The Black Box ToolKit

Serious about science: Serious about timing

The Black Box ToolKit v2

Robotic Key Actuator Guide

Rev. RC2 (20130214) Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.

Credits:

Author: Dr. Richard R. Plant, C.Psychol, CSci, AFBPsS

Covers the following hardware:

The Black Box ToolKit v2 Robotic Key Actuator

For the following platforms:

Microsoft Windows XP SP3, Vista SP2 (32/64), Windows 7 SP1 (32/64)
Windows 8 (32/64)

Contact details:

The Black Box ToolKit Ltd
PO Box 3802
Sheffield
S25 9AG
UK

Phone: +44 (0)114 303 00 56
Fax: +44 (0)1909 561 569

Email: info@blackboxtoolkit.com
support@blackboxtoolkit.com
sales@blackboxtoolkit.com

Web address: www.blackboxtoolkit.com

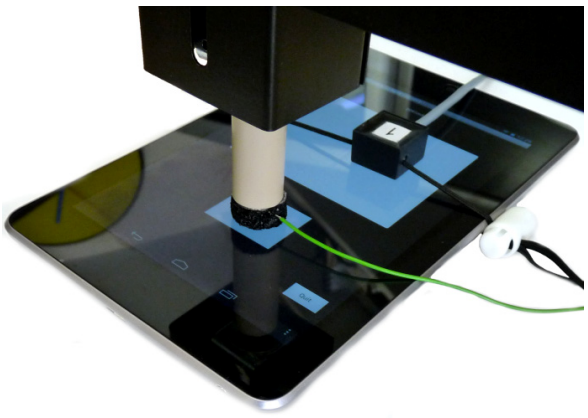
Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.

Contents

 Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.

1. Introduction

The Black Box ToolKit Robotic Key Actuator (RKA) enables you to trigger your own response devices, e.g. keyboards, capacitive touch screens etc., without the need to disassemble them. It provides a simple alternative to using the BBTK's Active Switch Closure (ASC) method where two wires need to be physically fixed to your own keys switch contacts.



The RKA is a activated by sending a TTL output on TTL Out 1 in response to a stimulus trigger, e.g. a visual stimulus detected on one of the Opto-detectors. When activated it will press the key, or touch screen, for the duration you specify.

Although the RKA is designed to be as consistent as possible as with any mechanical device there is a start-up latency which needs to be taken into consideration and subtracted from the target Response Time (RT) you instruct the BBTK to generate. The start-up latency is the time needed for the RKA solenoid to begin to move and ultimately complete a press using the plunger. The start-up latency is established via a simple calibration routine each time you use it.

You should also pay close attention to how you position the finger relative to the key or screen area you wish to press. We recommend positioning the RKA centrally over the area you wish to press and have a consistent air gap. The air gap between the RKA and the

Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.

key, or touch screen, can be consistently set using the included fixed height shim which is approximately the thickness of a coin.

Finally you must ensure that the RKA is fitted with its conductive foam shock absorbing pad at all times. This High Density conductive foam pad helps prevent key bounce and improves consistency. If testing capacitive touch screens such as those found on Apple iPad's, Android Tablets, Microsoft Windows Surface etc. it can be grounded to ensure touches are registered correctly.

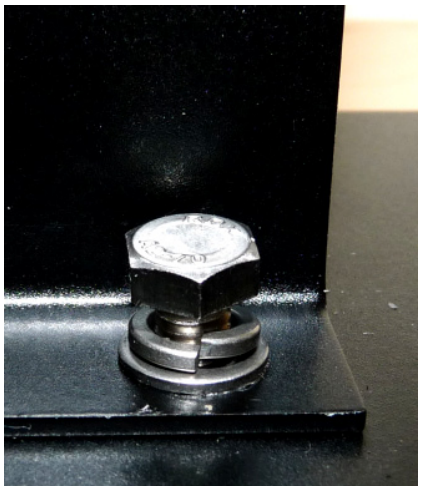
You are advised to check the integrity of the pad each time you use the RKA and replace the High Density conductive foam with the same type using thin double sided tape. Replacement pads and tape are available to order from our website.

3.1 Assembly Instructions

Before you can use the RKA its weighted feet need to be attached to the gantry.

To do this lay the weighted feet on a flat surface so that they match the photo shown above.

Use the M5 bolts to attach each foot to the gantry so that it is aligned centrally as shown in the photo opposite.



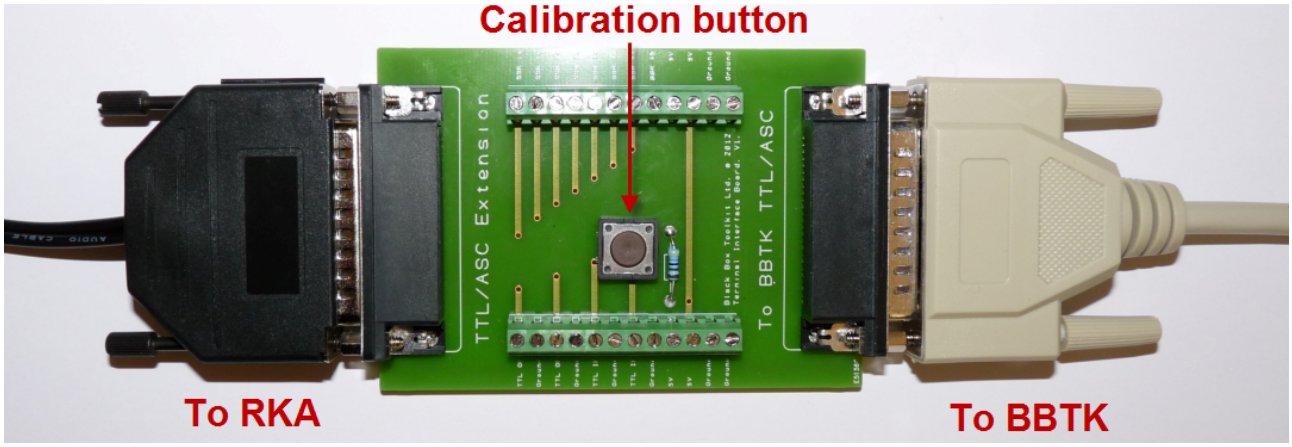
Use an appropriately sized spanner, wrench or socket to tighten each bolt so that the RKA is stable and matches the photo of a fully assembled version.

The split washer should rest next to the bolt head followed by the standard washer as shown.

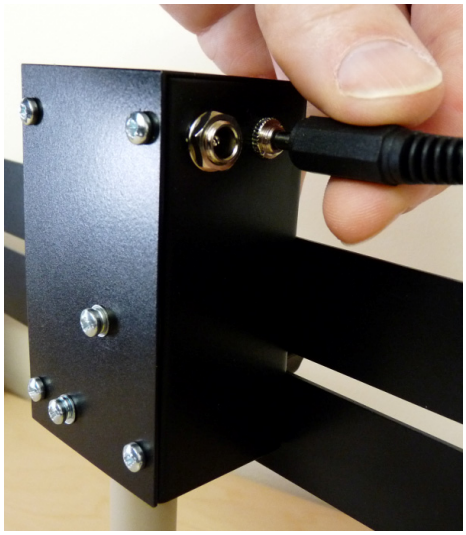
Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.

2. Connecting the Robotic Key Actuator to the Black Box ToolKit

The RKA comes with its own Breakout Board which replaces the standard one supplied with the BBTK. It is functionally identical but has an additional calibration button which is used to establish the mechanical start-up latency and recoil time. The Breakout Board is connected to the BBTK as normal. The RKA TTL Trigger Lead is connected to the TTL/ASC Extension socket as shown on the left below. Note you should not wire anything to either TTL In 1 or TTL Out 1 on the Breakout Board whilst using the RKA.

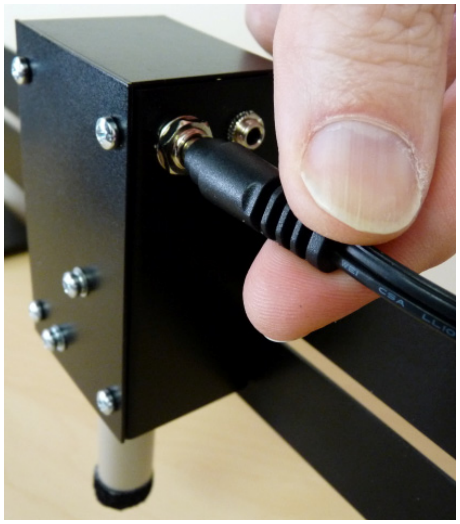


The RKA TTL Trigger Lead is permanently wired to TTL Out 1 from BBTK via the 25-way TTL/ASC extension port.



Plug the 3.5mm RKA TTL Trigger Lead jack into the 3.5mm socket on the solenoid enclosure.

Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.



Next plug the 24v Power Supply lead into the power socket on the moveable solenoid enclosure which is affixed to the gantry bridging your response device.

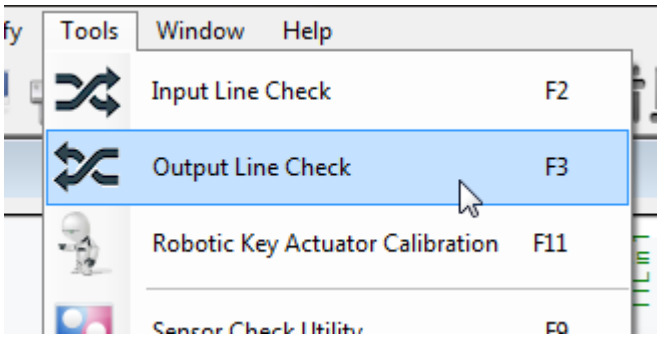
Once everything is connected you can turn on the power to the RKA.

WARNING: Only use the Power Supply Unit shipped with the RKA. Also ensure you do not use the RKA PSU with the BBTK. Any damage caused by use of incorrect Power Supplies is not covered by our standard warranty.

The RKA PSU a switch mode power supply that outputs 24v (with a positive centre pin). It will work on mains supply voltages 100v-240v and is suitable for use in most regions.

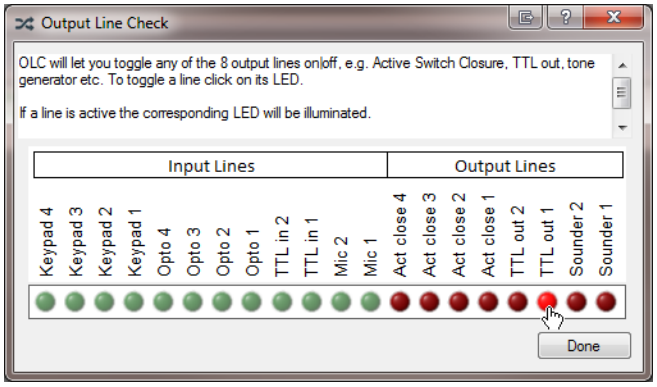
The BBTK RKA is not supplied with a mains power lead.

You will need to source a IEC C13 female lead (IEC 60320). These are standard computer power supply leads that will be terminated in a plug suitable for your regions mains power company's outlets. You should ensure that this is has a 3A fuse (where applicable).



To test the RKA is working correctly start the Output Line Check utility in the PC software by pressing F3 or by selecting it from the Tools menu.

Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.



Each time you click on the TTL Out 1 LED the RKA should activate and stay active until you click on the LED again. That is, it should press and then release.

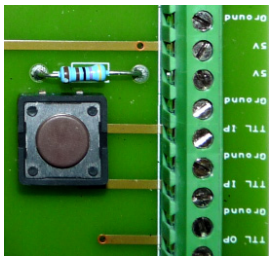
When you have finished click Done.

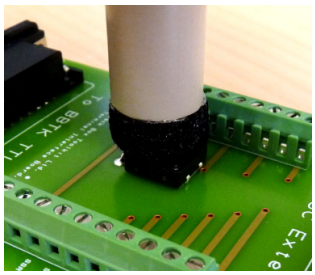
When the RKA is not in use you are advised to turn off its power supply.

Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.

3. Calibrating the Start-up Latency for the RKA

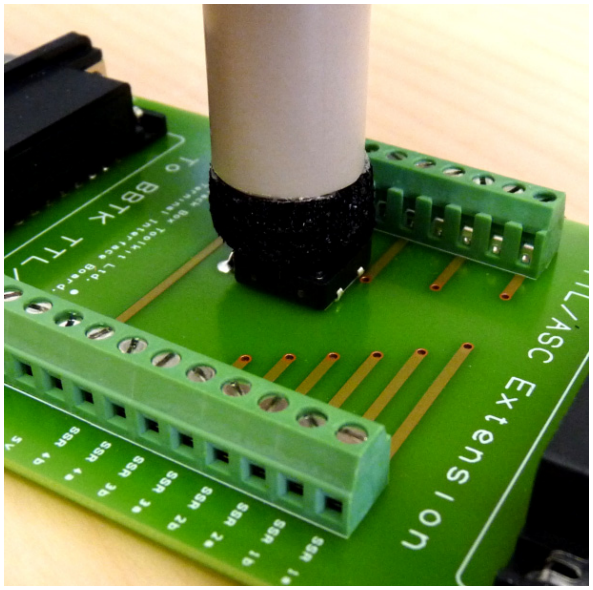
Because the RKA is a mechanical device you are advised to calibrate it each time you use it. This establishes the start-up latency which you will need to subtract from your target Response Time (RT). The start-up latency is the time needed for the RKA solenoid to begin to move and ultimately complete a press using the plunger. For example if the start-up latency is 15ms to achieve a Response Time of 300ms in DSCAR you would need to enter a RT of 285ms (285 + 15 = 300ms).





To begin position the RKA plunger centrally above the Calibration Button on the Breakout Board.

Loosen the thumb wheel to move the solenoid enclosure and plunger left and right across the gantry and vertically up and down. When you are happy tighten the thumb wheel.

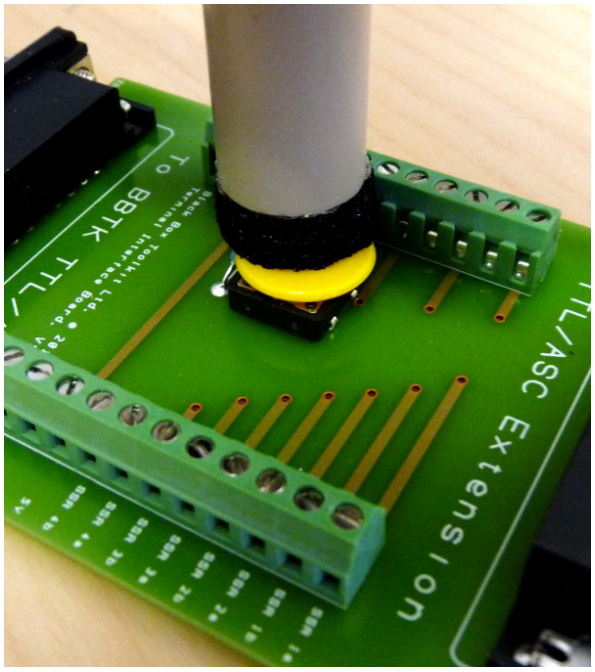


Using the RKA with a Keyboard, Mouse or Response Pad

The foam should rest on the button but should not activate it. You can pull the plunger down manually to test fit and to make sure the button is activated when pressed. When the button is pressed the TTL In 1 LED will illuminate on the front panel of the BBTK.

Note: When you test your own response device key/button you should ensure you position the plunger using this method to ensure consistency.

Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.

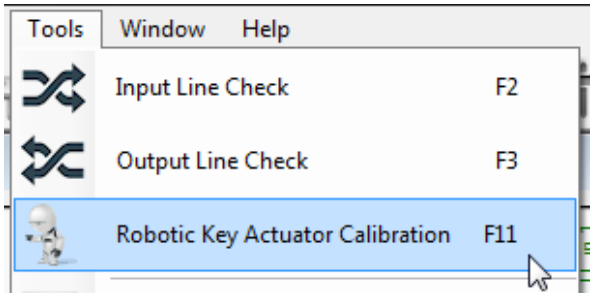


Using the RKA with a touch screen device

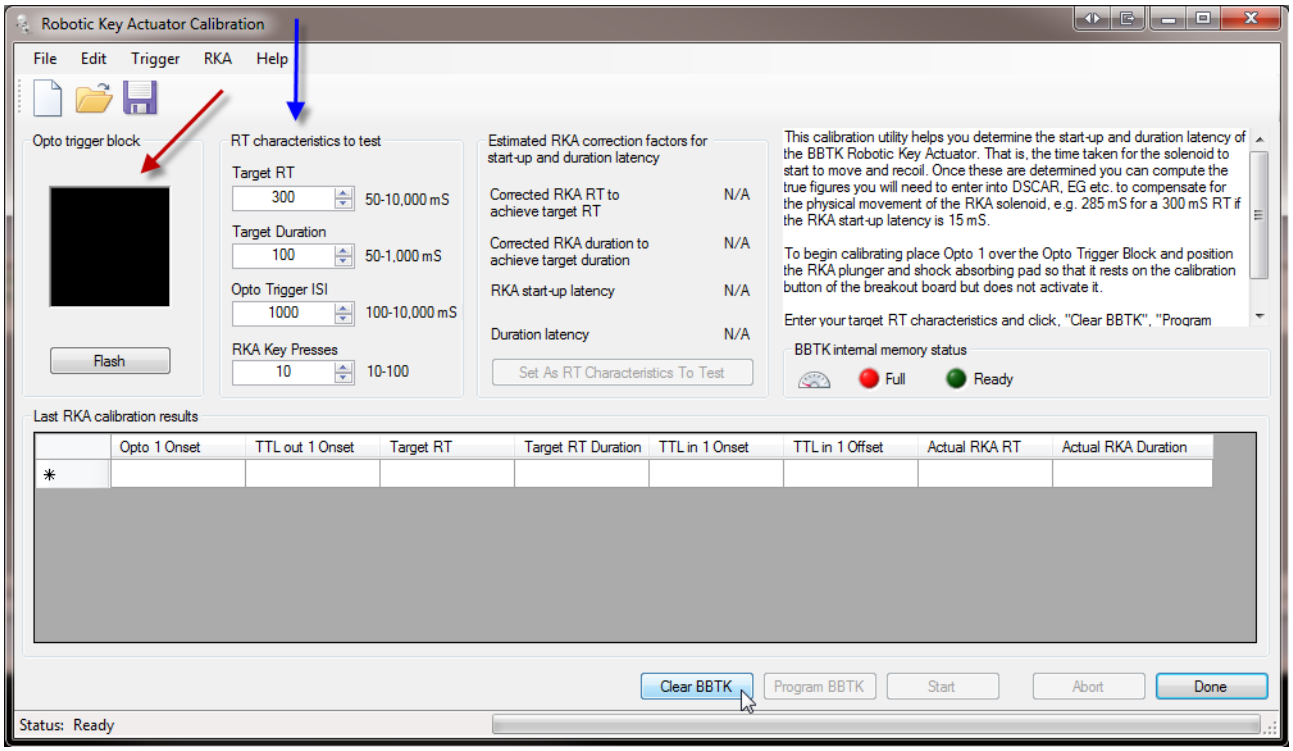
Once centrally positioned insert the supplied insulated shim which is approximately 1mm in thickness (shown opposite in yellow). You need to use the shim to ensure you have a consistent air gap when setting up the RKA with a device such as an Apple iPad or Android tablet.

The foam should rest on this but should not activate the button. You can pull the plunger down manually to test fit and to make sure the button is activated when pressed. When the button is pressed the TTL In 1 LED will illuminate on the front panel of the BBTK. When you are happy with your positioning carefully remove the shim.

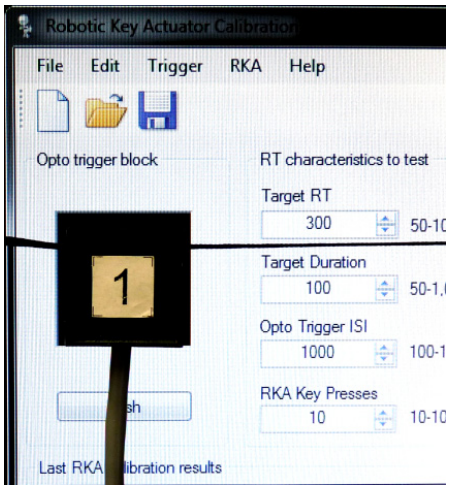
Note: When you test your touch screen you should ensure you position the plunger using the shim method to ensure a consistent air gap before removing it.



To begin calibration start the Robotic Key Actuator Calibration routine by pressing F11 or selecting it from the Tools menu.



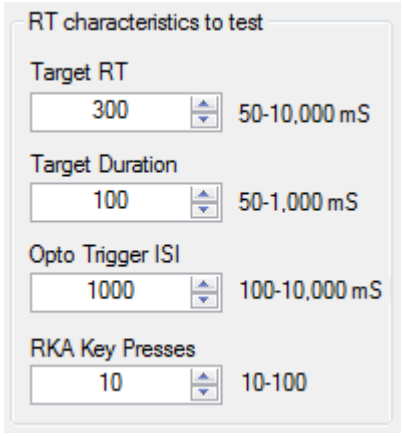
Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.



When the calibration window appears place Opto 1 over the Opto Trigger Block area (red arrow). Initially this will be a black square.

To ensure the Opto triggers correctly click the Flash button and allow it to trigger the Opto as it alternates between a black and white block. The black and white block will alternate at the ISI frequency entered, e.g. 1000ms by default (blue arrow).

If you need to adjust the activation threshold do so now using the Sensor Threshold Manager as detailed in the BBTK User Guide.



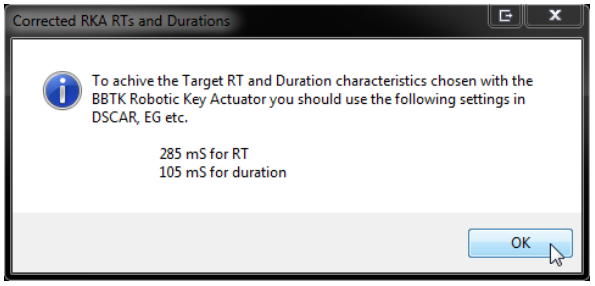
By default the RT which the RKA will try to achieve is 300ms. That is a TTL signal will be sent to the RKA 300ms after the white opto trigger block has been detected on Opto 1.

The RKA plunger will be held down for a duration of 100ms.

It is unlikely that the RKA will be able to achieve these RT characteristics without entering corrected figures to account for mechanical start-up and duration latency.

To determine what these corrected figures are click Clear BBTK, Program BBTK and then Start.

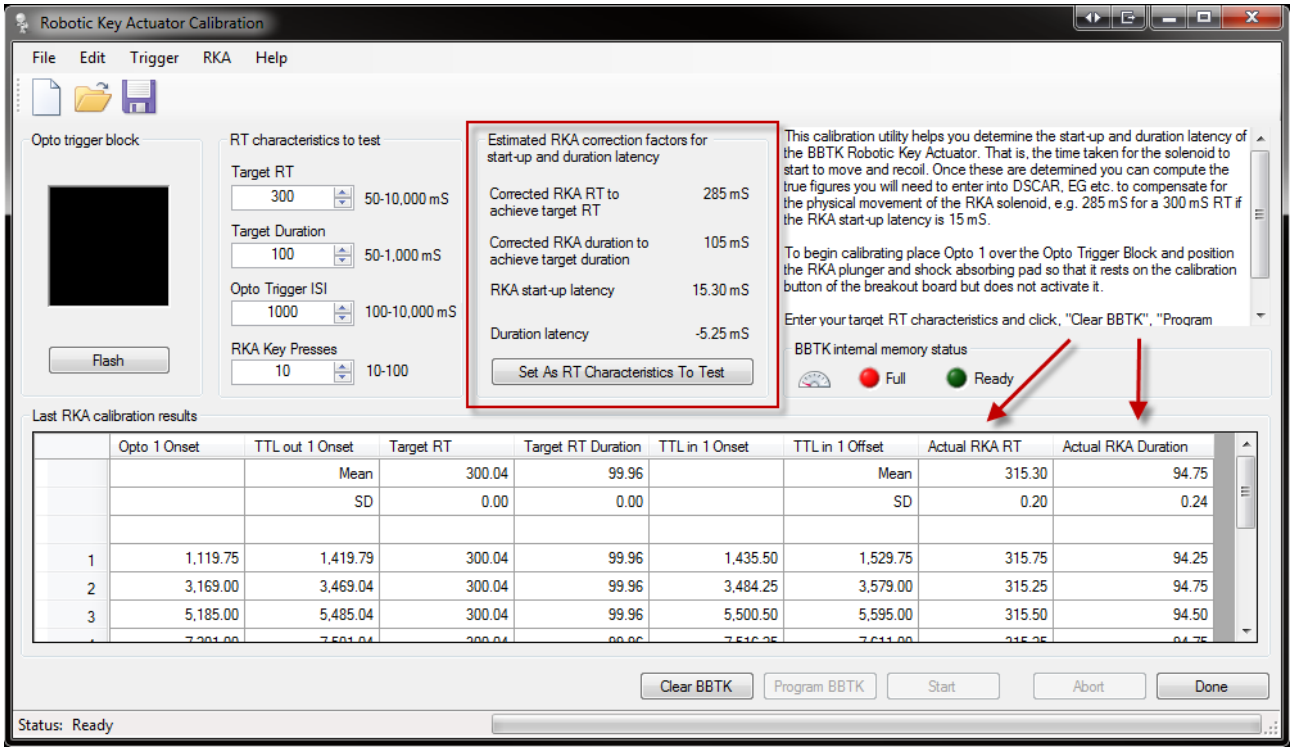
As each visual stimulus is detected a TTL Out 1 signal will be generated in response to activate the RKA and a TTL In 1 will be detected when the calibration button is pressed by the plunger. All three events should appear to occur almost simultaneously as indicated by the LEDs on the BBTK front panel.



Once finished a dialog will popup which shows the corrected times you would need to enter to actually achieve the RT characteristics you entered, i.e. 300ms RT and 100ms duration.

It is these corrected figures that you should use in other BBTK modules when testing your own paradigms, e.g. DSCAR, EG, EGPT etc.

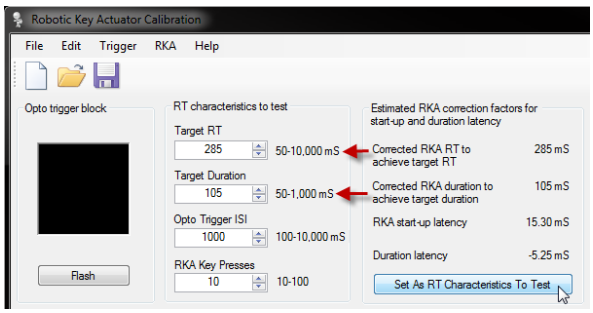
Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.



	Opto 1 Onset	TTL out 1 Onset	Target RT	Target RT Duration	TTL in 1 Onset	TTL in 1 Offset	Actual RKA RT	Actual RKA Duration
		Mean	300.04	99.96		Mean	315.30	94.75
		SD	0.00	0.00		SD	0.20	0.24
1	1,119.75	1,419.79	300.04	99.96	1,435.50	1,529.75	315.75	94.25
2	3,169.00	3,469.04	300.04	99.96	3,484.25	3,579.00	315.25	94.75
3	5,185.00	5,485.04	300.04	99.96	5,500.50	5,595.00	315.50	94.50

Details of the correction factors that need to be used are also shown in the middle frame (red box). In this case the RKA start-up latency was 15.30ms too long and the duration 5.25ms too short to achieve the target RT of 300ms with duration of 100ms.

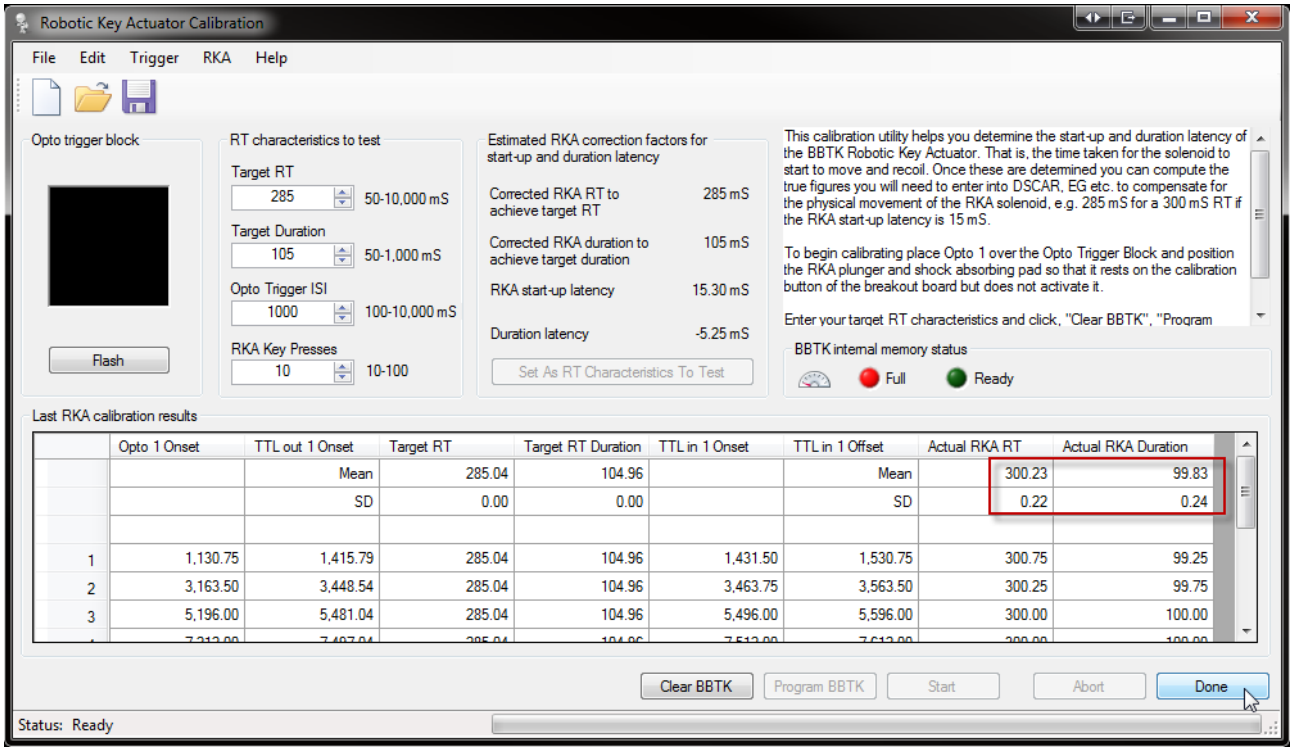
This can be confirmed by examining the Actual RKA RT and the Actual RKA Duration columns of the Last RKA Calibration Results spreadsheet (red arrows)



To verify the corrected figures are suitable you should rerun the calibration routine again after clicking on Set As RT Characteristics To Test. This will copy the corrected figures into the Target RT and Target Duration boxes (red arrows).

To begin click Clear BBTK, Program BBTK and then Start.

Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.



When the calibration run finishes the Actual RKA RT and Actual RKA duration columns should match your original target RT and duration, i.e. 300ms and 100ms respectively (red box). You are unlikely to achieve exact targets as the RKA is a mechanical device and is not comparable to using a more precise TTL to TTL signal.

Occasionally you may need to manually tweak the RT Characteristics To Test by one or two milliseconds and rerun the calibration routine.

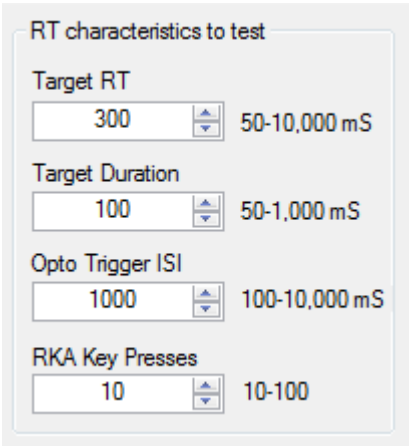
The RKA should be consistent to within 1-2ms if it has been set up correctly. If you cannot achieve this level of consistency you should contact us for advice.

Once you have established your specific RKA start-up latency you are ready to test your response device. When you construct Stimulus-Response sequences in DSCAR etc. remember to use the corrected RKA RT and duration, i.e. 285ms RT and 105ms duration in this example. Remember RTs recorded by your paradigm should equal 300ms and 100ms duration and not 285ms and 105ms.

Note: Always position the RKA plunger exactly as you had it during calibration. Use the supplied shim to ensure you have a consistent air gap if testing a touch screen device and always make use of the supplied shock absorbing High Density conductive foam. If the foam is damaged or squashed it should be replaced.

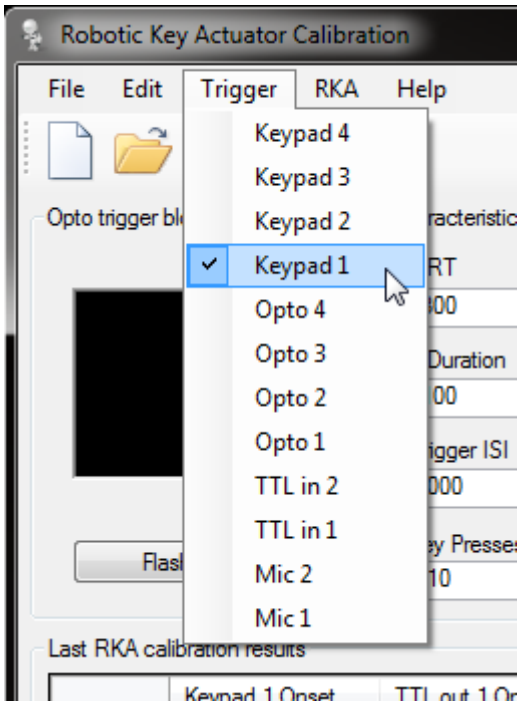
Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.

3.1 Advanced Use of The RKA Calibration Routine



The RKA calibration routine has various settings which can be altered depending on your requirements.

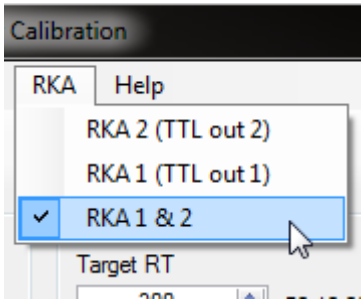
The target RTs can range between 50ms and 10 secs with a duration of 50-1000ms. The Opto Trigger ISI can range between 100 and 10 secs and the number of calibration trials/plunger presses can be between 10 and 100.



You can also change the trigger which signals to the RKA to make a response. In the example shown opposite the BBTK Keypad 1 button is used to trigger the RKA plunger.

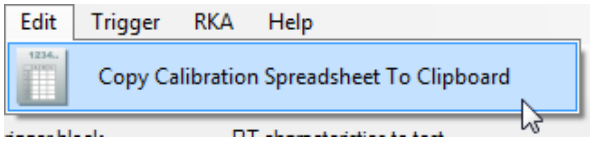
Any of the standard 12 input lines or sensors can be used. However you should ensure that you leave an appropriately long ISI time between triggers. Do not try to trigger while a response is in progress.

By default you should not use TTL In 1 as that is the line to which the RKA calibration button is connected. You are also advised not to use TTL Out 1 as that line activates the RKA plunger.



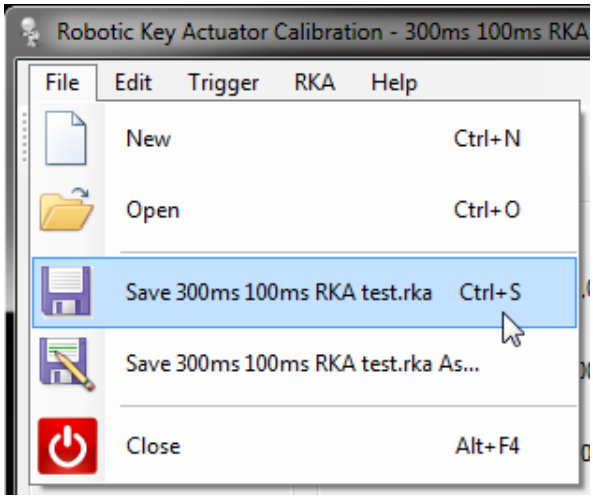
If you have more than one RKA, or would like to simultaneously generate a TTL signal on TTL Out 2, you can change output settings under the RKA menu.

Here a TTL signal will be simultaneously sent to TTL Out 1 and 2. By default the RKA is activated by TTL Out 1.



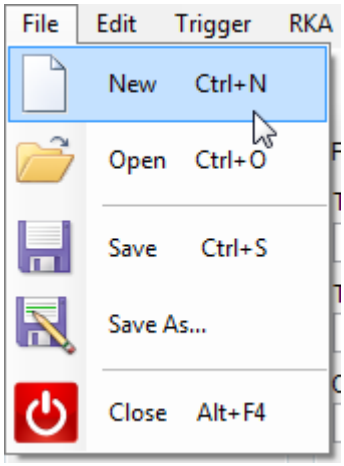
Once you have collected RKA calibration data you have the option to Copy and paste it into a spreadsheet such as Microsoft Excel.

Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.



RT Characteristics To Test can be saved for later calibration runs. By default these are saved with a *.rka extension.

For example if your standard Target RTs are 300ms with a 100ms duration you might choose to load previous RKA calibration settings at 285ms and 105ms duration and recalibrate from that baseline.



To reset the calibration routine to its default settings click on New or press CTRL+N.

You may want to do this if you are testing a new range of potential RT correction factors.

Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.

4. Using the RKA with a Keyboard

Once you have established the inherent start-up and duration latency of the RKA as described in section 3 you are ready to use it to trigger your own response device. It is crucial that you replicate the positioning you used in the calibration phase to ensure identical start-up latency. It is important to note that the RKA does not take into account key travel of your response device. That is, the distance your key needs to travel downwards in order to register a response. The calibration is carried out purely to establish the mechanical start-up latency of the solenoid and plunger and not that of your response device. Typically laptop keyboards have the shortest mechanical key travel as compared with desktop variants.

To begin position the RKA plunger centrally above the key you want it to press.

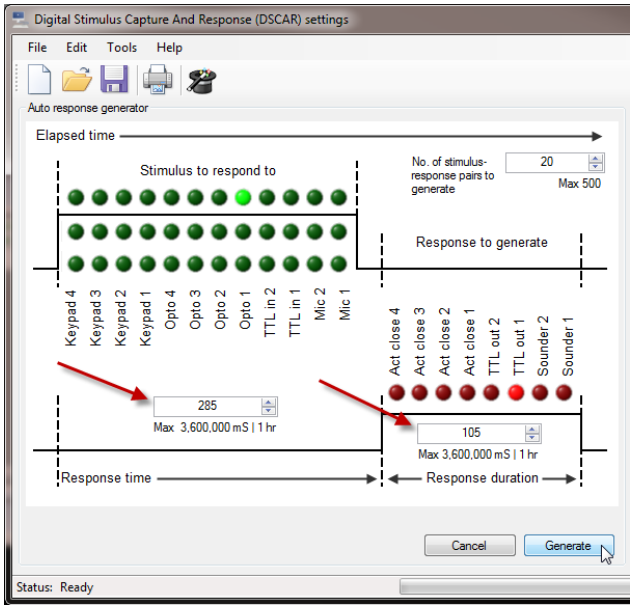
Loosen the thumb wheel to move the solenoid enclosure and plunger left and right across the gantry and vertically up and down. When you are happy tighten the thumb wheel.

The foam should rest on but not activate the key. You can pull the plunger down manually to test fit and to make sure the key is activated when pressed. The aim is to replicate the fit when you calibrated the RKA using its calibration button.

As a final check ensure that the plunger and high density conductive foam do not foul any keys adjacent to them.

WARNING: The Black Box ToolKit Ltd cannot be held liable for any damage caused to devices through use of the Robotic Key Actuator howsoever caused. By using the Robotic Key Actuator you accept sole responsibility for any subsequent damage. The end user should evaluate fitness for purpose prior to using the Robotic Key Actuator with any given device.

Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.



When creating a Stimulus-Response sequence in DSCAR remember to subtract the calibrated start-up latency from the Response Time you wish to test.

In the example shown opposite if the RKA start-up latency was 15ms, the Response Time in this case would be:

285 + 15 = 300ms

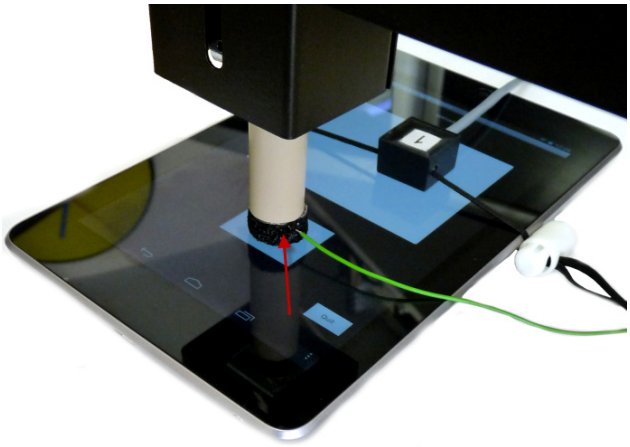
Generally for a standard key tap/touch we recommend a key down/touch duration of 100ms. If your study records the key down/touch duration remember to subtract the calibrated duration latency. In this example the RKA duration latency was -5ms so 105ms has been entered for response duration.

In this example an event on Opto 1 will trigger the RKA which is activated each time a TTL Out 1 event is sent from the BBTK.

Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.

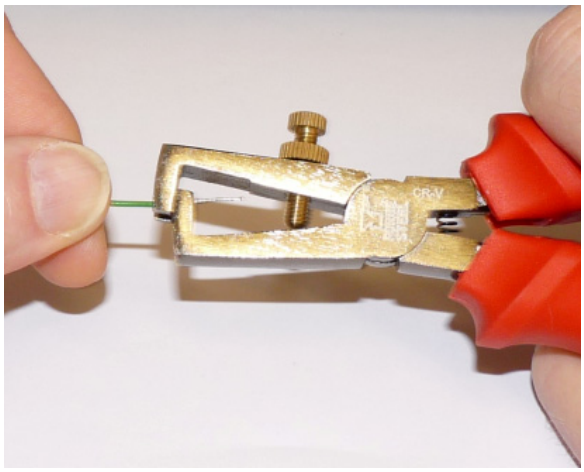
5. Using the RKA with a Touch Screen

Using the RKA with a touch screen is similar in principle to using it to press a key on a keyboard.



In the example shown opposite the RKA has been positioned above an on-screen button. An Opto-detector is positioned over a white marker block so that a RKA response is triggered when using DSCAR. The trigger block will need to switch from black to white when you wish to trigger the RKA.

For a capacitive touch screen to register a response a Grounding Wire needs to be inserted into the High Density conductive foam as shown.



Generally about 1cm, or just under half an inch, of bare Grounding Wire should be inserted into the High Density conductive foam centrally.

If required you may need to strip the plastic sheath back to expose the metal wire.

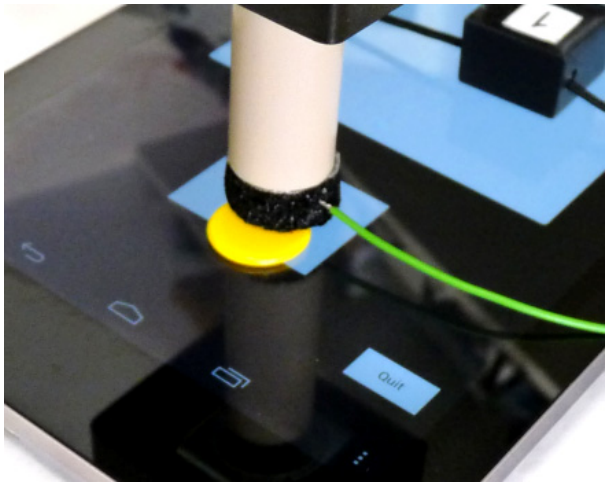
The other end of the Grounding Wire needs to be inserted into a grounding terminal on the Breakout Board. Here it has been terminated in the Ground bottom left of the Breakout Board.

Unless you ground the High Density conductive foam a touch may not be registered correctly by your device.

Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.

To begin position the RKA plunger centrally above the screen area you want it to press.

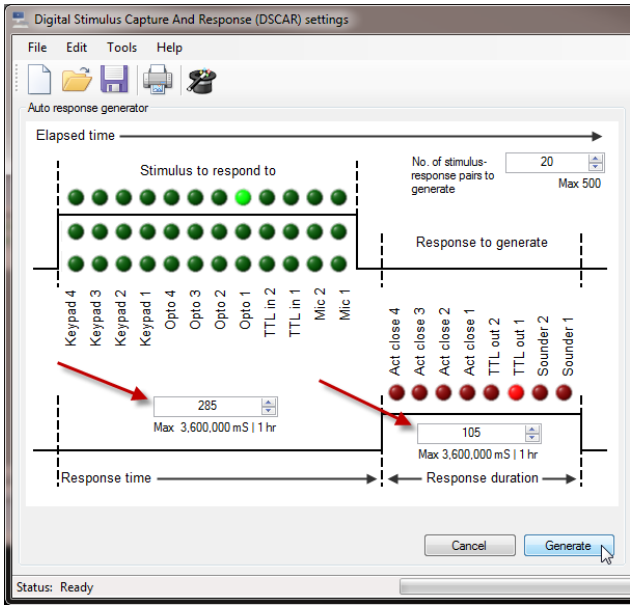
Loosen the thumb wheel to move the solenoid enclosure and plunger left and right across the gantry and vertically up and down. When you are happy tighten the thumb wheel.



Once centrally positioned insert the supplied insulated shim which is approximately 1mm in thickness (shown in yellow opposite).

The foam should rest on this but should not activate the touch screen. You can pull the plunger down manually to test fit and to make sure the touch is registered when pressed. When you are happy with your positioning carefully remove the shim.

This ensures that there is a consistent air gap of the same height to when the calibration tests were done.



When creating a Stimulus-Response sequence in DSCAR remember to subtract the calibrated start-up latency from the Response Time you wish to test.

In the example shown opposite if the RKA start-up latency was 15ms, the Response Time in this case would be:

285 + 15 = 300ms

Generally for a standard key tap/touch we recommend a key down/touch duration of 100ms. If your study records the key down/touch duration remember to subtract the calibrated duration latency. In this example the RKA duration latency was -5ms so 105ms has been entered for response duration.

In this example an event on Opto 1 will trigger the RKA which is activated each time a TTL Out 1 event is sent from the BBTK.

You are advised to check the integrity of the pad each time you use the RKA and replace the High Density conductive foam with the same type using thin double sided tape. Replacement pads and tape are available to order from our website.

Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.

6. Using the RKA with Mice and Other Response Devices

If using a mouse or other response device that is prone to move when pressed using the RKA plunger you are advised to temporally fix it to the desk. This can be done using Blue Tack/Blue Tac/Blu Tac, Silly Putty/Magic Putty or equivalent.

Anything which is used to temporally fix posters to walls should work well when rolled into a ball and compressed against your response device.

In the example opposite the left mouse button will be pressed by the RKA.

Any movement of the mouse is prevented by the Blue Tack anchors which surround the device.

Note how the plunger and solenoid enclosure has been adjusted to an angle appropriate for reliably pressing the mouse button (red arrow).

Remember that you should carry out the RKA calibration routine with each response device you test.

Note: If you are holding mice or other response devices stationary using this method you should ensure that they do not move during testing. If the air gap increases significantly this could affect recorded Response Times adversely.

WARNING: The Black Box ToolKit Ltd cannot be held liable for any damage caused to devices through use of the Robotic Key Actuator howsoever caused. By using the Robotic Key Actuator you accept sole responsibility for any subsequent damage. The end user should evaluate fitness for purpose prior to using the Robotic Key Actuator with any given device.

Copyright © 2013 The Black Box ToolKit Ltd. All rights reserved.