

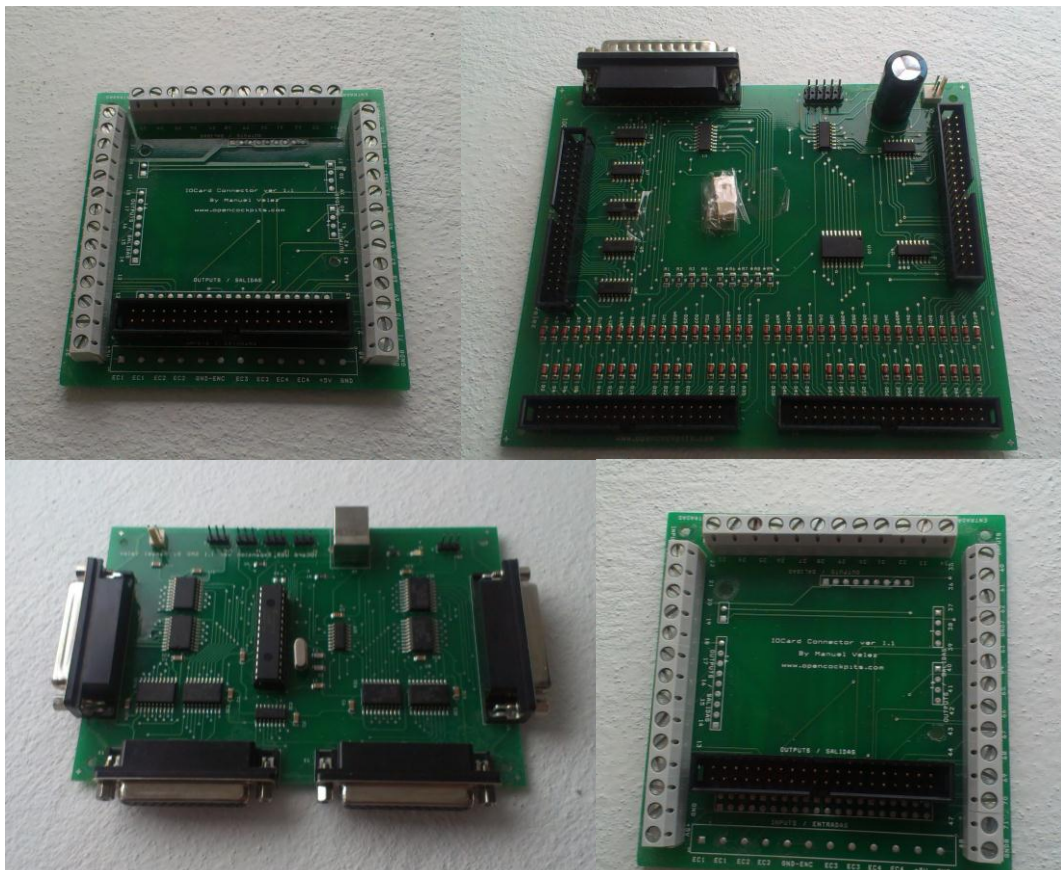
Review of
4x IOcards (PCBs)
Manufactured by Opencockpits

Intro

We all know flight simulation hardware as yokes, pedals, throttle quadrant, various complete P&P modules etc. which certainly helps in creating a more realistic flight simulation experience for the desktop pilot but....., what if you need a module that is not already created, or if you have an idea for a module or several modules of your own creation, how can you then connect this to the flight simulator.

If you have the skills you can of course just build the desired module yourself, but not all knows how to create a PCB and certainly not how to create the correct PCB and furthermore how to do the connection to the computer and adding software to be able to program the PCB. The solution could very well be to purchase an already completely assembled PCB which e.g. could be an IOcard (input/output card) including programming software or even without the software.

I have seen several different versions of IOcards and in this review I have had the pleasure of testing both an Input and an Output card together with a Master card and a USB Expansion card, all created by Opencockpits and used on a string so that all connections are gathered into just one single USB connection to the computer.



Purchase, Packing and Delivery

I purchased all four PCBs on one order together with some other parts as switches and wires etc. which I needed to complete the test. The purchase was done through Opencockpits web shop which has a direct link from their website and the navigation and purchase went with ease. The website and web shop both features a language change option, so the website can be read in English as well.

When selecting the PCBs in the web shop I found that for some of the PCBs there were actually several versions to select as e.g. just a semi manufactured PCB without components or a DIY assembly set or even a completely mounted and tested PCB ready for use. This is nice if you like to do the soldering etc. yourself, but in my case I went with the completely mounted and tested PCBs.

I also noticed that if the PCB needed some additional parts as e.g. a certain wire to connect to another card or similar, then this was highlighted on the product page. Of course I liked that because that helped me make sure that I remembered to order all what was needed and not missing a small component or similar.

There were several options for selecting a delivery method and forwarder after your own choice (well of course within the limits of the selection in the web shop). This time I selected the option with Eurodis with a transport lead-time of 4-5 working days. This was a fine selection and about a week later I received my package, so the promised delivery time was perfect.

The PCBs were each carefully wrapped in bubble plastic and then placed in a hard cardboard box together with the rest of the parts that I ordered. As an additional precaution the box was also filled with a lot of polystyrene foam pieces which covered both of the sides and ends, and the bottom and the top of the box together with the spaces in between the PCBs and the parts.

The quality of the packing and transport was really high and the parts all arrived in perfect condition without any transport damages.

Parts Included

The parts included in this review are the following:

- USB Expansion Card (2T3)
- Master Card (2T1) including parallel cable (4TC2)
- Input Connection Card without encoder feature (3T5)
- Output Connection Card (3T4)

Additionally I also purchased wires in various colors, some replica Boeing B737 toggle switches and also some LEDs in both green and red color – all could be found and purchased at Opencockpits web shop. There was just two parts that I had to source from a local DIY shop which were the resistors that I needed for the output/LEDs to work properly and a 5v power supply – actually you can purchase the 5v power supply directly at the web shop, but that I unfortunately overlooked and bought one at the local DIY shop.

All cables are included for each PCB except for the parallel cable used to connect the Master Card to the USB Expansion Card – this I had to order separately, however that was not an issue and it was highlighted on the product page of the Master Card.

The way I setup these PCBs was as a string, limiting the number of USB connections to my computer down to only one USB. This is really nice and helps keeping the wiring spaghetti to a minimum.

The USB Expansion Card is the first card on the string providing a connection from the Master Card to the computer. Then I connected the Master Card to the USB Expansion Card using the parallel cable which now opened up a huge number of possibilities. The USB Expansion Card also features four analogue connectors.

One Master Card can control up to 72 Inputs which equals to 72 pcs On/Off toggle switches or 36 On/Off/On toggle switches etc. Furthermore the Master Card also controls up to 45 Outputs which could cover e.g. LEDs used in various annunciators. Together with that, each Master Card also features a bus that enables the connection of up to four Display Cards (each card controls 16x 7-segments displays), so the Master Card is truly a **Master Card**.

To scale it, each USB Expansion Card can control up to four Master Cards providing and extreme number of connection possibilities. A total of 288 Inputs, 180 Outputs and 4 analogue connectors for e.g. yoke, rudder etc. can be connected to the computer through only one single USB cable – that is awesome!

Basically neither the Input- nor Output Connection Cards are necessary to get all these inputs and outputs, but these cards provides a faster and more user friendly connection between the switches/LEDs and the PCBs due to the cable fitting by screw connectors that are mounted on these cards.

Also by adding these small cards to the string, I found that I could better manage to place them closer to the switches and LEDs which they should support, and hereby again limiting the wiring spaghetti to a minimum.

It could seem quite expensive to purchase 4x PCBs just to add some inputs and outputs, but reality is that the cost is very low if you calculate price per input/output compared to several other IOcards that I have checked on the internet. If we max out the setup we get 1x USB, 4x Master and 4x parallel cable = \$380 and this gives totally 472 input/outputs/analogue etc. resulting in a total of \$1.24 / input/output, which is a very fair price compared to other cards available on the internet. The solution is not the cheapest on the market but is still far from the most expensive (that I found) which had a price of more than \$4/ input/output and I have not even included the displays.

USB Expansion Card



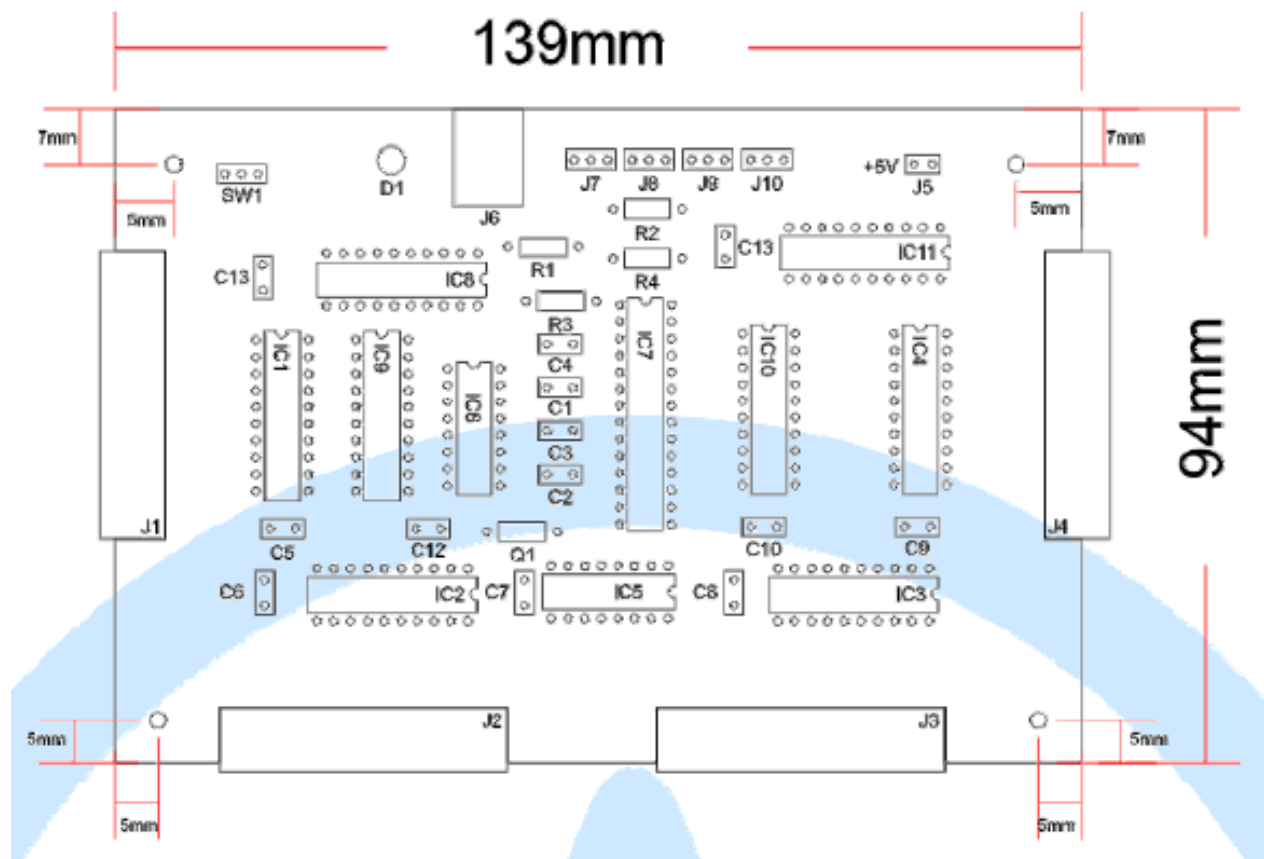
The USB Expansion Card is a highly recommended and quite important card if the need is to connect several cards to the home cockpit setup. Opencockpits has many different cards within their portfolio and also several cards which can be connected to the computer directly, but if you need several cards each using a USB connection, this will result in the need of several USB connections to the computer.

The function of the USB Expansion Card is simply to connect several cards on strings and then just have one single USB connection to the computer. The cards that can be connected to the USB Expansion Card are the Master Cards from Opencockpits. Furthermore the USB Expansion Card also features four analogue connectors which can be used to connect throttle, stick and pedals etc.

One single USB Expansion Card can connect a total of four Master Cards providing the home cockpit builder with an exceptional number of possibilities for both, inputs, outputs and displays. The new USB Expansion Card features SMD technology and includes four A/D converters.

The price is only EUR 38.- ex VAT which is approximately USD 50.- and this also includes one USB cable for the connection to the computer.

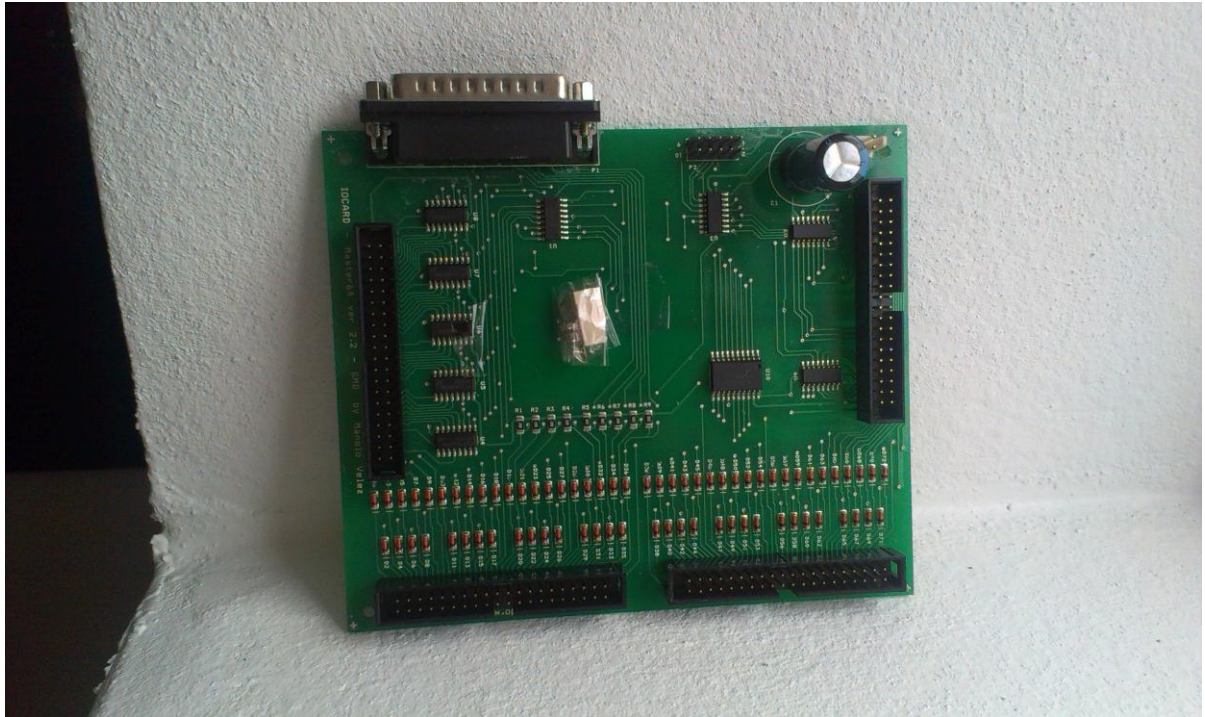
The USB Expansion card can be purchased as a “clean” PCB without any components or as a DIY assembly set if you like to do the soldering yourself or wants to save some money. It can also be purchased as a completely build PCB tested and ready for use. The material number for the complete version is 2T3.



Description of the connectors found on the USB Expansion Card and specifics for some of the components:

- J1, J2, J3 and J4 are connectors for the four Master Cards in the correct assigning order
- J5 is the connector for the Masters power supply – however this is not necessary since the USB Expansion Card receives sufficient power through the USB cable
- J6 is the USB connector toward the computer
- J7, J8, J9 and J10 are connectors for the analogue connections such as yoke, stick, throttle, pedals etc.
- SW1 is for a microchip reset possibility
- C1, C2 and C3 are all ceramic condensers 220nF
- C4 => C13 Condenser 0,1mF
- Q1 is a Quartz crystal 6 MHz
- IC1, 2, 3, 4, 8, 9, 10 and 11 are 74HC541
- IC5 is 74HC253
- IC6 is 74HC139
- IC7 is 16C745

Master Card

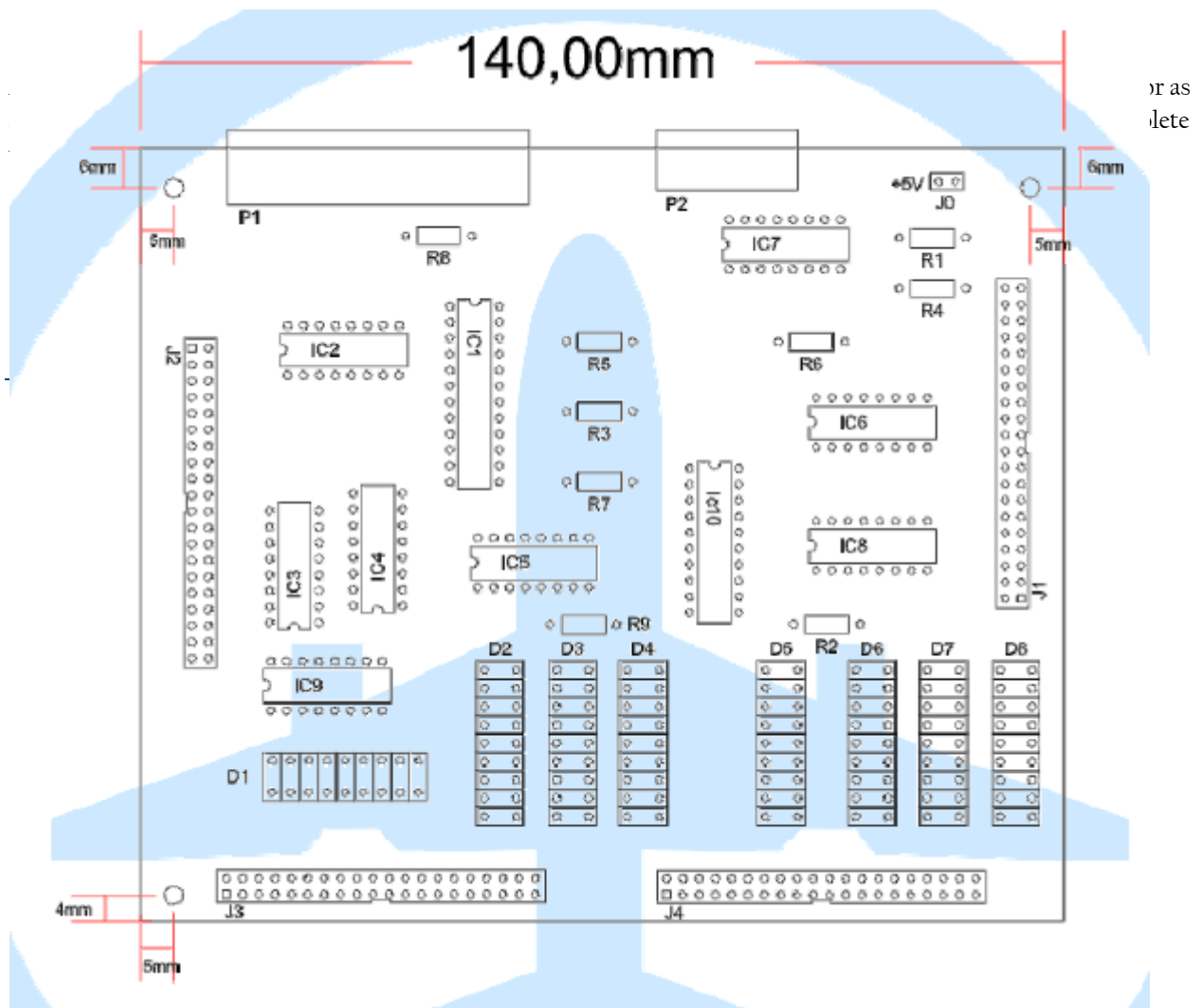


The Master Card is a real master piece and an incredible advantage to the home cockpit builder because by adding just one of these cards into the setup, it provides the home cockpit builder with 72 digital inputs, 45 digital outputs for e.g. LEDs etc. and together with this, additional outputs supporting the display cards – up to a total of 4 display cards in a series can be connected to just one single Master Card giving a total of 64 usable digits per Master Card.

The Master Card connects to the USB Expansion card using a parallel cable. This cable is not included but can be purchased separately at Opencockpits web shop. The Master card can be used for connecting switches, LEDs etc. directly to the home cockpit setup, or it can be used to connect other cards as the Input / Output cards described later. It is also possible to connect the Master Card to the USB Expansion Card directly without the use of the parallel cable – just connect the output female connector on the USB Expansion to the input male connector on the Master Card. This eliminates the use of the parallel cable and reduces the electronic noise.

If the Master Card is used directly in the home cockpit setup, then the connection to the switches and LEDs etc. will have to be done by soldering the wires directly to the Master Cards bus connectors. However, if you dis-like that way of connecting switches, LEDs etc. the Master Card can also be connected through the four bus connectors with a standard 40-pin bus cable. This cable can either be connected to PCBs with cable screw fittings or even directly to switches or LEDs etc. and now without the need for soldering.

The price for one Master Card is EUR 55.- ex VAT which is approximately USD 73.- and all that is needed as extra is the parallel cable which cost EUR 7.- ex VAT = approximately USD 9.- and which can also be purchased from the Opencockpits web shop and a 5v power supply also available at the web shop.



Description of the connectors found on the Master Card – please note that the sketch is with the old Master Card layout:

- P1 is the connector to the USB Expansion Card
- P2 is the connector for the 7 auxiliary outputs
- J0 is the connector for the power supply which is needed for the Master Card (5V and is not included)
- J1 is the bus for the display cards
- J2 is the connector for outputs as exit, LEDs and relays etc.
- J3 and J4 is the connectors for the inputs

Remember that there is needed a 5V power supply for the Master Card – in my setup I have purchased a power converter 220V ⇒ 5V which is just a standard wall socket plug-in with an outlet of 5V. When connecting the power supply to the Master Card you can use the female plug, which is taped onto the front and center of the Master Card.

Theoretically the Master Card will partly function without the power supply since the USB Expansion Card receives power from the USB connection – however there is quite a power consumption in the PCB which could cause some ghost presses if no additional power is supplied.

The input connections are made through bus J3 and J4 and they are put into groups of 9 inputs together with one GND (common) – this setup is of course also created the same way on the Input Connection Card, so that the connection between these cards is super easily done by the standard 40-pin bus cable.

Please notice that if you are connecting e.g. switches for input pin 1 and 2 you must use the GND (common) that supports this input section => in this case the pin 10. If you use a GND (common) from a different section than the input pin, the result will be a none working switch.



If you are to connect more than one Master Card to your USB Expansion Card, the J3 and J4 inputs will look like the schematics here below (featuring a 4 Master Cards setup)

Master card number	J3 inputs	J4 inputs
1	0-35	36-71
2	72-107	108-143
3	144-179	180-215
4	216-251	252-287

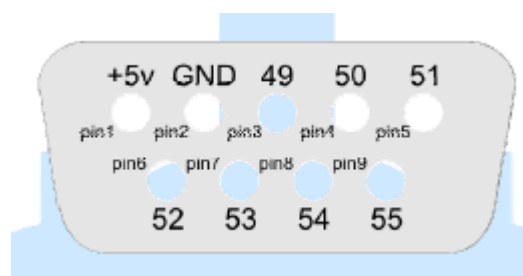
The output connections are made through bus J2 and P2 where J2 has 38 outputs and P2 has additional 7 outputs. The Output Connection Card is connected to J2 using a standard 40-pin bus cable and the schematics for the Output Connection Card are of course aligned with the schematics for the Output bus J2.

Each output provides 5V and app. 25mA meaning that connecting e.g. a single LED will require adding a resistor to the circuit. Standard LEDs are app. 0,7v giving the calculation $(5v - 0,7v) / 0,01 = 430\Omega \rightarrow$ this is also why Opencockpits recommend to use a 470 Ω resistor in a circuit with a single LED.

Connector J2

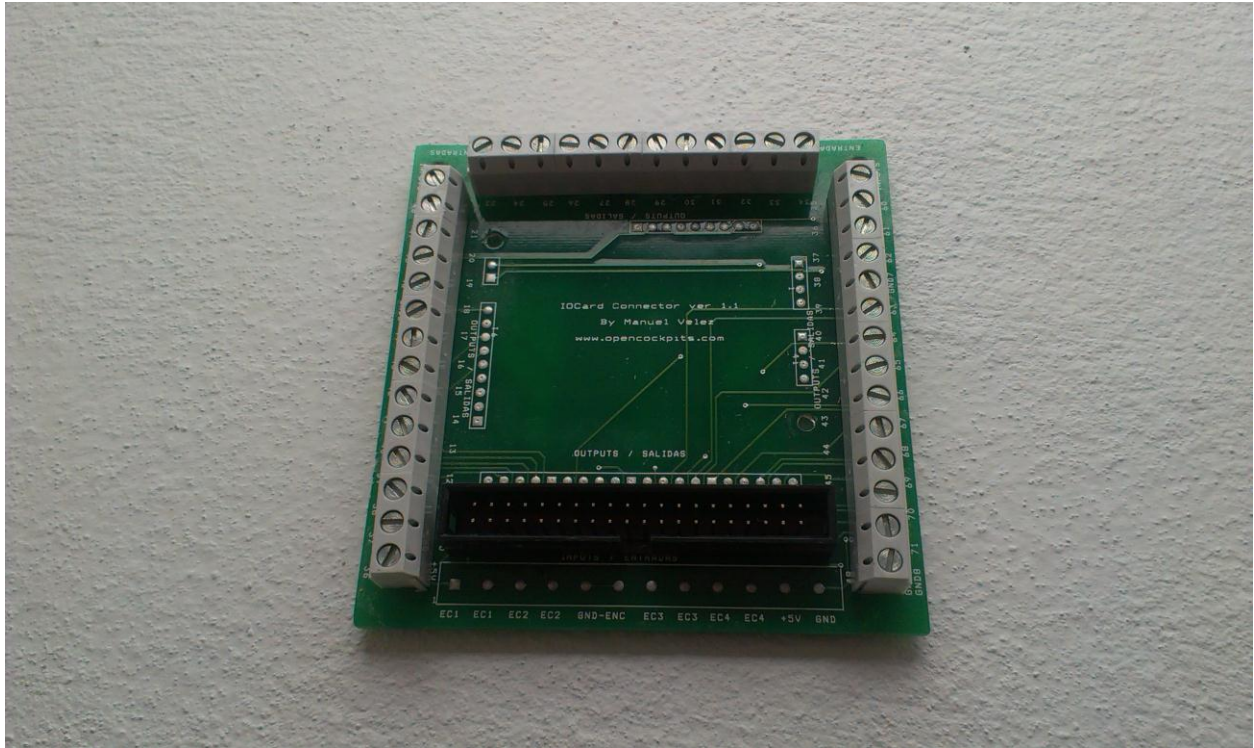
OUTPUTS	GND	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
PINS	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
PINS	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39
OUTPUTS	+5V	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47

Connector P2



Display Cards are connected through Connector J1, but since I have not included a display card in this test setup, I will not get into any specifics on that part.

Input Connection Card



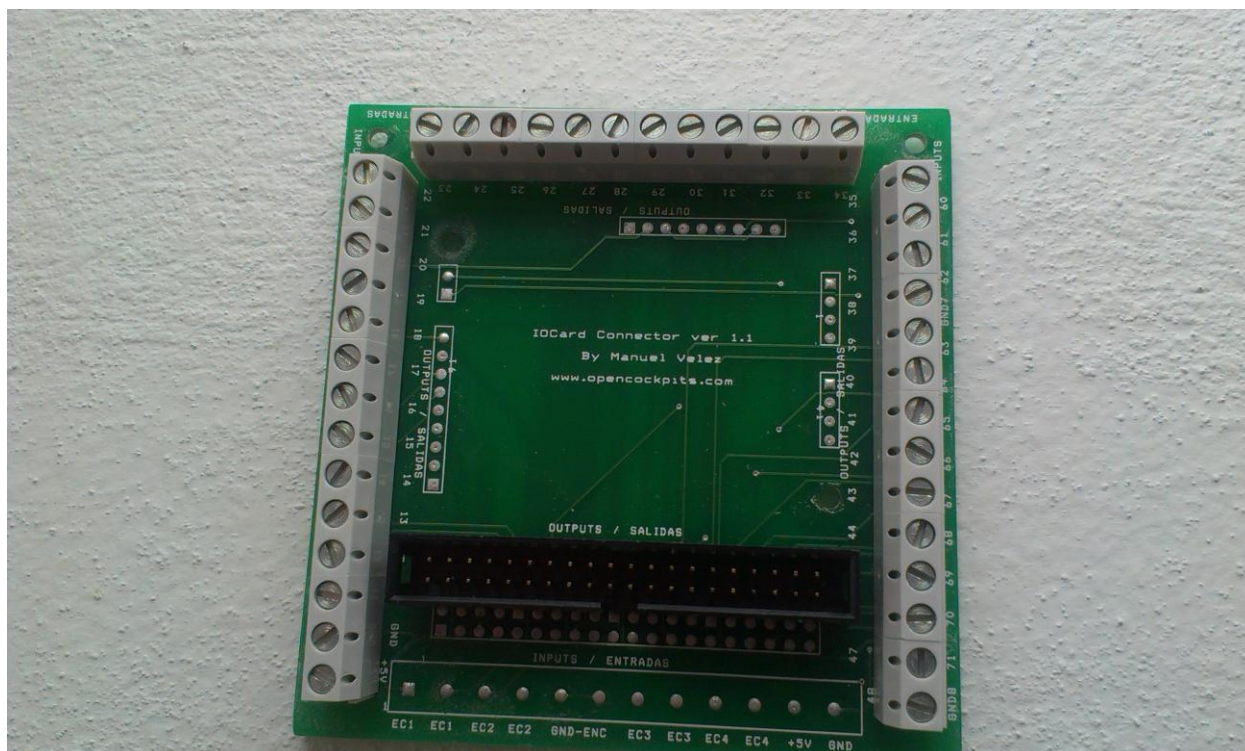
The Input Connection Card is a superb solution for the home cockpit builder that does not want to do soldering or frequently has the need for making changes to the setup of switches etc. The card is a rather small card but still it adds a huge advantage when connecting switches etc. to the home cockpit because the connection of wires are now done using cable screw connections instead of soldering.

The usage of the cable screw connections makes this PCB a very flexible card – on the other hand, it also makes the card irrelevant for home cockpit builders that want connections done by soldering wires etc. In my opinion this card is really an important card because my skills mastering a soldering iron is not very good (novice), but using a screwdriver I believe that most people will find to be easy.

The Input Connection Card is connected directly to the Master Card using a standard 40-pin bus cable (included) and is like a remote PCB part of the Master Card. The card features a total of 36 inputs and can actually be purchased as two versions. The first and simplest version is the version used for this test which only features the 36 inputs, but the card can also be purchased as a version also featuring the control of four encodes but then only 35 inputs.

The price for one Input Connection Card is only EUR 18.- ex VAT which is approximately USD 24.- and this includes the 40-pin bus cable. The material number for the tested version is 3T5. This card can only be purchased as a completely build and tested PCB ready for connection.

Output Connection Card



The Output Connection Card is extremely similar to the Input Connection Card – I am quite sure that the PCB and components are in fact the very same, and the only difference is the 40-pin bus connector which is soldered a bit higher than on the Input Connection Card.

As the Input Connection Card this Output Connection Card features the same cable screw connectors, which in my opinion makes this card very flexible within my home cockpit, because I quite often change connections when adding new hardware etc.

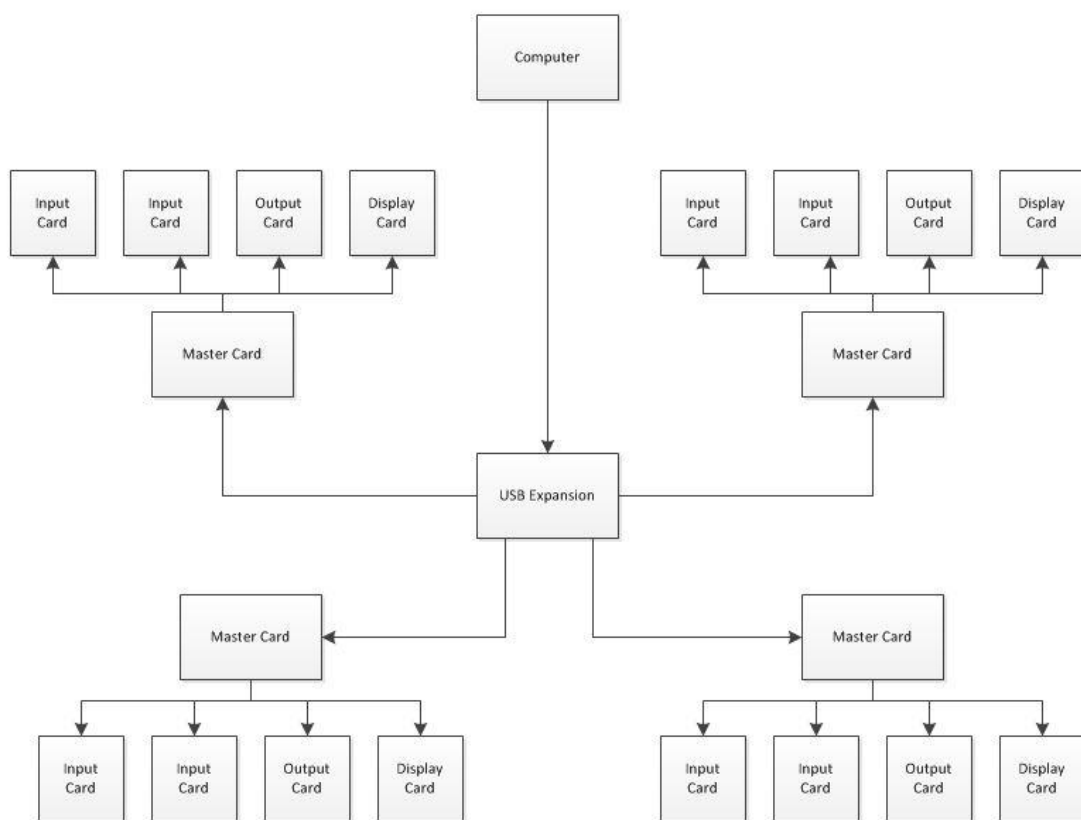
The Output Connection Card is connected directly to the Master Card using a standard 40-pin bus cable which is also included for this card. The card features a total of 38 outputs and can only be purchased fully assembled, tested and ready for use. Opencockpits has also other output card solutions, but these I have not tested and therefore they are not included in this review.

The price for one Output Connection Card is only EUR 18.- ex VAT which is approximately USD 24.- and this also includes the 40-pin bus cable earlier mentioned. The material number is 3T4.

Setup

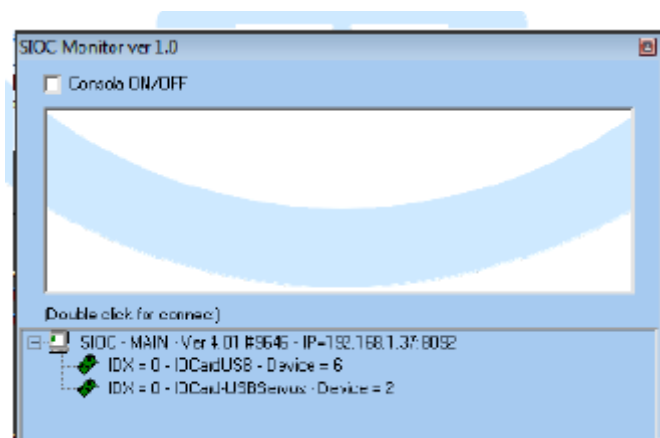
A logical setup of PCBs can look many ways, but I have tried to draw how these PCBs included in the review could be set up. Well.... Actually in the drawing I have also included the first display card for the series of four display cards for each Master Card.

Basics are; Computer => USB Expansion Card => Master Card => Input, Output and Display

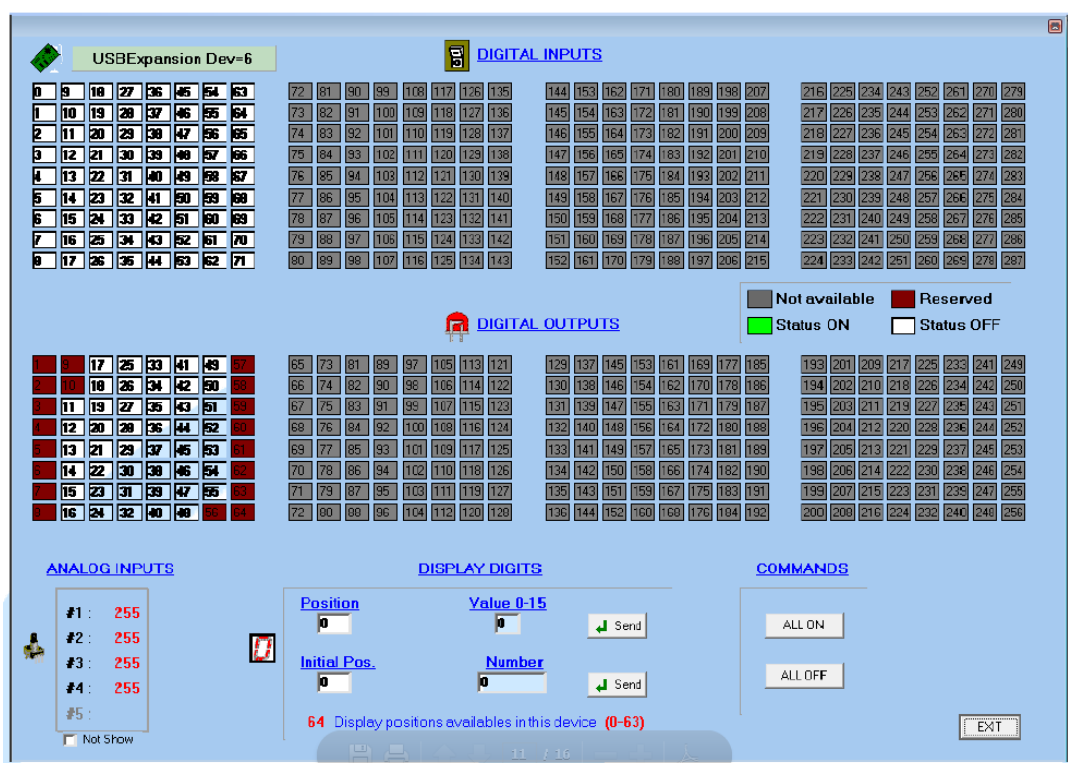


To do the programming of the PCBs there are several ways but when working with PCBs from Opencockpits I find it natural to use the SIOC software. This can be downloaded directly from Opencockpits website and is a rather user friendly programming software. I am still just a novice within the terms of using the SIOC software, but there are several manuals that can help and guide you in the right direction (all found as downloadable pdf files at the web shop or simply just a quick Google search)

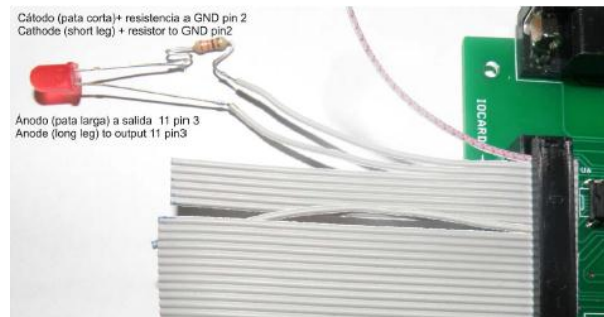
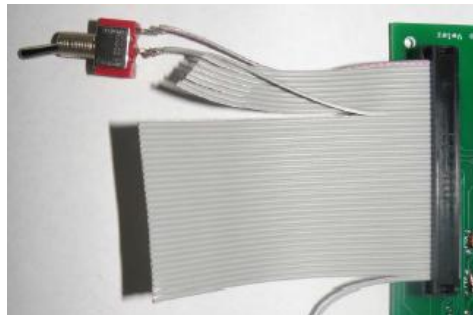
What you need to do is to install the SIOC software, connect all the PCBs and switches/LEDs etc. and then start up the SIOC software to verify that the cards are functioning as required. When the SIOC software is activated, press the SIOC Monitor button and a screen with the connected IOCards will pop-up.



Double click on the USB Expansion Card which is listed here as the IDX IOCARDUSB – Device = 6 – this takes us to the overview of all connections made to/from the USB Expansion Card, meaning that the overview we now will see will cover all the Input/Output/Display cards connected to each their series of Master Cards.



If we e.g. connect a switch to the J3 connector and set it up logically as the first switch = connecting to the first pin which is pin 1 and the GND common to the pin 10, and then connect an LED to the J2 connector as output 11 which is pin 3 and the GND common pin 2, we will get the overview as shown here below:



You can see that only one input card (J3) is connected because this card section is white with white buttons (the gray sections are the available bus section that not yet has any connections). The same goes for the output card (J2) => the reason for why you can see four output sections is because the USB Expansion Card supports up to four Master Cards that each supports one output card bus section.

What you can also see is that we now have both a switch and an LED connected to the setup with an active status (the green color). This means that the connection works and all we now have to do is the programming of the switch and LED. A detailed manual of how to use the SIOC software can be downloaded from [Opencockpits web site](http://Opencockpits.com), but if you are not that interested in writing the codes yourself, I would recommend to Google search for a complete code for each of the switches, LEDs etc. that you want activated - just copy/paste the code into the SIOC but remember to change the input and output numbers to fit your setup! (whoever wrote the code you are using, probably does not have the exact same switch connected to the exact same pin etc.)

I found that doing the programming within the SIOC software took me quite some time because I could not write the commands myself (didn't know how to) but instead I searched the internet and found the various commands

that I needed, already written and just ready for a copy/paste – that really helped me out a lot and also saved me a lot of time. For a detailed explanation of the SIOC programming I will refer to the downloadable manual from Opencockpits website.

I also tried to do a test using FSXs assignment tool and also using FSUIPC directly for the programming, but this however was not possible. I had connected all PCBs correctly and also remembered to include the 5v power supply to the Master Card, installed the SIOC to make sure that the PCBs were active and able to be programmed, but unfortunately I could not get the connection to the FSUIPC directly. I am not sure if this is due to something that I have overlooked or if it actually is not possible. I know that FSUIPC and SIOC can work together, but do the programming of switches directly with FSUIPC just wouldn't work for me. Anyway – this is of course not an issue since I just used the SIOC instead, but still something that could have been awesome if it had worked.



Conclusion

My overall impression of these PCBs was really good. The quality is high and the PCBs are created using the SMD technology. They have a fair size and are easy to mount into a home cockpit setup – just put a screw in the small hole that are drilled in each corner of the PCBs.

Connecting the PCBs are easily done using 40-pin bus cables and parallel cables, and the schematics of each PCB is very well described and pictured in the downloadable manuals together with a step-by-step guide of how to install the SIOC software and get the PCBs recognized and activated for programming.

For me it was awesome that I furthermore could connect Input and Output PCBs that featured screw connectors so that I didn't have to worry about doing a lot of soldering. This also gave me more flexibility when adding more hardware or changing the hardware setup of my home cockpit.

The setup featuring the Opencockpits PCBs are a superb and very powerful solution for a home cockpit – the included SIOC software is extremely flexible and all the wiring spaghetti can really be limited to a minimum because all PCBs can be connected on a string instead of a USB solution for each PCB.

Pricewise I find this solution to be fair – if you have a small home cockpit setup and no plans for expanding the setup, this might be a little over the edge, but if you instead have a quite complex setup or plans for expanding your setup, then I would most certainly recommend using these PCBs.

I rate the PCBs from Opencockpits with a full house of 5-Stars. They are of a very good quality and together with a superbly and flexible software, the PCBs become a very powerful unit for the home cockpit setup. I thank Opencockpits for providing the flightsim community with such incredible fine PCBs.

Rays Aviation

