

# How To...Sim Panel Connect

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## Creating Your Panel

Creating your panel is quite simple using 'Sim Panel Connect' and Phidgets.

Begin with a piece of 1/4 inch board from your local hardware store. For my prototype, I used 1/4" by 19 1/2" wide by 14 1/2" tall. The actual measurements were taken from a 2002 Cessna 172.

The panel to the left is a fairly standard VFR layout. 3 banks of 4 leaving us room for 11 instruments total. 1 provides room for the yoke. Depending on what you are using for a yoke, you will quite likely be able to modify it to work with this panel.

The yellow square indicates the area that we will be constructing. For added authenticity you could purchase the plastic bezel (faceplate) from Cessna, but for our purposes, we will use a piece of \$2.00 plywood, and \$4.00 lexan.



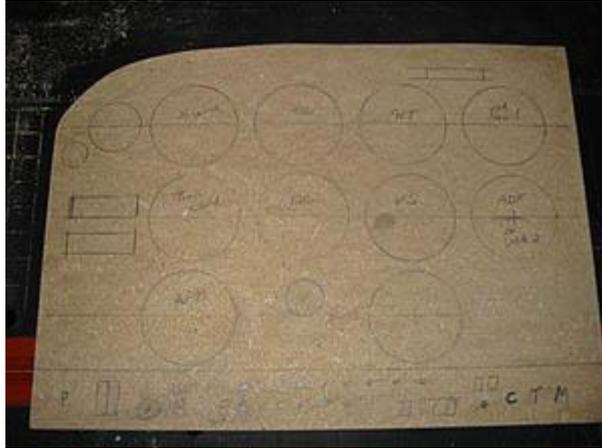
## Step 1 - Draw Out The Panel

With your wood cut to 19 1/2 inches wide by 14 1/2 inches tall, your first step will be to draw out your panel. At this point we only want to draw the panel. **DO NOT CUT ANY HOLES YET.** Some of our gauges will require the 3 1/8 hole while others will not. For now, we will just draw the instrument circles.

Starting from the bottom of the panel, (19 1/2" side) measure upward 2" and draw a line from end to end. The area below this line will be our switches/circuit breaker panel.

Draw another line across the width of the board at 4", 7 1/2", and 11". Using a compass; draw evenly spaced circles representing your gauge faces 3 1/8" in diameter. Circles should be equally spaced and line up both vertically, and horizontally. Write the gauge name inside the circles once drawn. Starting with the top row, instruments will be (left to right) Airspeed, HSI, Altimeter, and VOR1. The middle row will be (left to right) turn coordinator, DG, Vertical speed, and ADF. The bottom row will be (left to right) engine RPM, blank, CHT/EGT, and another blank area. (the right hand blank area will house the Phidget Text LCD). Remember that the third one in from the right is left clear for your yoke. Simply draw a 3/4" circle in this area above the horizontal line to represent the yoke..

Using the top photo as a template, draw the necessary circles to mark the clock, vacuum, and voltmeter. You will also need to draw the rectangles for fuel gauges, oil pressure, and oil temp (left of the turn coordinator), as well as the outer, middle, and inner marker lights (above VOR 1). These suggested locations only, the panel layout is entirely at your discretion.



## Step 2 - Stepper Motor installation

The airspeed, engine RPM, altimeter and heading indicator will all use unipolar stepper motors. Currently Phidgets.com does not have any 1.80/step unipolar motors on their web site. I have used the Soyo SY42STH38-0806A from Robotshop.ca. Be sure to check with the folks at Phidgets as they may have something comparable. The Sim Panel Connect program has been written for a motor of 1.80 per step.

Once you have your stepper motors you will need to remove part of the casing in order to use it as a template. Carefully remove the four screws that hold the motor case together. Once the screws are removed carefully lift the face off the stepper motor. This is the shaft side (as shown in the photo) - do not remove the back.



Drill a hole in the center of your gauge ring the same size as the hole for the motor shaft. Using the drill bit, center the plate over the hole as shown and drill the pilot holes for the mounting screws. Once the

four mounting holes are complete, remove the plate and re-drill the holes at the proper size. Be careful when drilling the pilot holes to not damage the threads of the plate. Counter sinking the mounting bolts is recommended so that your instrument face will fit flush against the wood. (depending on the length of mounting bolt used, you may have to use spacers on each screw to get the shaft in the correct position. Approximately 1/4" should be sticking through the board)

Put the plate back on the motor and mount it to the back of your panel. Prior to mounting the motor, you may want to thread the end of the shaft to mount the indicator needle. This will give the instrument a slightly 'cleaner' look when completed, but I have found it much easier to simply use an R/C aircraft axle keeper. Remove the hex screw and replace it with a 1 1/2 inch bolt of the same size. Cut the head off and paint it white to resemble a needle. Tighten it onto the shaft with a pair of pliers rather than a hex wrench.

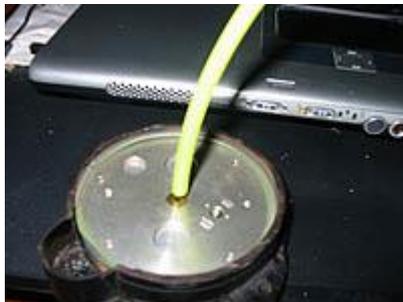
When the airspeed indicator has been completed, do the same for the engine RPM and the heading indicator. We will leave the Altimeter for now. We will tackle it in section 3.

### Step 3 - Stepper Driven Altimeter

I have used a regular aircraft altimeter in my Sim Panel. The main 'guts' of this system that run the dials is only about 1/2 inch thick. The remainder of the case is filled with pressure reading devices to operate the instrument.

The gearing to operate the indicator needles is closest to the face plate. For illustrative purposes, I used my trusty hacksaw to cut the casing down to a manageable size. With the casing cut away, you can see the 'drive shaft' much clearer. I would recommend removing the snap rings that hold everything in place and removing the entire assembly.

Once the assembly is removed there will be 4 screws that hold the pressure reading equipment in place. Remove these screws and the pressure reading equipment. Be very careful when removing the pressure assembly! The shaft that you see sticking out of the middle is attached to the main drive gear by a very small wire. If you break this wire, the unit will be unusable. (Yes, this is my second altimeter.)



Once you have removed all of your pressure reading devices, slip a length of R/C aircraft fuel line over the shaft. This will be the 'coupler' to a stepper motor to drive the system. If you have cut the altimeter case as I have here, the screws can easily be re-used to fabricate a stepper motor mount. If you have left the case in-tact, a stepper motor can be mounted on the back of it. The rubber fuel line will provide some 'flex' but you should try to mount the stepper motor shaft in-line with the indicator needle drive shaft.

Note on stepper motor - At the time of writing, I am experimenting with the 7.5 degree/step motors available through Phidgets due to their size.

## Step 4 - Servo Driven Instruments

Servos are available from Phidgets.com or your local hobby store. Almost any servo will work, however I would recommend the full size HiTec servos. I have used the HS-311 servos in the prototype but the HS 322HD will work just as well. The smaller mini-servos may work, but if you are to use them, be careful of voltage and current draw. Use the mini-servos offered by Phidgets.com.

### Vertical Speed

Vertical speed or rate of climb is one of the easiest gauges to build. Simply drill a 1/4" hole through the plywood at the center of the gauge. Mount the servo on the back of the plywood with the main drive extending through the hole. Use a chisel to thin the plywood to approximately 1/8" where the servo will mount on the back-side so that the servo drive will stick through the plywood. A face piece template is included. Once all gauges are complete print it onto a full sheet of label paper and stick it to your creation.



### Turn Coordinator

The turn coordinator is created in exactly the same manner as vertical speed above.

Although not complete in this photo, the slip indicator mounted below is created with a plastic tube. Simply attach a wire to the ball, paint it white so it will be less noticeable and attach another servo to the back of the plywood in a manner that when attached to the wire, will move the ball laterally.

### VOR 1 CDI and GS

This is my first attempt at a VOR indicator. Both the CDI needle and glide slope are functional as well as the outer, middle, and inner marker lights.

Work is currently being done to create a fully functional unit in which the degrees will be variable and rotate. (will be available in Sim Panel Connect version 1.2)



## Attitude Indicator

The attitude indicator is one of the most complex instruments to build because it is required to provide movement in two planes, bank as well as pitch. The problem is that the portion of the instrument providing pitch information is required to rotate with the portion of the instrument that provides bank/horizon information

Using a 3 1/8" hole saw, cut a circular piece of wood from a sheet of 1/4" plywood. This will leave you with a 3" circular piece of wood with a hole in its center.

Mount the largest available servo horn to the center of the circular plywood. This will create the 'base' of the gauge. Here, I have glued the plywood to the servo horn and reinforced it with aviation lock-wire. If you use screws to attach the plywood, countersink the heads to ensure a flat plywood surface.



Having made the 'base', mount the second servo to it as shown in the picture to the left. Don't worry if it is not centered. We will address this later.

Now, mount the second 3" circular piece of plywood using stand-offs. The entire piece will be inserted into a 3" pvc pipe. When inserted, the 'stand-off' ply-wood piece should be flush with the end of the pvc pipe with the 'base' servo sticking out the back of the pvc.

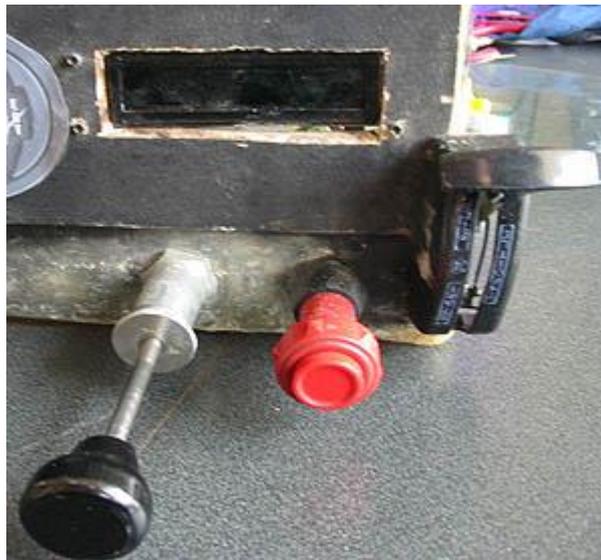
To provide pitch information I have used a plastic paint can lid. The edges of the 3" standoff piece have been trimmed for the 'legs', and small bolts threaded through wooden blocks are attached to the R/C aircraft bell-crank knuckles to provide a pivot point.

A length of wood dowel will attach between the legs for stiffness and the servo arm will then attach to the wood dowel at its center.

This will provide pitch information while rotating for bank.

## Additional Controls, Lighting, Etc.

The pictures below show the LCD interface, throttle, mixture, and flaps control. The throttle and mixture controls were removed from a Cessna 172. Cessna has a service life on these items which requires replacement approximately every 5 years. Check with a local aircraft mechanic... he/she may have some kicking around that you could purchase. The flap lever is a simple lawnmower throttle control



To mount the phidget sliders, I simply attached 1/8" plywood to the control housing with 'C' clamps. R/C aircraft push rods are fashioned and attached to the control cables with electrical wire ends and R/C aircraft axle keepers. By drilling through the 'handle' of the slider, I was able to use R/C fittings to attach the wire to the slides. Although not visible in this photo, the flaps slide is mounted in a similar manner. (Note - when purchasing a lawnmower handle, be sure that it provides sufficient travel so that the slide can be moved along its full length)

The prototype pictured does not include a prop control however it has been written into the program and can be constructed in the same manner as the throttle or mixture.

## Text LCD

The program has been written to provide a readout of Com 1 active and standby, Nav 1 active and standby, Nav 1 DME, as well as an electronic indication of VOR 2 (top right). Radios are fully functional and interactive with FSX. DME provides a reading in full nautical miles.

VOR 2 reading is...

- |>> = more than 20 degrees off course (fly right),
- |.> = more than 10 degrees off course (fly right),
- |.. = within 10 degrees off course (fly right),
- |. = within 5 degrees off course (fly right),
- | = on course
- .| = within 5 degrees off course (fly left),
- ..| = within 10 degrees off course (fly left),
- <.| = more than 10 degrees off course (fly left),
- <<| = more than 20 degrees off course (fly left)



## Text LCD - Interface Inputs/Outputs

The interface will provide eight inputs and eight outputs. As shown above, LCD's have been wired to provide outer middle and inner markers (three outputs). The program will also provide red and green lights for gear position (two outputs), interior lights (one output) and two additional outputs yet to be determined. These are all controlled by analog switches on the sim panel that are completely interactive with FSX. Switches (inputs) will include: battery on/off, alternator on/off, nav lights (includes beacon), strobes, interior lights (turns lights on in panel as well as FSX), landing light, avionics, and pitot heat.

Sliders occupy four of the digital inputs. Another is used to create the magneto/starter switch.

## Wiring Connections

Text LCD Inputs	Text LCD Outputs	Text LCD Sensors
0 Master Battery Switch	0 Blank	0 Throttle
1 Alternator Switch	1 Blank	1 Blank
2 Landing Light	2 Blank	2 Blank
3 Strobe Lights	3 Blank	3 Flaps
4 Nav Lights and Beacon	4 Outer marker LCD	4 Mixture
5 Blank	5 Middle Marker LCD	5
6 Blank	6 Inner Marker LCD	6 Mags/starter switch
7 Blank	7 Interior lights LCD(s)	7 Blank

Sensor Inputs

LCD Outputs



Sensor Inputs

Switch Inputs

Below is a list of parts used in the prototype. As you can see, for little more than the price of a single gauge/instrument, you can have a full panel (single engine VFR). The second advantage to this system is that the kit can be built in stages. Begin with the interface kit and wire in the throttle, flaps, mixture and switch panel. When finances permit, move on to the stepper motor controller or Advanced servo 8-motor.

## 8-Motor Servo Controller

 <p>0 Vertical speed 1 Nav1 CDI 2 Nav1 Glideslope 3 Blank</p>	<p>4 Vertical speed 5 Pitch 6 Bank (attitude indicator) 7 Bank (turn coordinator)</p>
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## Unipolar Stepper Control

 <p>0 blank 1 Heading 2 RPM 3 Airspeed</p>
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**Parts List (prices listed are given in Canadian \$ and are based on invoice prices at time of purchase. Please check Phidgets.com or any of their suppliers for current prices.)**

1	PhidgetStepper Unipolar 4-Motor controller	\$75.00
3	Soyo SY42STH38-0806A stepper motors	\$80.00
1	3314 - PM42L-048-17 950g-cm Unipolar Stepper	\$6.50
1	PhidgetAdvancedServo 8-Motor	\$90.00
7	HS 322 Servo	\$84.00
1	PhidgetTextLCD 20X2 : White : Integrated PhidgetInterfaceKit 8/8/8	\$125.00
4	Phidget Slider 60	\$44.00
3	Phidget rotation sensor	\$21.00
1	Sim panel connect software by Living Sky Aerobatics	\$65.00
		\$590.50

**As you can see, you can build your own for little more than other suppliers are charging for a single instrument!**

**Purchase the PhidgetStepper, the PhidgetAdvancedServo, or the PhidgetTextLCD separately over time to lessen financial impact. The software is written to recognize each component individually.**

**Sim Panel connect is also available for twin engine aircraft, jets, and helicopters.**

**Updates to this manual will be available at [http://www.livingskyaerobatics.com/index\\_files/FlightSim.html](http://www.livingskyaerobatics.com/index_files/FlightSim.html)**

For specific information, feel free to contact us by E-mail.

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