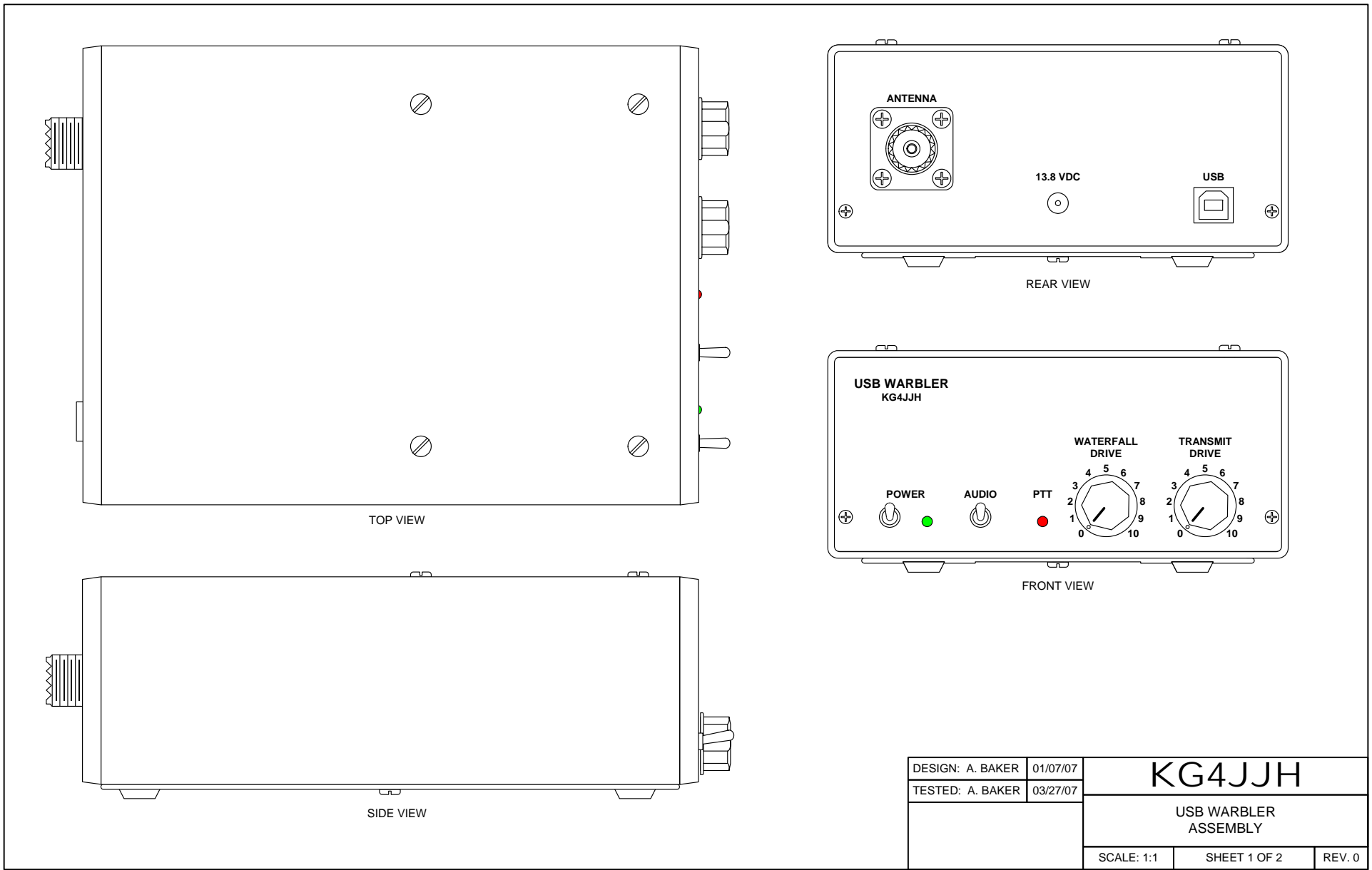
This project demonstrates a practical method for adding a USB interface to any radio using economical "Plug and Play" devices. And, while not as fancy as some of the newer units, it will get you on the air with a quality signal. The interface protects against RF entering the computer by incorporating audio isolation transformers and an optical isolator. The PTT function is performed by a true RS-232 serial link to the rig. To demonstrate that the laptop's soundcard was unencumbered, I popped in a CD and listened to music while calling CQ.

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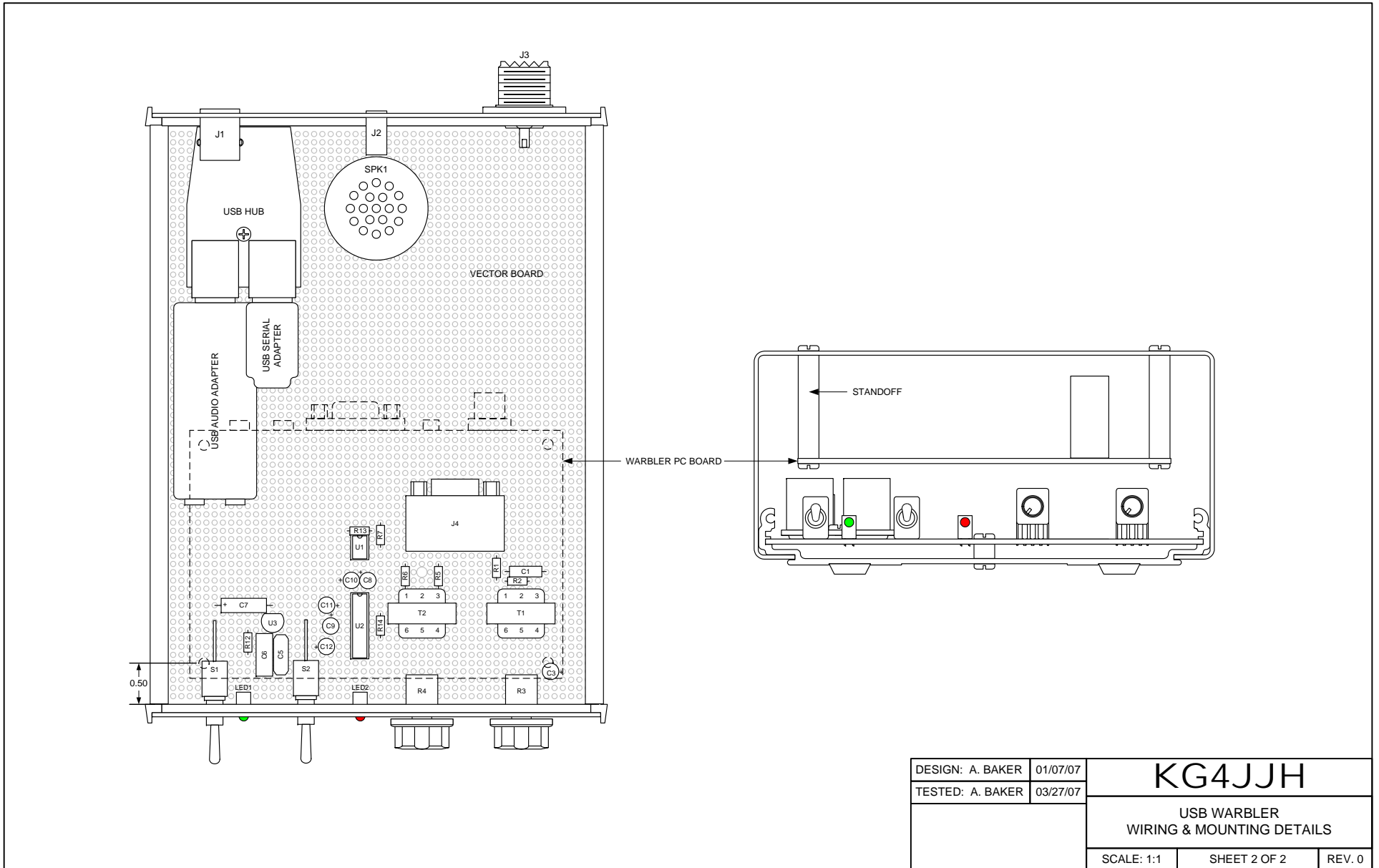
Notes

1. Dave Benson, K1SWL, “The Warbler”, <http://smallwonderlabs.com/>
2. 4-Port USB Hub, Micro Innovations, \$10 at Wal-Mart.
3. DigiPan, H. Teller, KH6TY, N. Fedoseev, UT2UZ, and D. Nechitailov, UU9JDR, <http://www.digipan.net/>
4. To view assigned COM ports in Windows XP, go to Control Panel, System, Hardware, Device Manager, Ports (COM & LPT).
5. MixW, N. Fedoseev, UT2UZ, and D. Nechitailov, UU9JDR, <http://www.mixw.net/>
6. Clint Hurd, KK7UQ, “Isolating Sound Card Interface for SSB Transceivers”, <http://kk7uq.com/html/download/Manual2E.pdf>





DESIGN: A. BAKER	01/07/07	KG4JJH		
TESTED: A. BAKER	03/27/07			
		SCALE: 1:1	SHEET 1 OF 2	REV. 0



DESIGN: A. BAKER	01/07/07	KG4JJH		
TESTED: A. BAKER	03/27/07			
		SCALE: 1:1	SHEET 2 OF 2	REV. 0