BOEING 737 EFIS UNIT for the PMDG

Built using Encoder Support on Leo Bodnar's BU0836 card

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BU0836X connections)

I have been lucky enough to
have a BU0836 Joystick
controller card here from Leo
Bodnar which is capable of
reading rotary encoder's via it's
normal direct or matrix switch
inputs. So after a few days of
experiments I decided to build a working EFIS unit for my 'indoor' PMDG 737 'Test Rig'.
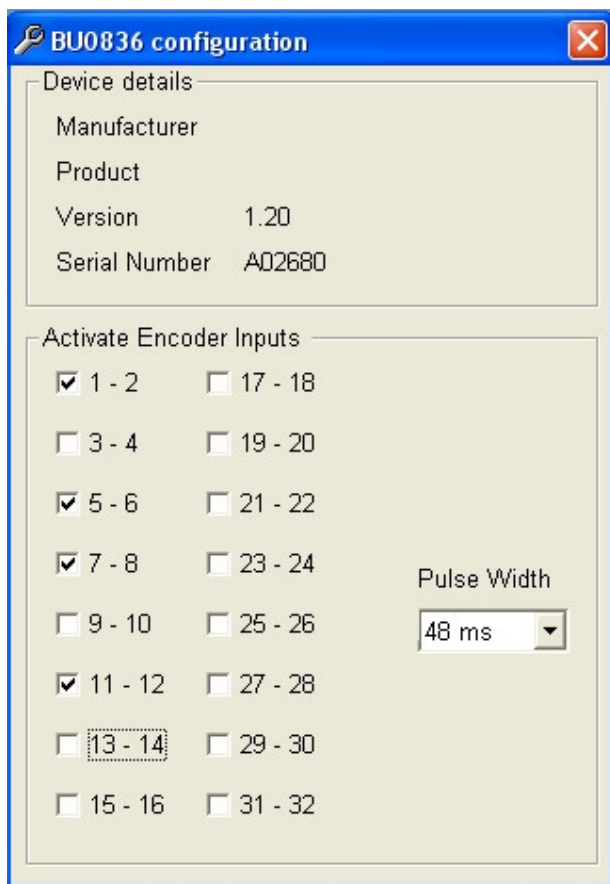
NOTE: BU0836 and Encoders.

Leo tells me that any card purchased since the 1st December 2007 has the firmware for encoders
already written on it. But, until you 'flash' the card using the utility to tell it what switch inputs
are from encoders, it will perform exactly like a standard joystick controller. Once the final
version of the utility is right, it will be available
on the Technical page of my website.

It's very simple really, Plug in the Card, run the
utility and simply tick which pairs of switch inputs
you will use for the encoders.

Leo tells me this is the same whether you use the
direct (simple) or matrix inputs. The connection
diagrams are available on Leo's website at
http://www.lbodnar.dsl.pipex.com/joystick/
Here's a copy of the utility I have. For the first
build I have selected the four you can see. 1-2
will be for Mins, 5 – 6 will be for the ND Mode, 7
– 8 for the ND Range and 11 – 12 for the Baro
encoders. Switch inputs 3 – 4 and 9 – 10 will be
used for the 'push to make' switches fitted into
the encoders. And we will need another 13
switch inputs for the remaining functions that we
need on the EFIS unit

For a more realistic build, we will have to use
rotary encoders with a built in 'push switch'
because all the controls on the EFIS unit have
several functions apart from the obvious.

This card will only accept inputs from simple 2 bit
binary (gray scale) encoders having one
switching action per détente. My encoder of
choice is the CTS288 which is readily available,
very cheaply from Opencockpits in Spain.

I have not tried any other encoder yet because
all the others I have are 4 bit. Here's a link to
the data sheet for the CTS288 so you can compare other encoders for an alternative.
http://www.ctscorp.com/components/datasheets/288.pdf.   The CTS part no is
288VCC0F161B2, my thanks to David Bowles for that.

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TRUTH TABLE 2 BIT BINARY

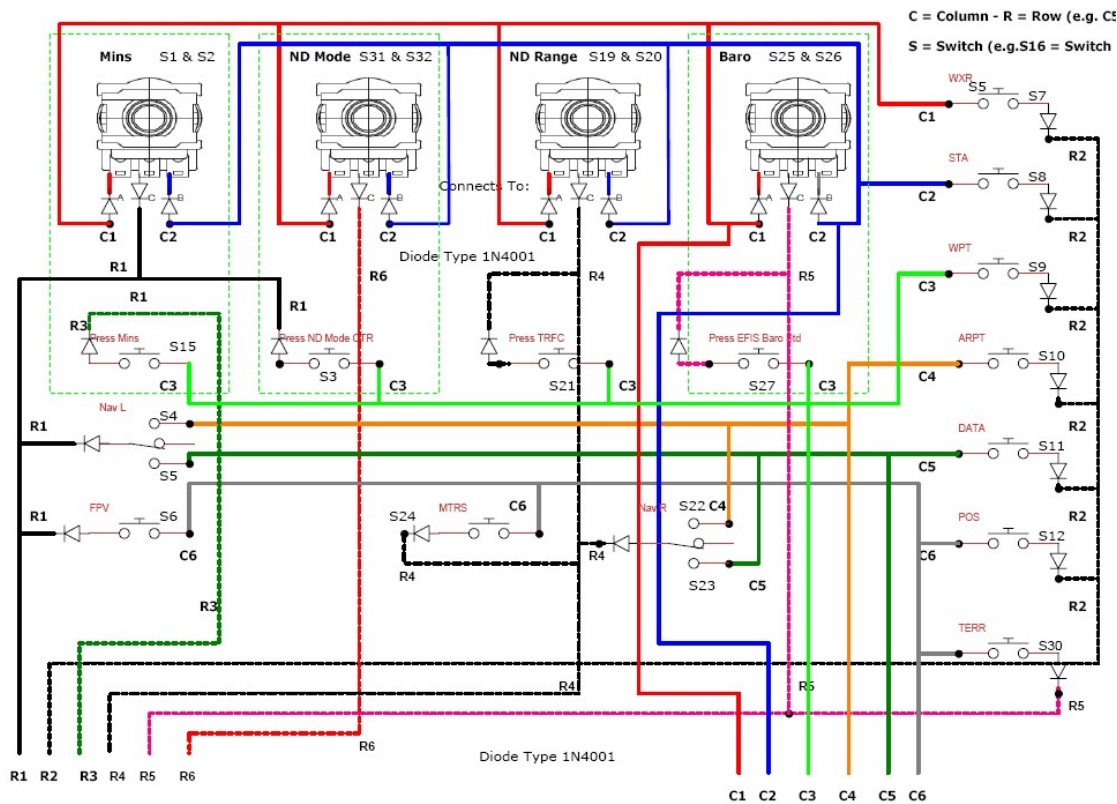| DENOTES CONTACT CLOSURE TO COMMON																	
B	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
A	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0
POS. NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Above is the switching table from the CTS288. See why it's called binary? The contact between each input is either open or closed (0 or 1) in relation to the common. So for example, if you look at position 3, both A & B are in contact with the common. Now turn the encoder one click either way and the contact state changes. If you turned it anti clockwise then only A is in contact with the common and if you turned it clockwise only B is in contact with the common.   So a switch change state has taken place. Your control card will see this switch change state and know which way you have turned the encoder. It can then act accordingly.


This is the CTS288 Rotary Encoder c/w 'Push to Make' Switch. They are available from the Opencockpits shop at www.opencockpits.com.   They are relatively inexpensive, nice quality and robust.   This is exactly how they work.
If you look at the drawing below of the CTS288, it has 5 connector pins, a set of two which are the push to make switch and a set of three which are the encoder contacts. These are labelled A, B & C with C being the common.
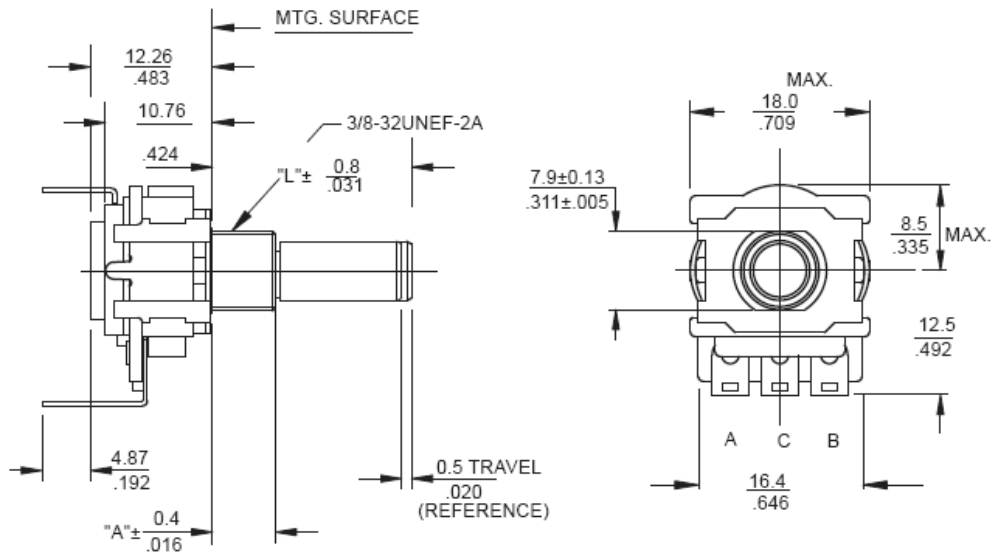

Remember the A, B and C relationship because we are going to use that when connecting up to the BU0836 joystick controller. The 'push to make' switch can be connected any way round because it's just a simple contact switch.

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C = Column - R = Row (e.g. C5

S = Switch (e.g.S16 = Switch

Mins S1 & S2 ND Mode S31 & S32 ND Range S19 & S20 Baro S25 & S26

Connects To:

Diode Type 1N4001

Diode Type 1N4001

Here's how I connected it all up to the BU0836 controller. The C and R designations represent which Column and Row I have connected to on the Matrix. The S designation represents the Switch No. that the Column/Row pair operate on.   There is a full A4 .pdf file of the connection diagram on my website at http://www.737ng.co.uk/EFIS_BU0836.pdf

Remembering the Row is the 'common' in any group of 6 switches, I have used a 1N4001 diode on every switch to prevent 'loopback' of switching signals steering the switching from the Column to the Row.
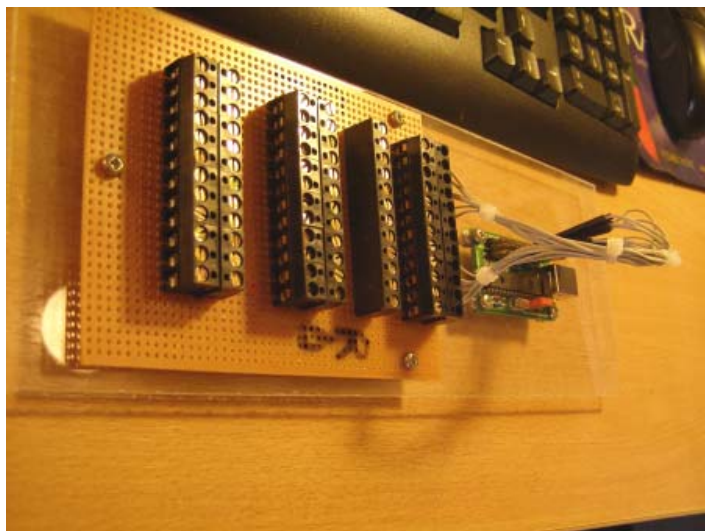
I find the easiest way to construct a Matrix is by using simple stripboard and PCB connectors. The stripboard has copper strips running down the length. It is punched with standard 1/10" pitch holes which allows me to use the PCB connectors which are again standard pitch. These have a pin on them which you simply push thru the holes and solder to the copper strip. Easy, Cheap and quick to make. This is the actual Matrix Board I made for the EFIS. Less than 2 hours and I even stopped for a coffee :o)

Stripboard and Connectors available in the UK from www.rapidonline.com

Stripboard Part No. 34-0515

Connectors Part No. 77-2446

www.737ng.co.uk
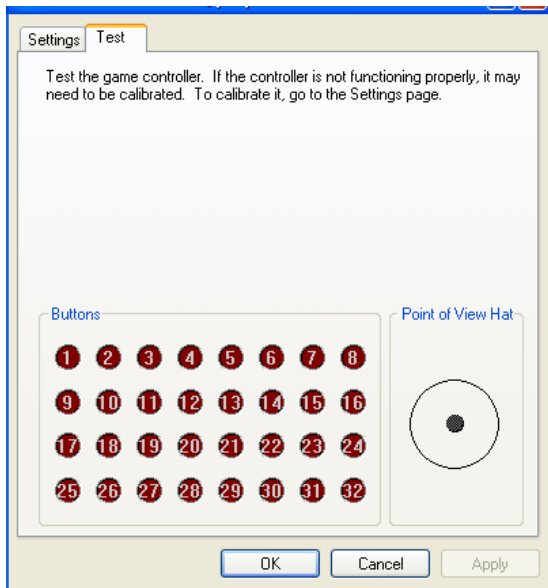
Having made all the connections, it's off to the control panel to test them. They all work – Great :o)

Ok, so what we have done up to now is connect push button switches, toggle switches and CTS288 rotary encoders to the BU0836 Joystick Controller to Emulate Joystick Button Presses.

The encoders will give us accurate directional repeated switching. The more we turn the encoder, the more times it will emulate a joystick button push (like repeatedly pressing that button). The Push and Toggle switches are pretty straight forward.

Right now all the switches are working, it's time to make them operate the EFIS functions in the PMDG, so go into the PMDG/Keyboard Commands Menu. Select EFIS in the Command Category Dropdown List and then Print the commands out because you are going to need to refer to them shortly. Please don't take any notice of my Key commands, I have my own much simplified system of key commands. You will have to assign what you have in your print out because these are the commands that your own setup uses.
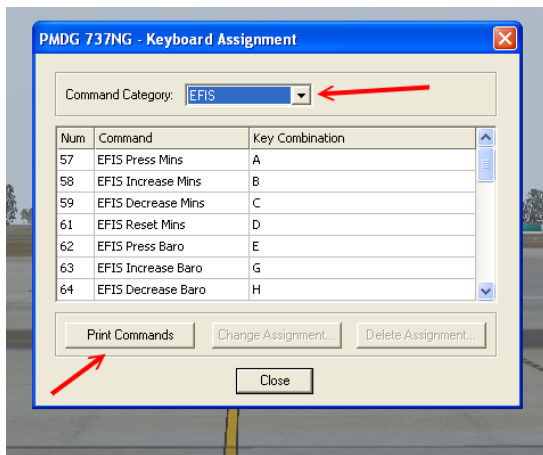
You are going to need a registered copy of FSUIPC for the next stage of the setup – you did register it didn't you :o)
At the time of writing I have v3.75.

With FS running open up FSUIPC and on the Buttons and Switches Menu Page you will be able to have FSUIPC 'see' the joystick card input when you turn an Encoder or press a button. It will then return a Joystick # & Button # to identify that input.
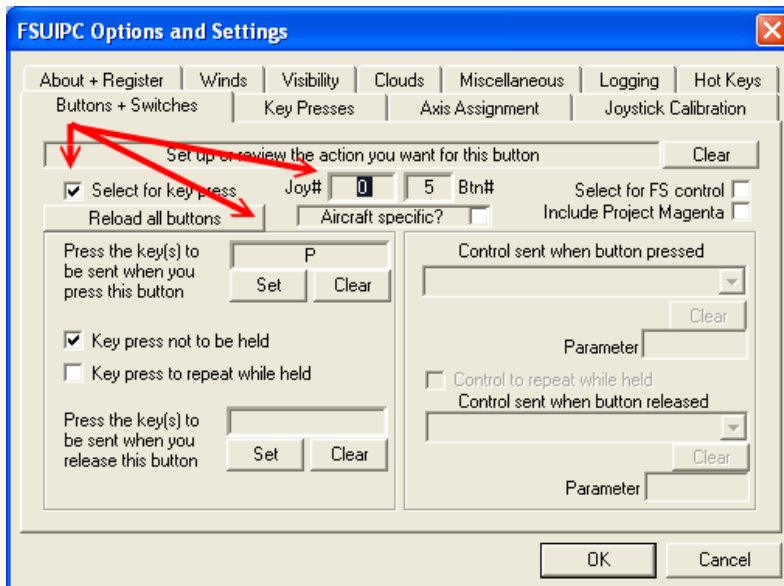
Check the Select for key press box and in the box below set the key to be sent when you operate that component. Now systematically work your way across the switches (remember there's 25) until you have assigned all the keys to each input that correspond with your PMDG Key Command Assignments.

That's it, now go fly and check that each of the encoders/pushbuttons and switches do exactly what you expect.

Frontplate - BOEING 737NG EFIS UNIT

Well we want it to look the part don't we :o)   So, I went ahead and ordered an EFIS Faceplate kit from Opencockpits here:
http://www.opencockpits.com/catalog/product_info.php?cPath=23_25_40&products_id=72
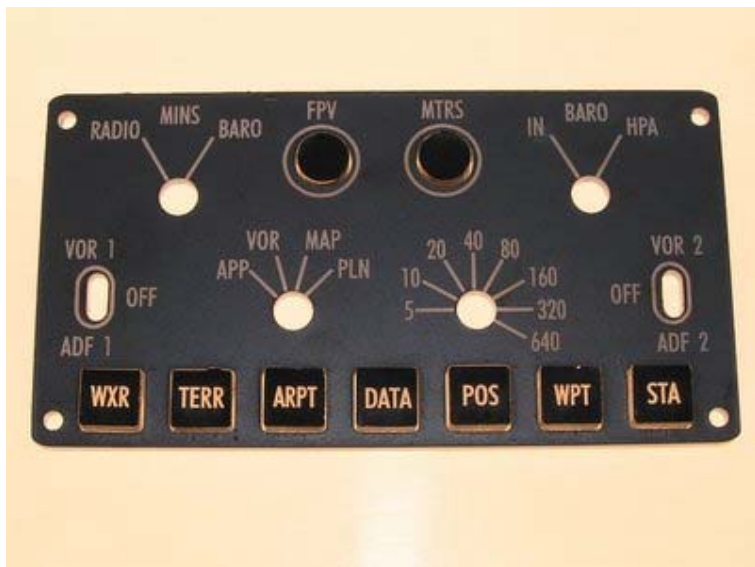
You can also buy these from Manolo at www.hispapanels.com (nice guy).

This is how it costed out:
Faceplate - 30 euro
4 CTS288 Encoders – 12 Euro
12 tactile switches – 6 euro
4 Grey Knob – 8 euro
Opencockpits Shipping -15 euro
BU0836 Card – 32 euro delivered
2 (On)-Off-(On) switches – 2 euro
Stripboard – 3 euro
Connectors – 3 euro
Cable 1 euro

Total Cost – 112 euro / £82 / $163
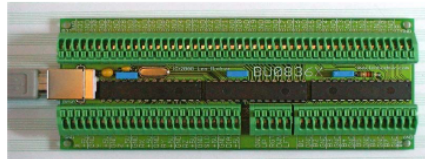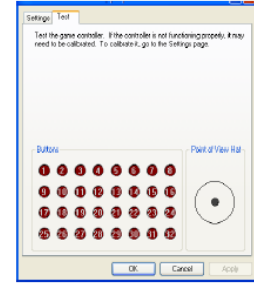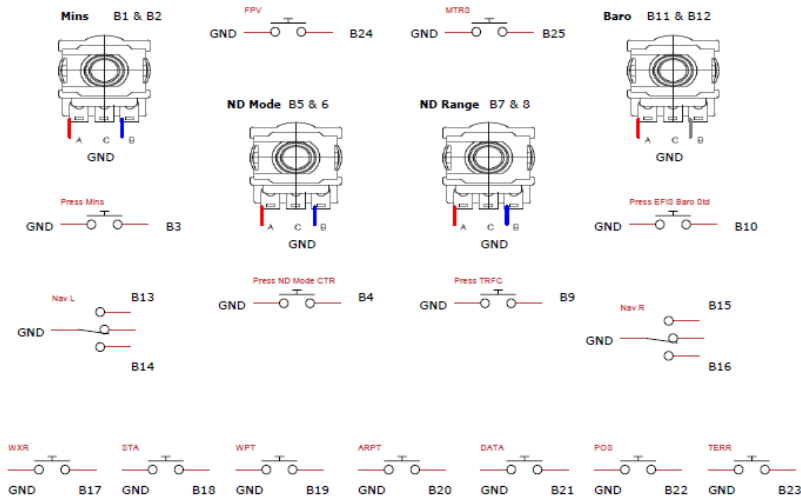
Constructing the EFIS Using the BU0836X Board……

The initial document was originally written because I made these using a standard BU0836 card. However with Leo introducing the BU0836X board, life has become so much easier. No more soldering, no more matrix boards and no more diodes, great.
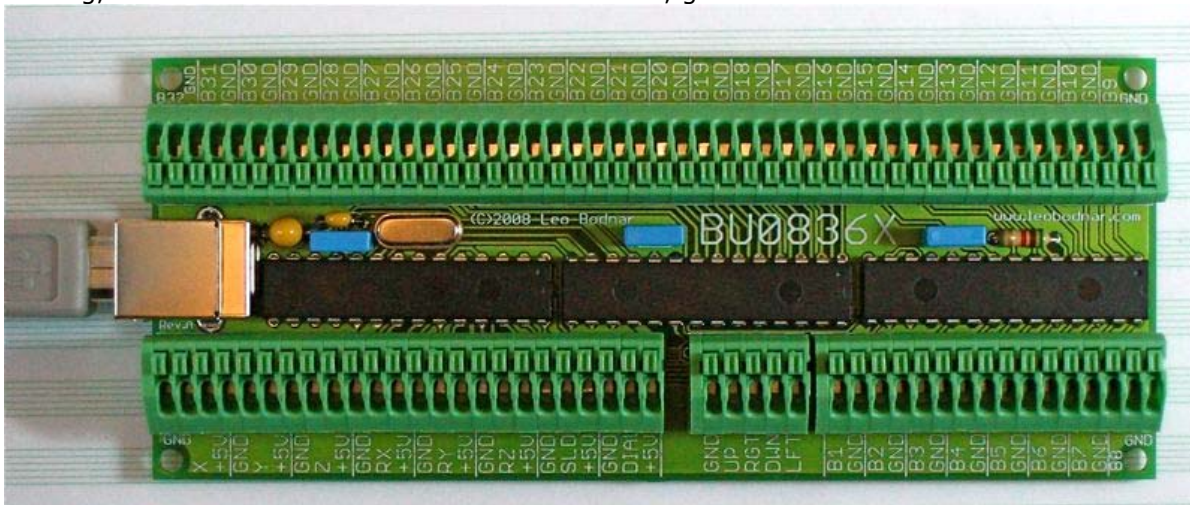
Every input on this card is independent, so using the X board, there is no more working out which row/column is which button and where the diodes go.   But my original diagram does not help people deciding to build using the X board and I have had several mails asking me to help.
So here we go………..

First like the standard card, the X board is a joystick controller. It's axes inputs have 12 bit resolution giving unprecedented accuracy and levels of control.   It has 32 independent inputs each being a GND and a B No. For example B30 & GND or B17 and GND etc. When you connect it, it will be recognised by your system and installed.   It then appears in the list of game controllers as a joystick.

Encoder Inputs are selected exactly as we do with the standard card.

Here's the basic connection diagram showing which buttons to connect to. You can get a full size .pdf file here at www.737ng.co.uk/EFIS_BU0836X.pdf .

In this example I have used Leo's utility to tell the X board that inputs 1-2, 5-6, 7-8 and 11-12 have encoders as the input switch. The remainder of the inputs are simple toggle or pushbutton switches.

Setup is exactly the same as with the standard card letting FSUIPC see the input as a button press and then assigning the key to be sent on that button.