

## Throttle Quadrant Information

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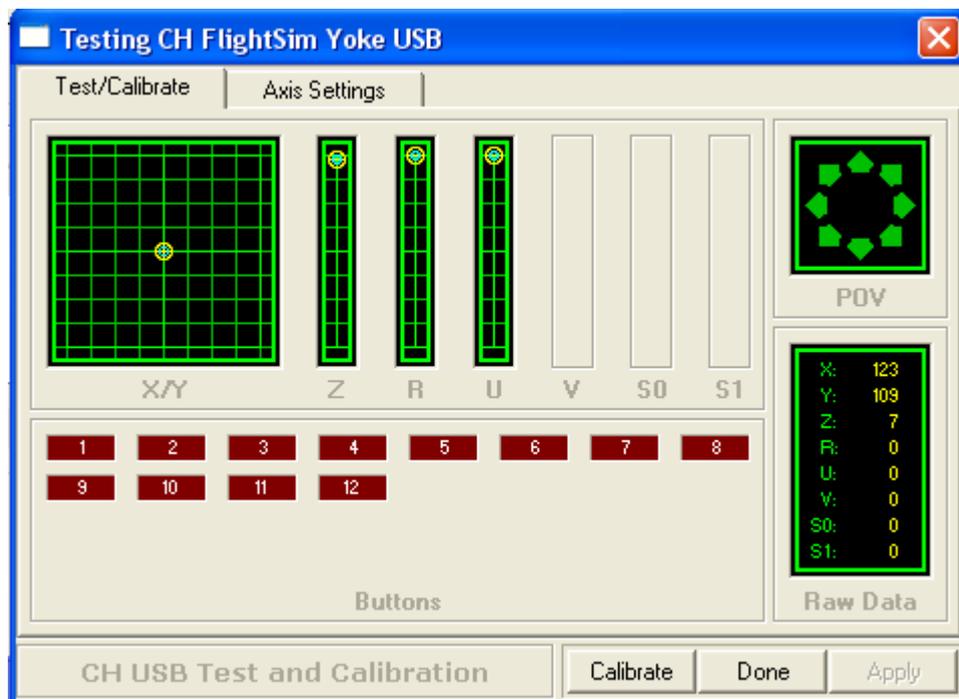
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Commercially available Throttle Quadrants are very expensive and most hobbyists need a great deal of justification to go out and buy one. For the serious builder though they are a 'must have' item to replicate the cockpit of your chosen aircraft.

This document discusses and will hopefully instruct you in the workings of a **USB** device. You never know, it may even inspire you to build a TQ of your own.

Most people are familiar with a Joystick or Flight Sim Yoke. The most popular is probably the CH Products one. These sticks or yokes control certain functions in your flight sim by using AXES. The value on the AXIS is set via a variable potentiometer (usually 100kohm resistance) which controls at which part of the axis the assigned function should be at.



Here's a shot of the CH Products Control Manager from which you calibrate your Yoke (or Rudders). Remember the word Calibrate, it is very important.

On the USB CH Yoke, there are 5 AXES. X,Y,Z,R and U. These by default control the Elevators, Ailerons, Throttle, Mixture and Propellor Pitch. However, they don't have to. You can assign these AXES to any function within FS which requires an AXIS to drive it. For example Flaps, Spoiler,Rudder etc. But let's leave well alone with the CH Products Yoke it's working and that's where we want to stay with it.

OK, here's the deal. For a TQ, you will need 5 AXES as follows...Throttle 1, Throttle 2, Spoiler, Flaps and Reversers (a registered copy of FSUIPC is used to set the reversers, but will not accommodate a separate reverser for each engine, so we just use 1).

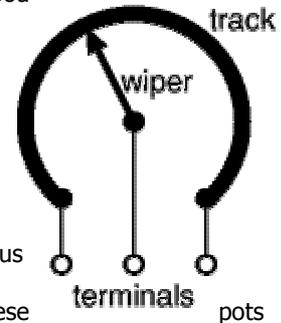
Now there are several options available to you to connect your AXES to FS. What I did was to 'strip out' 2 SAITEK Cyborg Joysticks, each having 4 AXES, that gave me a total of 8 AXES from which I could choose (it also gave me 3 spare for expansion in future versions of MSFS). What I wanted was the control cards from them to which I was going to attach my 100kohm variable potentiometers.



Left is an illustration of a typical variable potentiometer. There are two main types, Rotary and Slide. Notice it has three terminals. Usually the centre terminal is for the Wiper. How it works is like this. The two outside terminals are generally joined together with a carbon or Metal Composite track. The wiper moves along the track and changes the resistance between the two end terminals. It is this change that is read by the control card and sent to the computer as a value. We are talking here about very simple

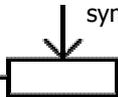
Carbon Track LINEAR variable potentiometers which are available from any good Electronics Hobby Shop very cheaply.

Right is a basic diagram of a variable potentiometer. Usually USB devices apply 5v d.c. to the two outside terminals and as the resistance changes when the wiper is moved along the track, so the resultant voltage changes which is read by the wiper and sent to the computer as a value.



OK to re-cap, we know that we need a joystick to control the AXES of any given function. We know that the joystick has built into it several variable potentiometers and a control board.

It then follows that if we have the control board on the workbench in front of us And we connect our own variable potentiometers to the corresponding leads from the board, we should be able to control functions in MSFS by rotating these backwards and forwards.....agreed? OK good.

This is the  symbol for a variable potentiometer. The arrow represents the wiper. It is important that you pay special attention when connecting the wiper that it is indeed connected to the correct connection. The other two leads can be connected any side of the pot. There are several options in both MSFS and FSUIPC to reverse the Axis. However for your information, by changing the two outside leads around, you will change the way the pot sends its value. That is to say when connected, it increases in value when turned clockwise, if you swap the two outside leads, it will decrease.....Get it? You do, Great :o)

OK, the moment of truth. You have your control card with the 100k pots connected. You now need to Plug it into a spare USB port on your computer. With Plug & Play USB devices, your computer should find your card and tell you New Hardware Found and it is installing the drivers for it and finally inform you that your new hardware is installed and ready for use.

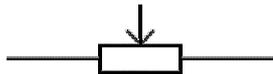
OK, now go to Control Panel and then Game Controllers. You now need to CALIBRATE the Card/Stick. I am going to assume that you actually know how to do this. It's not Rocket Science and of course you will already have done it with the Stick you have.

When you are in the Game Controllers Calibration Menu, you will see that it tells you how many AXES you have at your disposal. Usually 3 or 4. But in the case of the Opencockpits USB Card which I am going to go on and explain about you have 5.

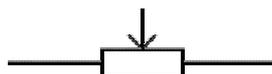
Remember we talked about needing 5 axes for our Throttle Quadrant. Well I used 2 Controller Cards. The Opencockpits Card means that you can simply use that card because of it's ability to deliver 5 AXES control to the MSFS Computer. I like the Opencockpits ideas, they are some very smart guys.



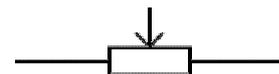
Irrespective of whether you use the Opencockpits Joystick AXES Card or whether you go down the route of using a couple of Joystick Controllers, you will need to Assign the AXES to functions in MSFS.



Axes 1 (X) No 1 Throttle



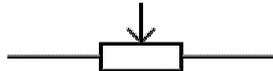
Axis 3 (Z) Reversers



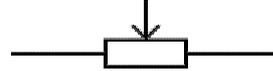
Axis 2 (Y) No 2 Throttle



Axis 1 (X Axis Stick 2 \*\*) Spoiler



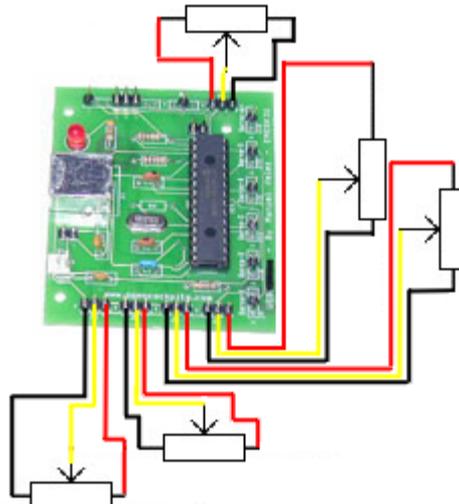
Axis 2 (Y Axis Stick 2 \*\*) Flaps



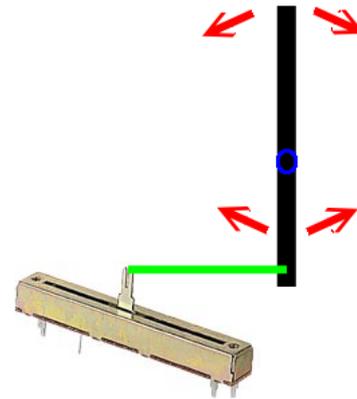
This just an example. Please remember that your Stick/Card may not show the same AXES names or references. You will know the names/references from the Games Controller Calibration Window.

\*\* In the above example, it is assumed that we are using 2 separate Joystick Cards. With the OpenCockpits Card, simply number the axis 1 to 5.

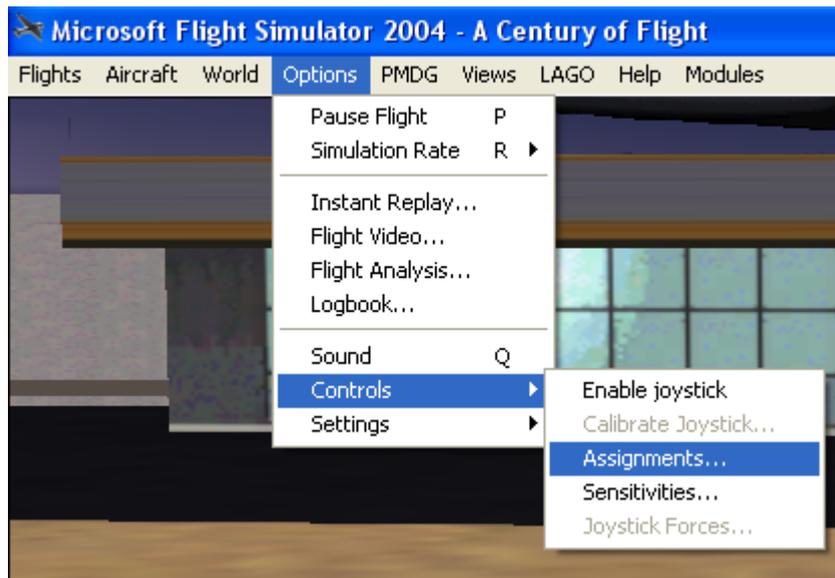
This is how I will eventually connect up my Throttle Quadrant using the OPENCOCKPITS Joystick AXES Card. The 5 Potentiometers will be connected to the 4 3 pin Plugs at the bottom of the card and the 5<sup>th</sup> pot will be connected to the Plug top right. When you connect this Card to your Computer, it finds it as a USB Axes Card with 24 buttons. The 5 axes will be assigned to the two throttles, spoiler, flaps and the Thrust Reversers as described previously. Now I will have 24 Joystick Buttons to play with and to assign to different functions. Quite an amazing piece of kit this card and very good value for money too. See it at [www.opencockpits.com](http://www.opencockpits.com)



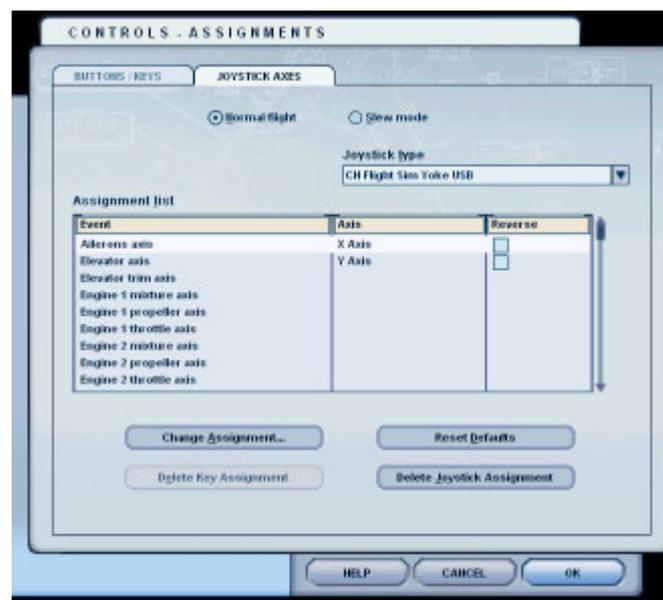
Here is the basic idea for the motion. What you have to do is to translate backward/forward motion on the lever into motion along the potentiometer. Without complex gearing it is impossible to use rotary potentiometers because we want to use the whole range of the pot, not just part of it. So slide pots are ideal for this. There is a little bit of mathematics (or if you prefer 'pissing about') required to calculate how far from the hinge point you need to attach the driving rod, but again it's not rocket science....remember how boring Geometry was in school, now you can put it to good use.



Now Finally let's take a look at Assigning the Axes in MSFS.



This is done like this. From the FS Menus, select Options/Controls/Assignments.....click on the Joystick Axes Tab and you will have a screen like this.....



Let's assume that you have plugged in your USB Joystick Card(s) and have Calibrated the Axes....you haven't ? OK, go do it now.....

Now is the time to assign the axes to functions in the Flight Sim. First Step is to Select your Joystick card in the Joystick Type Drop Down Menu. You will be presented with a table of options for all the

available functions which can be controlled with an axis. You must now decide what functions you want to control with the axes. For my purpose I will assign Engine Throttle 1, Engine Throttle 2, Flaps, Spoiler and Mixture. Select the Function you want to assign to and by selecting the Change Assignment Button you will be allowed to assign an axis to that function. Repeat the process for each axis that is to be assigned. Please remember that if the lever moves the wrong way to that which you would expect, you can tick the Reverse Box to change it round. At present I have two joystick cards controlling my TQ, so I have assigned the first 3 on the first Joystick controller and the other two on the second card. Eventually, I will have the 5 axes on the Opencockpits card and assigned to that as described above.

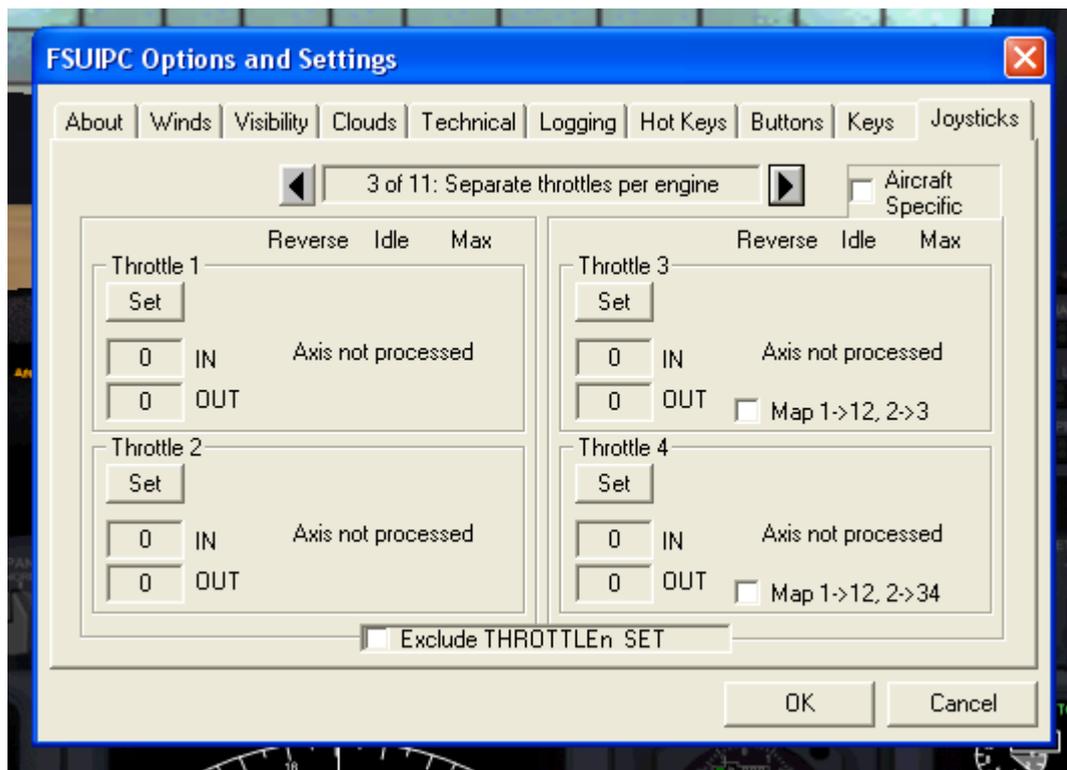
Remember that the reversers will be assigned to the Mixtures Axis. FS uses this axis on jets for the Thrust Reverse.

### **THE MOMENT OF TRUTH HAS REALLY ARRIVED !!!**

Go Fly it. Test the levers in operation. Believe me it is not going to work perfectly. FS is notoriously unpredictable, Unreliable and inaccurate when working with add-on items. Yes I mean both Hardware and Software. I'm sure that it works perfectly in Beta Testing with nothing added on in the Game Studios Labs, but out here in the Real World everything changes. Oh! You know already...sorry. Now you will have to play around with sensitivities and null zones for each axis in turn until you get it responding as it should.

I have found that I can improve the accuracy of the axis by processing it in FSUIPC by Pete Dowson. Wherever would we be without Pete and his interface utility. Just about every add-on you can think of communicates with FS thru this utility. Please support Pete and his work by registering your copy. You will need a registered copy of FSUIPC to process the axes anyway :o)

This is what it looks like.....



On the Joysticks menu, you can process your axes for a more accurate representation. Essential with things like Flaps and Spoiler which you want responsive at the correct point on the travel of the lever. It's not very realistic having Flaps 30 deployed halfway along the lever travel or having the spoiler deploy only to find you cant get it down.. Read the FSUIPC Manual for in detail instructions of how to process your axes.....it's compulsive reading, but well worth while.

**FOOTNOTE.**

First and foremost this is a discussion and not a 'how to' document. I receive so many e-mails from prospective builders who want to add a Throttle of some kind but who either cannot warrant the expense involved or are just purely interested in how it works. The purpose of this document is to entertain and provoke the thought process.

I welcome any comments or corrections and even criticism as long as it's constructive. My pleasure is derived from finding out how to achieve something and then sharing it with others who do not have the same amount of time free that I have.

I hope you enjoyed reading it and it got you thinking.....thanks for your time.

Best Regards .... Ian P.Sissons

p.s. I almost forgot....If you are using the CHProducts Yoke and flying a Jet, apart from the throttle lever, what do you use the other two levers for? Nothing, what do you mean nothing. Why don't you assign them to operate your Flaps and Spoiler or Flaps and Reversers?