



# The Black Box ToolKit

*Serious about science: Serious about timing*

## The Black Box ToolKit 4 Button USB Response Pad with Slider/Fader v1



Credits:

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Covers the following hardware:

The Black Box ToolKit 4 Button USB Response Pad with Slider/Fader

For the following platforms:

Microsoft Windows XP SP3, Vista SP2 (32/64), Windows 7 SP1 (32/64)  
Windows 8 (32/64), Windows 8.1 (32/64), Windows 10 (32/64), Windows 11 (64)  
Mac OS 8/9, OS-X  
Linux 2.4 and greater

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## Introduction

The USB Response Pad with slider/fader is designed to work as a fully Plug In & Play millisecond accurate keyboard and runs at Full Speed USB 2.0. This makes it easy to integrate with your own scripts and software and enables it to be tested in a simple text editor.

It can function in three different modes as outlined below. Each mode offers a subtly different way of reporting button status and slider position.

In each mode the buttons operate identically to a standard response pad, or keyboard, where a keystroke is repeated whilst the button is held down.

Depending on mode the slider position is reported slightly differently. To allow different Likert Scales it is possible to set the slider granularity from 2 to 32 positions in Mode 1 & 3. In mode 2 the slider can report up to 1024 different positions for fine grain assessment of movement. Each mode allows for various configuration options to be set, e.g. how long the slider needs to before a position report is output.

In all modes to request the current slider position press and release the Scroll Lock key on your keyboard or send a Scroll Lock API call via your own experiment to mimic a key press and release. The current slider position can be requested from the response pad by pressing and releasing the Scroll Lock key. This can either be done physically or through an API call. To switch the response pad into another mode you will need to use the Tools | Startup Options... menu.

### MODE 1

By default buttons will produce keystrokes, 1, 2, 3 & 4. Whilst a button is held down the key will repeat until released as if you held a key down on a standard keyboard.

The slider will produce a continuous stream of key presses and releases for each of the 32 positions it is moved, i.e. (left) abcdefghijklmnopqrstuvwxyz[]/;' (right). This is independent of the status of the physical buttons and keystrokes produced.

### MODE 2

By default buttons will produce keystrokes, a, b, c & d. Whilst a button is held down the key will repeat.

The slider will produce a 4 digit number followed by a return keypress, i.e. CRLF, for each of the 1024 positions it is moved once stationary, i.e. from left to right: 0000 to 1023. This is independent of the status of the physical buttons and keystrokes produced.

### MODE 3

By default buttons will produce keystrokes, 1, 2, 3 & 4. Whilst a button is held down the key will repeat.

The slider will produce a key press and release for each of the 32 positions it is moved once stationary, i.e. (left) abcdefghijklmnopqrstuvwxyz[]/;' (right). This is independent of the status of the physical buttons and keystrokes produced.

## Troubleshooting

Regardless of operating mode you are advised to check functionality at the start of each experimental session before you begin to collect data using the Windows App or a plain text editor.



## Button Up Debouncing

A built in debouncing window means that a button must be cleanly up for 25ms before a button/key up keystroke is sent. This means that button down durations will be elongated by +25ms. Response Times (RTs) are unaffected as they are registered on the leading edge of a button down.

## TTL Event Marking and Triggering via Digital Input and Output Ports

Two RJ 45 sockets provide for digital TTL I/O. These can be used for event marking button down events and for encoding slider position in Binary Coded Decimal. In addition two TTL Input Trigger lines are also provided. By using these two ports it is possible to event mark or trigger in EEG and Eye Tracking studies for example.

## 4x TTL Out

Each of the four buttons produce a +5V active TTL signal using the RJ45 socket (pins 1-4 = But 1-4, pin 8 = GND). TTL signals from the four primary buttons will be elongated by +25ms due to button up debouncing.

## Slider TTL Out/2x In

The position of the slider in Mode 1 and Mode 3 are represented in Binary Coded Decimal using five +5V active TTL lines (pins 1-5, pin 1 = u, 2 = 2, 3 = 4, 5 = 8 & 5 = 16). Two TTL input lines (pins 6 & 7) can be used to produce a keystroke. Pin 8 = GND.

## External Response Buttons

Up to four external push-to-make buttons can be connected via the 3.5mm mono sockets labelled But 1 to But 4. WARNING: Use of poor quality external buttons may adversely affect timing accuracy.

## App and firmware Updates

To download the Windows App, for firmware updates & support please visit [www.blackboxtoolkit.com](http://www.blackboxtoolkit.com).

## Worked example

Often researchers need to measure more than simple button presses in Judgement and Decision Making studies. Currently there are no easy to use response pads for measuring nite judgements across Likert Scales.

Our new USB response pad with slider, or fader like those used in music recording studios, allows for up to 1024 positions over a 15 cm track. Slider position is reported as either a series of standard keystrokes or as a number between 0 and 1023 followed by return. For EEG studies TTL Event Marking lines allow for the position of the slider to be reported alongside button status.

By moving the slider left or right the participant has the opportunity to make finer decisions. In addition to the slider up to four buttons can be located anywhere on the lid. A selection of colors and formats are available along with clear caps under which labels can be inserted. There are also sockets for up to 4 external buttons

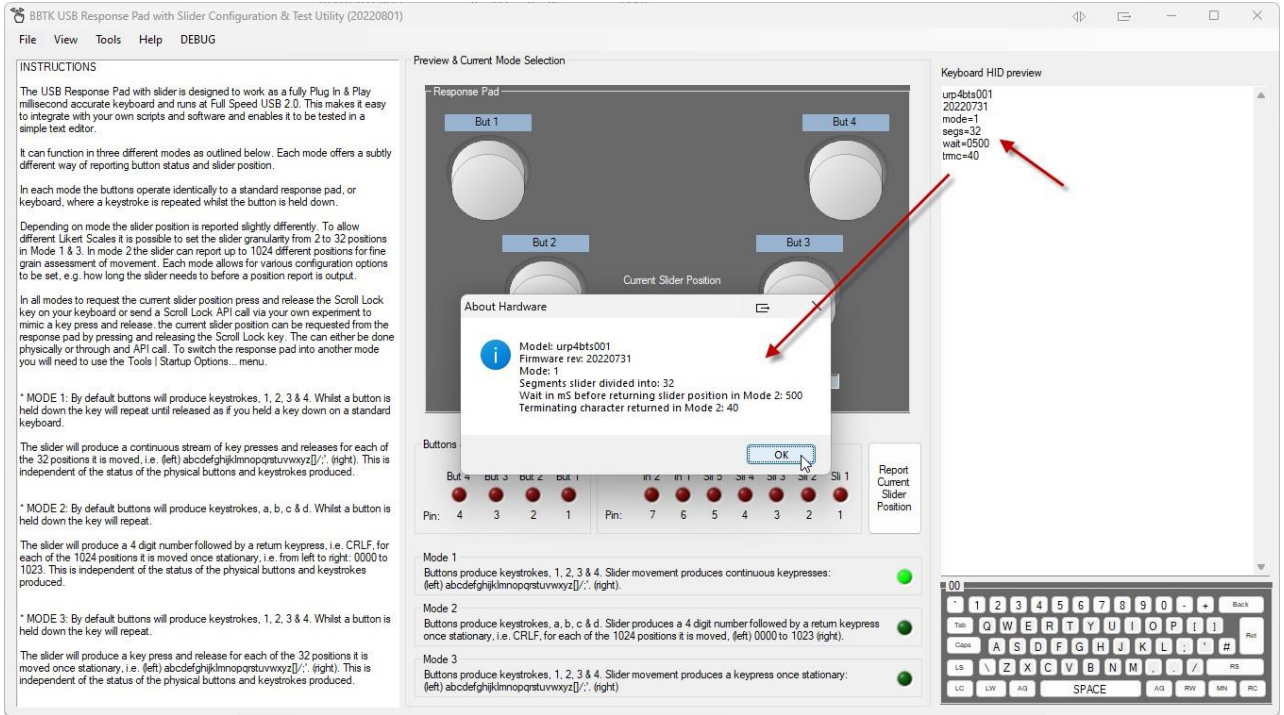
Shown below is a simple worked example illustrating how to use the 1-4 button USB response pad with slider/fader. It is intended to give you a flavour of how the URP Slider could work for you and how easy it is to use.

### ***Step 1: Running your experiment, presenting stimuli and collecting responses***

This example will be using our URP Slider partner App in place of an actual experiment to more clearly illustrate the concepts involved and how the slider position and button presses are reported as keystrokes to your experiment.

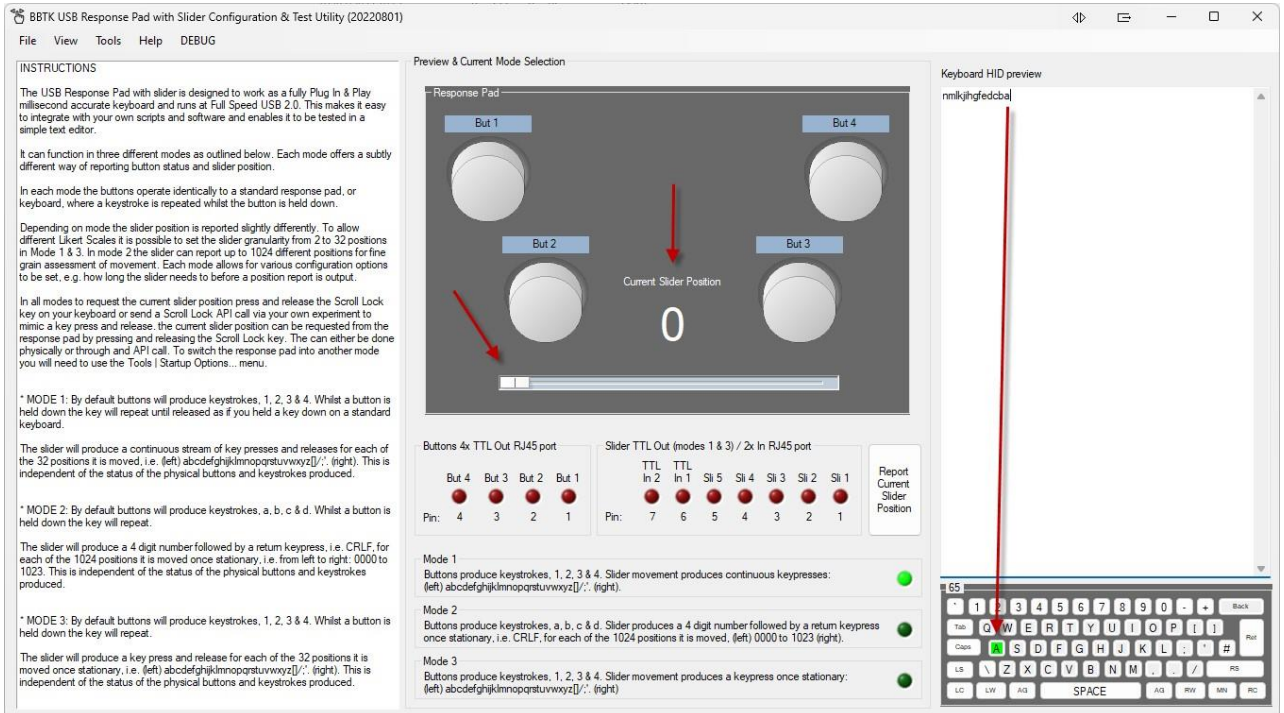
Once you are familiar with the concepts it should be relatively simple to integrate it within your own study. In this example we are going to look at rating how happy you are on a Likert Scale and then moving on to the next question using the top right button.

When first plugging in the response pad you can request its current settings by pressing the NUMLOCK key on your keyboard. The settings will be typed back to your PC as though they had been typed into a text editor on a keyboard. If you had a text editor open when you pressed NUMLOCK you would see them typed as shown on the right below in the Keyboard HID preview window.



**Step 2: Working out where the slider is positioned before you start your experiment**

Before your experiment starts you should move the slider around before moving back to a known position. Generally the slider is moved back to the far left, or position 0 (zero) as shown below. If you move to position 0 and no buttons are pressed all TTLs will also be 0 V. This can be done in our App as shown below or at the start of your experiment and only needs to be done once.





**Step 3: Presenting a question and making a rating on a****Likert Scale**

Remember that the URP Slider works just like a keyboard so in your experiment you only need to monitor for the last key pressed when the slider is moved. Generally one of the buttons is used to accept the response/rating and move on to the next question.

For example, you might present a mood based question like the one shown below:

Q1. Move the slider to show how happy you currently feel?



Sad



Happy

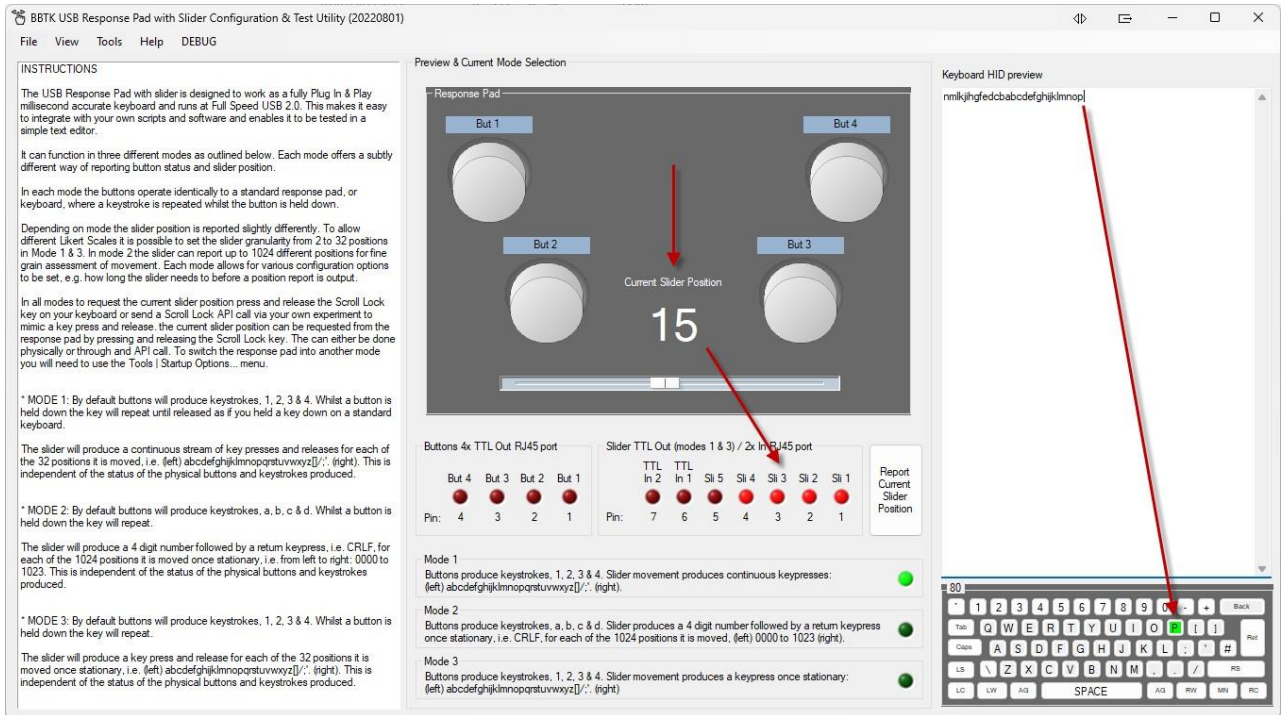
Your participant might move the slider to somewhere in the middle as shown in the URP Slider App below. Here we can see that the slider has been moved to position 15, which is around the mid point. The last character to be typed would be the letter "p" once the slider had stopped moving.

You can also see that 4 TTL lines from the 5 bit port are lit representing the slider position as a binary value 01111 or 15. If you were using an EEG it would be possible to feed these into the the Digital Trigger In port so that you stored a value and marker for the response.

Decoding slider position values is easy as all you need to do is convert the TTL binary encoding to decimal using the table below.

In this case the slider position is  $1 + 2 + 4 + 8 = 15$ .

Decimal	16	8	4	2	U
Binary	0	1	1	1	1



**Step 4: Accepting a rating**

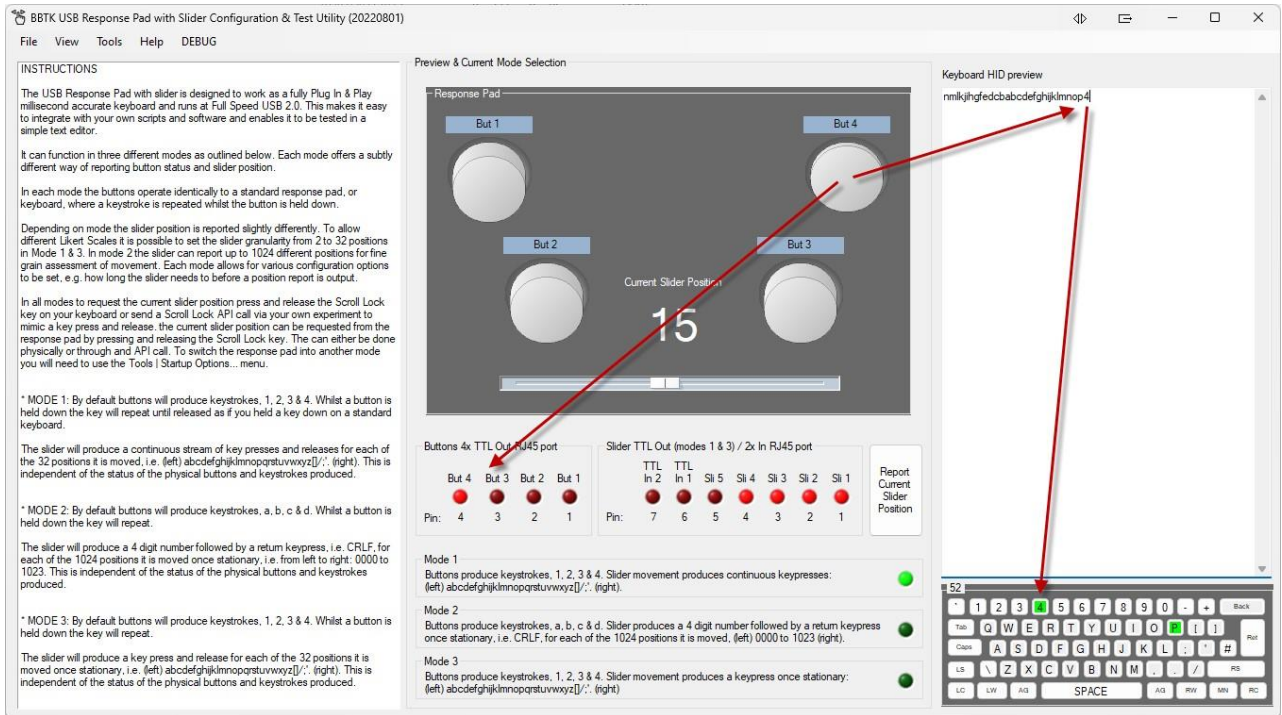
To accept a rating you could wait for a button press in your experiment. In this case button 4 is used to accept the rating and move on to the next question. In the URP Slider App below we can see when the button is pressed as a number 4 is typed.

In your experiment you would store the last character, a "p" or position 15, once you saw a number 4 being typed.

Pin 4 on the button TTL port would go to +5 V to indicate the button was being pressed. It would also be possible to take this button press as a response in order to record a response time in your experiment.

TTL pin	4	3	2	1
Button	4	3	2	1





**Step 5: Moving on to the next question and storing slider position**

When moving on to the next question you would already know where the slider was positioned if no movement was made, i.e. still at "p" or position 15. So if button 4 was pressed in response to the question below and there was no letter change, you would know that the slider was still at position 15. If any other letters were received then you would know that the slider had moved.

Q2. Move the slider to show how happy you NOW feel after thinking about a day or event you enjoyed?



Sad



Happy

**Going further with the URP slider**

Depending on the mode you are running the URP Slider in you could have between 2 to 1024 slider positions rather than the default 2-32. This could allow for very fine grain judgements.

You could easily provide visual feedback of slider position in your experiment as all you would need to do is assign a typed letter to an on-screen position.

As the URP Slider also has 2x TTL Trigger In inputs you could also use it to mark or synchronize with other equipment.

Finally you also have the choice of three modes when running the URP Slider as shown below. This enables you to choose how you want the slider position reported to your experiment and how ne grain you want the slider position to be.

