FluCom Interface Board / HAT for Raspberry Pi

Build Manual and Bill of Materials

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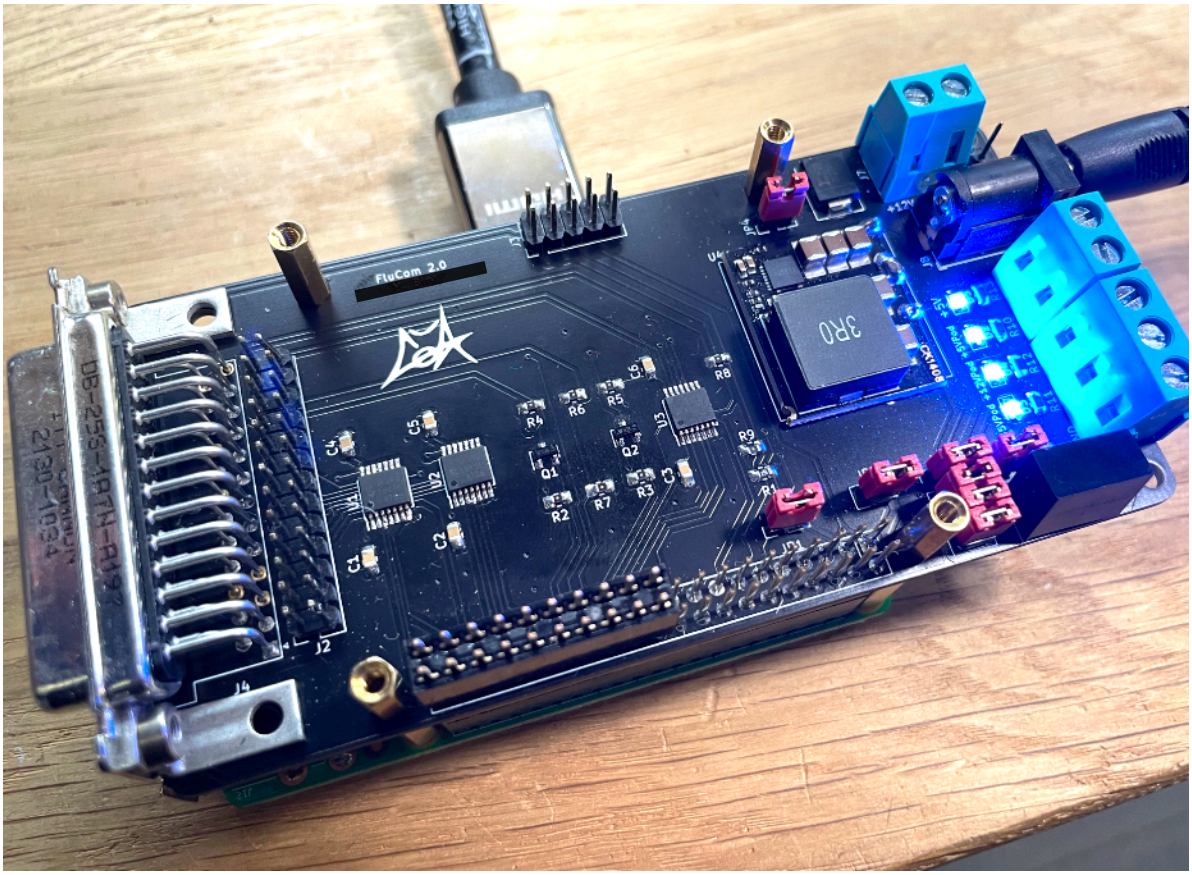
FluCom Interface Board / HAT for Raspberry Pi



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.

It does not support the Fluke 9000 series probe / signature analysis, as this will require additional hardware. If and when this functionality will be implemented we cannot tell yet.

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 system.

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

Logic level shifting is done by TXS0104E IC's for the databus as well as POWERFAIL and !PODPRESENT lines.

For handshaking / control lines, individual channels are used (MOSFET- driven for !MAINSTAT / !RESET and a simple voltage divider for !PODSTAT and SYNC), as running the handshaking lines through the level shifter IC's would result in unstable communication.

The board can 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, simple reverse voltage protection is provided by D1. If powered in this configuration, jumpers J6 enable/disable the individual rails. These jumpers could also be used to physically switch on and off the power rails.

Alternatively, external power inputs can be used to power the individual rails (5V Raspi, 5V Pod, -5V Pod and 12V Pod) using the 5 channel 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 here, so please be careful.

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

This 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

The current Version of the Board uses TSSOP packages for the level shifters as these were the only ones available at the time when the board was designed. These require decent to good soldering skills and equipment (preferably a microscope or at the very least a good lense).

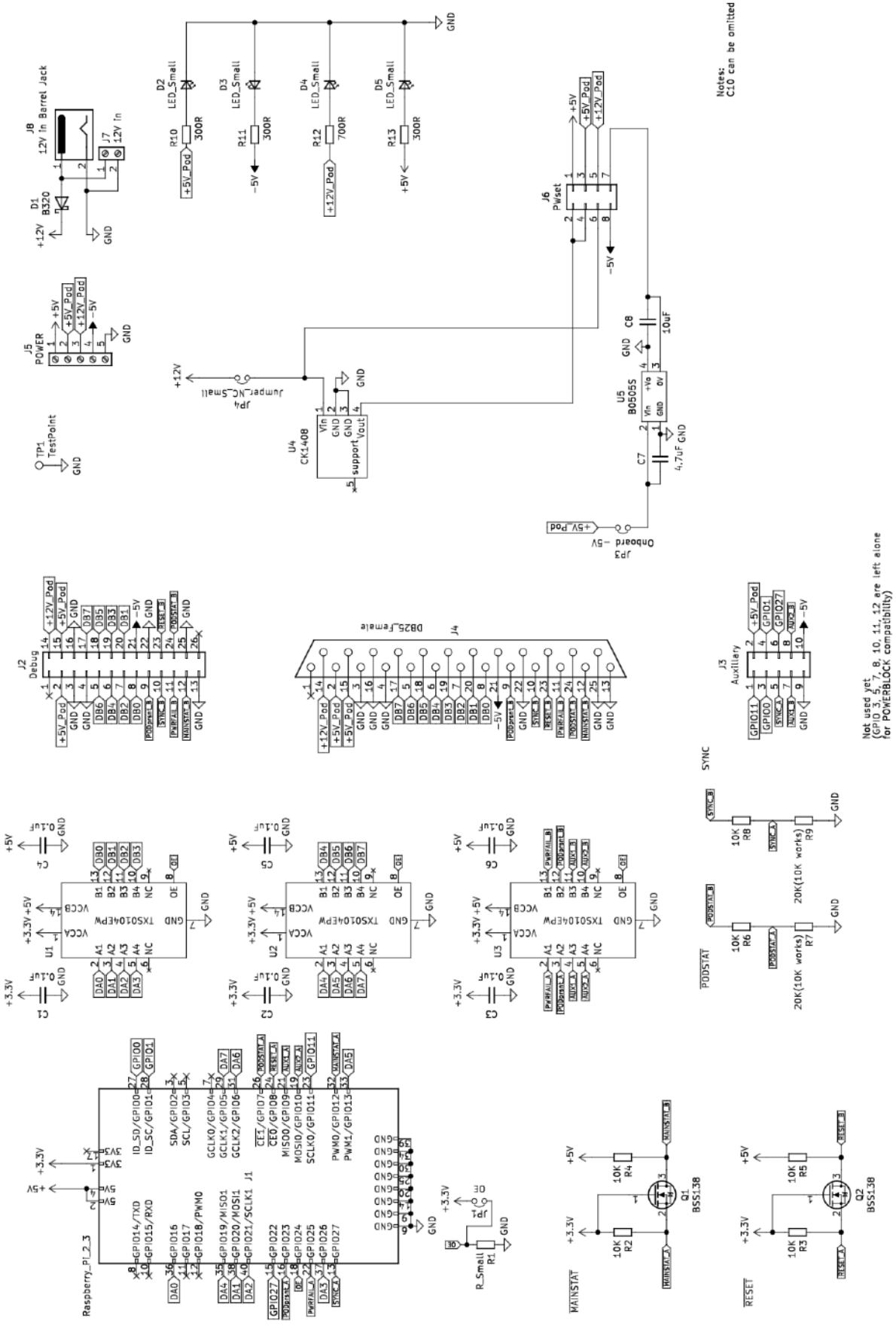
Also, a wide spaced header (or a stack of two) will be needed to connect to the Raspberry Pi in order to provide enough clearance for the pod- connectors.

The rest of the board should be pretty straight forward to assemble.

As usual, I would strongly recommend soldering all low-profile components (SMD) first.

Good luck with building and have fun!

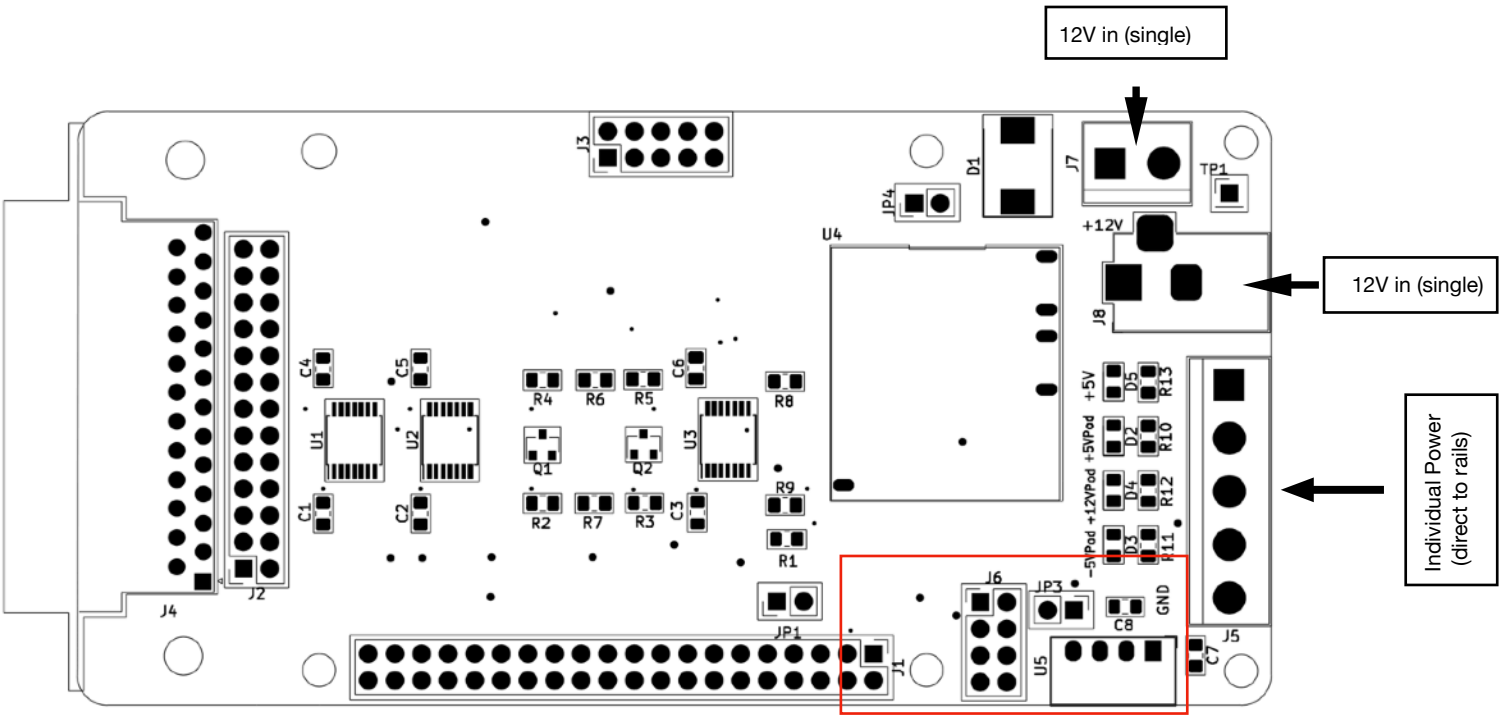
4) Schematics



5) Bill of Materials

Component	45			
Ref	Qnty	Value	Cmp name (KiCad)	Footprint
C1, - C6,	6	0.1uF	C_Small	Capacitor_SMD:C_0805_2012Metric_Pad1.15x1.40mm_HandSolder
C7,	1	4.7uF	C_Small	Capacitor_SMD:C_0805_2012Metric_Pad1.15x1.40mm_HandSolder
C8,	1	10uF	C_Small	Capacitor_SMD:C_0805_2012Metric_Pad1.15x1.40mm_HandSolder
D1,	1	B320	B320	Diode_SMD:D_SMC
D2, - D5,	4	LED_Small	LED_Small	LED_SMD:LED_0805_2012Metric_Pad1.15x1.40mm_HandSolder
J1,	1	Raspberry_Pi_3_4	Raspberry_Pi_3_4	Connector_PinHeader_2.54mm:PinHeader_2x20_P2.54mm_Vertical
J2,	1	Debug	Conn_02x13_Top_Bottom	Fluke6809POD:PinHeader_2x13_P2.54mm_Vertical_Fluke_Numbering_mirrored
J3,	1	Auxillary	Conn_02x05_Odd_Even	Connector_PinHeader_2.54mm:PinHeader_2x05_P2.54mm_Vertical
J4,	1	DB25_Female	DB25_Female	DSUB-25_Female_Horizontal_P2.77x2.54mm_EdgePinOffset9.40mm
J5,	1	POWER	Screw_Terminal_01x05	TerminalBlock:TerminalBlock_bornier-5_P5.08mm
J6,	1	PWset	Conn_02x04_Odd_Even	Connector_PinHeader_2.54mm:PinHeader_2x04_P2.54mm_Vertical
J7,	1	12V in	Screw_Terminal_01x02	TerminalBlock:TerminalBlock_bornier-2_P5.08mm
J8,	1	12V in Barrel Jack	Barrel_Jack	Connector_BarrelJack:BarrelJack_Horizontal
JP1,	1	OE	Jumper_NC_Small	Connector_PinHeader_2.54mm:PinHeader_1x02_P2.54mm_Vertical
JP3,	1	Onboard -5V	Jumper_NC_Small	Connector_PinHeader_2.54mm:PinHeader_1x02_P2.54mm_Vertical
JP4,	1	Jumper_NC_Small	Jumper_NC_Small	Connector_PinHeader_2.54mm:PinHeader_1x02_P2.54mm_Vertical
Q1, Q2,	2	BSS138	BSS138	Package_TO_SOT_SMD:SOT-23
R1,	1	10K?	R_Small	Resistor_SMD:R_0805_2012Metric_Pad1.15x1.40mm_HandSolder
R2, - R6, R8,	6	10K	R_Small	Resistor_SMD:R_0805_2012Metric_Pad1.15x1.40mm_HandSolder
R7, R9,	2	20K(10K ok?)	R_Small	Resistor_SMD:R_0805_2012Metric_Pad1.15x1.40mm_HandSolder
R10, R11, R13	3	300R	R_Small	Resistor_SMD:R_0805_2012Metric_Pad1.15x1.40mm_HandSolder
R12,	1	700R	R_Small	Resistor_SMD:R_0805_2012Metric_Pad1.15x1.40mm_HandSolder
TP1,	1	TestPoint	TestPoint	Connector_PinHeader_2.54mm:PinHeader_1x01_P2.54mm_Vertical
U1, U2, U3,	3	TXS0104EPW	TXS0104EPW	Package_SO:TSSOP-14_4.4x5mm_P0.65mm
U4,	1	CK1408	CK1408	Converter_DCDC:CK1408
U5,	1	B0505S	B0505S	Converter_DCDC:Converter_DCDC_muRata_CRE1xxxxxSC_THT

6) Jumper Settings / Connectors



Connectors:

J1: Raspberry Pi GPIO
J2 and J4: Pod connectors
J3: Not used yet (add on board?)
J5: Screw terminal for direct power inputs
J6: Power Jumpers. See pictures on the right side. Could in theory be used to switch individual rails on/off.

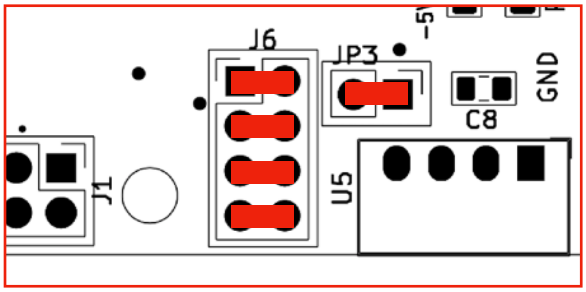
From top to bottom:
+5V
+5VPod
+12VPod
-5VPod

J7: Screw terminal (single 12V input)
J8: Barrel jack (single 12V input)

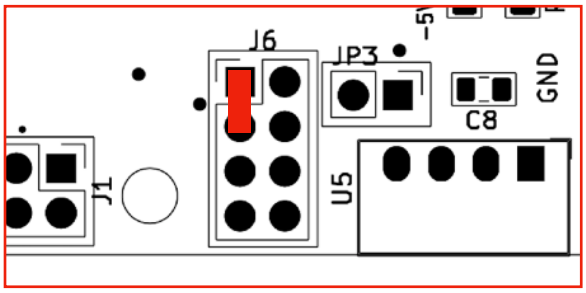
Jumpers:

JP1: Chip enable for the level-shifters (will most likely be removed in later revisions)
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

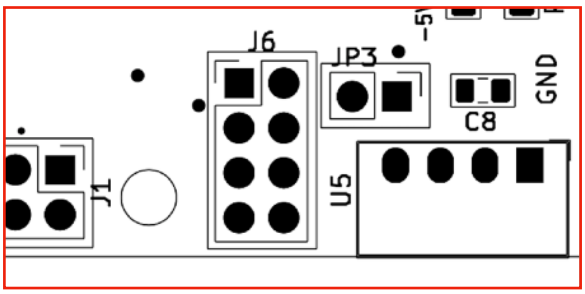
This might look a bit complicated, but referring to the schematics, things should be obvious.



Single 12V input (JP4 must be closed!)



Individual inputs (only one +5V used)



All individual inputs used

7) Notes, ToDos and known issues

- JP1 will most likely be removed in the future, enabling/disabling the level shifters via GPIO 24 (PIN 18) in software.

  At the moment it is tied high by JP1, enabling the level shifters at all time.
  It is therefore important, that you do not try to drive GPIO 24 low when the FluCom board is mounted and JP1 is set; this might damage the GPIO pin(s) as it would be driven against the +3.3V power rail.

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

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

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

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

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

9) BSS138BK MOSFET
   1727-1141-1-ND

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