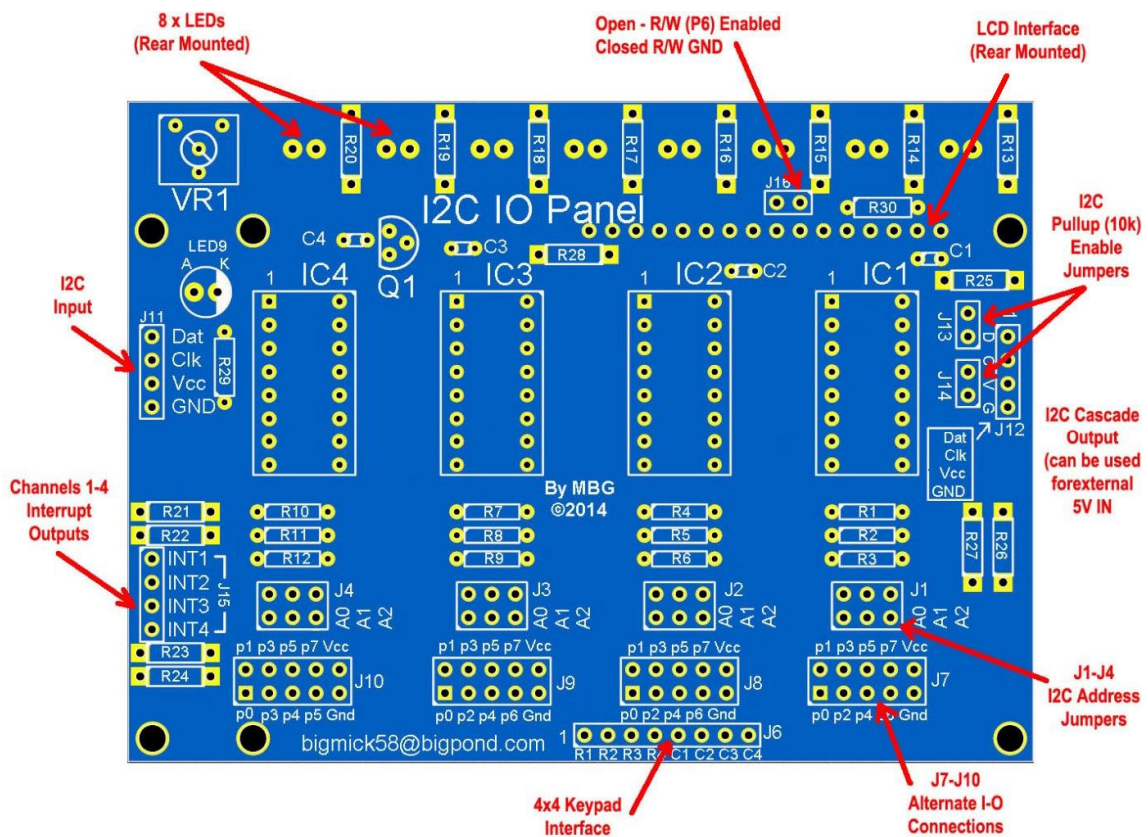
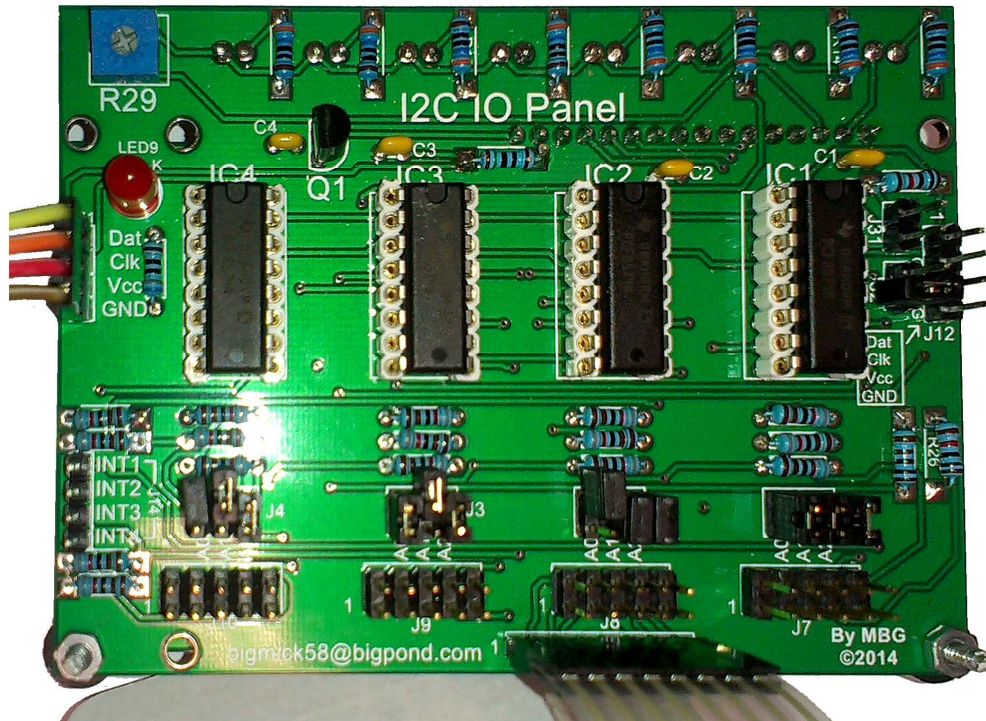


IO Panel



Preamble:

The IO Panel project came about due to a need to drive quite a few more I-O lines than were available on my small CPU board. I explored several options and ultimately decided that there was nothing already out there in the real world that met my requirements so I designed my own.

The IO Panel uses 4 readily available IO expander chips to manage 4 x 8bit (total 32bit) IO ports all on the one I2C interface, effectively giving 32 IO lines by only using 2 from the CPU board. The IO panel has 4 individually addressable IO expanders and whilst 3 of them have been given specific tasks they, of course, can still be used for different purposes than the IO Panel was originally designed for, by using headers J7-J10.

The IO Panel is designed to mount directly on the back of either a 20x4 or 16x4 LCD module and thus make a reasonably compact module as shown below:



As mentioned above, the IO panel has 4 dedicated, readily available IO expander chips, these are available fairly cheaply from most electronic parts suppliers but can also be found for under 50c each on eBay. The IO expander part, used here, is a PCF8574 chip, there is a PCF8574A chip that can be used but the 'A' variety has a base starting address of 38H (56 Decimal).

The IO Panel can be cascaded to another IO Panel so that 64 IO lines are available on the 1 pair of I2C lines. (Or 128 if another 2 more panels using PCF8574A chips are added) 😊

Description:

Each IO channel should be given an individual address so that they will not conflict with each other.

Configure the address headers by using 2 pin jumper links on J1-J4 using the following table.

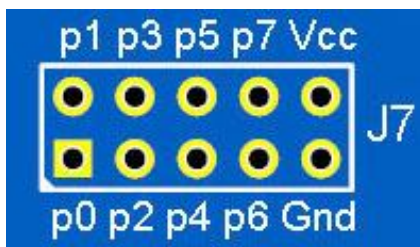
Note! The photo on page 1 shows Channel 1 addressed as 20H (32 Decimal) through to Channel 4 at 23H (35 Decimal).

Address	A0	A1	A2	As linked in Photo above
20H (32 Dec.)	ON	ON	ON	IO Channel 1 (LCD)
21H (33 Dec.)	OFF	ON	ON	IO Channel 2 (KeyPad)
22H (34 Dec.)	ON	OFF	ON	IO Channel 3 (LEDs)
23H (35 Dec.)	OFF	OFF	ON	IO Channel 4 (Spare)
24H (36 Dec.)	ON	ON	OFF	
25H (37 Dec.)	OFF	ON	OFF	
26H (38 Dec.)	ON	OFF	OFF	
27H (39 Dec.)	OFF	OFF	OFF	

Construction:

Building the IO Panel is very straight forward, the only consideration to be careful of is that the LCD header and LED1-LED8 are mounted on the bottom layer of the IO Panel.

Each Channel can be treated individually, if for instance you do not require an LCD interface for your project the IO lines from Channel 1 also go to Header J7 which also has GND and Vcc conveniently available as shown below, each Channel has a similar connector provided for 'real world connectivity' (J7-J10).



As can be seen Channel 1's IO is available on J7 as p0-p7 as well as Power and GND.

Channels 2-4 have a similar connector at J8-J10.

Vcc:

Whilst the Vcc power supply may be 3v3 or 5v, generally, because of the LCD, this is 5v as most LCD modules will not function with only a 3v3 power source. If your CPU module cannot supply enough power to drive the IO board (typically 100mA with ALL LEDs and LCD back light ON) then the cascade header (J12) may be used to supply an external 5v source but **do not connect 5v from your CPU board as well (only connect I2C Data, Clock and Gnd).**

Jumper Options:

J13, J14

Open – Pull-ups Disabled

Closed – Pull-ups Enabled

These enable or disable the 10k Pull-up resistors on the I2C Data and Clock lines. Generally there should be pull-ups on **either** the CPU module OR the IO Panel (**Not both**).

J16

Open – R/W Control enabled

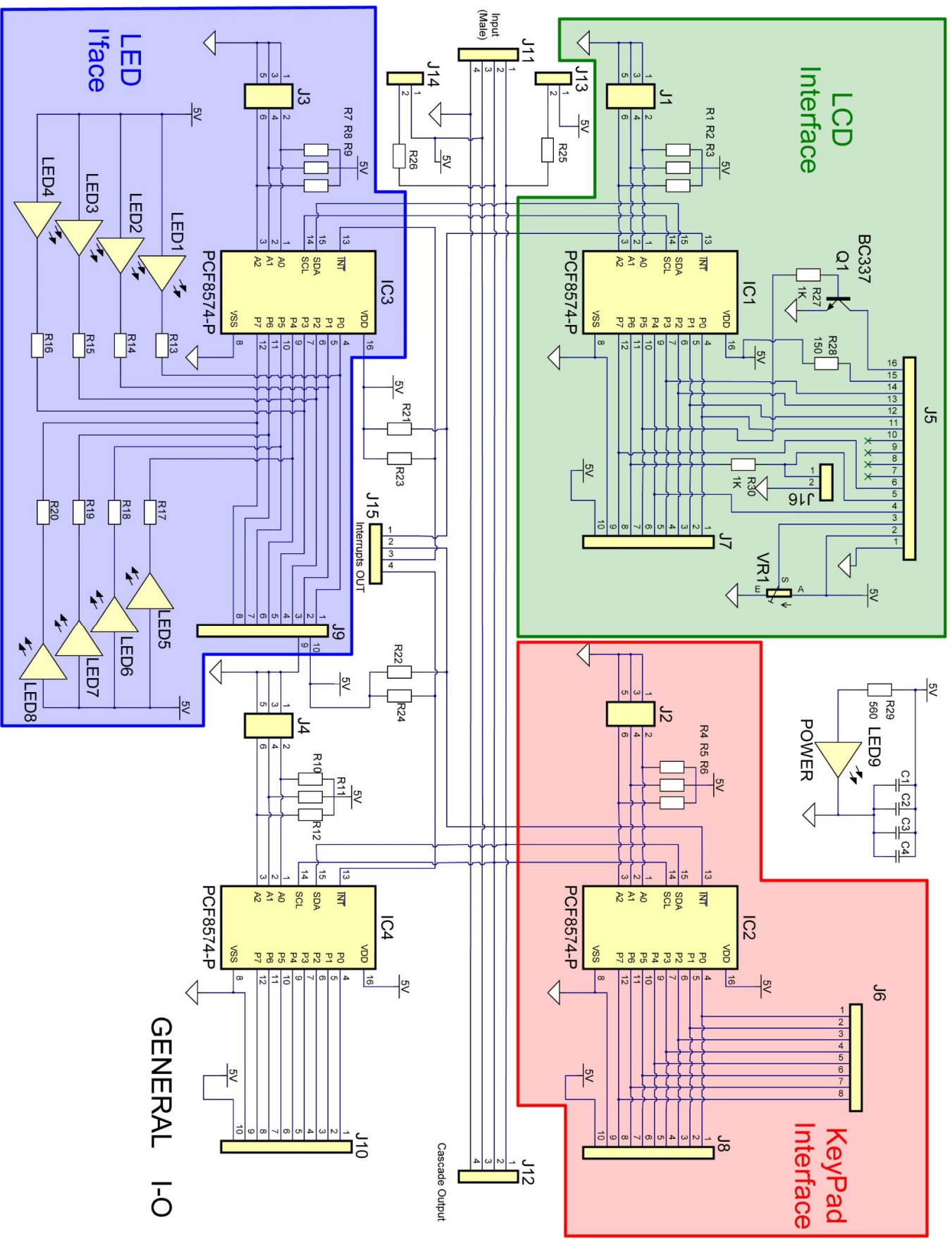
Closed – R/W Control disabled

Channel 1 (LCD Interface) can interrogate the R/W line of the LCD module if desired by setting Channel 1 p6 high for READ and low for WRITE, to support R/W control on the LCD J30 needs to be Open. Generally, most software I have seen just expects the R/W pin of the LCD module to be connected to GND and a suitable delay (2ms or so) added between writes, therefore the default is to have this jumper Closed.

BOM:

Reference	Type	Comment	Reference	Type	Comment
C1	100nF	0.1" pin spacing	Q1	BC337	NPN 500ma GP transistor
C2	100nF	0.1" pin spacing	R1	10k	1/4 Watt
C3	100nF	0.1" pin spacing	R2	10k	1/4 Watt
C4	100nF	0.1" pin spacing	R3	10k	1/4 Watt
IC1	PCF8574	I/O Expander	R4	10k	1/4 Watt
IC2	PCF8574	I/O Expander	R5	10k	1/4 Watt
IC3	PCF8574	I/O Expander	R6	10k	1/4 Watt
IC4	PCF8574	I/O Expander	R7	10k	1/4 Watt
J1	3x2 6 Pin DIL Male Header		R8	10k	1/4 Watt
J2	3x2 6 Pin DIL Male Header		R9	10k	1/4 Watt
J3	3x2 6 Pin DIL Male Header		R10	10k	1/4 Watt
J4	3x2 6 Pin DIL Male Header		R11	10k	1/4 Watt
J5	16 Pin SIL Male Header	Rear Mounted	R12	10k	1/4 Watt
J6	8 Pin SIL Male Header		R13	560R	1/4 Watt
J7	5x2 10 Pin DIL Male Header		R14	560R	1/4 Watt
J8	5x2 10 Pin DIL Male Header		R15	560R	1/4 Watt
J9	5x2 10 Pin DIL Male Header		R16	560R	1/4 Watt
J10	5x2 10 Pin DIL Male Header		R17	560R	1/4 Watt
J11	4 Pin SIL Male Header		R18	560R	1/4 Watt
J12	4 Pin SIL Male Header		R19	560R	1/4 Watt
J13	2 Pin SIL Male Header		R20	560R	1/4 Watt
J14	2 Pin SIL Male Header		R21	10K	1/4 Watt
J15	4 Pin SIL Male Header		R22	10K	1/4 Watt
J16	2 Pin SIL Male Header		R23	10K	1/4 Watt
LED1	5mm LED	Rear Mounted	R24	10K	1/4 Watt
LED2	5mm LED	Rear Mounted	R25	10K	1/4 Watt
LED3	5mm LED	Rear Mounted	R26	10K	1/4 Watt
LED4	5mm LED	Rear Mounted	R27	1K	1/4 Watt
LED5	5mm LED	Rear Mounted	R28	150R	1/4 Watt
LED6	5mm LED	Rear Mounted	R29	560R	1/4 Watt
LED7	5mm LED	Rear Mounted	R30	1K	1/4 Watt
LED8	5mm LED	Rear Mounted	VR1	10k-Trim	TRIMPOT
LED9	5mm LED	Power OK			

Schematic:



Default Interfaces:

LCD (Channel 1)

The LCD interface is wired as follows, and conforms to the `4 bit' mode of LCD control. Trimpot, VR1, adjusts the LCD contrast to user preference.

p0 = LCD D4
p1 = LCD D5
p2 = LCD D6
p3 = LCD D7
p4 = LCD RS
p5 = LCD Backlight Control (High is ON)
p6 = LCD R/W Control (if J16 is OPEN)
p7 = LCD E

KeyPad (Channel 2)

The 4x4 Keypad is configured as follows:

Pin1 = Row1
Pin2 = Row2
Pin3 = Row3
Pin4 = Row4
Pin5 = Column1
Pin6 = Column2
Pin7 = Column3
Pin8 = Column4



Compatible with most of the cheap membrane keypads, available on eBay for around \$1 ea.

Software reading of the keypad is managed by WRITING to Channel 2, setting all of the Rows and columns HIGH, then cycling each column one by one (with a LOW) followed by a READ (stripping off the high order - Columns -) to determine if any of the keys are pressed (a ROW will be read LOW if a key is pressed). Knowing the Column you set Low and the Row you read as a Low gives you the key pressed.

NOTE! The PCF8574 chip has a neat feature that will set its interrupt pin LOW if any of the input pins change their state, so as a start if all the columns were set LOW and the rows set HIGH then when a key is pressed a ROW will go low causing the interrupt (INT2) to go low to inform the CPU board of a key press. Then your CPU should execute its keypad routine to drill down to which key(s) is being pressed.

LEDs (Channel 3)

The LEDs are controlled by Channel 3, a LOW written to any of the outputs (p0-p7) will illuminate the appropriate LED, and conversely a HIGH will turn the relevant LED off.

General IO (Channel 4)

Channel 4 was added due to the fact that, as there are only 8 possible addresses that a PCF8574 chip can be configured to, it seemed logical that I design the IO Panel to have four channels each so that cascading two IO Panels will give the full range available and thus have 8 channels in total.

Taking it to the extreme, however I feel this would be an unlikely scenario, it is possible to cascade four IO Panels to give 16 channels (128 IO lines) in total but two of the IO Panels would need to be fitted with PCF8574A chips which have addresses in the range 38H (56 Decimal) to 3FH (63 Decimal).

Channel 4 is for general purpose use and could be used to drive relay boards (providing a suitable relay driver is catered for on the relay boards) or to monitor (digital) sensors or drive more LEDs etc.

Notes on using J7-J10 Alternate IO headers:

If you desired to not use one of 'standard' interfaces and just wished to have access to the IO lines via the alternate headers, J7-J10, the following cautions should be observed to avoid components used for the standard interfaces affecting these IO lines.

Channel 1 (LCD)

If you don't wish to drive an LCD module then the following components will not be required and may affect subsequent use of these IO lines.

R27, R28, R30 & Q1

Channel 2 (KeyPad)

No impact

Channel 3 (LEDs)

R13, R14, R15, R16, R17, R18, R19, R20, LED1-LED8

Channel 4

No impact