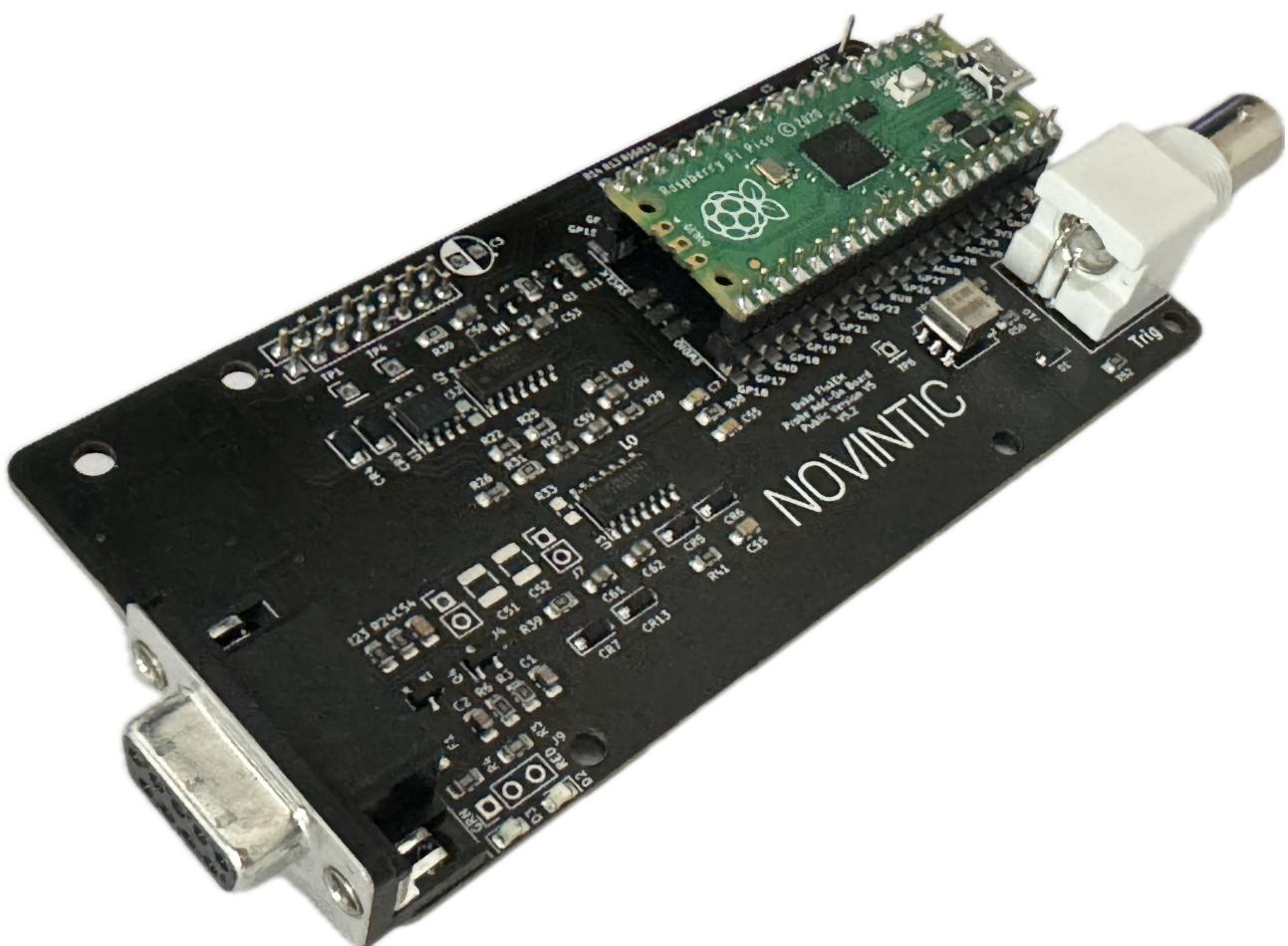


FlukeEmu / FluCom (aka „Duke FlukEM“)

Probe Add-on-Board

Build Manual and Bill of Materials



1) Table of Content

- 1) Table of Content
- 2) General description
- 3) A bit more detailed
- 4) Board Layout
- 5) Schematics
- 6) Bill of Materials
- 7) Notes, ToDos and known issues
- 8) DigiKey Parts list

2) General description

This add-on board for the FluCom Raspberry Pi HAT provides full probe functionality for the FlukeEmu/FluCom hardware/software Emulation of the Fluke 9010A Micro-System Troubleshooter.

Basically this makes the Fluke 9010A emulation feature- complete.

As much of the original circuitry as possible was implemented using a Raspberry PICO microcontroller.

However, due to the original design of the probe, a significant amount of analog circuitry had to be reproduced in order to keep the system working with legacy probes.

3) A bit more detailed

The Fluke 9010A Micro-System Troubleshooter's probe provides additional diagnostic features and tools such as:

- Logic level detection
- Signatur analysis
- Event counting
- Pulse generation

It can be used in ‚free run mode‘ or synced to address or data cycles. It does also provide an external sync signal.

In order to add to the above mentioned functionality to our existing hardware / software solution for 9010A emulation, we decided to take a ‚hybrid‘- approach:

The Analog section (probe compensation, high- to low impedance conversion, probe control signals) was kept as close as possible to the original design in order to maintain compatibility to the original probe. For the rest / majority of the circuits a Raspberry PICO microcontroller was used to keep the overall design simple, cheap and flexible.

All in all, our tests suggest that our emulation performs at least as good as the original probe and meets or exceeds the original specifications.

Of course, we did not test our design in all possible / extreme environments or to complete destruction, so please keep that in mind and use it at your own risk.

Having said that, our design does feature the same over/under- voltage protection as the original. The fuse is implemented by a self resetting ‚polyfuse‘; while this can add some protection it is of course not as fast as a traditional fuse, therefore high probe voltages will most likely cause significant damage. Just don't probe voltages above +30V and below -30V as stated in the Fluke 9010A Manual.

If you do not plan to use the trigger out function some parts can be left away: TR2, J10, C71, R52 and R56.

We have tried to keep the symbol references the same as in the original design wherever possible and meaningful (for stuff like Testpoints). This is part of the explanation, why the numbering might seem a bit odd at times.

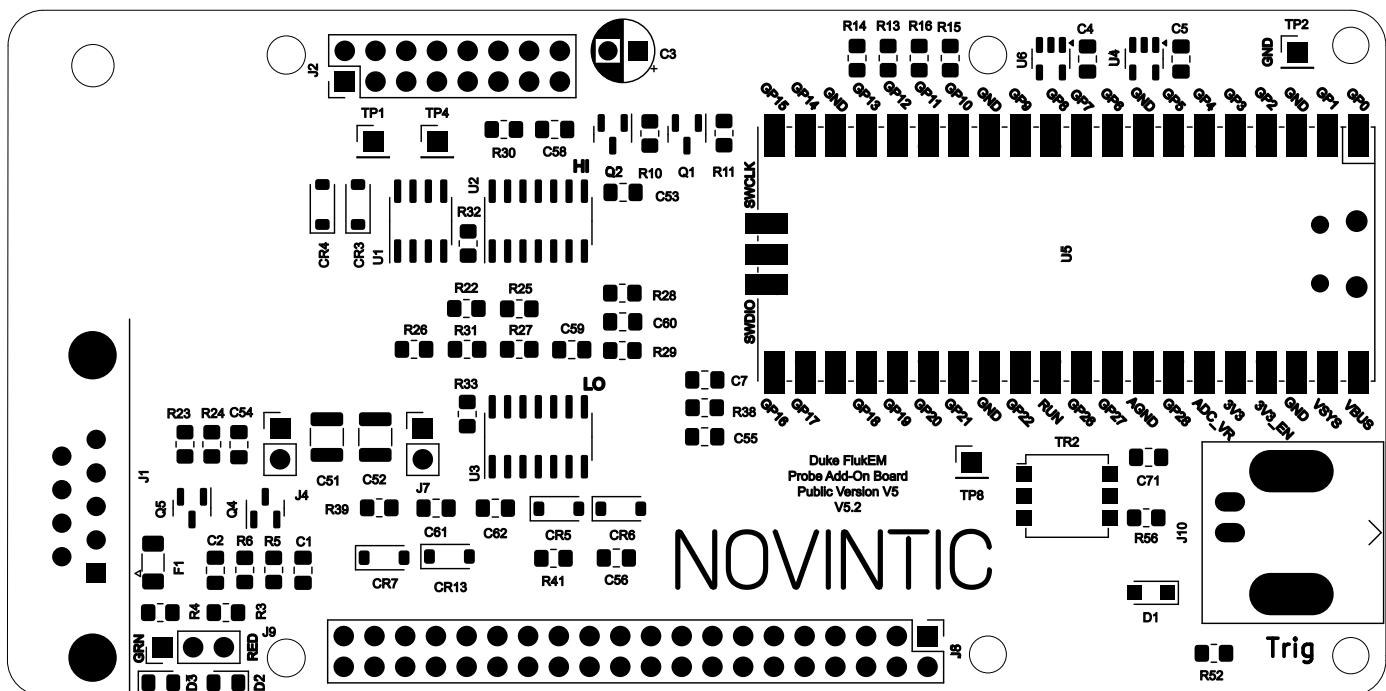
The variable capacitors on the input section can most likely be omitted (s. notes below).

In general, building the probe board is a bit more involved than the base FluCom interface; however it can be quite easily done with decent soldering skills and equipment. You will not need to make any changes to the FluCom board or the FlukeEmu software; just stack the probe board on top and you should be ready to go.

The firmware (APPLICATION.uf2) for the Raspberry PICO can just be copied to its root directory which can be accessed by pressing and holding it's button while plugging in the micro- USB- cable. It will then be recognized as an external USB storage device.

Good luck with building and have fun!

4) Board Layout



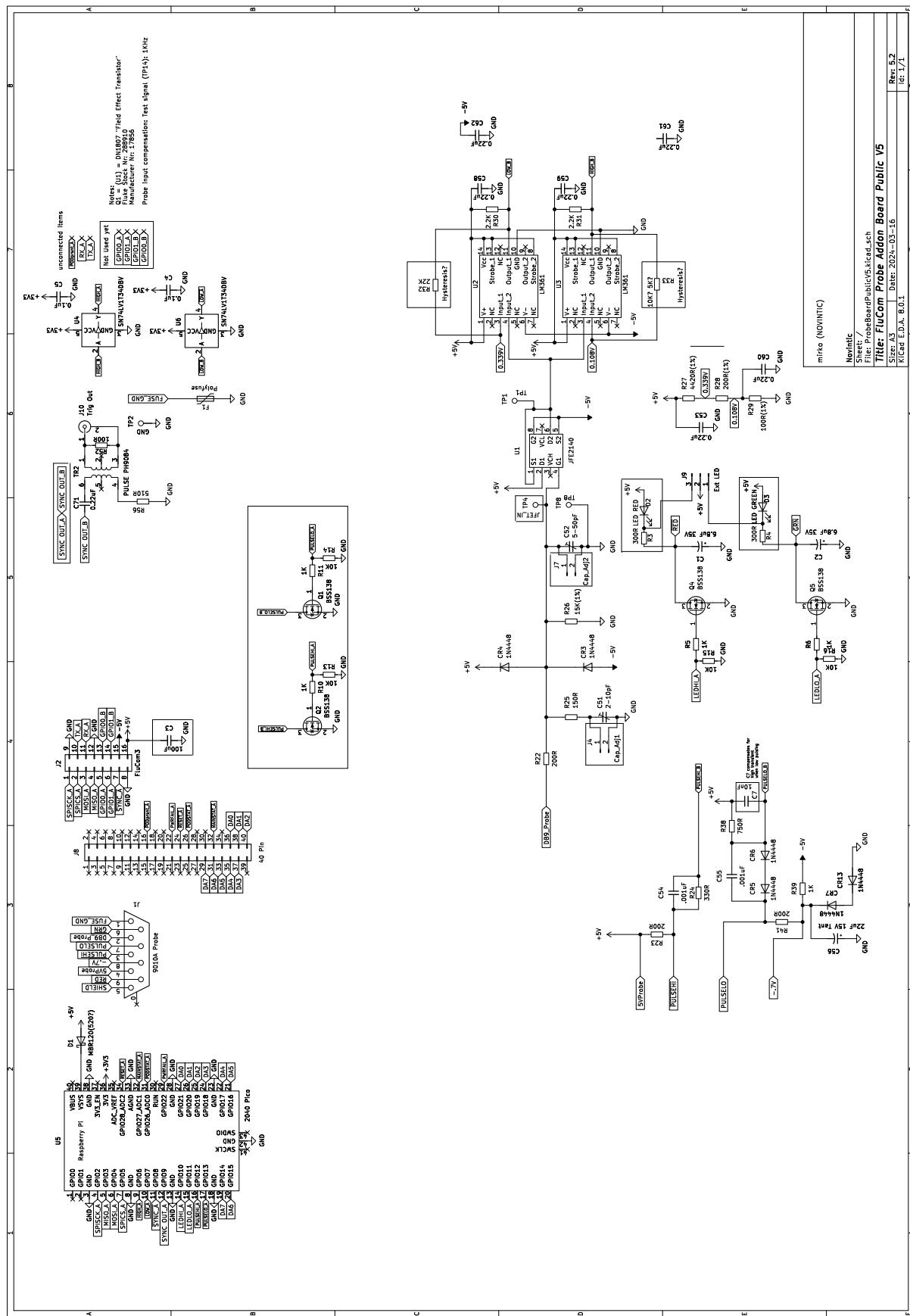
Notes:

C3, C61, C62 R32 and R33 can be omitted

J9 can be used to control external LEDs. Center pin is common anode.

The trigger circuitry can be omitted entirely if you don't need trigger out (which you most likely won't): TR2, C71, R56, R52 and of course J10

5) Schematics



6) Bill of Materials

ProbeBoardPublicV5

Comment	Designator	Footprint	LCSC
6.8uF 35V	C1,C2	Capacitor_SMD:C_0805_2012Metric_Pad1.18x1.45mm_HandSolder	C5139488
100uF	C3	Capacitor_THT:CP_Radial_D5.0mm_P2.50mm	
0.1uF	C4,C5	Capacitor_SMD:C_0805_2012Metric_Pad1.18x1.45mm_HandSolder	C126469
2-10pF	C51	Capacitor_SMD:C_1210_3225Metric	
5-50pF	C52	Capacitor_SMD:C_1210_3225Metric	
0.22uF	C53,C58,C59,C60,C61,C62,C71	Capacitor_SMD:C_0805_2012Metric_Pad1.18x1.45mm_HandSolder	C152875
.001uF	C54,C55	Capacitor_SMD:C_0805_2012Metric_Pad1.18x1.45mm_HandSolder	C46553
22uF 15V Tant	C56	Capacitor_SMD:C_0805_2012Metric_Pad1.18x1.45mm_HandSolder	C77071
10nF	C7	Capacitor_SMD:C_0805_2012Metric_Pad1.18x1.45mm_HandSolder	C303893
1N4448	CR3,CR4,CR5,CR6,CR7,CR13	Diode_SMD:D_SOD-123	C8601
MBR120(520?)	D1	Diode_SMD:Nexperia_CFP3_SOD-123W	C130880
LED RED	D2	LED_SMD:LED_0805_2012Metric_Pad1.15x1.40mm_HandSolder	C94741
LED GREEN	D3	LED_SMD:LED_0805_2012Metric_Pad1.15x1.40mm_HandSolder	C2297
Polyfuse	F1	Capacitor_SMD:C_1206_3216Metric_Pad1.33x1.80mm_HandSolder	
9010A Probe	J1	Connector_Dsub:DSUB-9_Female_Horizontal_P2.77x2.84mm	
Trig Out	J10	Connector_Coaxial:BNC_Amphenol_B6252HB-NPP3G-50_Horizontal	
FluCom3	J2	Connector_PinHeader_2.54mm:PinHeader_2x08_P2.54mm_Vertical	
40 Pin	J8	Connector_PinHeader_2.54mm:PinHeader_2x20_P2.54mm_Vertical	
Ext LED	J9	Connector_PinHeader_2.54mm:PinHeader_1x03_P2.54mm_Vertical	
BSS138	Q1,Q2,Q4,Q5	Package_TO_SOT_SMD:SOT-23	C5190146
10K	R13,R14,R15,R16	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	C510098
200R	R22,R23,R41	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	C328389
330R	R24	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	C328393
150R	R25	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	C328383
15K(1%)	R26	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	C706307
4420R(1%)	R27	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	C185701
200R(1%)	R28	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	C328389
100R(1%)	R29	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	C706199
300R	R3,R4	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	C114529
2.2K	R30,R31	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	C163972
22K	R32	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	
10K? 5K?	R33	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	
750R	R38	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	C416169
1K	R5,R6,R10,R11,R39	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	C115316
100R	R52	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	C706199
510R	R56	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	C228886
PULSE PH9084	TR2	Transformer_SMD:Pulse_P0926NL	
JFE2140	U1	Package_SO:SOIC-8_3.9x4.9mm_P1.27mm	C2915160
LM361	U2,U3	Package_SO:SOIC-14_3.9x8.7mm_P1.27mm	C2868536
SN74LV1T34DBV	U4,U6	Package_TO_SOT_SMD:SOT-23-5	C100024
2040 Pico	U5	MCU_RaspberryPi_and_Boards:RPi_Pico_SMD_TH	

7) Notes, ToDos and known issues

- The probe compensation implemented in the original circuit uses 2 variable capacitors to calibrate the circuit to individual probes: C51 (2-10pF) and C52 (5-50pF). A 1kHz Square wave is used in the calibration process (as described in the Service Manual for the 9010A).

Variable capacitors off that value in SMD package are hard to find and expensive, so these have not been tested. The board works fine without them.

Also, by adding capacitance to the input section, you will loose high frequency performance.

So, as long as you are not servicing nuclear ICBMs or something the like, not populating C51 / C52 should be just fine.

- We have tried to use a dual comparator IC (NE521) instead of the two LM361s to reduce the component count; however this design would prove to be unreliable at higher frequencies.

8) DigiKey Parts list

By ,popular demand'. It is incomplete as some parts that were used we had laying around or were bought at a local store

- 1) Resistors:
All resistors are 1/8W, 0805. For example:
RNCP0805FTD1K00CT-ND
- 2) Capacitors:
All SMD capacitors used in our builds were ceramic, 0805, 25V. For example:
1276-1244-1-ND
- 3) Cap Trimmers (C51, C52) (please read notes below)
3-15pF: 1674-1018-1-ND
8-40pF: 1674-1021-1-ND
- 4) MBR 120 (520)
Just used an appropriate Schottky diode to protect the USB port if unit is powered (did not have DigiKey part..)
- 5) 1N4448 Gen Purpose Diodes
1N4448W-E3-08GICT-ND
- 6) PTC Polyfuse 100mA
18-1206L010/60WR-ACT-ND
- 7) LM361
296-47682-1-ND
- 8) JFE 2410 Dual JFET
296-JFE2140DRCT-0
- 9) BSS138BK MOSFET
1727-1141-1-ND