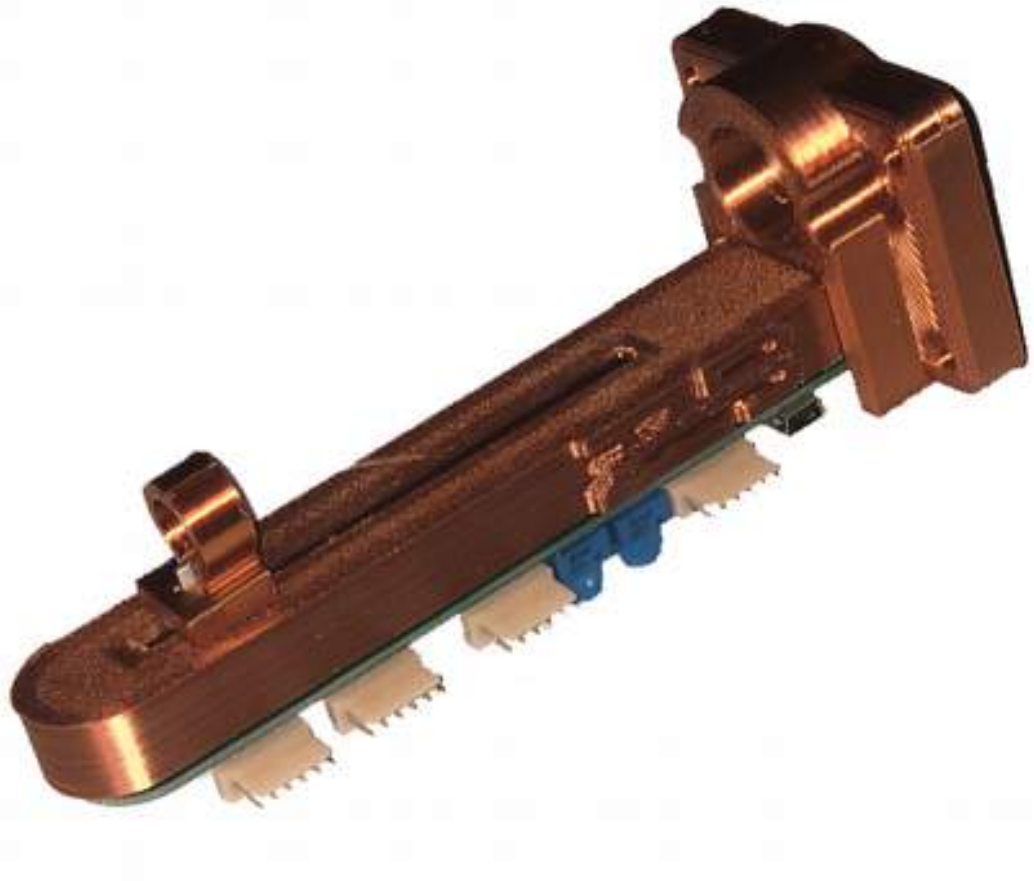
DIGITAL / ANALOG PLUNGER
INSTALLATION & USE

Firmware V3R4 and Higher



BEFORE YOU BEGIN

Working with electricity comes with huge risks that should never be taken lightly, safety should always come first.

To avoid personal injury, possible damage to equipment or danger of fire, all work on electronic equipment should be conducted following these safety procedures.

General Safety

Before working on any electronics, consider following these basic safety precautions to help reduce any hazards.

- Remove any electronic equipment you're testing or working on from the power source.
- Never assume the power circuit is off. Test and test again with a voltmeter to confirm.
- Remove fuses and replace them only after the power to the circuit is disconnected.
- Don't connect power to a circuit until you're done working on it and rechecked the work.
- Always ensure that all electronics equipment is properly grounded
- If it's damaged, replace it. For instance, replace cables instead of repairing with insulating tape.
- Always use the right electronics repair and maintenance tools.
- Always return covers after removing them to reduce the risk of electric shock.
- Make sure your circuit is not overloaded.
- Always have safety equipment like a fire extinguisher, a basic first aid kit and a mobile phone nearby.

Personal Safety

Here are some personal safety precautions to keep in mind:

- Always keep your work area dry.
- Always work in a well-ventilated area.
- Don't wear flapping or loose clothing when working.
- Don't work with metallic jewelry on your hands like watches, rings and bracelets.
- Always wear non-conductive shoes.
- Always remove power to a circuit before connecting alligator clips.
- Always wear safety goggles.
- Be careful when handling large capacitors as they can still hold high voltage even after you've disconnected the circuit from power.

Static Damage Prevention

Static electricity can damage electronic devices and your system. To avoid damage, keep static-sensitive devices in their static-protective bags until you are ready to install them.

To reduce the possibility of electrostatic discharge, observe the following precautions:

- Limit your movement. Movement can cause static electricity to build up around you.
- Handle the device carefully, holding it by its edges or frame.
- Do not touch solder joints, pins, or exposed printed circuitry.
- Do not leave the device where others can handle and possibly damage the device.
- While the device is still in its antistatic bag, touch it to an unpainted metal part of the system unit for at least 2 seconds. (This action removes static electricity from the package and from your body).
- Remove the device from its package and install it directly into your system, without putting it down. If it is necessary to put the device down, place it onto its static-protective bag. (If your device is an adapter, place it component-side up.) Do not place the device onto the cover of the system or onto a metal table.
- Take additional care when you handle devices during cold weather. Indoor humidity tends to decrease in cold weather, causing an increase in static electricity.

Disposal

Observe the approved methods and ordinances of your locality with regard to proper disposal of used electronic appliances.

Table of Contents

INCLUDED IN KIT

1pc Upper Housing/Mount
1pc Lower Control Housing
1pc Slider Block / Clip
1pc Stainless E Clip
2pc Flat Washer – Shim
3pc 1/2” x #10 x 32 Machine Screw
3pc #10 Star Washer
4pc 30” 6pin Wire Harness
1pc 6' USB2.0 MiniB Cable

THEORY OF OPERATION

The Zebsboards Digital / Analog Plunger consists of a 22 button keyboard/gamepad encoder, an accelerometer based analog nudging sensor and a linear potentiometer plunger sensor all combined into one compact device.

Button input is based on button switches connecting the input to the signal ground when pressed. These signal grounds are then converted to hard coded keypresses or gamepad button presses internally and sent the computer through the full speed USB connection.

Analog nudge sensing is accomplished by monitoring the signals sent by an adxl335 accelerometer to the microcontroller on the circuit board. These signals are fully smoothed and referenced to an auto calibrated center position giving reliable and repeatable results.

Sensing of the movement of the ball shooter rod (plunger) is done through a B10K linear potentiometer.

Since its inception, the plunger has had the ability to read the travel of the rod in either a positive or negative direction allowing for proportional movement either by drawing back the rod and releasing it or by 'smashing' the rod with the palm of your hand (palm smash). As well, by supplying the plunger with a ground signal on the ZBLaunch lead (Zebsboards Ball Launch) the plunger has the ability to be able to switch between acting as a traditional plunger or as a substitute for a Launch Ball button for tables without plunger mechanisms.

Starting with Firmware revision 3.5 (current) the ZBLaunch wire connection is no longer required as it has been replaced by a simple serial control command. The plunger can now be switched between keyboard and full gamepad emulation by serial control commands as well.

INSTALLATION AND CONNECTION

Suggested opening for Plunger (template available at end of manual)

Insert ball shooter in opening (ball shooter not included)

Mount plunger upper housing using supplied machine screws and star washers

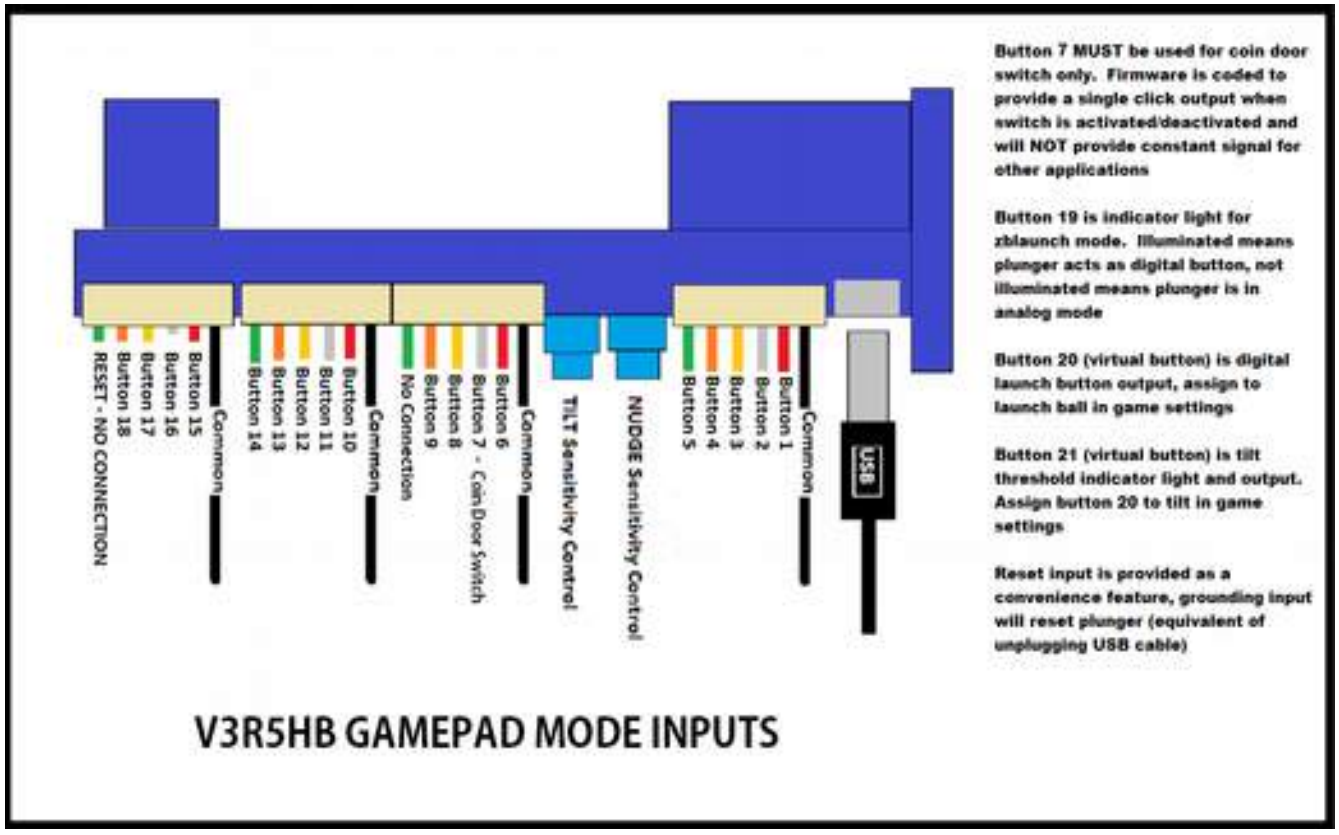
Make sure not to overtighten and damage the plunger housing plate. Screws should be tight enough to hold the ball shooter in place but not so tight as to split mounting plate.

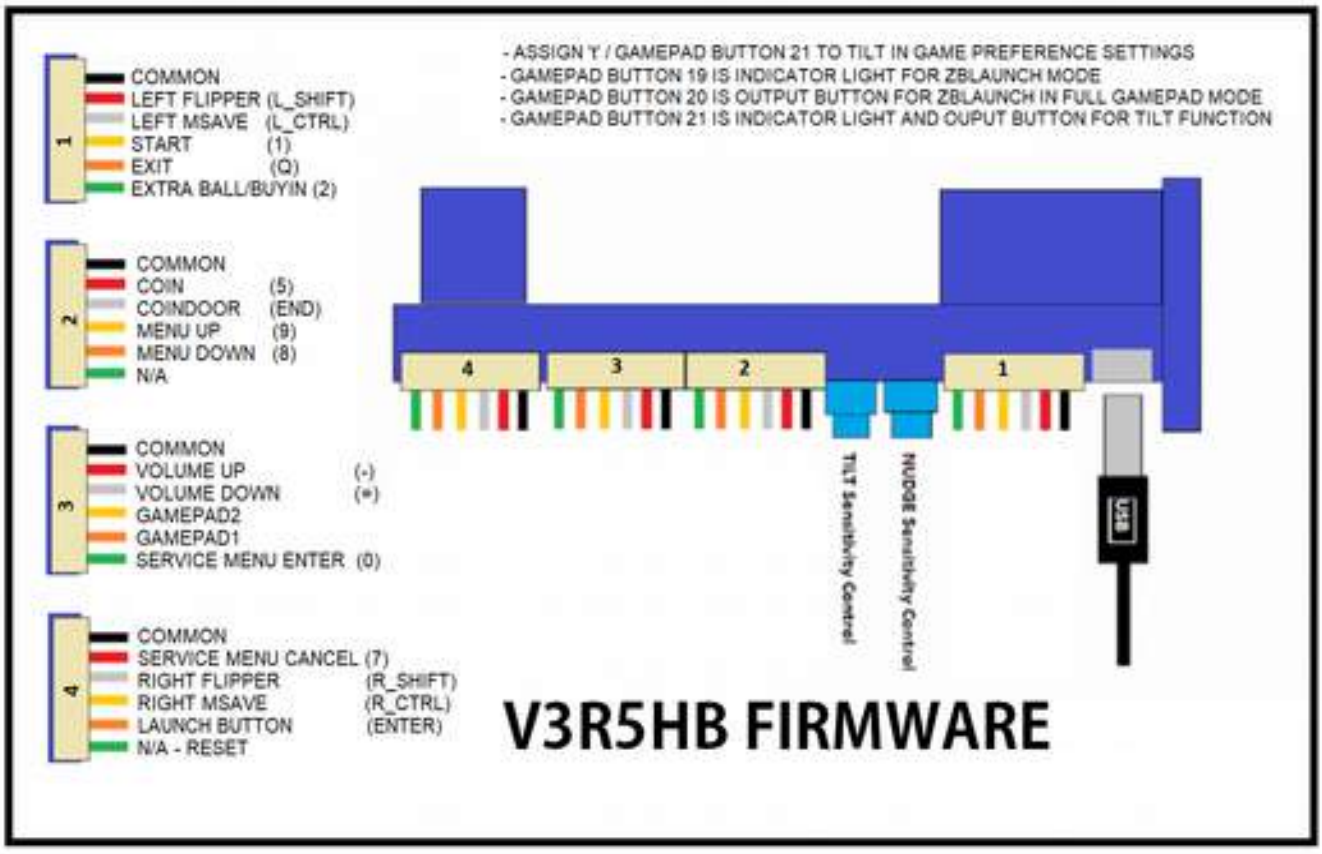
If the angle of the plunger is too high toward the front, put the supplied panhead wood screws into the bottom holes of the plunger and tighten to bring down the nose of the plunger.

If the angle is too low at the front shim the backside of the plate at the bottom with some cardboard (or other material).

Note that slider block is mounted between the c-clip and shooter rod spring.

Connections

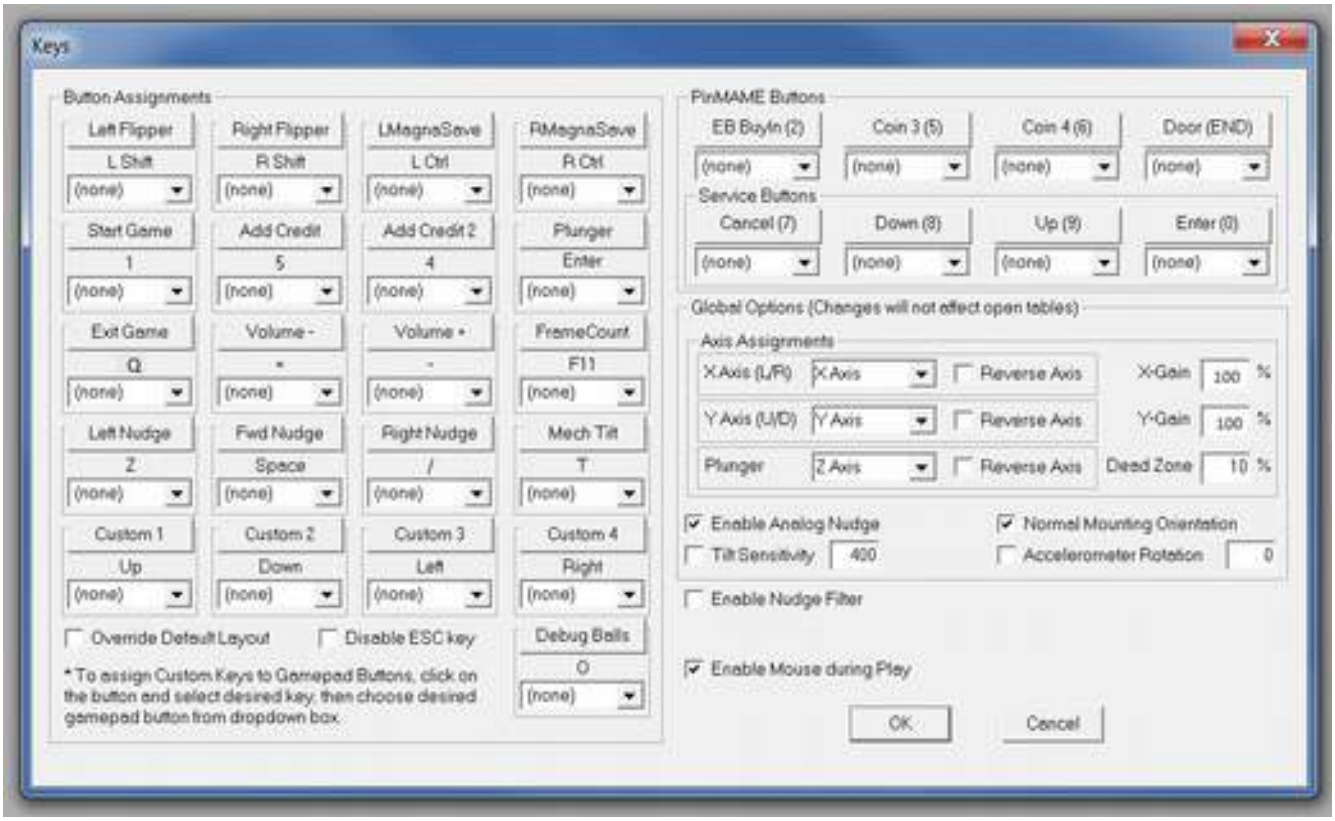




The plunger is hardcoded for the Standard button layout for Visual Pinball. Additionally, there are 2 gamepad buttons available to be assigned to any function not covered by the hardcoded keystrokes in keyboard mode.

There are 18 Physical Gamepad button connections plus the virtual ZBLaunch Button (31) and the virtual TILT Button (32). Extra button indicators in the Gamepad Control Panel are for indication usage in the Calibration Routine.

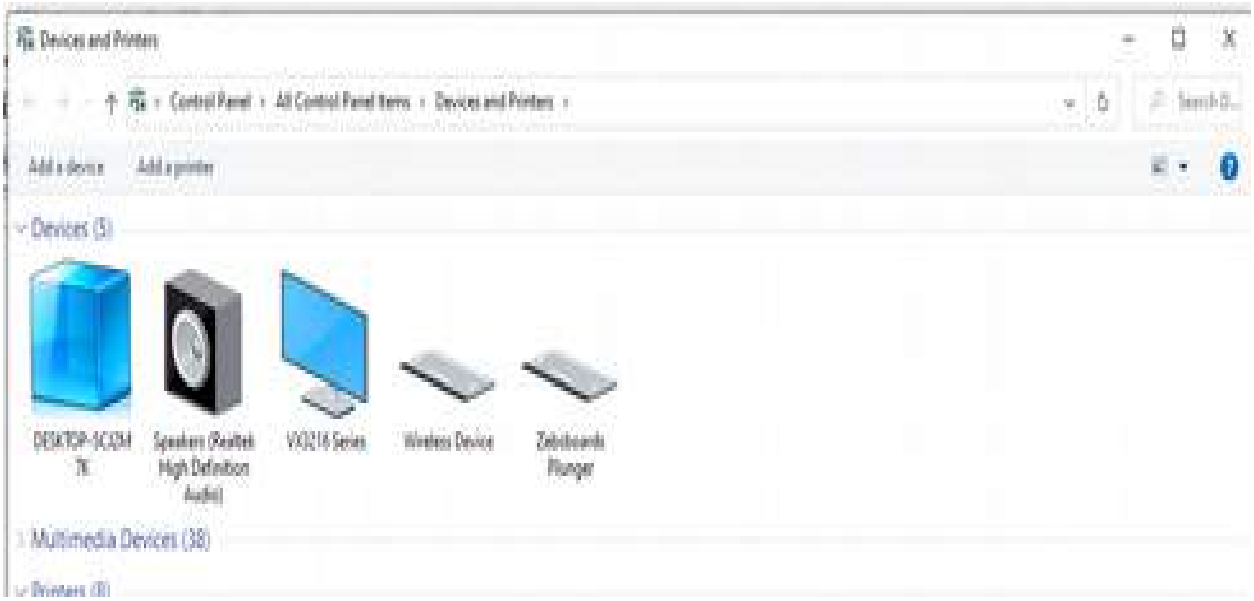
Typical VPX settings for Nudge and Tilt



Calibration

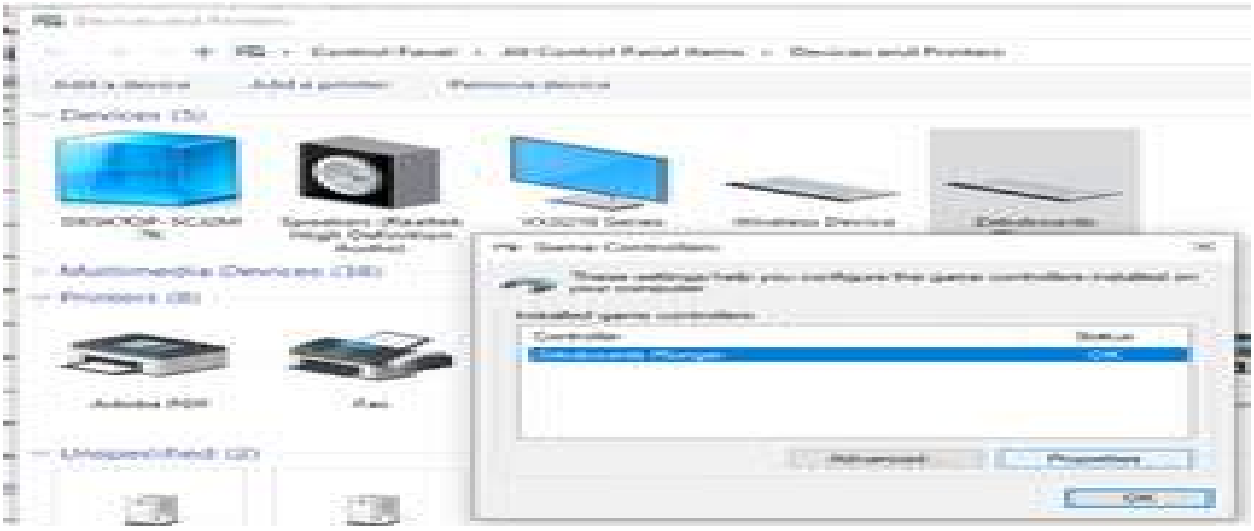
Firmware posted after and plungers sold **December 14, 2020** now come with a simple hardware calibration routine built in. For cabinets 3/4" thick this should not be needed but for those with non-standard cabinets or those experiencing erratic plunger performance it is recommended to run the calibration routine.
With the plunger mounted in your cabinet start your computer and switch to the Gamepad controller applet in windows ....

Open the DEVICES AND PRINTERS screen

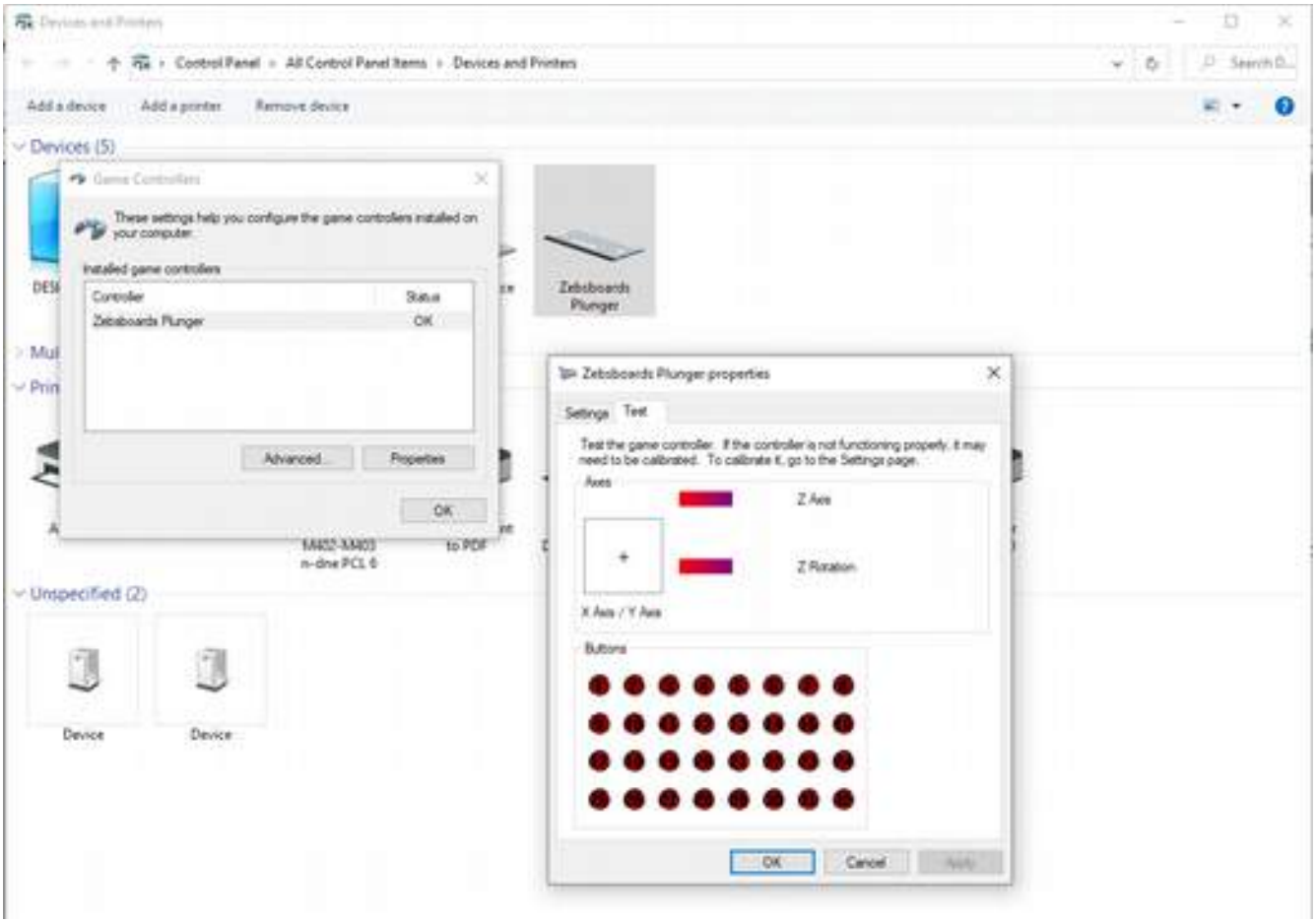


Right Click on the Zebsboards Plunger icon and select Game Controller Settings in the drop down menu that appears ...

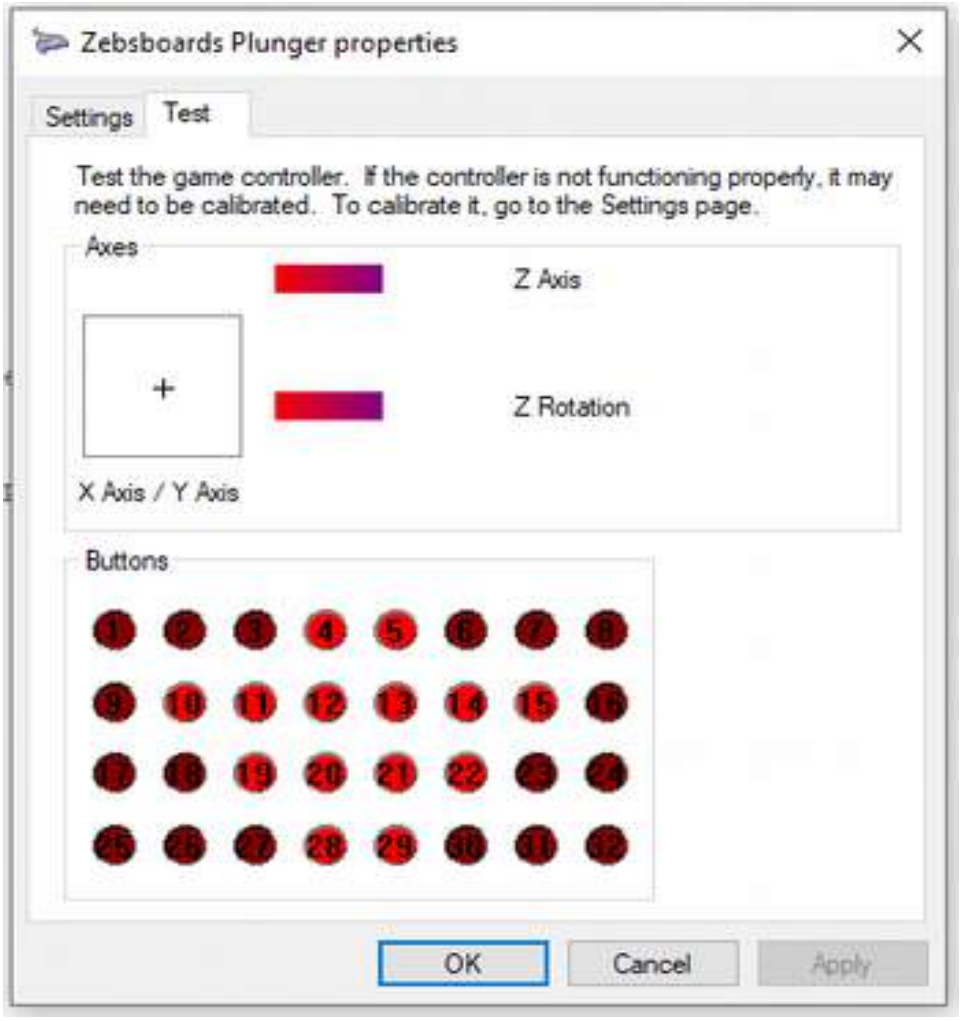
Select Properties and click on 'OK' ...



Which will bring you to the Test screen ...



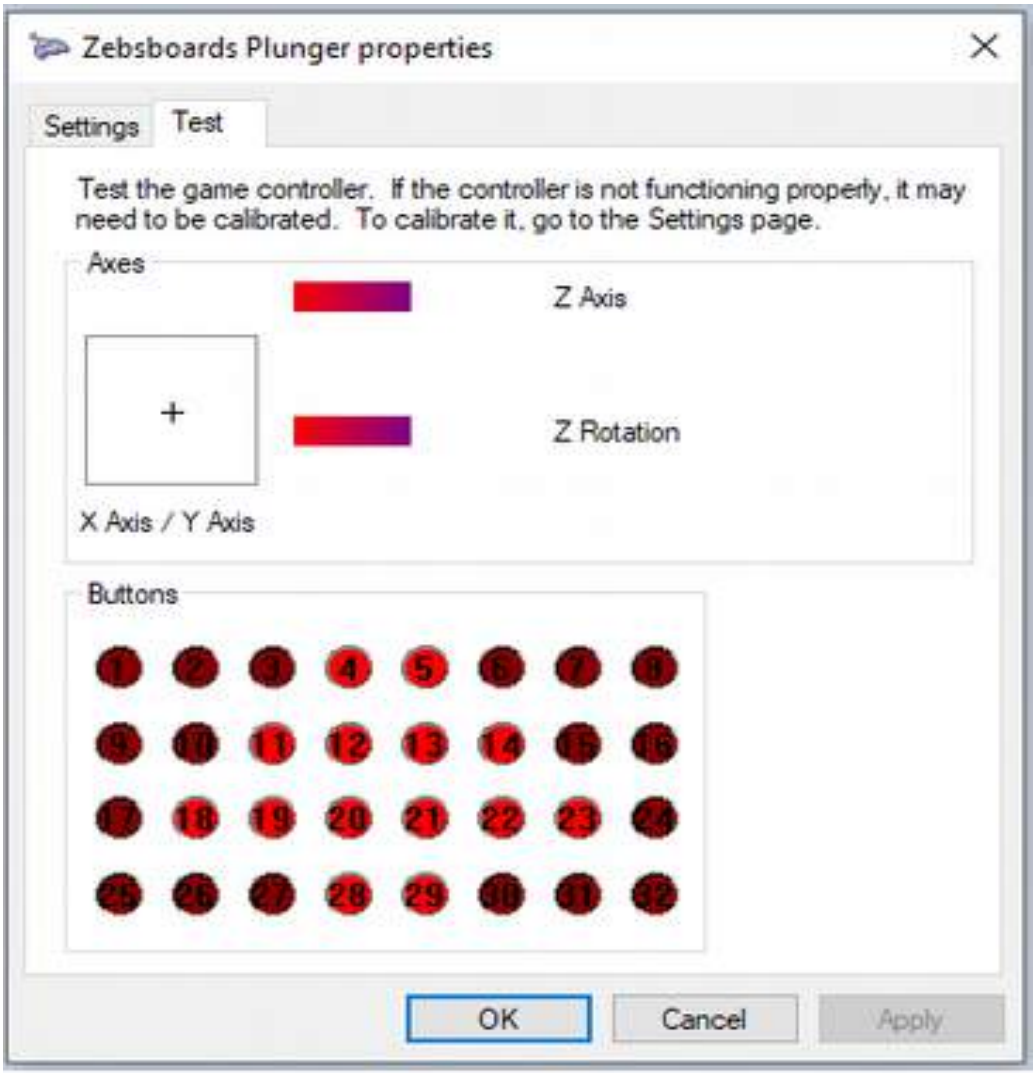
With this screen open, **press the LEFT FLIPPER and START BUTTONS at the same time. The Button Display will display an DOWN ARROW in lighted buttons .....**



Pull Back the plunger to the FULL LENGTH OF TRAVEL and release it.

If you have pushed the plunger in by accident the button lights will flash several times and then light back up as the DOWN ARROW and you can try again.

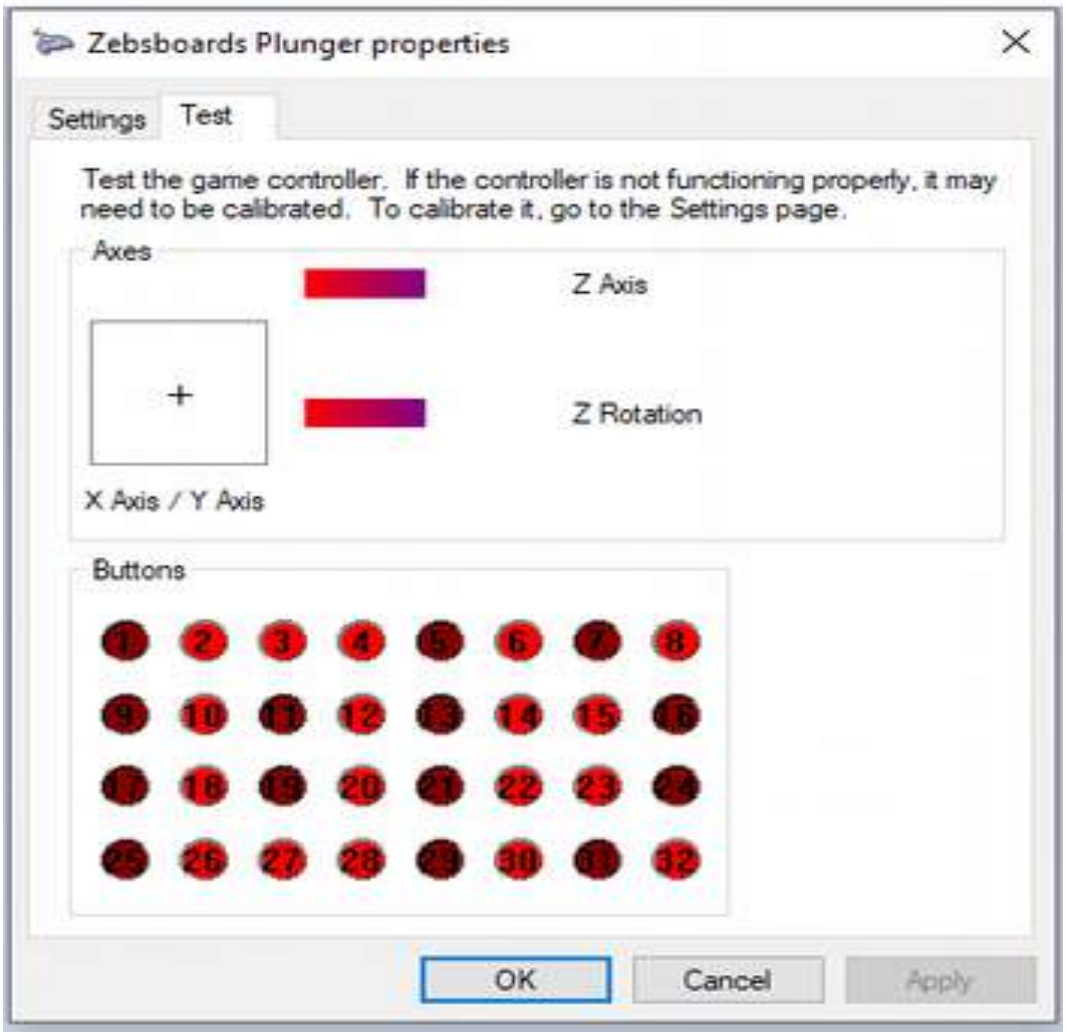
Upon successfully pulling and releasing the plunger the button display will change to an UP ARROW ...



Press the plunger FORWARD to the full extent of travel and release it.

If you have pulled the plunger in by accident the button lights will flash several times and then light back up as the UP ARROW and you can try again.

Upon successful completion of the routine the button lights will change to display OK.



After a few seconds the button lights will go back out and the normal screen will be displayed.

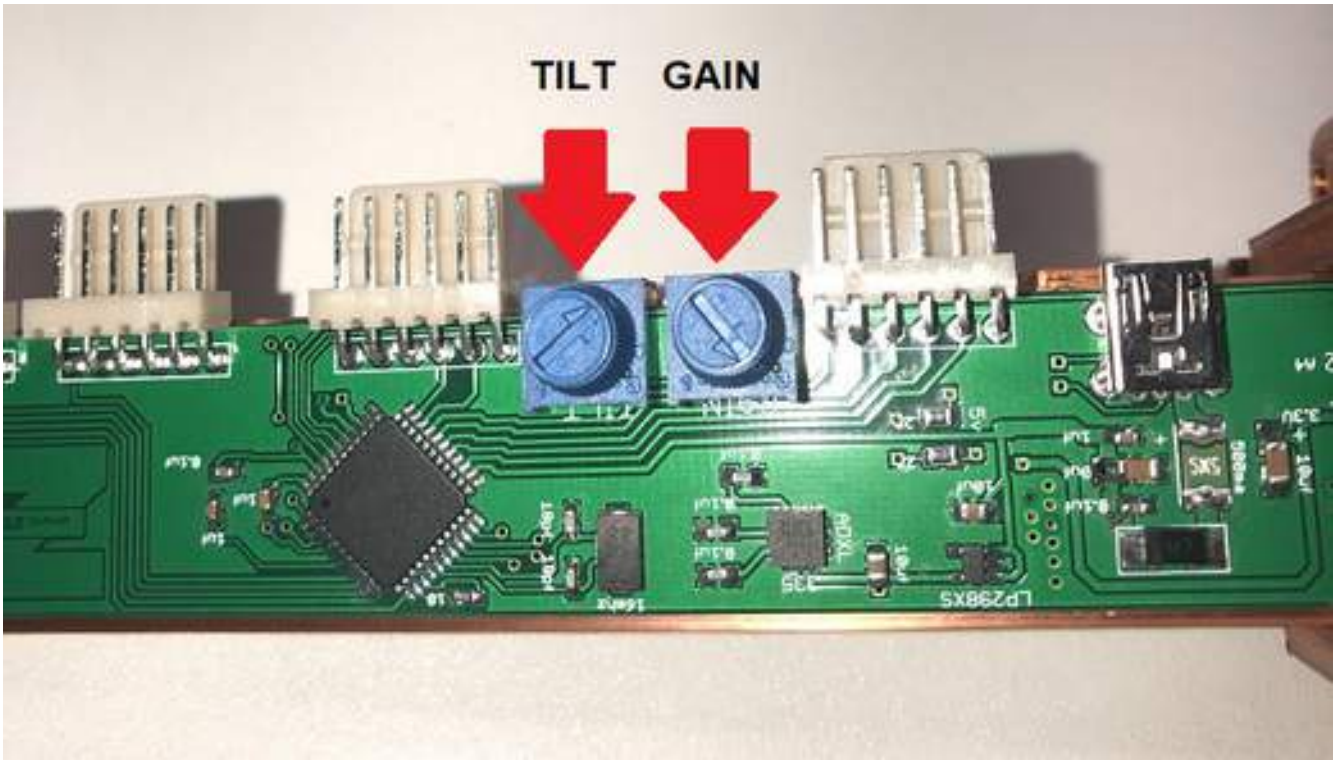
At this point pull the plunger and release it to reset the plunger and make use of the new values. **Pull and release and press and release the plunger several times** to verify proper operation.

If the operation is erratic the plunger was not pulled completely back or pressed completely in during the routine, Press the LEFT SHIFT and START BUTTONS and repeat the above procedure.

When you are satisfied with the plunger behaviour you can exit the screens.

The values measured by the calibration routine are stored in the non-volatile memory of the plunger and will not change when the plunger is disconnected or the computer is powered off.

Nudge and TILT adjustment



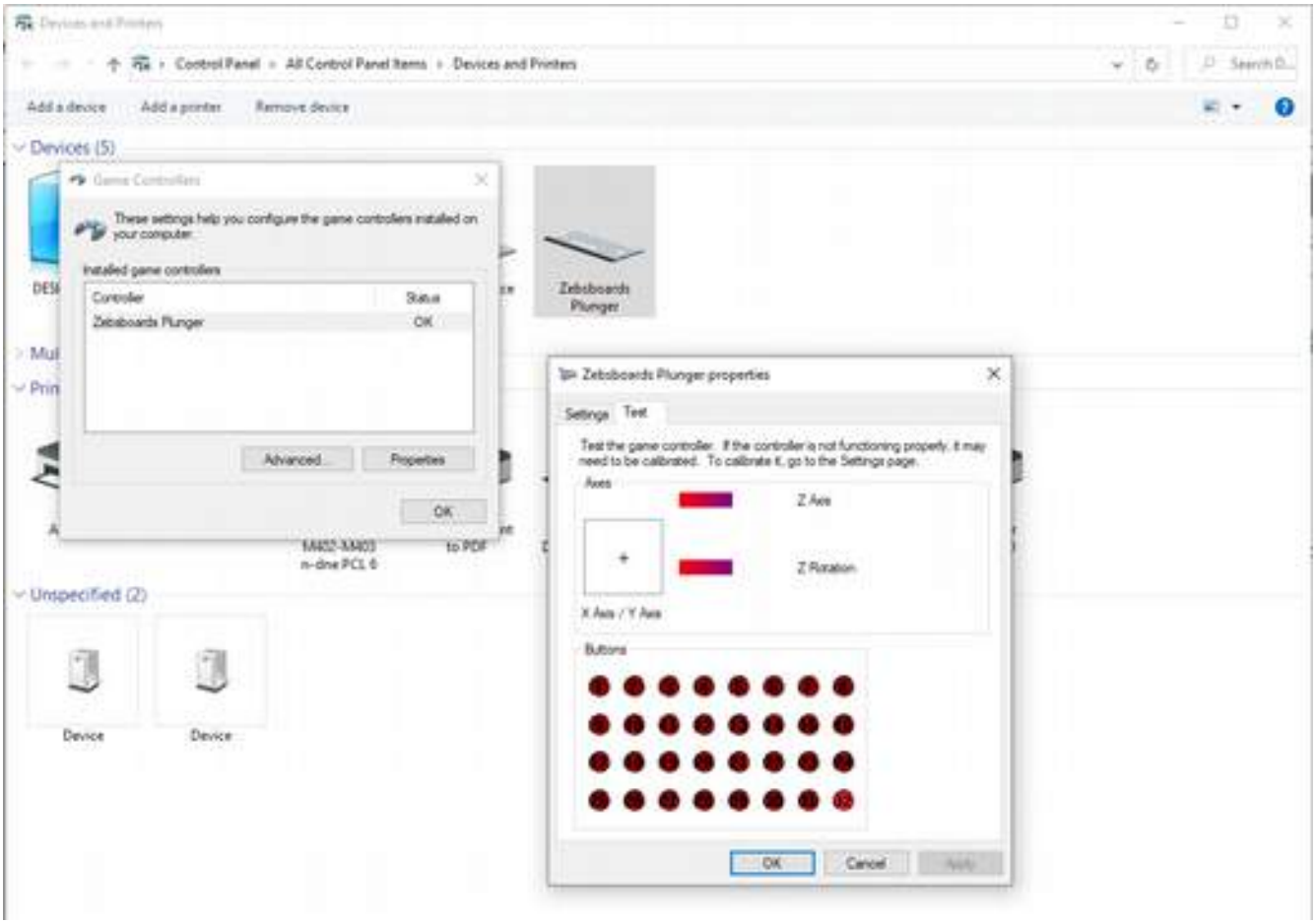
Nudge Adjustment

The gain on the nudge signal from the accelerometer can be adjusted from 0% - 100% by turning the indicated knob as seen in the picture above. Best practice for adjusting is to open a table in Visual Pinball and adjust the knob until the desired response is found. Turning the knob clockwise increases the sensitivity and counter clockwise decreases the sensitivity.
If the adjustment cannot be made to your satisfaction, open the preferences\keys tab of the settings in Visual Pinball and increase or decrease the gain settings as required. Repeat the above procedure.

Adjusting the nudge sensitivity with the knob can create an offset in the centering of the x and y axis of the plunger during calibration. If you notice a considerable pull in any direction after adjustment, simply unplug the USB cable from the plunger and reconnect it. This will force a reset of the plunger and will calculate a new center position for both axis.

It is recommended to set the nudge gains to the desired level before setting the TILT level as reversing the order will likely disrupt your TILT setting.

TILT Adjustment



Button 32 is the last button in the list (shown in red) and is the TILT button

To check the level of gain for tilting the machine, nudge the cabinet at a level that you feel is appropriate for tilting and adjust the TILT knob until Gamepad Button 32 flashes.

Set the button number to 32 in the VP keys and preferences Screen to use the tilt function.

The use of the letter 'T' for tilt in the firmware has been discontinued to eliminate the hang-up that could occur with windows due to a misadjusted tilt level causing the 't' button to be continually pressed in keyboard mode..

Turning the knob clockwise increases the sensitivity and counter clockwise decreases the sensitivity.

The TILT routine has a limiting timer in it that will debounce the TILT command by prohibiting the T keypress from occurring more than once every 2 seconds. When adjusting the TILT level be sure to allow for the delay timer to complete before trying to tilt the machine again.

Manual Control

With the latest revision there are 2 manual switching modes that have been implemented.

The first is switching into the calibration utility which is accomplished by pressing

LEFT FLIPPER and START buttons at the same time.

The second is manual switching between GAMEPAD and KEYBOARD input modes.

By pressing the RIGHT FLIPPER and START buttons at the same time you can toggle between GAMEPAD and KEYBOARD button input modes.

Recognition of the buttons is done onn a hardware/firmware level and can not be re-assigned.

SERIAL CONTROL

Serial commands can be used to change 2 states, the controller type (keyboard / gamepad) and the plunger function (digital / analog – Launch Button / Traditional Plunger).

The commands used for this are sent as string values as listed below:

ZBGP Gamepad Mode - Button presses are sent as gamepad button presses and device appears to software as a gamepad only

ZBKB Keyboard Mode - Button presses are sent as keystrokes (hard coded in firmware), 2 gampepad buttons and device appears to software as both a keyboard and limited gamepad. ***By default the plunger starts in Keyboard Mode at system startup.***

In either of the above modes the axes are recognized as gamepad axis points (x, y – nudging, z – plunger).

ZBLA Analog Plunger Mode - Plunger acts as a traditional mechanical plunger would, pulling back or pushing in reports a z axis movement. ***By default the plunger starts in Analog Plunger Mode at system startup.***

ZBLD Digital Button Mode - Pushing in on the plunger sends either an ENTER keystroke (Keyboard Mode) or GAMEPAD BUTTON 20 press (Gamepad Mode) for as long as the plunger is pressed in

Typical Usage

Switching between keyboard and gamepad modes is usefull for systems using Visual Pinball and PinballFX2/3. Due to the reliance on VPINMAME, Visual Pinball responds best to keyboard controllers as VPINMAME and some tables have keystrokes coded directly. In the case of PINBALLFX2/3 or The Pinball Arcade, a full gamepad is prefereable as it makes setting up xbox360ce (the controller interface software) as easy as can be. Being able to switch modes completely removes the need for TSR software such as XPADDER or JOY2KEY.

Control Batch Files / VBS Scripts

The easiest method of sending the commands to the plunger are by the following batch files or vbs scripts (the vbs scripts are used to run the batch files in hidden command boxes).

In order to use the files, the serial port assigned to the plunger needs to be entered in the batch files.

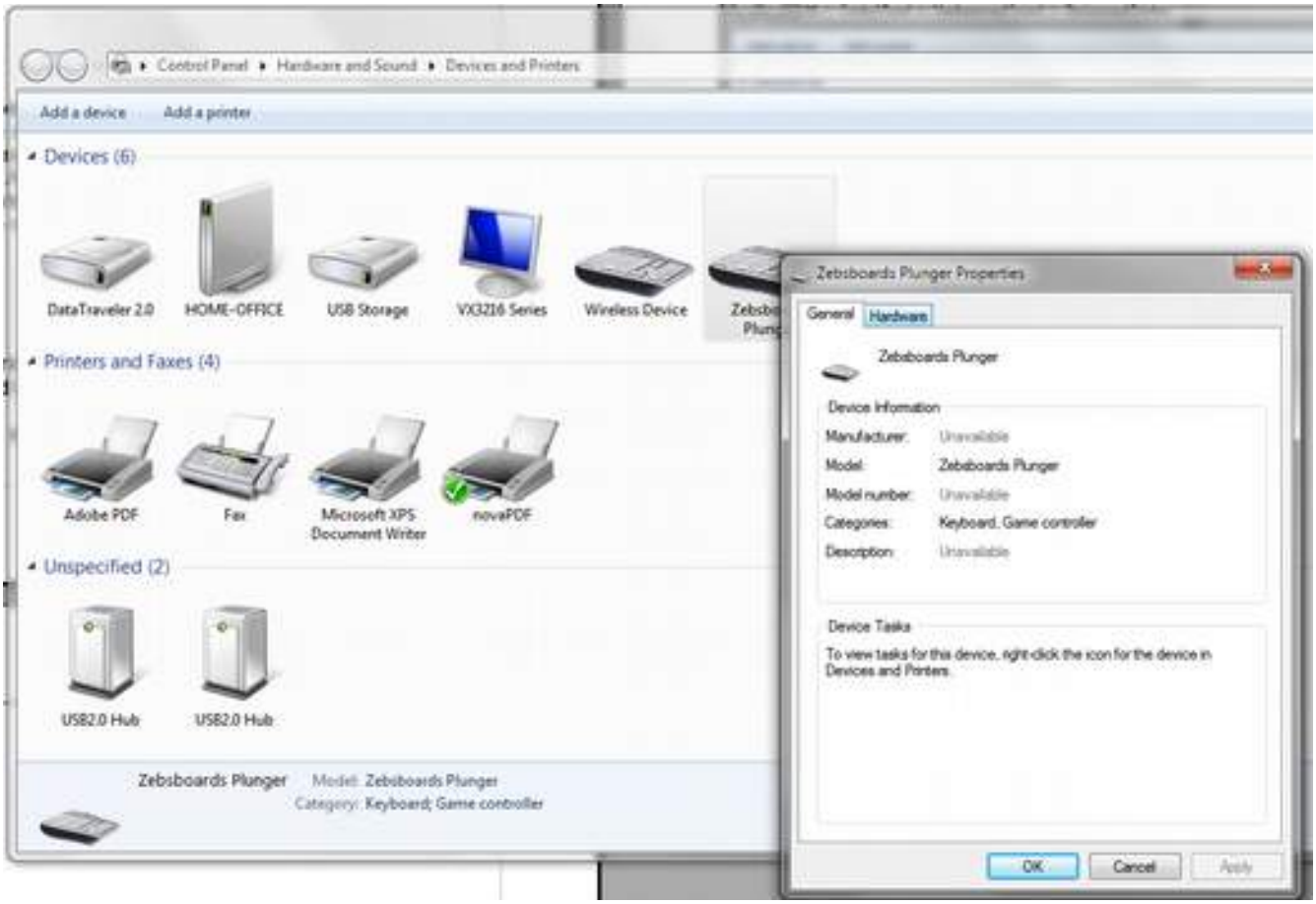
Finding The Plunger ComPort

To find the comport assigned to the plunger do the following:

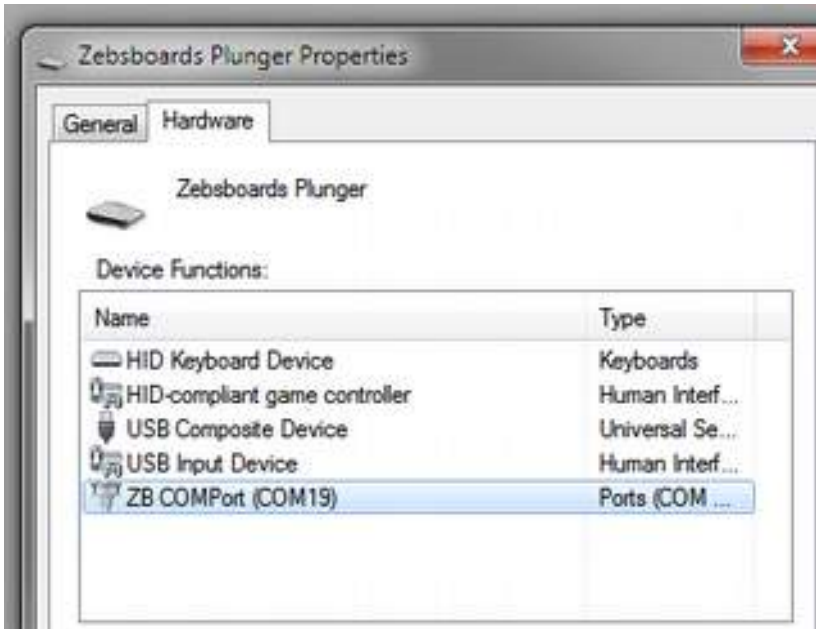
Open Devices and Printers screen and locate the zebsboards plunger

Right Click on the zebsboards plunger and select properties

Select the Hardware tab



Make note of the comport in the listing



Modifying the Batch Files

Download the Plunger Serial Control Batch files from here ...

https://www.zebsboards.com/forum/ext/dmzx/fileupload/files/058891f25a26a978a0ff37761cbd7f2c.zip

Extract the files and open ZBGP.bat in notepad (right click and choose edit, don't double click to open).

Change COM number to match comport number found in device manager.

Save file and repeat for each of the following .bat files. Nothing needs to be done with .vbs files.

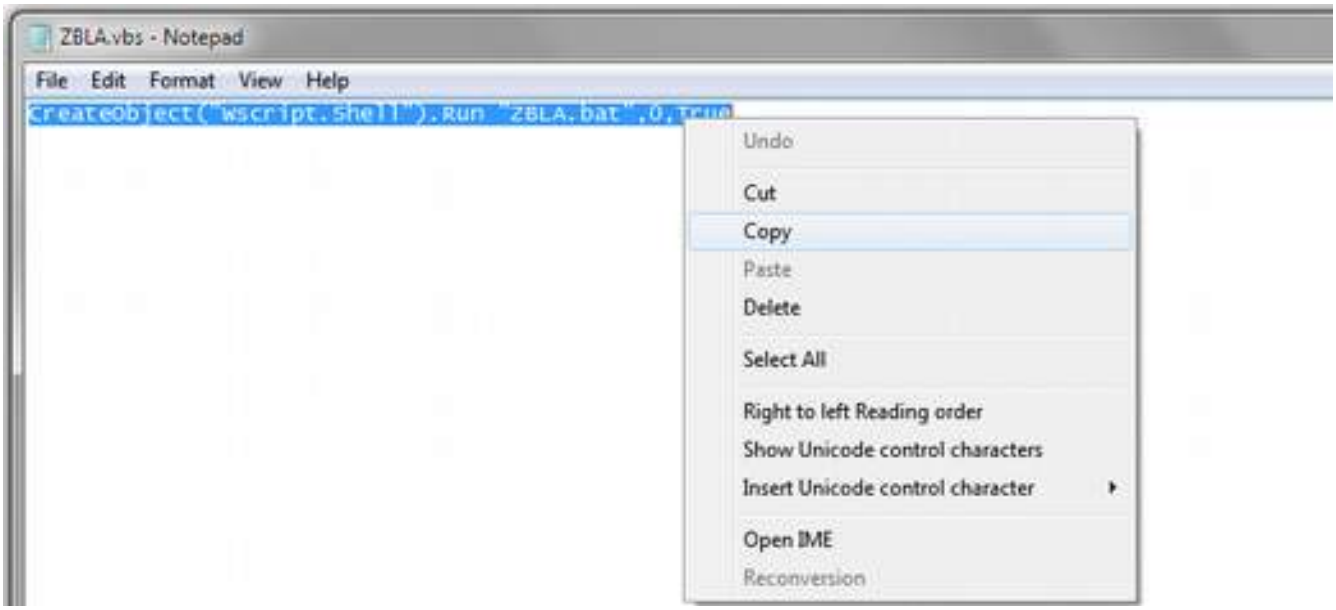
Using DIGITAL/ANALOG Switching Files

In Visual Pinball the easiest way to use the files (ZBLA / ZBLD) is to add the vbs command for the bat file directly into the script.

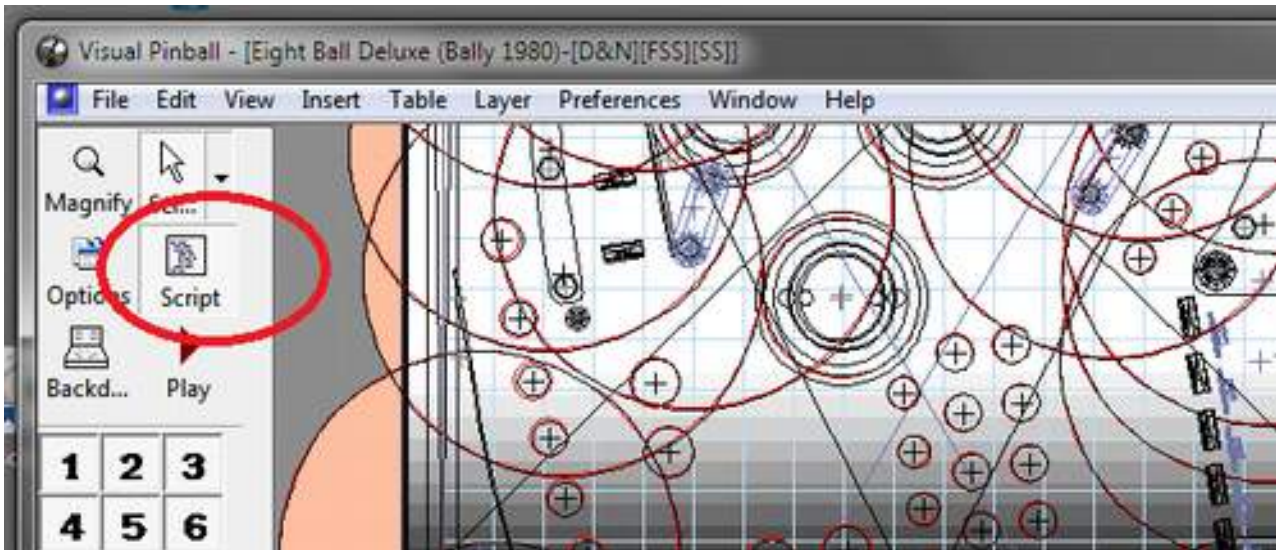
Start by copying ZBLA.bat and ZBLD.bat to the ..\VisualPinball\Tables directory of your vp installation.

Start the visualpinball editor and open/load a table that uses a mechanical plunger (ie: Eight Ball Deluxe).

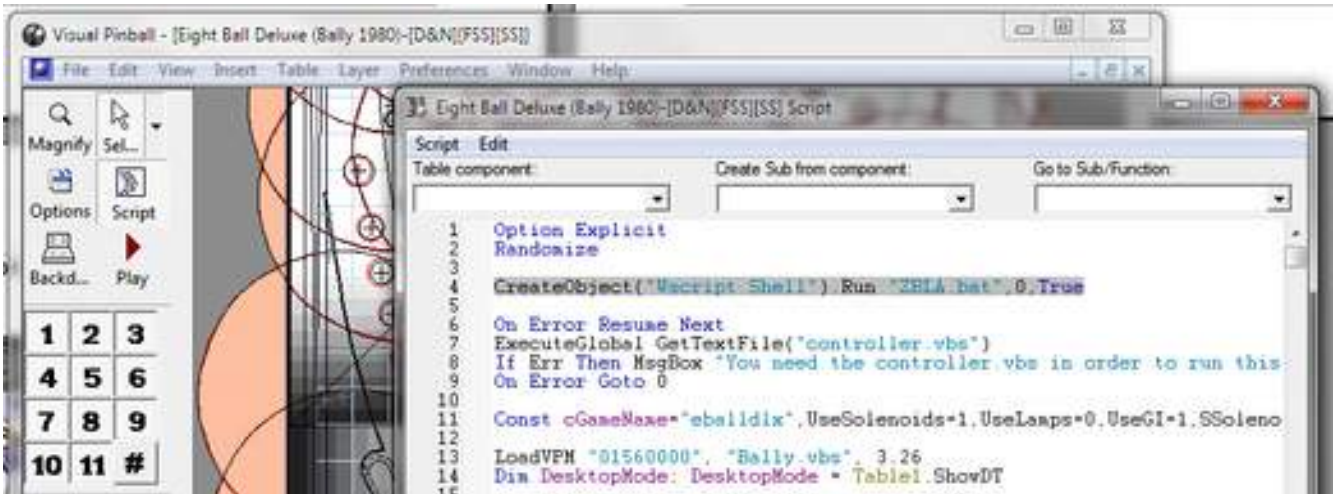
Open the ZBLA.vbs script file that unzipped with the ZBLA.bat file in notepad, highlight the line of text and copy it (right click and select copy).



Return to the VPEditor and click on the Script Button to the left of the table layout as shown below.

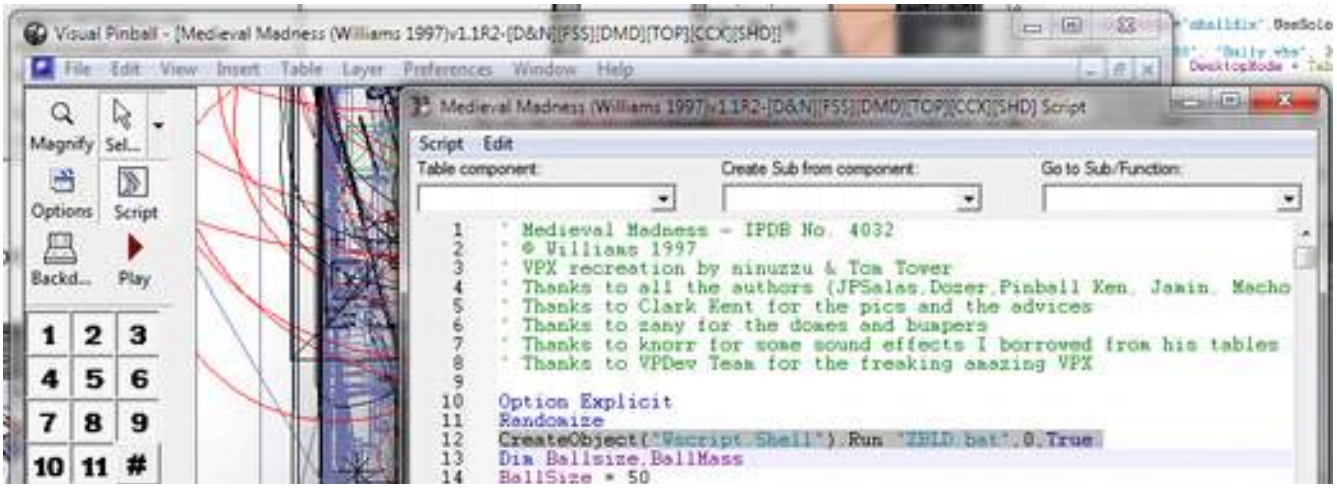


Paste the line of text copied from the ZBLA.vbs script int the table script as shown in Line 4 below.



Save the table and load a table that uses a Launch Button (ie: Medieval Madness)

Repeat the above procedure using ZBLD.vbs as shown below



Now run the Launch Button Table that you edited (Medieval Madness in the example).

You will find that the pushing on the plunger will launch the ball as if it were a launch button.

Now run the Analog Plunger table that you edited (Eight Ball Deluxe in the example).

You will find that the plunger operates as you would expect, pulling back and releasing and responding on screen to the plunger rod movement.

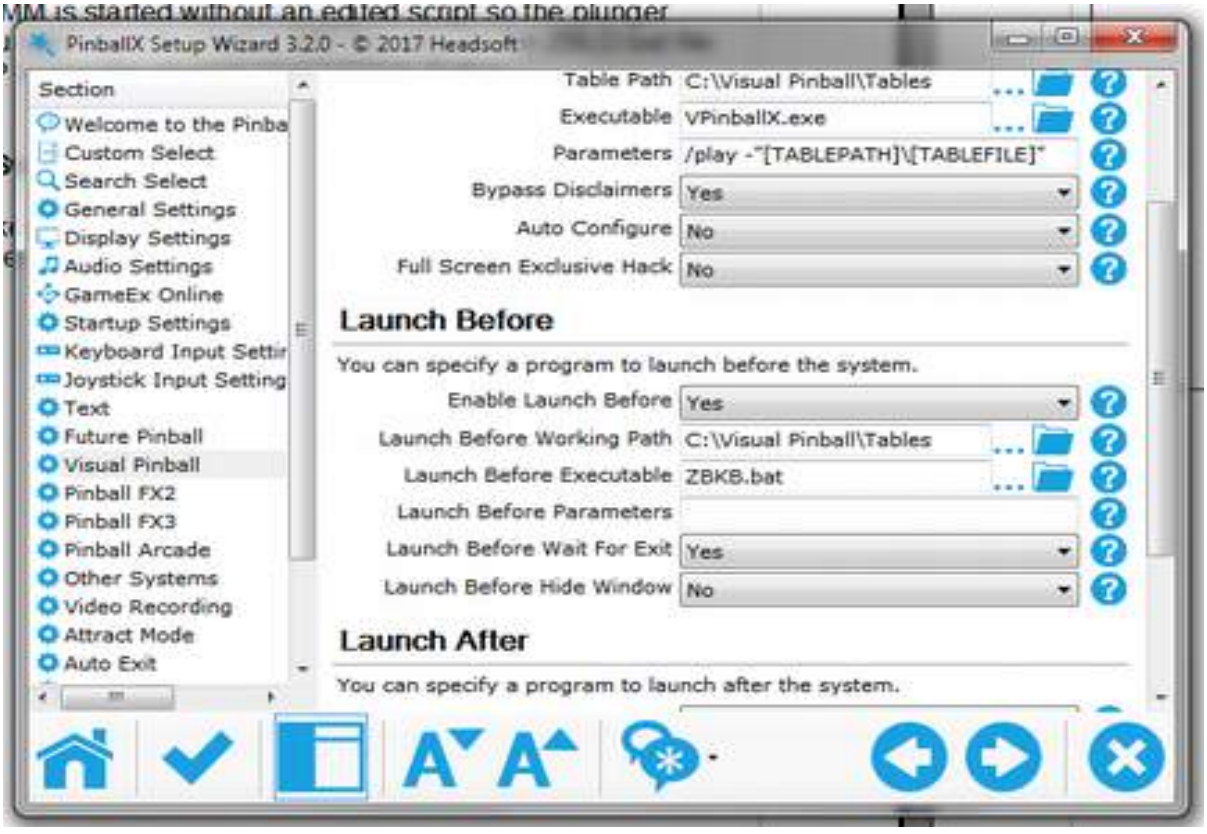
The main issue to remember is that if you are using the script edit method of switching the ball launch mode you will have to edit the script of every table you install with the proper command line. Failing to do so may leave you in the wrong mode when loading different tables if the mode line is missing

ie: EBD has the ZBLA.bat command and switches to Analog upon start. Upon exit the plunger is still in Analog mode but MM is started without an edited script so the plunger remains as an analog plunger. You can't launch a ball in MM this way so the ZBLD.bat file would have to be run outside of VP to use the plunger as a Launch Button.

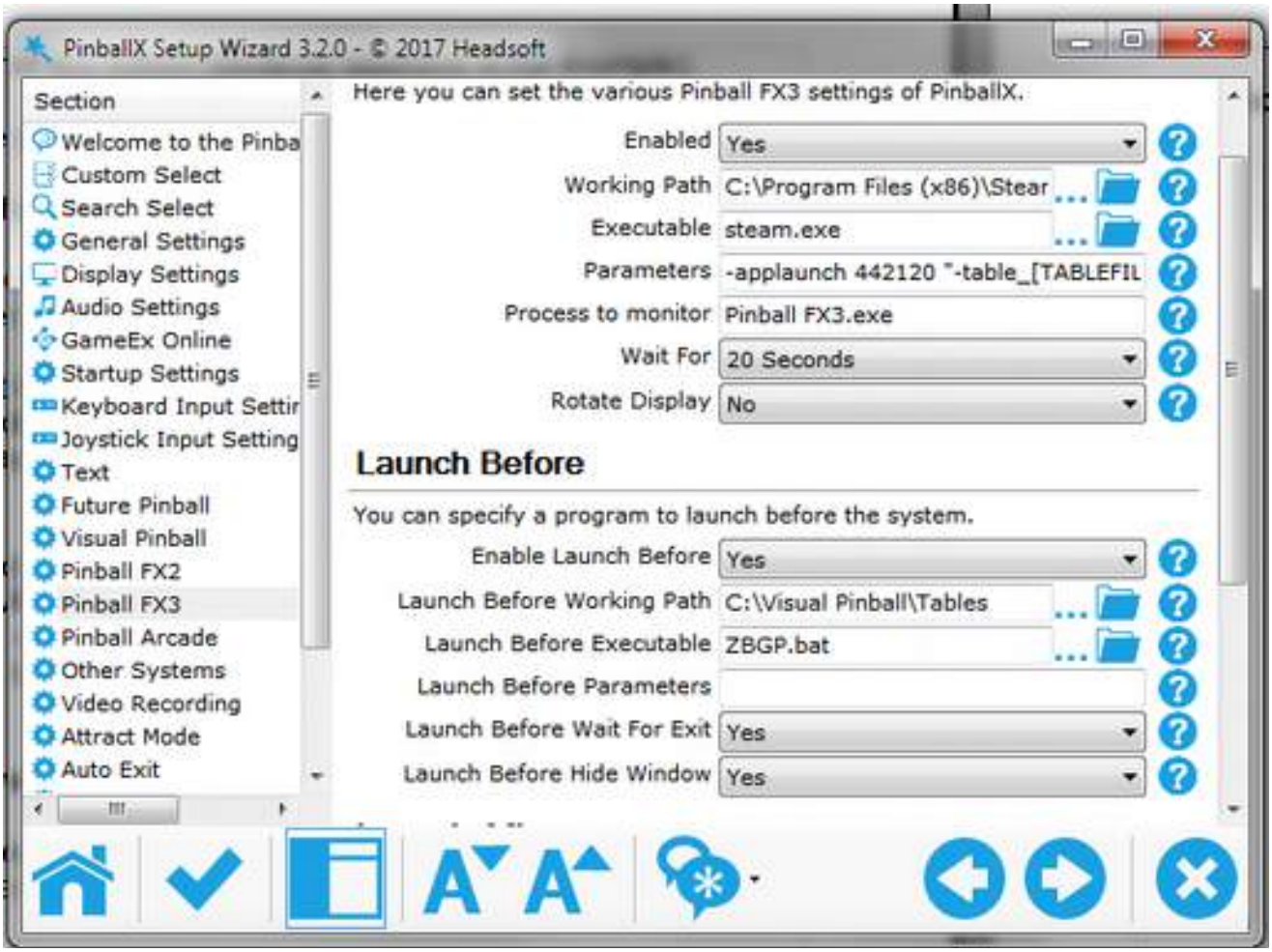
Using GAMEPAD / KEYBOARD Switching Files

Switching between gamepad and keyboard modes can be accomplished by running the appropriate bat file in the run before and/or run after sections of the PinballX settings.

Keyboard Mode



Gamepad Mode



Links to further Information

Identifying Your Plunger Firmware

https://www.zebsboards.com/forum/ext/dmzx/fileupload/files/d9eab665cbb79d11f0846a2f21d2d90e.pdf

A Simple Utility to Locate the Bootloader COMPort of your plunger

https://www.zebsboards.com/forum/ext/dmzx/fileupload/files/55b9c46b8ce7b56e63ea381bfa889cab.zip

Visit Zebsboards Forums for further information and firmware updates

https://www.zebsboards.com

TROUBLESHOOTING

Plunger has erratic behaviour on ball launch / doesn't return to 0 position

Make sure that the lower housing is pushed back fully against the Upper Housing mounting plate and not loose or slipping

Run calibration utility described earlier in this manual

Plunger doesn't calibrate properly in Windows calibration

Calibration in Windows is not needed and can give unwanted results, do not use Windows calibration tool. If you have used it, return to the calibration screen, click on “RESET TO DEFAULT”, click ok, exit the screen and reboot computer

Run the calibration utility described earlier in this manual

Plunger launches early before end of stroke

Plunger is not aligned properly. The plunger is designed to be mounted in 3/4” cabinet material, if the cabinet material is less than 3/4” shim out the Upper housing mounting plate by the difference

Make sure that the lower housing is pushed back fully against the Upper Housing mounting plate and not loose or slipping.

Run the calibration utility described earlier in this manual

Plunger causes computer to hang on boot

Tilt and / or Nudge settings too high. Turn down Tilt and Gain settings (blue knobs under plunger) and re-adjust software gain in nudging axis (x/y). Re-adjust Tilt sensitivity after setting nudge in software.

Possible issue with Plunger not resetting. Make sure that USB charging while computer is off is disabled in your BIOS (see mainboard manufacturer's manual for instructions)

Plunger won't switch on serial commands

Incorrect comport settings / driver not installed.

Open devices and printers and verify successful driver installation for plunger.

Open batch files in notepad and verify correct comport in file.

Verify that there are no comport conflicts with software assigned ports (Freezy's dmd script, Serial addressable led comport, etc)

Plunger Opening Template