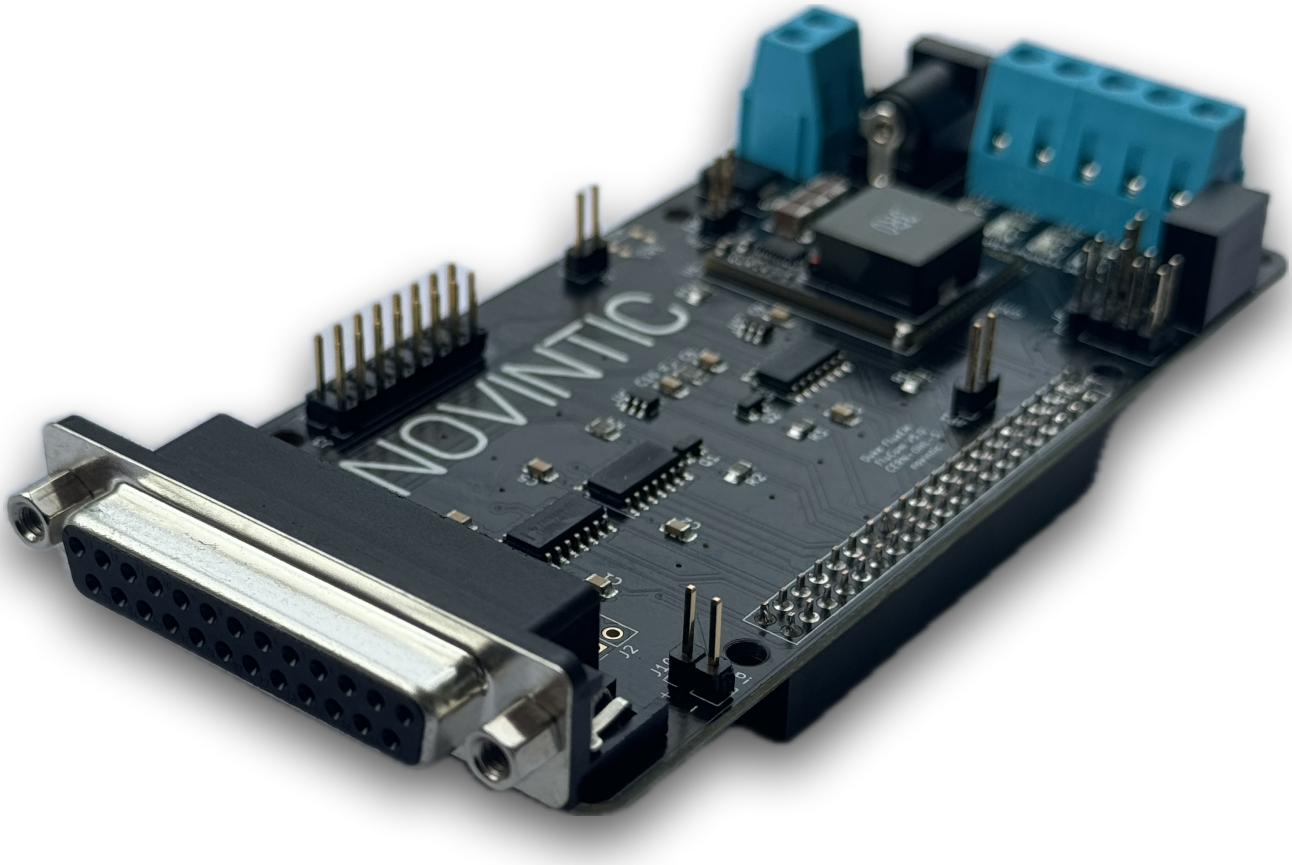
FluCom Interface Board / HAT for Raspberry Pi

Build Manual and Bill of Materials



1) Table of Content

2) General description

The FluCom Interface is a stack-on board (HAT) for a Raspberry Pi 3 or higher. It's purpose is to interface with Pods for the Fluke 9000 series Microsystem Troubleshooter which is still used today to diagnose and repair vintage computer equipment such as arcade game pcbs.

It is designed to be used in conjunction with the FlukeEmu software.

As of now, this software/hardware solution does provide all the basic functionality of an original mainframe/ pod system including serial port and virtual tape drive support.

To add optional support for the Fluke 9000 series probe / signature analysis, an add-on board is also 2available on our GitHub repository:
https://github.com/novintic/FlukeEmu-FluCom/tree/main/ProbeBoard

The idea behind the project is to use readily available parts to provide an as-simple-as-possible (cheap) way to replace a Fluke 9010a Mainframe.

The board and its design files are made available under the CERN Open Hardware License:
https://ohwr.org/project/cernohl/wikis/Documents/CERN-OHL-version-2

3) A bit more detailed

The board provides the levelshifting to interface with the Fluke 9000 series pods. The control lines are shifted separately from the data lines as running them through the same ICs would result in unstable operation. The database is shifted by a pair of TXS0104 bidirectional level shifters, the outgoing control lines by a pair of BSS138 MOSFETS and the ingoing control lines by 2 SN74LV1T34 buffers.

It does also provide power to both the Raspberry Pi and the pod using an off-the-shelf DC-DC converter, requiring only a single 12V external supply (using the barrel jack or the 2 channel- screw terminal). For these power inputs, reverse voltage protection is provided by D1.

Alternatively, external power inputs can be used to power the individual rails (5V Raspi, 5V Pod, -5V Pod and 12V Pod) using the 5 screw terminal on the side of the board. In this case, most jumpers can/should be omitted (more details below). No reverse voltage protection is provided on these terminals.

LEDs indicate power to the respective rails; the LEDs and their corresponding current limiting resistors can be omitted if you don't need them.

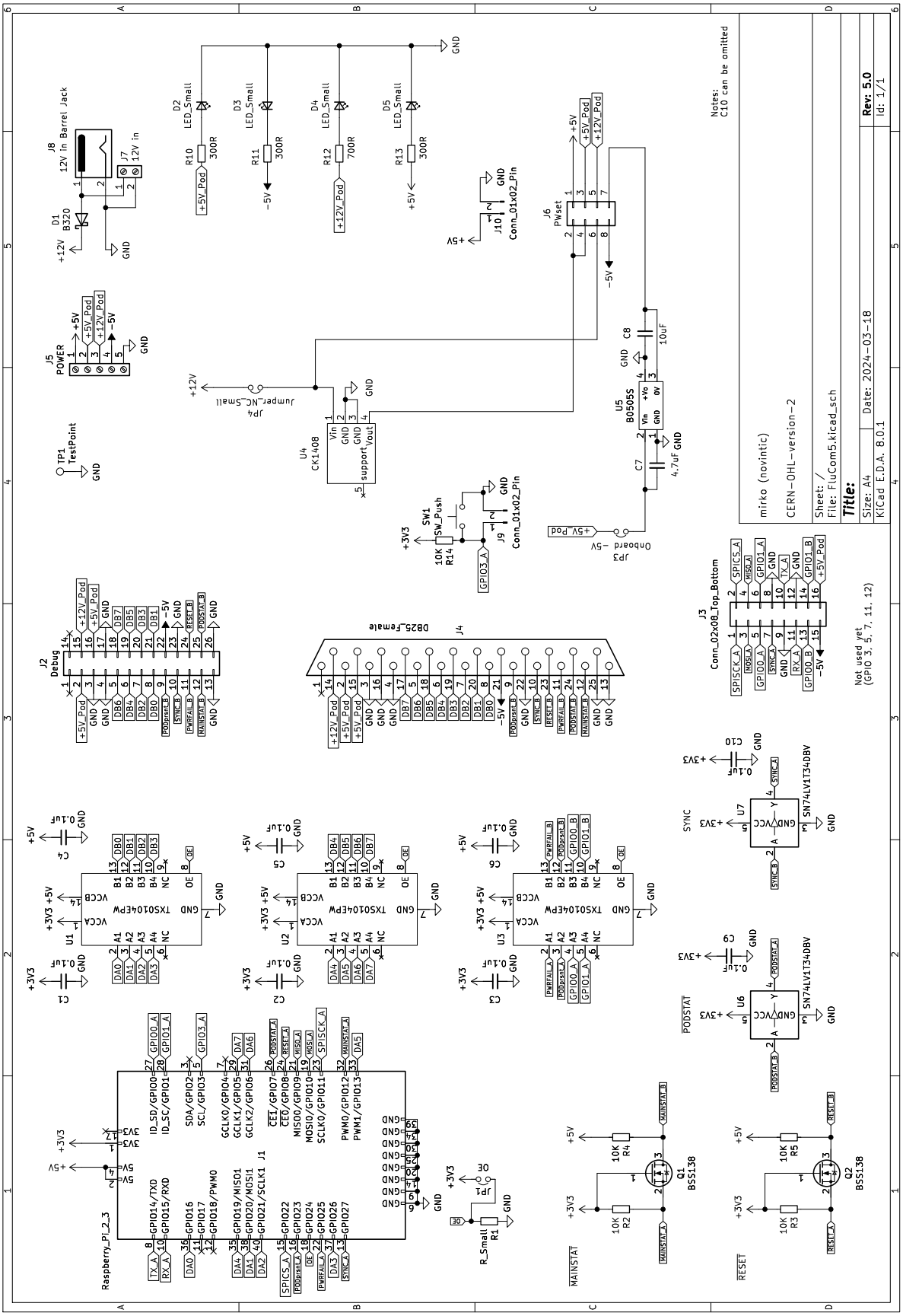
The following DC-DC- converter is used, as it can provide more than enough current to power a Raspberry Pi4 / Pod / Display combo even for more power-hungry pods:

https://www.robotshop.com/jp/en/dfrobot-dc-dc-buck-converter-614v-to-5v-8a.html

Connector J10 provides +5V to power a fan or the screen, J9 grounds GPIO5 which can be used as a soft power on/off button (seee below).

Good luck with building and have fun!

4) Schematics

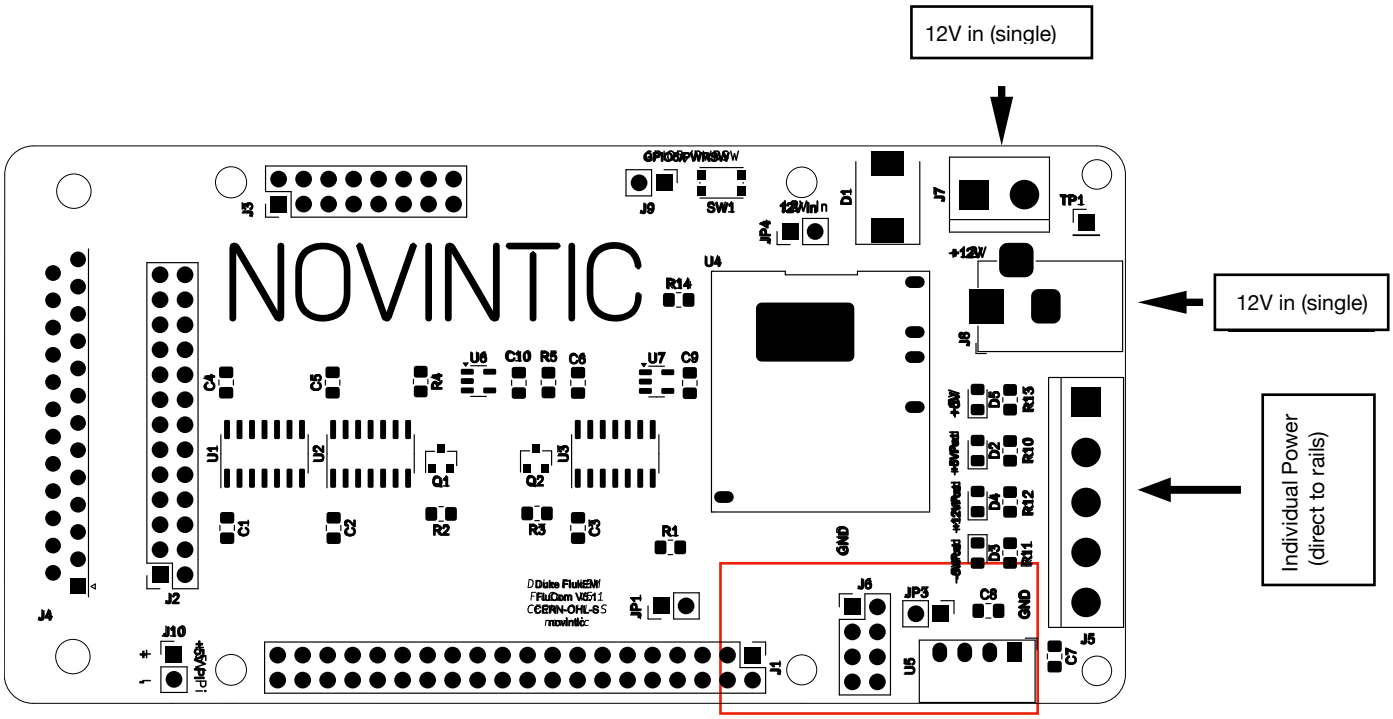


5) Bill of Materials

FluCom5

Comment	Designator	Footprint	LCSC
0.1uF	C1,C2,C3,C4,C5,C6,C9,C10	Capacitor_SMD:C_0805_2012Metric_Pad1.18x1.45mm_HandSolder	C138340
4.7uF	C7	Capacitor_SMD:C_0805_2012Metric_Pad1.18x1.45mm_HandSolder	C77077
10uF	C8	Capacitor_SMD:C_0805_2012Metric_Pad1.18x1.45mm_HandSolder	C83061
B320	D1	Diode_SMD:D_SMC	C134448
LED_Small	D2,D3,D4,D5	LED_SMD:LED_0805_2012Metric_Pad1.15x1.40mm_HandSolder	C189307
Raspberry_Pi_2_3	J1	Connector_PinHeader_2.54mm:PinHeader_2x20_P2.54mm_Vertical	
Debug	J2	Fluke6809POD:PinHeader_2x13_P2.54mm_Vertical_Fluke_Numbering_mirrored	
Conn_02x08_Top_Bottom	J3	Connector_PinHeader_2.54mm:PinHeader_2x08_P2.54mm_Vertical	
DB25_Female	J4	Connector_Dsub:DSUB-25_Female_Horizontal_P2.77x2.54mm_EdgePinOffset9.40mm	
POWER	J5	TerminalBlock:TerminalBlock_bornier-5_P5.08mm	
PWset	J6	Connector_PinHeader_2.54mm:PinHeader_2x04_P2.54mm_Vertical	
12V in	J7	TerminalBlock:TerminalBlock_bornier-2_P5.08mm	
12V in Barrel Jack	J8	Connector_BarrelJack:BarrelJack_Horizontal	
Conn_01x02_Pin	J9,J10	Connector_PinHeader_2.54mm:PinHeader_1x02_P2.54mm_Vertical	
OE	JP1	Connector_PinHeader_2.54mm:PinHeader_1x02_P2.54mm_Vertical	
Onboard -5V	JP3	Connector_PinHeader_2.54mm:PinHeader_1x02_P2.54mm_Vertical	
Jumper_NC_Small	JP4	Connector_PinHeader_2.54mm:PinHeader_1x02_P2.54mm_Vertical	
BSS138	Q1,Q2	Package_TO_SOT_SMD:SOT-23	C5190146
R_Small	R1	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	C510098
300R	R10,R11,R13	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	C365284
700R	R12	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	C229239
10K	R2,R3,R4,R5,R14	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	C510098
SW_Push	SW1	Button_Switch_SMD:SW_Push_1P1T_NO_CK_KSC6xxJ	
TestPoint	TP1	Connector_PinHeader_2.54mm:PinHeader_1x01_P2.54mm_Vertical	
TXS0104EPW	U1,U2,U3	Package_SO:SOIC-14_3.9x8.7mm_P1.27mm	C79342
CK1408	U4	Converter_DCDC:CK1408	
B0505S	U5	Converter_DCDC:Converter_DCDC_muRata_CRE1xxxxxSC_THT	
SN74LV1T34DBV	U6,U7	Package_TO_SOT_SMD:SOT-23-5	C100024

6) Jumper Settings / Connectors

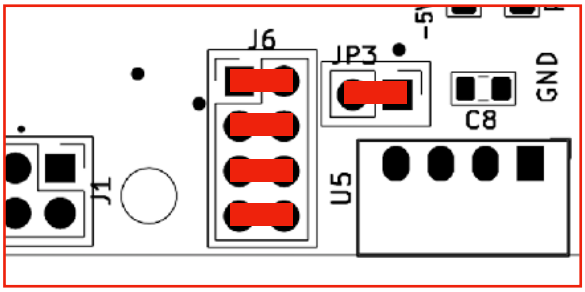


Connectors:
J1: Raspberry Pi GPIO
J2 and J4: Pod connectors
J3: Probe add-on board
J5: Screw terminal for direct power inputs
J6: Power Jumpers. See pictures to the right.
(Could also be used to switch individual rails on/off)
From top to bottom:
+5V
+5VPod
+12VPod
-5VPod
J7: Screw terminal (single 12V input)
J8: Barrel jack (single 12V input)
J9/Sw1: GPIO 5 to GND. Can be used as a soft-power switch by adding

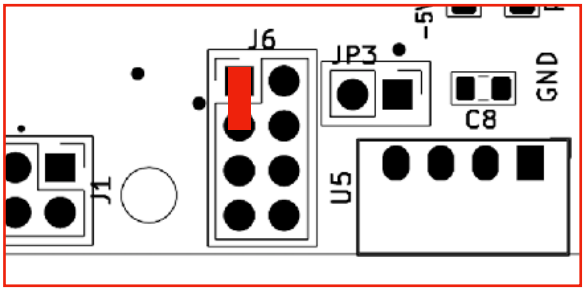
dtoverlay=gpio-shutdown
to
/boot/config.txt

J10: +5V Pod out. Can be used to power a fan / screen

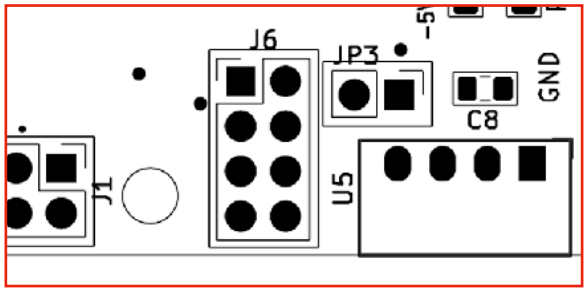
Jumpers:
JP1: Chip enable for the level-shifters (closed = enable)
JP2: (was removed)
JP3: Enable on-board -5V. (is powered by +5V POD rail).
JP4: Enable on-board DC-DC converter (generates +5V and +5VPod



Single 12V input (JP4 must be closed!)



Separate inputs but only a single +5V (connects +5V Pod and +5V)

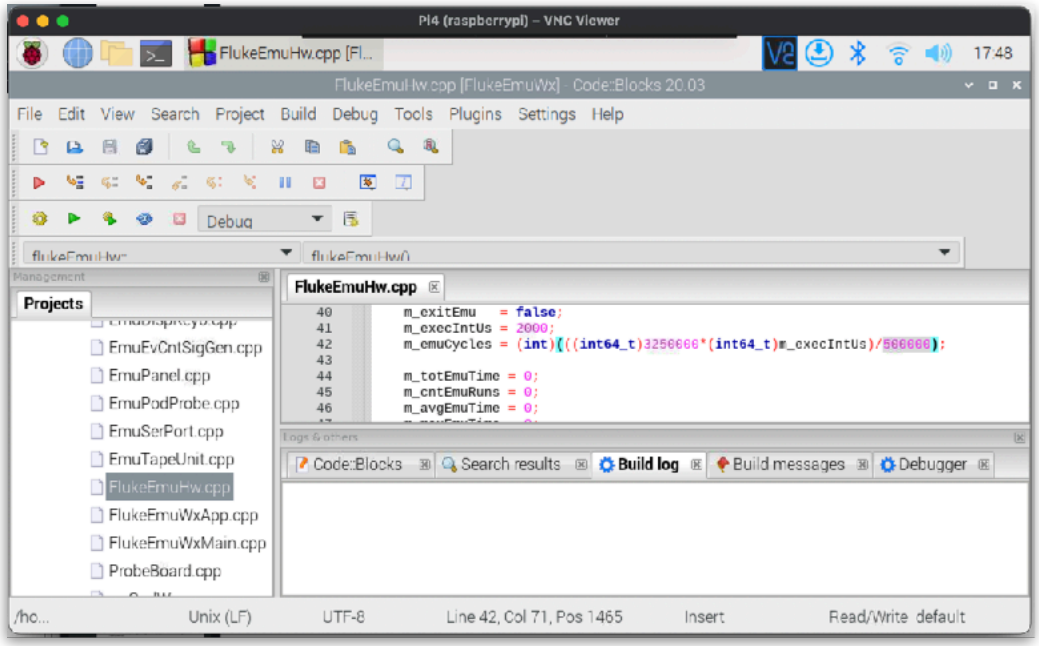


All separate inputs used

7) Notes, ToDos and known issues

- The Emulator - as it is configured now - will not run at full speed by default (as a matter of fact around half the 9010a speed). The Raspberry Pi is more than capable of running a Z80 emu at full speed though.

  To adjust the speed you can change m_emucycles in FlukeEmuHW.cpp. If you lower the divider (for example) as shown below for, the emu should run at double the speed..



- Power Supply and larger PODs:
  ‚Smaller' PODs such as Z80 or 6502 will work well with the ‚on board' power supply. ‚Larger' PODs such as 68K draw much more power and depending on the type of cable you use there will be a significant voltage drop.
  We tested the Emulator with a repro 68K POD which did work well. However, the voltage readings on the POD's ICs seems to be at the lower end of what is tolerable. Since the repro uses newer logic ICs this seems to be tolerated well.
  However, if you need to use ‚larger' original pods it might be a good idea to power at least the +5V POD rail with an adjustable external supply to guarantee stable POD operation.

8) DigiKey Parts list

By ‚popular demand'. It is incomplete as many parts that were used we had laying around or were bought at a local store (such as the 40 pin ‚stacking' headers).

1) Resistors:
   All resistors are 1/8W, 0805. For example:
   RMCF0805FT20K0CT-ND

2) Capacitors:
   All capacitors used in our builds were ceramic, 0805, 25V. For example:
   1276-1244-1-ND

3) Barrel - Jack connector:
   PJ-059AH

4) Levelshifters: Depending on which version of the package/board either
   SOIC: 296-34699-5-ND
   or
   TSSOP: 296-20697-1-ND (Obsolete)

5) SN74LV1T34:
   296-37177-2-ND

6) 5V DCDC Converter (onboard -5V):
   2725-B0505S-1WR3-ND

7) D-Sub 25 connector
   1003-3033-ND
   or
   1003-3029-ND

8) Screw terminals:
   2x: 102-6179-ND
   3x: 102-6180-ND

9) Schottky diode for reverse voltage protection:
   B320-FDICT-ND

10) BSS138BK MOSFET
    1727-1141-1-ND

11) AC/DC WALL MOUNT ADAPTER 12V 36W
    2306-WR9ME3000CCP-F(R6B)-ND