Basic documentation for to use IO32 cards system and display of Fabien Deheegher and SIOC OpenCockpits

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Summary

INPUTS / OUPTUTS IO32 CARDS

FD0001 - IO32 4AD primary card

32 inputs with common GND
32 outputs 5V 15 mA with common GND
4 analog inputs, one of which can be associated with the PWM drive for the backlight
Expandable to 128 inputs and 128 outputs by adding expansion cards (FD0002)

FD0002 – IO32 expansion card

32 inputs at common GND
32 outputs 5V 15 mA with common GND
Adds 32 additional inputs and 32 outputs to the FD0001 primary card.
3 expansion cards possible with the primary card, 128 inputs and 128 outputs

FD0003 - connection card

Card equipped with 2 connectors (40 pins female) for the connection on FD0001 primary card or FD0002 expansion card

Facilitates the wiring (32 inputs and 32 outputs with common ground)
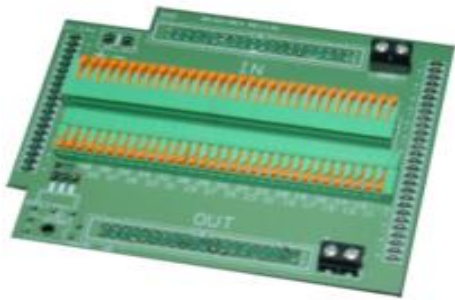
Card equipped with 2 connectors (40 pins female) for the connection on FD0001 primary card or FD0002 expansion card
Facilitates the wiring (32 inputs and 32 outputs with common GND)

Variant of the FD0003 card equipped with 'fast' connectors with clamps

Note: I recommend it because it is really useful for wiring
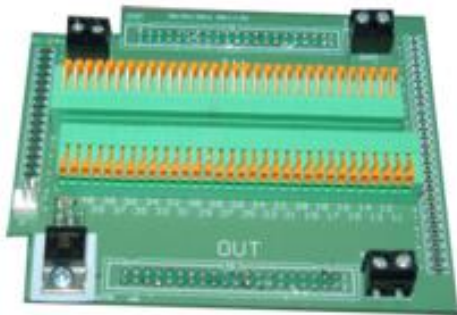
Card equipped with 2 connectors (40 pins female) for the connection on FD0001 primary card
Facilitates the wiring (32 inputs and 32 outputs with common GND)

Variant of the FD0004 card: equipped with a power dimmer (PWM) for the backlight
45W =
- 9A under 5V
- 3A under 12V
- 1,5A under 24V

Note: This card can only be mounted on the FD0001 Primary Card

DISPLAY CARDS

==FD0006 – 24 digits + 32 INPUTS card==

Optional card to be inserted on FD0001 primary card or FD0002 expansion card

- 24 digits 7 segments with common GND (common cathode)
- 4 IDC connectors 14 pins for 5 digits group
- 1 IDC connector 14 pins for 1 4 digits group
- 32 inputs with common GND
- No outputs

3 cards maximum: FD0001 primary card and 2 FD0002 expansion cards
Capacity of 72 digits in total

==FD0007 – 24 digits card with 'fast' connectors with clamps==

Optional card to be inserted on FD0001 primary card or FD0002 expansion card

variant of the FD0006 card equipped with 'fast' connectors with clamps

Note: I recommend it because it is really useful for wiring

==FD0008 - 24 digits card with 'fast' connectors with clamps + power dimmer==
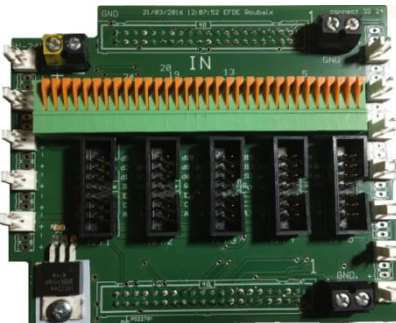
Optional card to be inserted on FD0001primary card

Variant of the FD0007 card equipped with a power dimmer (PWM) for the backlight
Same characteristics of the power dimmer for the backlight of the FD0005 card

Note: This card can only be mounted on the FD0001 primary card

FD0009- 5 white digits on PCB
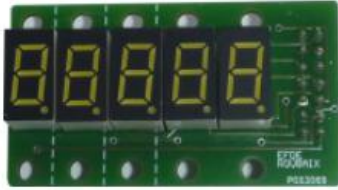
- Welded displays (5 digits)
- Equipped with a 14 pins IDC connector to connect to FD0006, FD0007 and FD0008 24 digits cards
- PCB dimensions: 51 X 30 X 20

FD0010 - 4 white digits on PCB

- Welded displays (4 digits)
- Equipped with a 14 pins IDC connector to connect to FD0006, FD0007 and FD0008 24 digits card
- PCB dimensions: 44 X 30 X 20

FD0011 - 3 white digits on PCB

- Welded displays (3 digits)
- Equipped with a 14 pins IDC connector to connect to FD0006, FD0007 and FD0008 24 digits card
- PCB dimensions: 36 X 30 X 20

FD0012 - 2 white digits on PCB

- Welded displays (2 digits)
- Equipped with a 14 pins IDC connector to connect to FD0006, FD007 and FD0008 24 digits card
- PCB dimensions : 28 X 30 X 20

color contrast filters (smoked, green, orange, blue and red) pre-cut 50X30 or cut to order

IO32 CARDS CONFIGURATION AND INPUTS / OUTPUTS NUMBERING

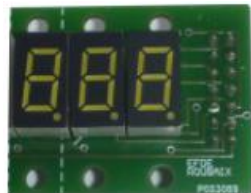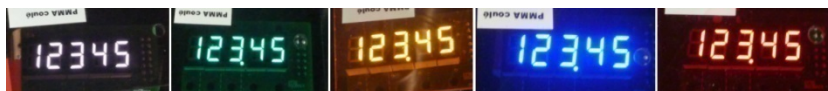This IO32 cards table shows how to configure an IO32 set. To create your composition, it is essential to start your configuration with the FD0001 primary card. You can extend your configuration with up to 3 FD0002 expansion cards. Next come the possible options with the connection cards, power dimmer and display cards. It should be noted that you can put a FD0005 or FD0008 power dimmer card only on the FD0001 primary card.

A set of IO32 cards cannot exceed 4 cards according to the configuration below. By convention, please note the numbering below:

- IO32 primary card 32 inputs and 32 outputs   #1
- IO32 expansion 32 inputs and 32 outputs   #2
- IO32 expansion 32 inputs and 32 outputs   #3
- IO32 expansion 32 inputs and 32 outputs   #4

IO32 CARDS CONFIGURATIONS

REF	DESIGNATION	IO32 PRIMARY #1		IO32 EXPANSION #2		IO32 EXPANSION #3		IO32 EXPANSION #4	
FD0001	IO32 PRIMARY	BASE	X						
FD0002	IO32 EXPANSION			BASE	X	BASE	X	BASE	X
FD0003	CONNECTION CARD: 32 inputs/32 outputs	OR	X	OR	X	OR	X	OR	X
FD0004	CONNECTION CARD: 32 inputs/32 outputs by 'fast' connectors with clamps	OR	X	OR	X	OR	X	OR	X
FD0005	CONNECTION CARD: variant of FD0004 + power dimmer	OR	X						
FD0006	24 DISPLAYS CARD: 32 outputs	OR	X	OR	X	OR	X		
FD0007	24 DISPLAYS CARD: 32 outputs by 'fast' connectors with clamps	OR	X	OR	X	OR	X		
FD0008	24 DISPLAYS CARD: variant of FD0007 + power dimmer	OR	X						

Below, the numbering table of the inputs and outputs indicating according to the configuration of the connection cards and displays cards. Depending on your choices regarding the display cards , you will notice that each time a display card is selected, 32 outputs are no longer available and the output numbering and shifted from an IO32 expansion card. It should be noted that you can only put 3 display cards on an IO32 set of 4 cards: # 1, # 2 and # 3).

NUMBERING	IO32 PRIMARY #1			IO32 EXPANSION #2			IO32 EXPANSION #3			IO32 EXPANSION #4	
	INPUTS	OUTPUTS	DISPLAYS	INPUTS	OUTPUTS	DISPLAYS	INPUTS	OUTPUTS	DISPLAYS	INPUTS	OUTPUTS
Numbering by default	00-31	11-42		32-63	75-106		64-95	139-170		96-127	206-234
Configuration with 1 display card	00-31		00-23	32-63	11-42		64-95	75-106		96-127	139-170
Configuration with 2 display card	00-31		00-23	32-63		24-47	64-95	11-42		96-127	75-106
Configuration with 3 display card	00-31		00-23	32-63		24-47	64-95		48-71	96-127	11-42

DECLARATION OF PRIMARY CARDS IN THE SIOC.INI FILE

The declaration in the SIOC.ini file is identical to that of the OpenCockpits cards. Connect your IO32 primary card with a USB cable to your PC and run SIOC:
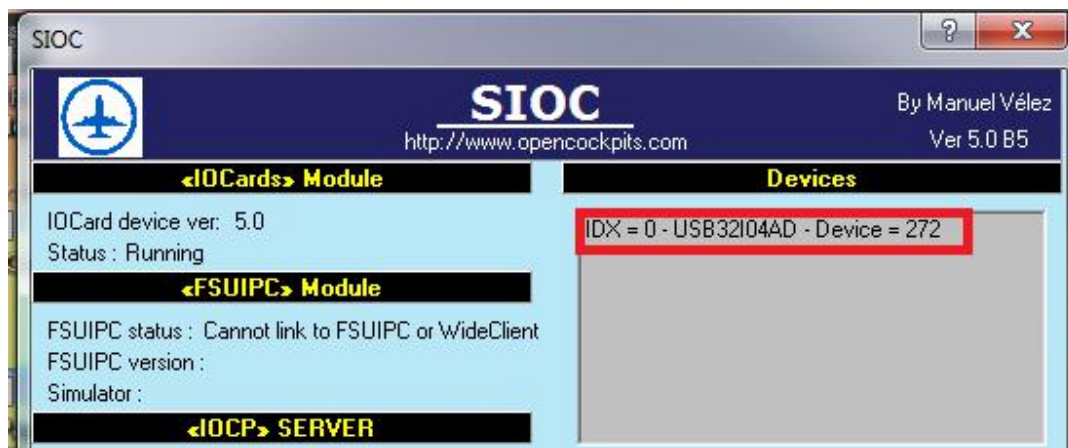
Line of SIOC.ini file: **MASTER= [device index] , [Type] , [Number of cards] , [USB device number]**

Device index: If only 1set IO32 primary card, IDX is equal at 0. 1 if second set of cards, etc.

Type: 4 for use IO32 primary card. The IO32 card type is identified by **USB32I04AD**

Number of cards :   Number of cards connected (FD0001 = 1, FD0001+ 1 FD0002 = 2, FD0001 + 2 FD0002 = 3, FD0001+ 3 FD0001 = 4)

USB device number: emulation of the USB device number. Device = 272 corresponding to the USB device number during the connection. Identify the USB port where you connect your primary IO32 card because if you change the port, a new USB device number will be assigned.

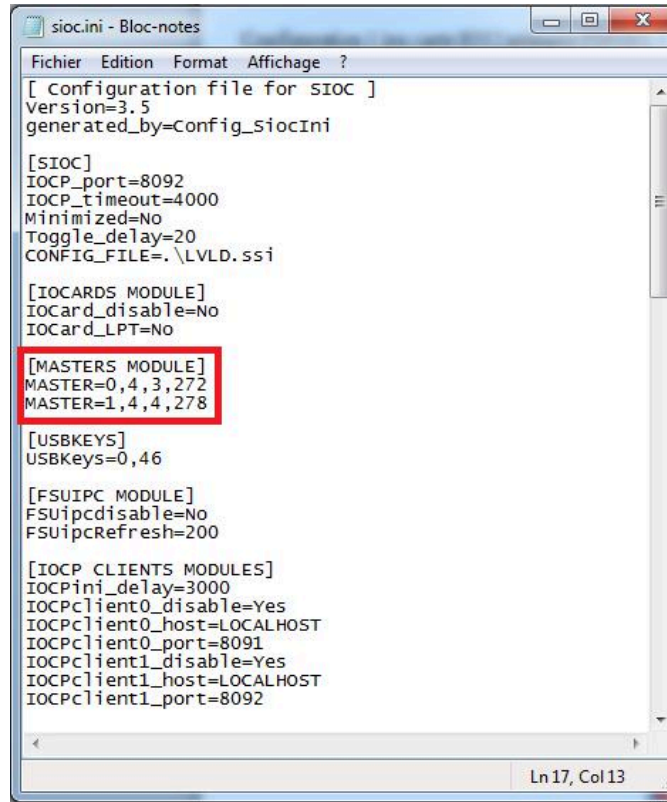Configuration the first set FD0001 primary card + 1 FD0002 expansion card:

 MASTER=0,4,2,272

Configuration the first set : FD0001 primary card + 2 FD0002 Expansion cards / the second set: FD0001 primary card + 3 FD0002 expansion cards:

MASTER=0,4,3,272
MASTER=1,4,4,278

Configuration SIOC.ini file:

DEVICE function in SIOC programming to identify IO32 card sets:

The FD0001 primary card with index 0 is identified by default in DEVICE 0 in SIOC programming. In the 2 examples below, it makes no difference between the first and the second example for the primary card having the index 0:

Declaration without DEVICE: Var 9006 Name MasterCa_SW Link IOCARD_SW Input 47 Type P
Declaration with DEVICE: Var 9006 Name MasterCa_SW Link IOCARD_SW DEVICE 0 Input 47 Type P

The FD0001 Primary card having the index 1:

Mandatory declaration with DEVICE: Var 9006 Name MasterCa_SW Link IOCARD_SW DEVICE 1 Input 47 Type P

And so on for the next FD0001 primary cards. This will be mentioned again in SIOC programming.
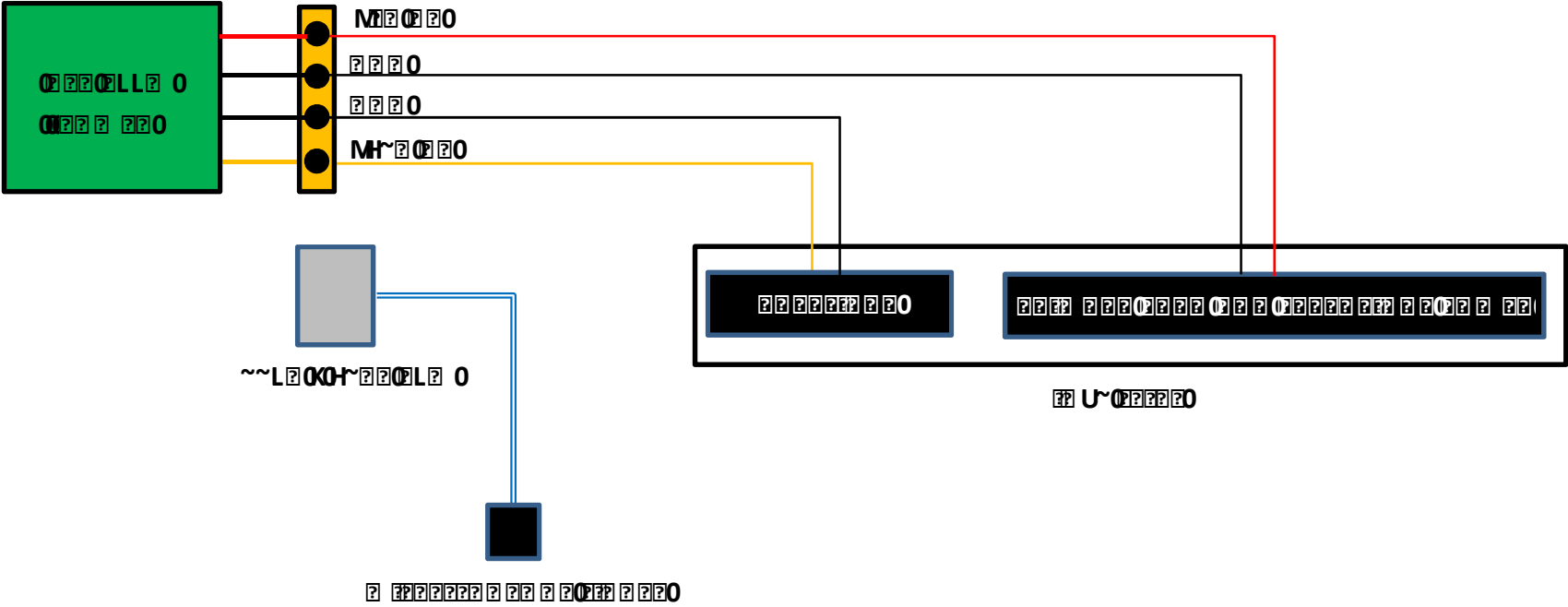
500 W ATX POWER BOX:

Put the green wire (motherboard connection) to the ground for starting at power on.

Storage unit connector (for example):

1: +12V yellow
2: GND 12V black
3: GND 5V black
4: +5V red

1 2 3 4
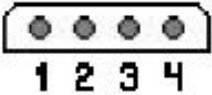
POWER SUPPLY 5V DC FOR FD0001 PRIMARY CARD AND FD0002 EXPANSION CARDS
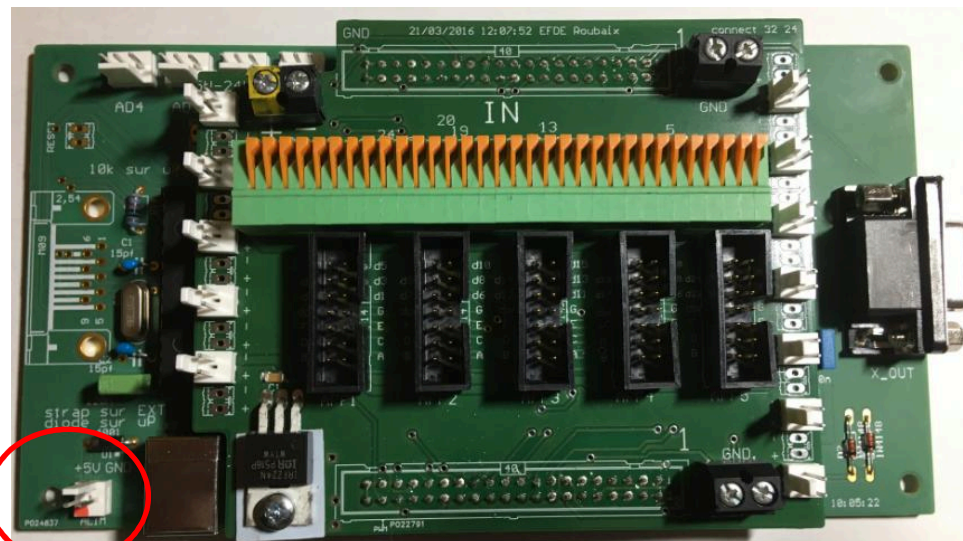
FD0008 24 displays with 32 inputs + power dimmer for backlight on the FD0001 primary card

We can notice that the + 5V is well identified and as well as the -5V (engraved on the PCB + 5V and GND). The + 5V and spotted by a red dot. So, there is no place to go wrong to connect + 5V and -5v to the connector. The FD0001 board is powered according to the indications below:

On the FD0001 primary card:
- FD0006, FD0007 and FD0008 cards with 24 digits
- FD0003, FD0004 and FD0005 with de 24 outputs: if it is plugged in more than 10 leds

On the FD0002 extension card : powered by the FD0001 primary card
- FD0006 and FD0007 cards with 24 digits
- FD0003 and FD0004 cards with 24 outputs : if it is plugged in more than 10 leds

Note : use regulated 5V DC via ATX power supply

POWER DIMMER FOR BACKLIGHT ON FD0005 and FD0008 CARDS, LIMITATIONS

5V-24V power

outputs: backlight connectors

outputs: backlight connectors

It is possible to add other connectors if necessary
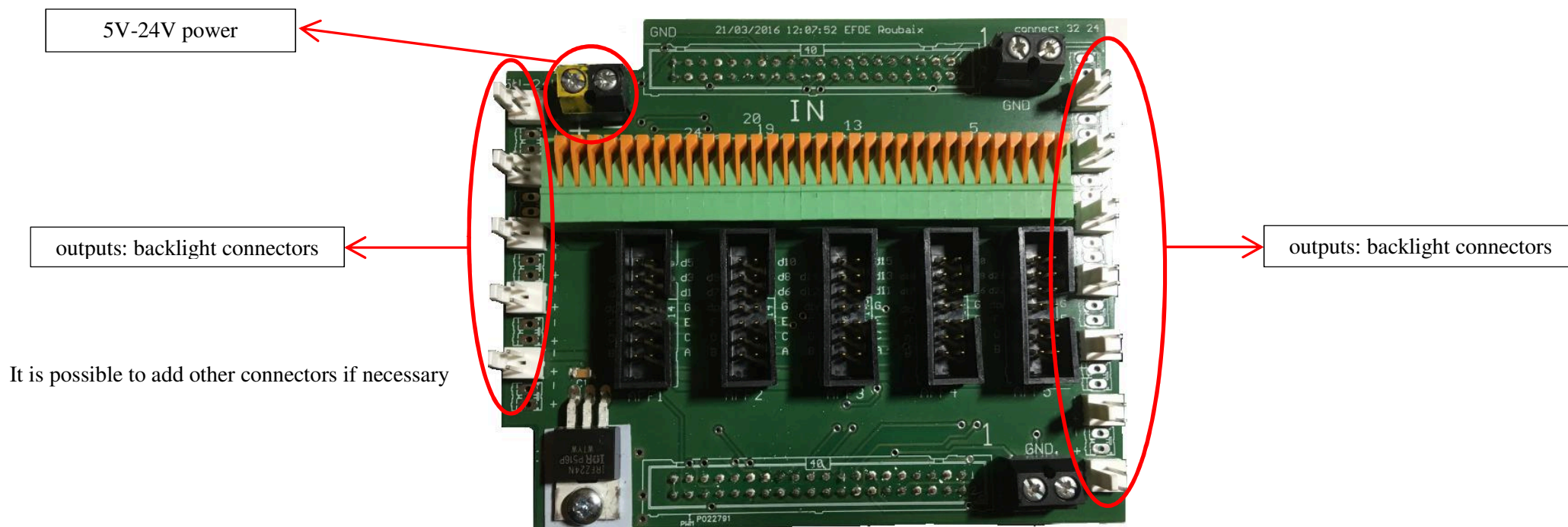
24 digits and 24 inputs + power dimmer FD0008 card (identical to the FD0005 card)
The 24 inputs and 24 outputs FD0005 card works in the same way for the power dimmer. It is worth remembering the limitations of use

45W =
9A under 5V
3A under 12V
1,5A under 24V

Therefore, it is necessary to calculate the consumption of what is going to be connected (LEDs, strip of LEDs) so as not to exceed the recommendations. **It is more than recommended for the backlight to use a regulated 12V DC** voltage (power supply adapted). The 'negative' pins of the backlight connectors cannot be used as GND for inputs and outputs.

The calculation starting from leds 5050 in band (60 leds per meter) 0.2W of consumption per led group of 3 leds: 150 leds X 0.2W = 30W, number of amperes = 30 W / 12V = 2.5A. The calculation is identical with leds 20 mA which is equal to 0.02W consumption per led.

AD4 analog input on the FD0001 card with power dimmer

Potentiometer 10K

1-GND
2-INPUT
3-OUTPUT
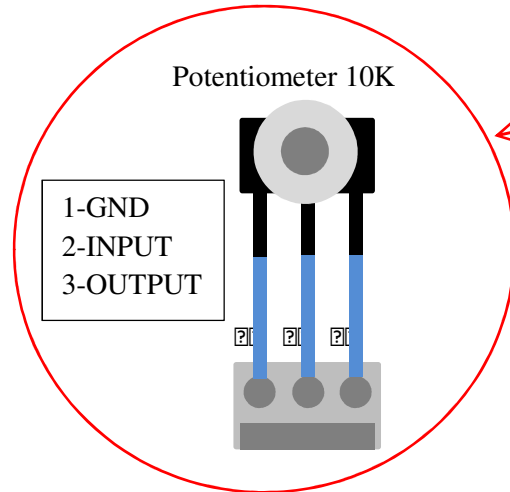
To be checked according to the type of potentiometer

FD0008 with power dimmer for backlight on the FD0001 primary card
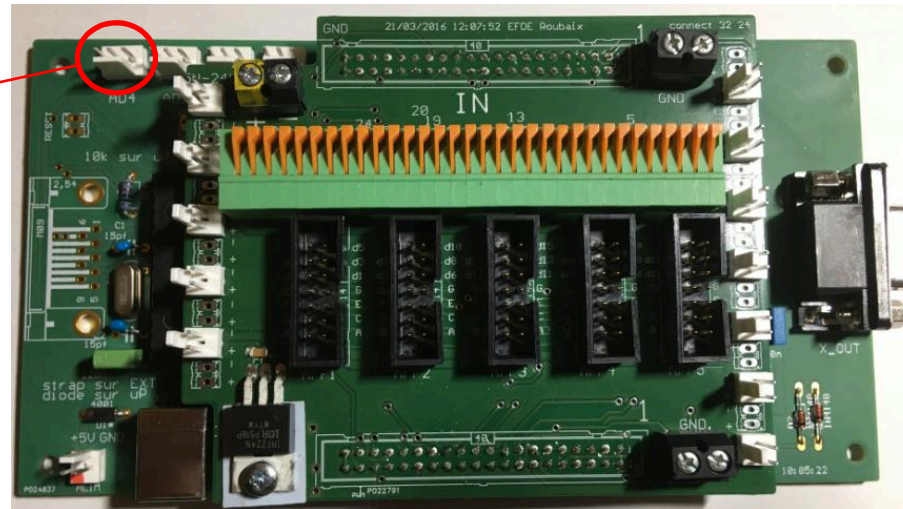
Applicable for FD0005 and FD0008 connection cards equipped with power dimmer for backlight

Script initialization of AD4 analog input:

```
// Fabien Deheegher
// AD4 analog input: Initialisation of dimmer on the FD0005 or FD0008 card

Var 0000, name init, Value 1      // cards initialization
{
   &InitCard = delay 2,200
}

Var 0001, name InitCard, static, value 1      // physical initialization of cards
    {
    &Ad4Dimmer = -999994
    &Ad4Dimmer = 16
    }

var 0002, name Ad4Dimmer, Link IOCARD_DISPLAY, static, digit 255, numbers 1
```

FD0001 PRIMARY CARD LINKS WITH FD0002 EPANSION CARDS

NEXT FD0002
EXPANSION CARD

FD0008 card on the FD0001 primary card
+ FD0004 card on the FD0002 expansion card
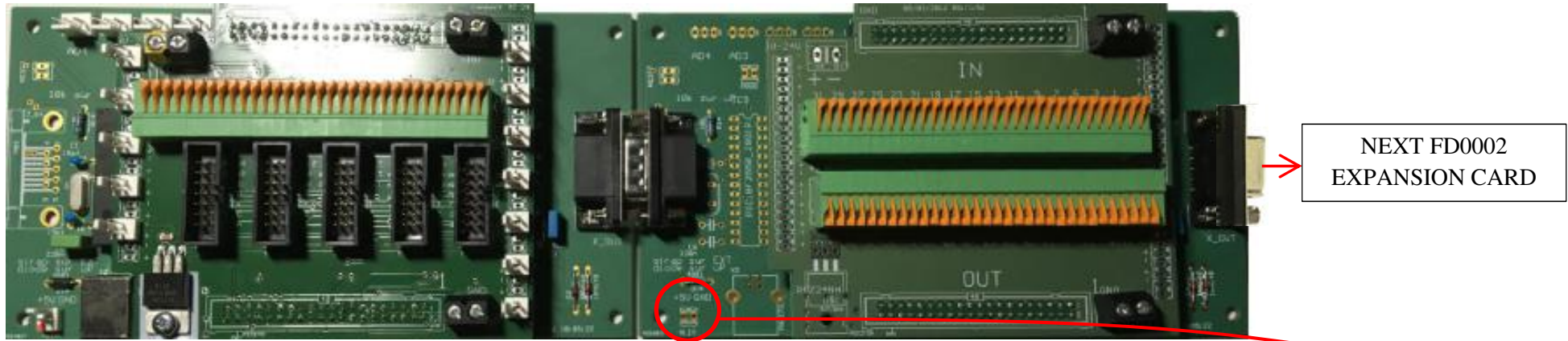
The link between cards is simply via the DB9 female and DB9 male connectors. One cannot go wrong because the FD0001 primary card is the first base card of the system with a DB9 female connector (left card on the picture). Then, connect the FD0002 Extension Card with its male connector (on the right in the picture). Up to 3 expansion cards can be connected for 128 inputs and 128 outputs (see the configuration table on page 7)

If for reasons of space, it is desired to have another location, it is possible to make the connection via a straight male-female DB9 cable. It should be noted that if the cable exceeds 1meter for the connection between FD0002 expansion cards and the outputs of the FD0003 or FD0004 or FD0006 or FD0007 connection cards have more than 10 leds, this requires powering the 5V the FD0002 expansion cards concerned:

DB9 male-female connector wiring: pin 1 on pin 1, pin 2 on pin 2, this up to pin 9.

MALE　　　　**FEMELLE**
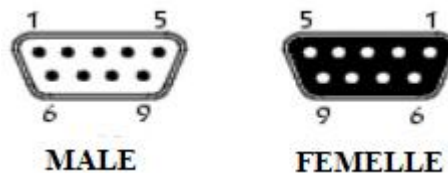
INPUTS / OUPTUTS MANAGEMENT AND GND CONNECTORS

INPUTS SIDE GND CONNECTOR

32 INPUTS

COMMON GND

32 OUTPUTS

OUTPUTS SIDE GND CONNECTOR
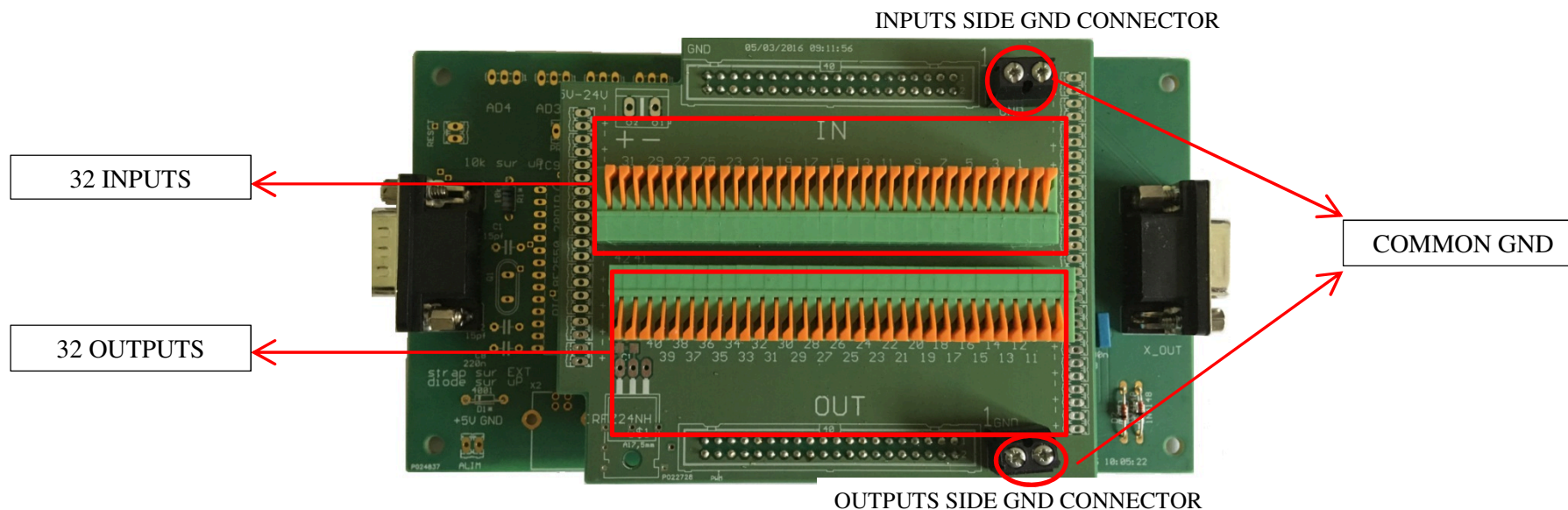
FD0004 connection card on the FD0002 expansion card

Applicable for FD0003, FD0004, FD0005 connection cards => 32 inputs and 32 outputs
Applicable for FD0006, FD0007, FD0008 connection cards => 24 digits, 32 inputs and not outputs

Each card has 2 GND double connectors. The GND connection can be indifferent on one or other of the connectors for the inputs and outputs. For optimal lines management, it is advisable to separate the GND between inputs and outputs between the 2 GND connectors. however, it is possible that korrys can have a common GND between leds and contactor. In this case, be pragmatic and decide to connect to one or the other of the GND connectors for the all korrys. Please group the GND inputs to be connected on inputs side GND connector and group the GND outputs to be connected on the outputs side GND connector. This is only a advice because of course the 2 GND connectors are common between inputs and outputs.

Reminder: the inputs / outputs numbering according to your configurations

NUMBERING	IO32 PRIMARY #1			IO32 EXPANSION #2			IO32 EXPANSION #3			IO32 EXPANSION #4	
	INPUTS	OUTPUTS	DISPLAYS	INPUTS	OUTPUTS	DISPLAYS	INPUTS	OUTPUTS	DISPLAYS	INPUTS	OUTPUTS
Numbering by default	00-31	11-42		32-63	75-106		64-95	139-170		96-127	206-234
Configuration with 1 display card	00-31		00-23	32-63	11-42		64-95	75-106		96-127	139-170
Configuration with 2 display card	00-31		00-23	32-63		24-47	64-95	11-42		96-127	75-106
Configuration with 3 display card	00-31		00-23	32-63		24-47	64-95		48-71	96-127	11-42

The objective is to provide the basics for those who have limited or no knowledge of SIOC. The examples shown are basic but clear in terms of cabling and programming. It will not be mentioned interfacing with FSX (offsets FSUIPC or others).

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- Prepare the assignment of lines related to your IO32 cards configurations as a table

IO32 #1 INPUTS (DEVICE 0)

	TESTED														
AD1				AD2				AD3				AD4	BACKLIGHT MCP		
	MCP (32)				MCP (19) / OVHD (13)				OVHD (32)				OVHD (32)		
	IN1.1 + BL				IN1.2				IN1.3				IN1.4		
N°	INPUT	TEST		N°	INPUT	TEST		N°	INPUT	TEST		N°	INPUT	TEST	
00	MCP-F/D CA			32	MPC-SPEED ENC. +			64				96			
01	MCP-F/D FO			33	MCP-SPEED ENC. -			65				97			
02	MCP-AT ARM			34	MCP-SPEED INTER			66				98			
03	MCP-SEL IAS/MACH			35	VOR1-AM SW			67				99			
04	MCP-N1			36	VOR1-FRQ ENC, +			68				100			
05	MCP-SPD			37	VOR1-FRQ ENC, -			69				101			
06	MCP-LNAV			38	VOR1-FRQ L/H SW			70				102			
07	MCP-VNAV			39	VOR1-CRS ENC, +			71				103			
08	MCP-FL CH			40	VOR1-CRS ENC, -			72				104			
09	MCP-HOLD HDG			41	VOR2-AM SW			73				105			
10	MCP-VS			42	VOR2-FRQ ENC, +			74				106			
11	MCP-HOLD ALT			43	VOR2-FRQ ENC, -			75				107			
12	MCP-BCRS			44	VOR2-FRQ L/H SW			76				108			
13	MCP-LOC			45	VOR2-CRS ENC, +			77				109			
14	MCP-APP			46	VOR2-CRS ENC, -			78				110			
15	MCP-L CMD			47	WIN-L MASTER CA			79				111			
16	MCP-C CMD			48	WIN-L CLOCK			80				112			
				49	WIN-R MASTER FO			81							
					R CLOCK			82							

- If possible, identify the inputs, outputs and GND by cables of color such as:

Inputs:
5V+   Red
5V -   Black

Outputs:
5V+   Blue
5V-   Grey

Backlight : twisted for example to make the difference with inputs / outputs wiring
12V+   Orange
12V -   Blank

- If possible, to protect your soldered wires on the components (heat-shrinkable sheath)

WIRING OF PRINCIPLE AND PROGRAMMATION
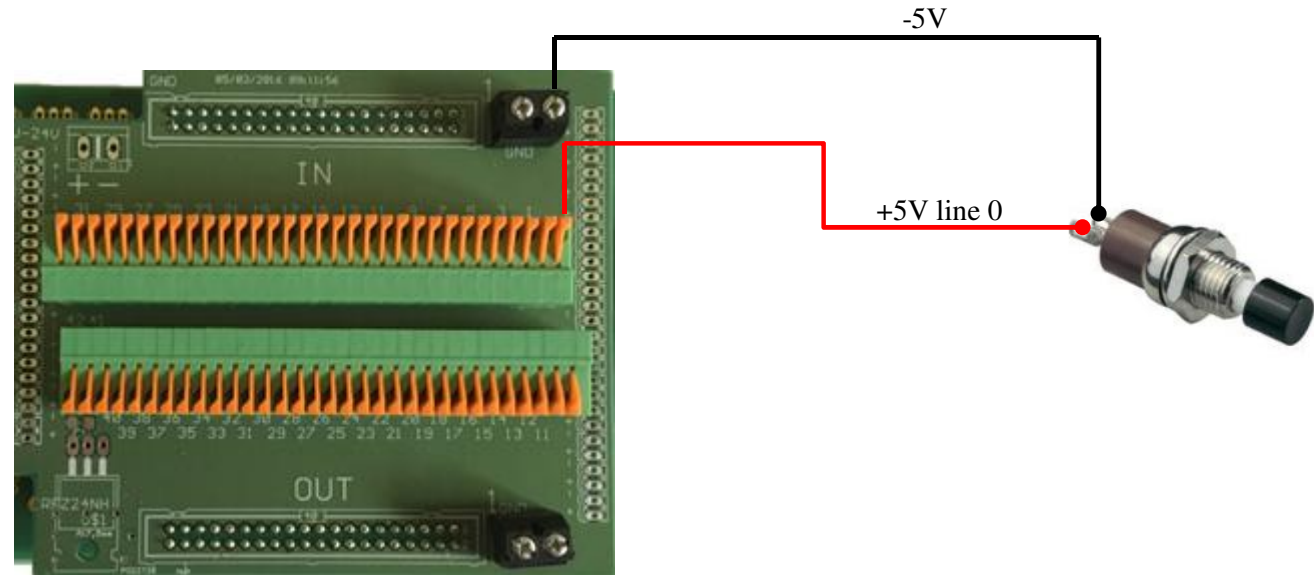
Push button ON / OFF momentary:

0

-5V

+5V line 0

Push button ON / OFF:

```
Var 9000 Link IOCARD_SW Input 0 Type P
```

When the push button is pressed and released, the variable 9000 is equal to 1 corresponding to the position ON
When the push button is pressed and released a new time, the variable 9000 is equal to 0 corresponding to the position OFF

push button functioning as ON / OFF momentary:

```
Var 9000 Link IOCARD_SW Input 0 Type I
```

When the push button is pressed and maintained, the variable 9000 is equal to 1 corresponding to the position ON
When the push button is released, the variable 9000 is equal to 0 corresponding to the position OFF
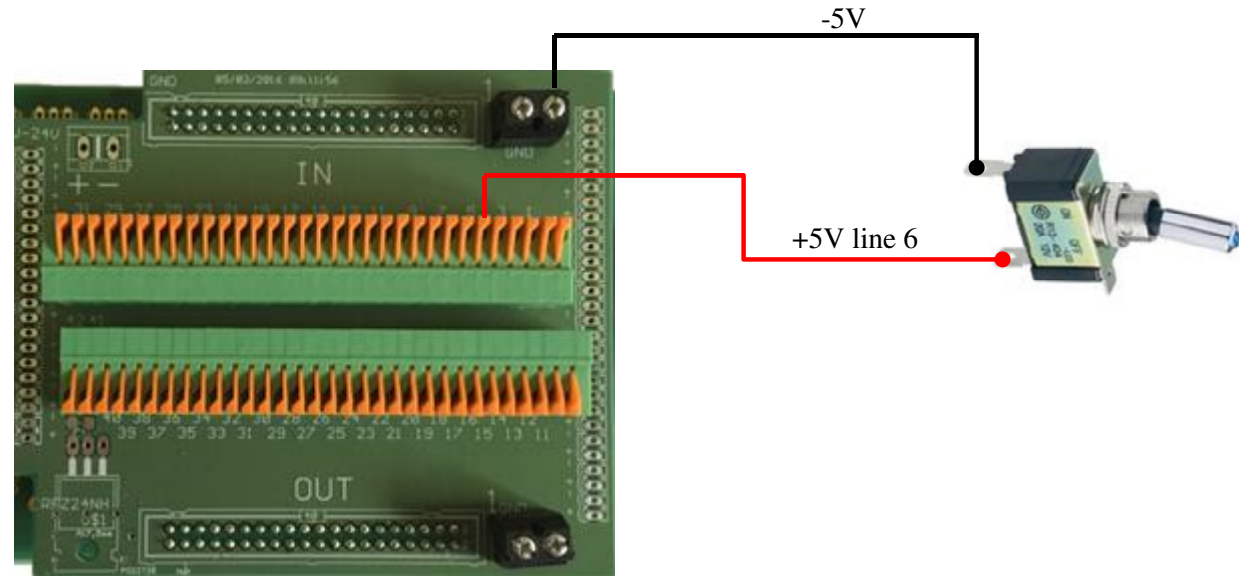
Le P type defines a switch OFF /ON
**Le I type defines a switch OFF / (ON) momentary**

0

Switch ON/OFF 2 pins:

The connection is identical at a push button. The switch has 2 mechanical positions: an 'Open' position and a 'Closed' position:

`Var 9000 Link IOCARD_SW Input 6 Type I`

The status of variable 9000 (0 or 1) is dependent on the physical position of the switch.

The momentary OFF (ON) toggle switch works in the same way as a push button (see example type I in page 17).

Rotary switch: rotary 3 positions example:
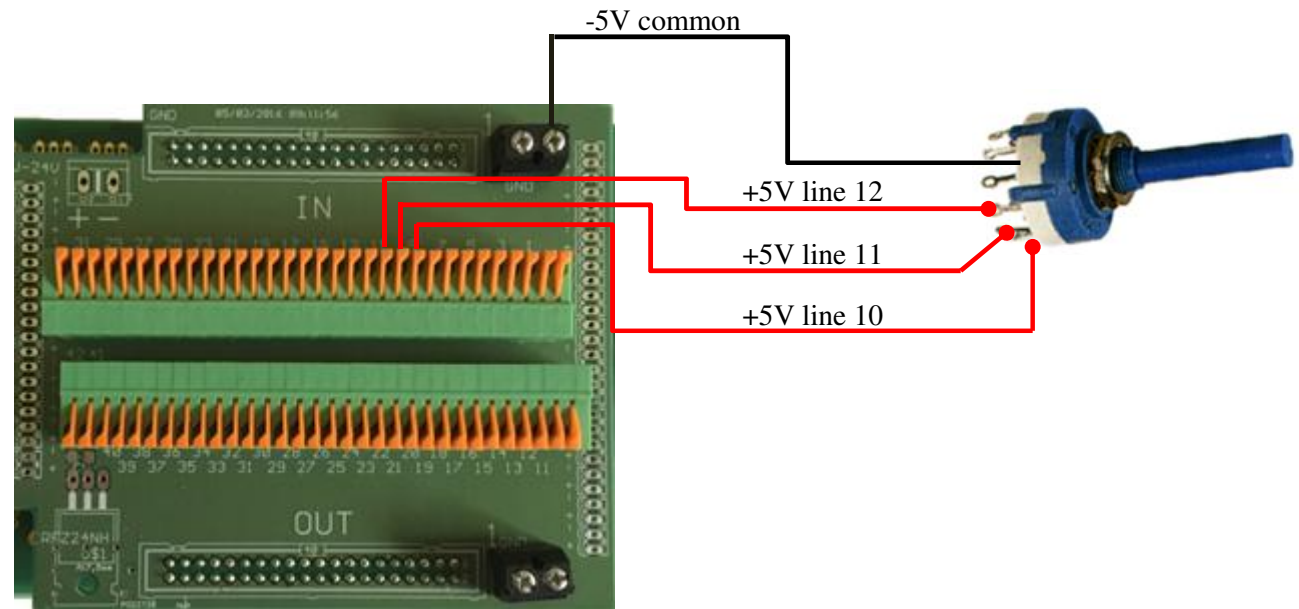
The rotary at 'n' positions (usually 8 and 12 default positions can be limited in number of positions) has a pin called common (GND) and 'n' pins representing each position of the switch. Each line has an entry in the definition of SIOC links. Let's take our example of the 3 positions rotary switch:

```
Var 9000 Link IOCARD_SW Input 10 Type I
Var 9001 Link IOCARD_SW Input 11 Type I
Var 9002 Link IOCARD_SW Input 12 Type I
```

The mechanical design of the rotary allows to have only one active line. If the rotary is on line 10, the variable 9000 will be equal to 1. The other 2 variables 9001 and 9002 will be at 0 (lines 11 and 12). The lines are type I (same behavior as an ON / OFF switch).
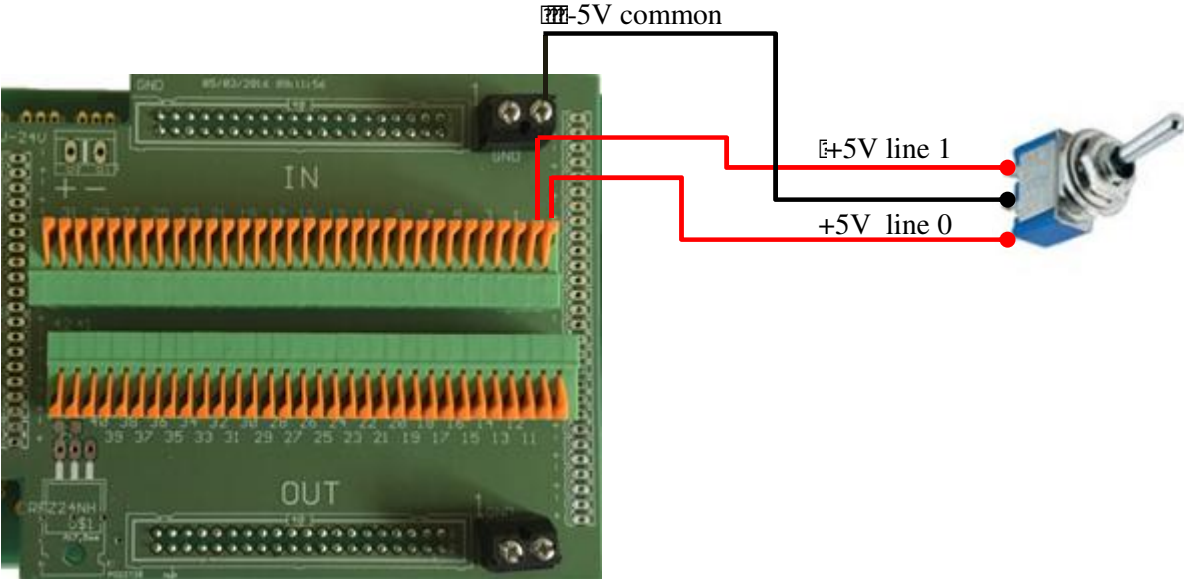
Switch ON / OFF / ON:

-5V common

+5V line 1

+5V line 0

This switch has a pin called common (GND) and 2 pins representing the 2 positions 'open'. It can be used only with one pin 'open' and the common. In this case, it behaves like a 2-pin ON / OFF switch (see example page18: 2-pin switch).

Chaque ligne à une entrée dans la définition des liens SIOC :

```
Var 9000 Link IOCARD_SW Input 0 Type I
Var 9001 Link IOCARD_SW Input 1 Type I
```

The status of the variables is dependent on the position of the switch. If the position of the switch is on line 0, the variable 9000 will be equal to 1 and the variable 9001 will be equal to 0 and vice versa if the position of the switch is on line 2.

The management of this switch is identical to that of a 2 positions rotary switch. This switch can be used to turn ON / OFF.

CTS288 encoder with push button OFF (ON) momentary:

+5V common

+5V line 2

+5V line 1

+5V line 0
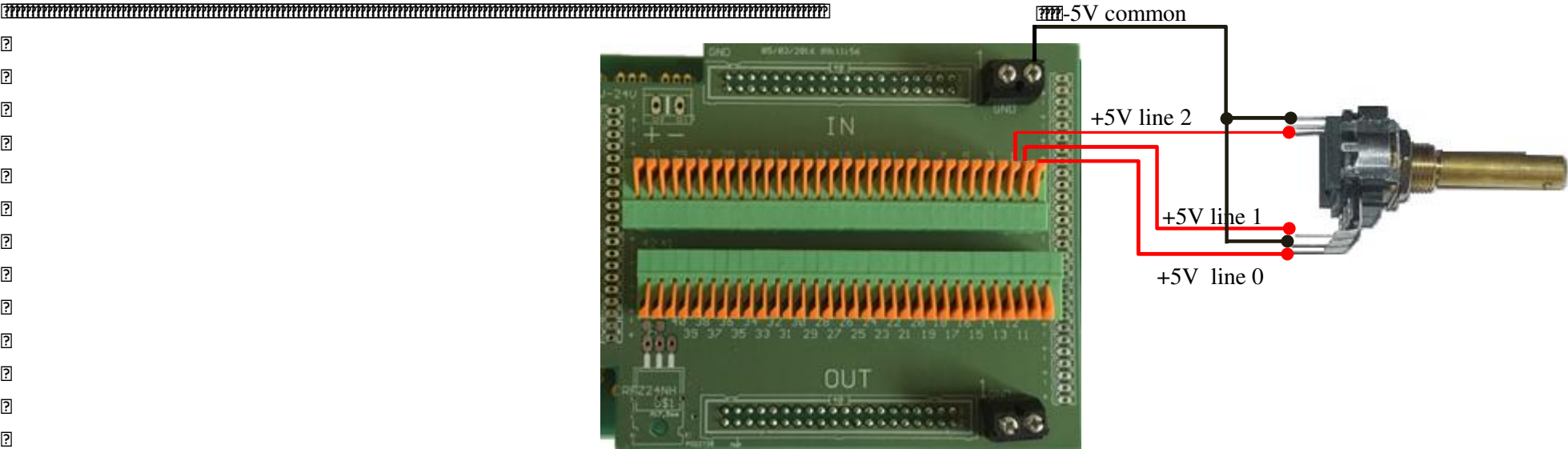
The encoder has a pin called common (GND) and 2 pins (one for each direction). The connection is identical to a 3 pins switch with the only difference that the two inputs must follow each other imperatively. The encoder must be of type CTS288 also called type 'GRAY' for a direct connection. If you use other types of encoders, you can go to the [Fabien website](#), a procedure to follow will determine your types of encoders and to associate the control card.

The SIOC link for this encoder is:

`Var 9000 Link IOCARD_ENCODER Input 0 Aceleration 2 Type 2`

The Line 0 is the first logical input and the 2nd is the line 1. You can set the acceleration in plus or minus with the value 'Aceleration'. Note that for this type of encoder in direct connection, the command line ends with Type 2.

For the push button (ON/OFF), SIOC link definition:

`Var 9001 Link IOCARD_SW Input 2 Type P`

Wiring leds, resistors:
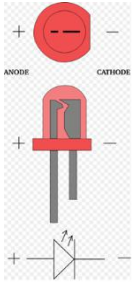
The plus (+) is named anode
The minus (-) is named cathode
The resistor is mounted after the cathode
The leds generally used are Ø 3 or Ø 5 mm 20 mA

Voltage according to the color of led:
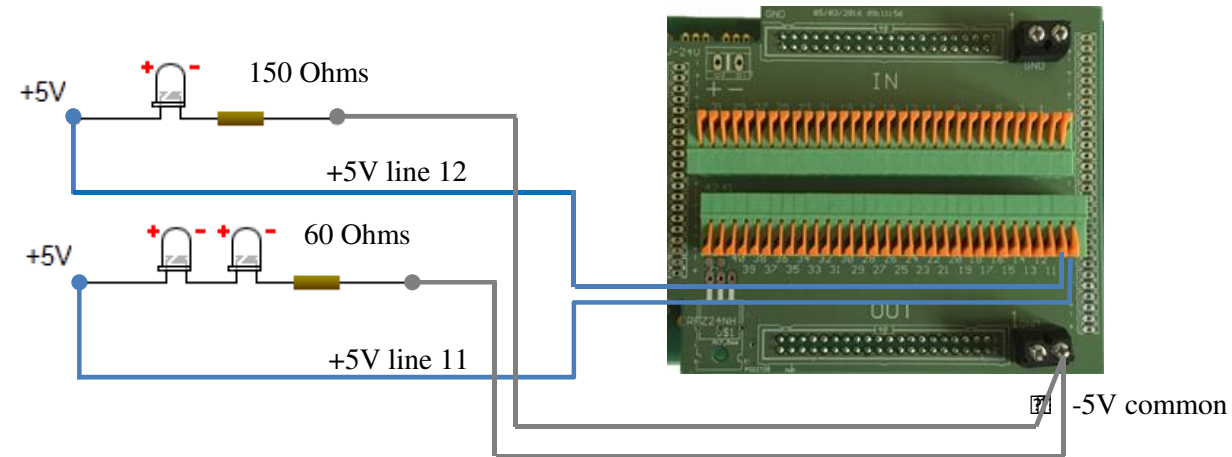Red   2.0V
Orange 2.0V
Yellow 2.1V
Green   2.2V
White   3.3V
Blue   3.3V

Example: yellow led 2.1V 20 mA in series of 2 leds and 1 single led

+5V   150 Ohms

+5V line 12

+5V   60 Ohms

+5V line 11

IN

OUT

-5V common

To remember:

(Supply voltage - LED voltage) / number of ohms led = value of resistor : (5V – 2.1V) / 0.020 = 145 rounded up = 150 Ohms
For the leds in series, the voltage added for 2 leds must be less than 5V which is the supply voltage. An resistor of 60 Ohms is Ok.

SIOC link definition:

```
Var  9001  Link  IOCARD_OUT  Output  11
Var  9002  Link  IOCARD_OUT  Output  12
```

Digits wiring:

Basic rule:

it is not possible to leave 'holes' for the digits wiring, for example: 1 – 2 – 3 – 4 – 5 – 7 -8 – 9. The numbering of digits must follow imperatively. It is not necessary to have 24 digits connected for the display system to work.

14 pins IDC connector: 14 pins IDC connectors
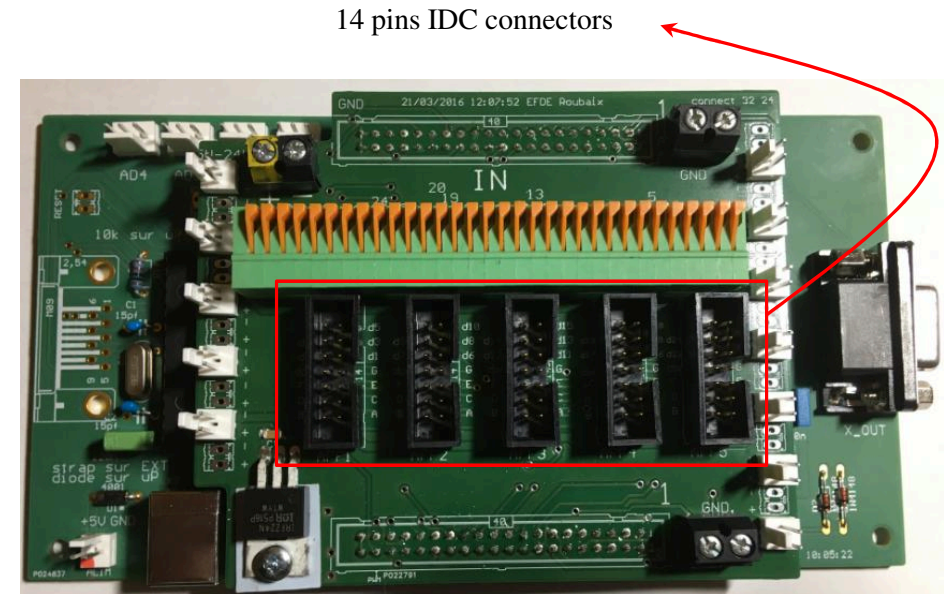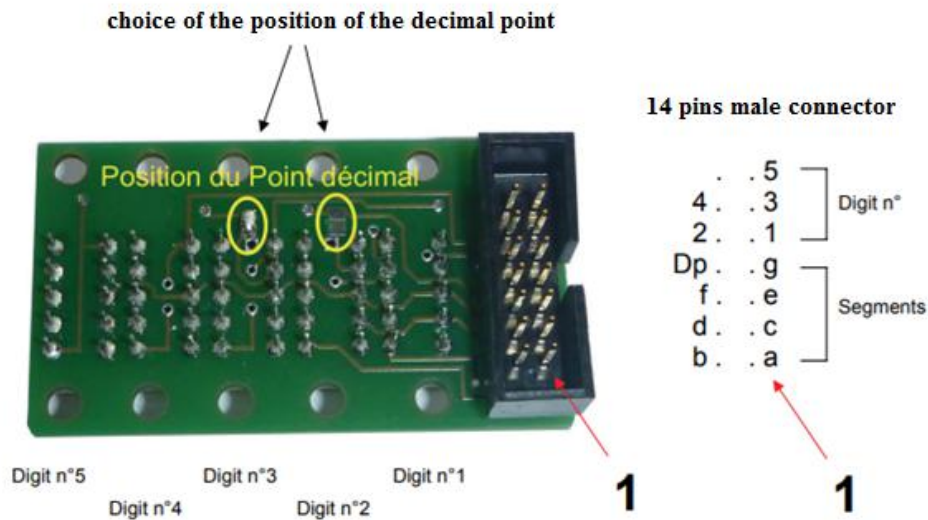
The 8 lines (A to G and DP) are common to all the displays of the same card. So, the 24 lines of digits use the same common (A to G and DP) from the same card. The connectors on the cards FD0006, FD0007 and FD0008 are identified AFF1 (5 digits), AFF2 (5 digits), AFF3 (5 digits), AFF4 (5 digits) and AFF5 (4 digits). The choice of the decimal point as shown on the schema is used to select the display of the decimal point (2nd and/or 3rd digit). In the case of a separate management (on an output), it is necessary to weld a wire on the bottom pastille or in the bottom hole of VIA at the back PCB: enlarged view of the PCB.

The female connectors are IDC model 14 pins pitch 2.54 mm (or HE10 norm) and use ribbon cable with pitch 1.27 mm 14 wires. See example of wiring click here

SIOC link definition for the 3 first digits FD0007 displays card on FD0001 primary card, SIOC index number 1:

```
Var 9000 name D_HDG0 Link IOCARD_DISPLAY Device 1 Digit 0 Numbers 1
Var 9001 name D_HDG1 Link IOCARD_DISPLAY Device 1 Digit 1 Numbers 1
Var 9002 name D_HDG2 Link IOCARD_DISPLAY Device 1 Digit 2 Numbers 1
```

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