

# **How to build a dual flaps indicator**

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## Introduction

The purpose of this tutorial is to show you how to build a dual flaps indicator by using the second generation servo circuit by Opencockpits.

The IOCards Project designed by Manuel Vélez (<http://www.opencockpits.com>) is based in several discrete electronic cards that let us connect hardware devices (switches, buttons, rotary switches, LEDs, displays, etc.) with flight simulation software.

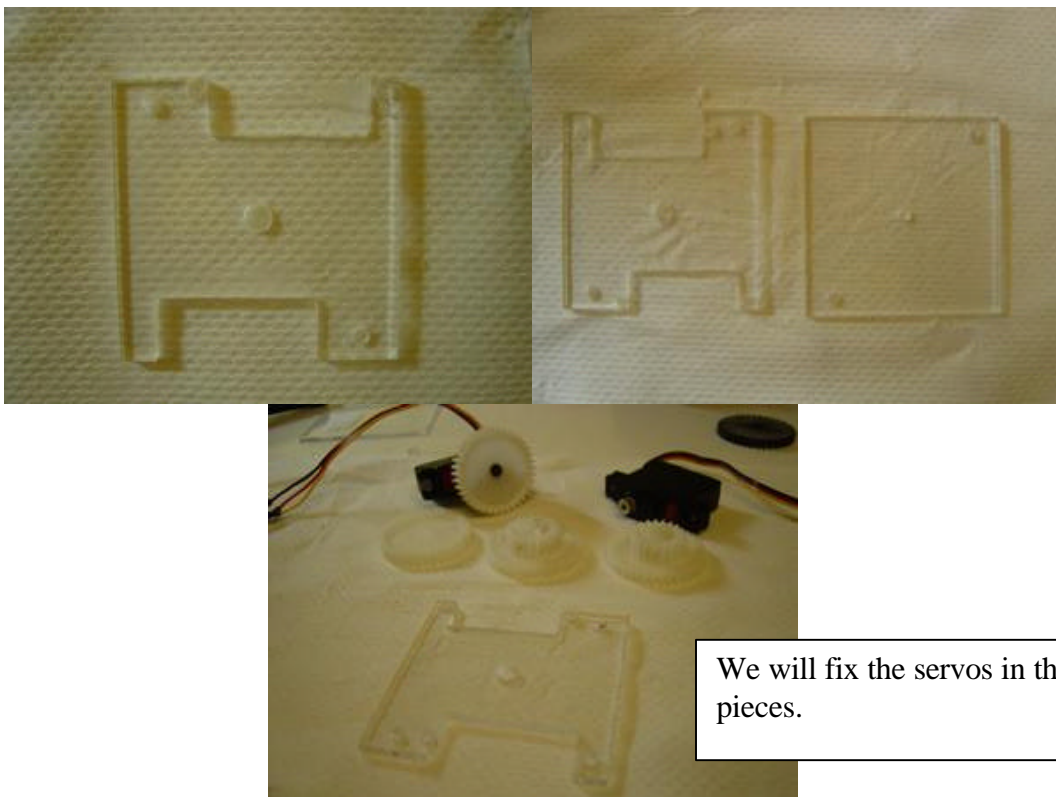
Many thanks to Peter Cos, Pedro Bibiloni, and the Analog Gauges Development Team: Carlos López, David Pousada, Manuel Vélez, Borja Perera, and Fernando Brea.

## Building a dual needle flaps indicator

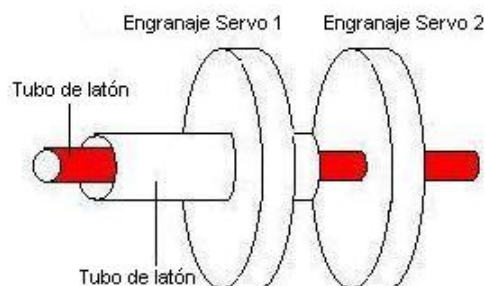
In this tutorial no measurements have been provided because it depends on the type of servos you use.

The materials and tools used are as follows: Dremmel, drill, saw for marquetry, saw for metal, black and white paint, sand paper, files, two microservos, plastic gearing (2:1 ratio; taken from a radio controlled car), 3mm and 5mm metallic pipes, 3mm and 5mm bits and 5mm metacrylate.

First step is to prepare the metacrylate where the servos will be installed. We will use the saw for marquetry and the sand paper/file for this.

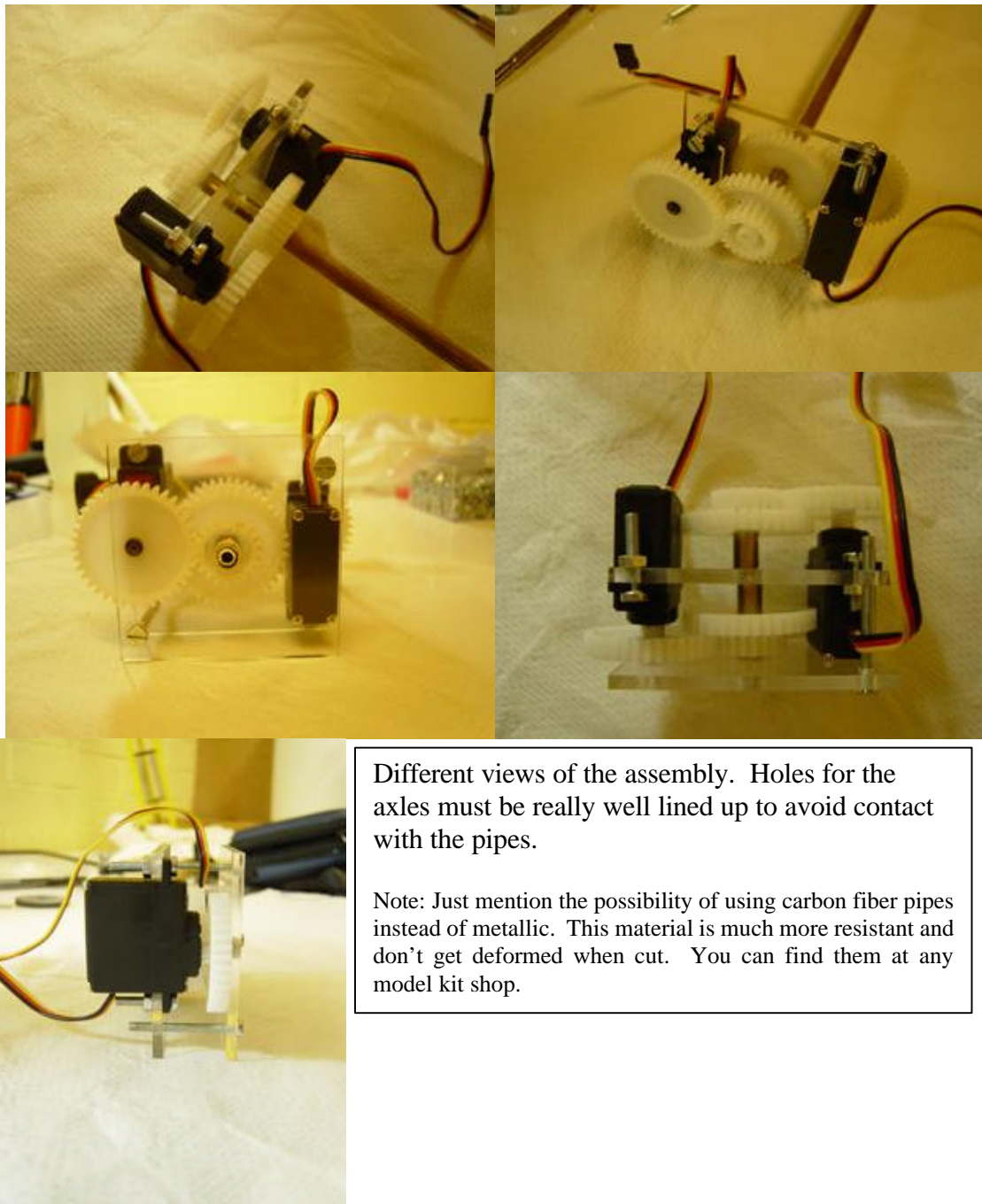


Second step is to think how to achieve the movement for two needles with concentric axles. This diagram shows how it is made:



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Now that we have the general idea how it works we can mount the system. We will cut the metal pipe with the saw for metal. Take a look at the pictures to see how the system is built:

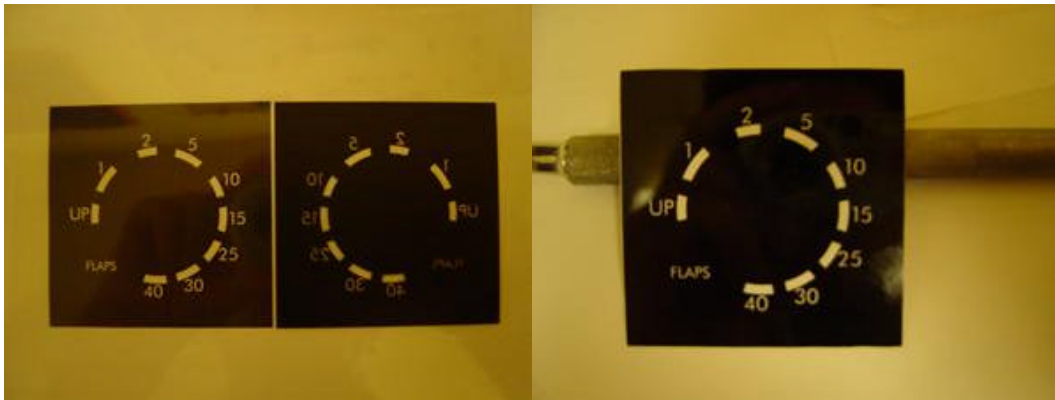


Different views of the assembly. Holes for the axles must be really well lined up to avoid contact with the pipes.

Note: Just mention the possibility of using carbon fiber pipes instead of metallic. This material is much more resistant and don't get deformed when cut. You can find them at any model kit shop.

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We have built the mechanical system. It's time now to build the mask and install the needles. I made the mask with two covers: the first one with paper for transparencies and the second with standard paper (the only material that gave me a white color when backlit). I printed the same picture on both pieces of paper.



The two layers of the mask

Both layers glued together.

For backlighting I'm waiting for the SMD LEDs I've bought. I've tested it with a normal lamp and the result was really good as you can see in the pictures below:



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Now we have to mount the needles. Since they are really small, I asked Peter Cos if he could build them for me. I think this is the most difficult part of this tutorial. Peter built them with metacrylate and then I painted them with black and white paint.



I wrote the Left and Right marks on the needles too:



Now we will fix the needles to the metal pipes. I glued them to the pipes with epoxy (**IMPORTANT**: before fixing the needles, check that when you turn the servos, the needles run from a little before UP to 40 or more). I also added a plastic cup to hide the axles.

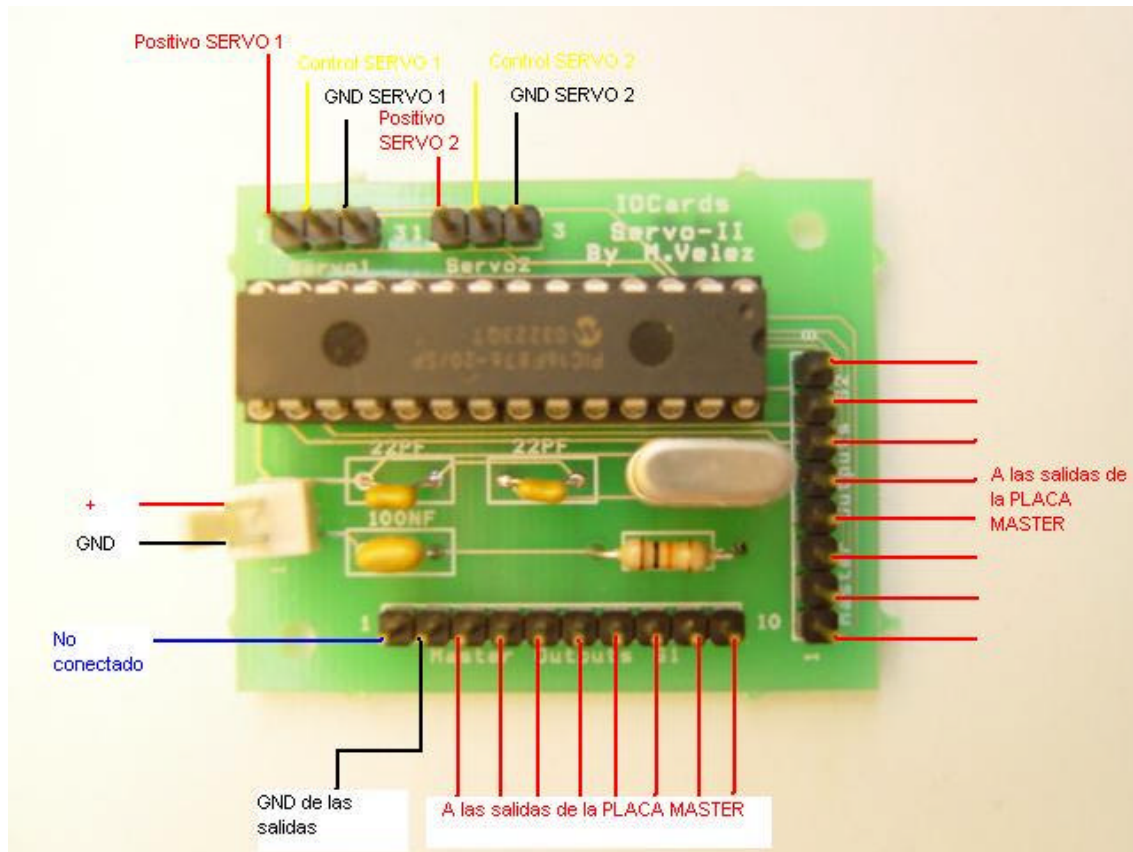


My flaps indicator (left) and the real one (right).



## Connecting the servos to the circuit

Let's have a look to the servos circuit:



For the first servo, we will use the 10 pins below. In this connector, pin #1 is not used, pin #2 is GND (the GND corresponding with the outputs used in the master card), and the rest are connected to eight consecutive master card outputs. We have connected the servo circuit to the Mastercard; now we are going to connect servo #1 to the servos circuit. We will use the left upper connector as indicated in the picture: red pin for positive, yellow pin for control (usually yellow cable in the servo) and black pin for GND.

If we want to connect a second servo to this circuit, we will use the other connector in the same way.

Once all is connected, we will connect the power source (from 4,5 to 5 VDC) to the corresponding connector (2 pin connector on the left side of the board in the picture above).



## Configuration for MS Flight Simulator

### Software configuration

We will use outputs from 29 to 36 for servo #1 and outputs from 37 to 44 for servo #2.

How do I set the movement limits with the Controller software?

Start the Controller software and click the Start button. Then activate the Servo Control checkbox and write the first output (29 for servo #1). Write 0 (zero) in the Value box and click OK. Click on the + button until the needle marks the UP position in the flaps indicator (or the 40 position, depending on the way of movement). Let's suppose we reach the UP position with a value of 76. Write down this number:

Servo 1 Up = 76

Continue clicking on the + button until the needle reaches the 40 position (or the UP position, depending on the way of movement). Let's suppose we reach the 40 position with a value of 220. Write down this number:

Servo 1 40 = 220

For the second servo we proceed on the same way (now First output would be 37). Let's suppose the following values:

Servo 2 40 = 66

Servo 2 UP = 202



With the values written down, we can close the controller software.

**NOTE:** MS FS only gives general information about the flaps position (no separate information for left and right flaps). The same is true with IOCGauges. The configuration that you are doing at this point only works for one needle. The moment IOCGauges is prepared to manage independent flaps needles it will be posted on the Opencockpits website. This tutorial is written as if this feature is available.

### \*.dat File Configuration

Start the ConfigIOCard software. We will define two variables Flap\_L and Flap\_R, with IOCGauges addresses #001 and #002. We will associate a function called FLAPS.

VARIABLES	SW-NORMAL	SWR / ENCODERS	DISPLAYS 7-S	SALIDAS Y CFG	DEF.FUNCIONES	MOTOR-S
VAR						
Nombre	Direccion	Longitud	Func. Asocda.	Valor inicial		
FLAP_L	#001		FLAPS			
FLAP_R	#002		FLAPS			

The FLAPS function is defined as follows:

If value > than 16383 then Value = 16383

If value < than 0 then Value = 0

Value = Value \* 64.247

VARIABLES	SW-NORMAL	SWR / ENCODERS	DISPLAYS 7-S	SALIDAS Y CFG	DEF.FUNCIONES	MOTOR-S
VAR						
Nombre	Si Valor > que	Entonces Valor =	Si Valor < que	Entonces Valor =	Valor=Valor por	
FLAPS	16383	16383	0	0	64.247	

Let's define the servos.

Servo #1: Initial output 29, associated variable FLAP\_L, left position (Servo 1 Up) 76, right position (Servo 1 40) 220 and central position ( (76+220)/2 ) 148.

Servo #2: Initial output 37, associated variable FLAP\_R, left position (Servo 2 40) 202, right position (Servo 2 UP) 66 and central position ( (66+202)/2 ) 134.

VARIABLES	SW-NORMAL	SWR / ENCODERS	DISPLAYS 7-S	SALIDAS Y CFG	DEF.FUNCIONES	MOTOR-S
VAR						
Nombre	Salida Inicial	Variable	Pos Izq.	Pos Central	Pos Der.	
SERVO_FLAP_L	29	FLAP_L	76	148	220	
SERVO_FLAP_R	37	FLAP_R	202	134	66	

Save the \*.dat file. We only have to calibrate the indicator for the intermediate positions.

## Gauge calibration

Start MS FS, start WideFS if necessary (IOCGauges in other PC), start IOCGauges and IOCard.

Press F5 and both needles have to be on the UP position. Press F8 and both needles have to change to the 40 position. But if we press F6 or F7 we can see that the needles don't work properly. We have to calibrate them.

Press F6 or F7 to set the first flaps position in the simulator. Open IOCGauges.ini file and change the value for Flaps1, increasing or decreasing it to set the needle over the first gauge mark. Save the file and restart IOCGauges software. Now the needle will change the position.

```
[ Posición de los puntos de Flaps para la gauge (0-16383) ]  
[ Position for Flaps gauges points (0-16383) ]  
Flaps1=1800  
Flaps2=4000  
Flaps5=6300  
Flaps10=8450  
Flaps15=10600  
Flaps25=12287  
Flaps30=14335
```

With a trial and error process we will set the needle on the first mark. We will repeat the process for the rest of the intermediate positions.

## Configuration for X-Plane

### Software configuration

We will use outputs from 29 to 36 for servo #1 and outputs from 37 to 44 for servo #2.

How do I set the movement limits with the Controller software?

Start the Controller software and click the Start button. Then activate the Servo Control checkbox and write the first output (29 for servo #1). Write 0 (zero) in the Value box and click OK. Click on the + button until the needle marks the UP position in the flaps indicator (or the 40 position, depending on the way of movement). Let's suppose we reach the UP position with a value of 76. Write down this number:

Servo 1 Up = 76

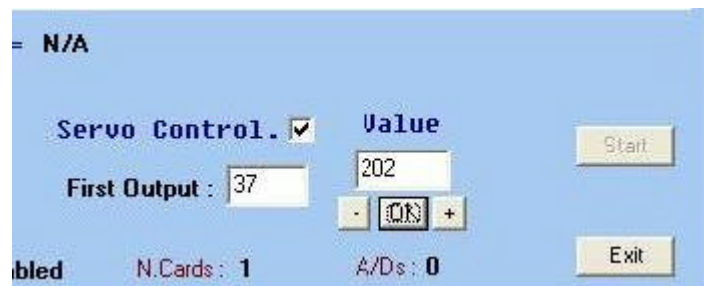
Continue clicking on the + button until the needle reaches the 40 position (or the UP position, depending on the way of movement). Let's suppose we reach the 40 position with a value of 220. Write down this number:

Servo 1 40 = 220

For the second servo we precede the same way (now First output would be 37). Let's suppose the following values:

Servo 2 40 = 66

Servo 2 UP = 202



With the values written down, we can close the controller software.

**NOTE:** X-Plane only gives general information about the flaps position (no separate information for left and right flaps). The same is true with IOCGauges. The configuration that you are doing at this point only works for one needle. The moment IOCGauges is prepared to manage independent flaps needles it will be posted on the Opencockpits website. This tutorial is written as if this feature is available.

### \*.dat File Configuration:

Start the ConfigIOCard software. We will define two variables Flap\_L and Flap\_R, with IOCGauges addresses #880 and #881. We will associate a function called FLAPS.

VARIABLES	SW-NORMAL	SWR / ENCODERS	DISPLAYS 7-S	SALIDAS Y CFG	DEF.FUNCIONES	MOTOR-S
VAR						
Nombre	Direccion	Longitud	Func. Asocda.	Valor inicial		
FLAP_L	#880		FLAPS			
FLAP_R	#881		FLAPS			

The FLAPS function is defined as follows:

If value > than 16383 then Value = 16383

If value < than 0 then Value = 0

Value = Value \* 1568.6274

VARIABLES	SW-NORMAL	SWR / ENCODERS	DISPLAYS 7-S	SALIDAS Y CFG	DEF.FUNCIONES	MOTOR-S
VAR						
Nombre	Si Valor > que	Entonces Valor =	Si Valor < que	Entonces Valor =	Valor=Valor por	
FLAPS	16383	16383	0	0	1568.6274	

Let's define the servos.

Servo #1: Initial output 29, associated variable FLAP\_L, left position (Servo 1 Up) 76, right position (Servo 1 40) 220 and central position ( (76+220)/2 ) 148.

Servo #2: Initial output 37, associated variable FLAP\_R, left position (Servo 2 40) 202, right position (Servo 2 UP) 66 and central position ( (66+202)/2 ) 134.

VARIABLES	SW-NORMAL	SWR / ENCODERS	DISPLAYS 7-S	SALIDAS Y CFG	DEF.FUNCIONES	MOTOR-S
VAR						
Nombre	Salida Inicial	Variable	Pos Izq.	Pos Central	Pos Der.	
SERVO_FLAP_L	29	FLAP_L	76	148	220	
SERVO_FLAP_R	37	FLAP_R	202	134	66	

Save the \*.dat file. We only have to calibrate the indicator for the intermediate positions.

## Gauge calibration

Start X-Plane with XPLUIPC R1 (or higher) and start IOCard.

Open XPLUIPC.INI file and look for the [ Posición de los puntos de Flaps ] section (flaps positions)

In this section we can see a value for each position. Changing these values we will adjust the position of the needles. In order to refresh the information, we have to stop the IOCP server from the X-Plane menu and restart it again. We have again a trial and error process.

And that's all.