SVXLINK TETRA LINK V4 F1IWQ 20/03/2021 board assembly instructions

This card is intended for the Raspberry Pi3B+ running with the svxlink software. It interfaces the Motorola TETRA MTM800(E) or MTM5x00 radio stations series. It allows dialogs using RS232 operating mode with the MTM. The SQ (COS) signal from the MTM800 can be picked up inside the station, or be fetched by AT commands using the UART of the Pi. For this feature, you must use the tetra-contrib branch from DL1HRC. The board has a speaker terminal block for the MTM and a speaker terminal block for listening locally the radio and the audio network channels. The board is double-sided screen-printed and metallized holes, with a double ground plane.

Description of terminal blocks, jumpers and settings

J2.1 = TxAud is the audio signal from the sound card from the pi to the sound input to the station
J2.2 = RxAud is the audio signal from the radio to the sound card to the pi (mic)
J2.3 = 0V
J2.4 = NC
J2.5 = Squelch from the radio. On the MTM800E, the signal must be fetched on pin 8 on the TDA (access to the GPS hatch). See note below.
J2.6 = 0V
An audio cable must be made to connect the sound card (SP-MIC) to terminal block J2. If you use the TETRA branch of svxlink and enable TETRALOGIC, you don't need to wire J2.5 (SQ)

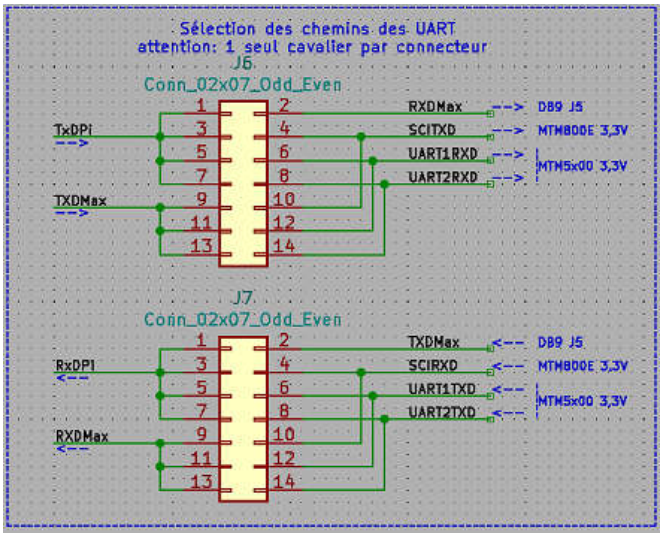
J3: connector to MTM800 (E)

J4: J4 is to be bridged between 1-2 or between 2-3 depending on the impedance (level) of the audio signal injected into the radio. Normally, you have to use an external sound card with the raspberry plugged into one of its USB ports ; J4.2 and J4.3 are bridged together (use EXTMICAUD) (*depend on sound device*)

J6 and J7: routing for UART from MTM800 / 5X00 (Rx and Tx) to Raspberry or DB9.
These two end-pins are used to route the signals from the UARTs of the MTM800 / MTM5x00 to the raspberry **or** the DB9.

For an MTM800E, position a strap on J6.3 and J6.4 and a strap on J7.3 and J7.4 to redirect the UART to the raspberry pi, to be used with SVXLINK.

For an MTM5x00, this depends on the control head (control head connected to the station) see paragraph Specific features for the PEI interface using MTM5x00 on page 4.



Place only one jumper on each terminal J6/J7

RXDSt232
MTM800(E)
MTM5x00 uart1
MTM5x00 uart2

TXDSt232
MTM800(E)
MTM5x00 uart1
MTM5x00 uart2

You must not both connect an MTM800 and an MTM5x00 to the interface. Connect only one jumper per terminal J6/J7.

The MTM800 only has one UART. It can be redirected to the DB9 front face or to the raspberry. The MTM5x00 has 2 UARTs.

Please read the specific part for MTM5x00

J8: pin to pin straight connector to the MTM5400

J9: bridge J9 (DTR-DSR bridge) to use the RS232 DB9 interface.

J10 and **J11**: see JP1 and JP2

J12: used to supply the raspberry with 5V instead of going through the usb power supply to the raspberry. *Beware of the polarity.*

J13 (HP-MTM) is the listening speaker of the MTM800-5x00 (HP + HP-)

J14, if it not bridged then disables the keyer to the MTM. This allows you only to listen on the SP J15.

J15 (HP1) is a terminal block for a speaker listening locally from the radio or the network.

J16 (ignition) to be connected to external 12V to automatically start the MTM as soon as the power is switched on. Switching this pin to 0V will turn off the MTM. This pin is therefore to be connected to the general 12V power supply.

J17 : RTS signal from UART1 to the MTM5x00 connector.

JP1: bridge JP1 to connect the PTT to GPIO16 of the raspberry.
Otherwise PTT is available on J10: solder a wire between J10 and the desired GPIO of the pi.

JP2: bridge JP2 to connect SQ3 (COS) to GPIO19 of the raspberry

Otherwise SQ3 is available on J11: solder a wire between J11 and the desired GPIO of the pi.

RV1: adjustment of the audio injected into the radio
RV2: adjustment of the audio received from the radio to the sound card
RV3: adjustment of the voltage switching point for the comparator LM311 (adjust to have 8.25V on terminal 3 of U1). This voltage is used to switch if the squelch signal goes from 4.5V to 12V: U1.7 = 3V if U1.2 = 12V
RV4: setting from the sound card audio output (network monitoring) to the local monitoring speaker on terminal block J15
RV5: audio adjustment for the audio output from the MTM (radio listening) to the speaker of the local listening on terminal block J15.

The DB9 is in the RS232 standard; it is used in operating mode (AT commands)

Cable made for SVXLINK board to MTM800E (J3) or MTM5x00 (J6)
You just need to make a straight cable. You can also use an HE10 20/26 points straight female-female ribbon. Pay attention to the direction of the connector when plugin. For MTM5x00 depending of the front head connected to the body station, you don't need the PEI signal lines on the J6 terminal. See below.

Using RS232
The RS232 serial link allows to use the AT commands when the MTM is running. The default settings are 9600 bauds, no parity, 1 start bit 1 stop bit, without RTS / CTS protocol according to the CPS settings. You can use an RS232 / USB converter to the PC.

Note: to manage the squelch signal, it is possible to use the MTM AT commands controlled from the Pi, using a software function.
In the case of using an MTM800, J6 and J7 must be bridged on positions 1-2 (RxDPi and TxDpi towards SCITXD and SCIRXD). In the case of using an MTM5x00, choose positions 3-4 or 5-6.

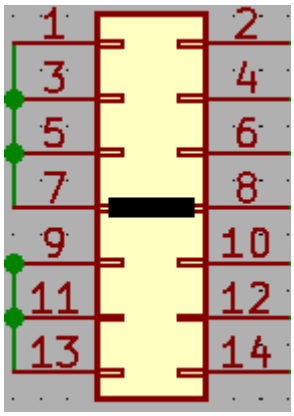
Specific features for the PEI interface using MTM5x00 series

The PEI interfaces for MTM5x00 stations series are routed either to the rear connector or to a DB9 depending on the "control head" connected to the station.

MTM5200 and MTM5400

If the station body (brick) is connected to a PMLN4904 "control head", then the PEI interface is available on the rear connector. It is at the 3.3V level. Use direct link on the board.

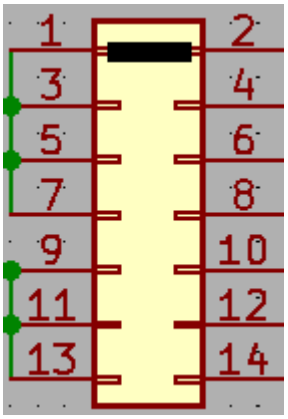
Control head
PMLN4904



Strap position for
J6 et **J7**:
J6.7 - J**6**.8
J7.7 - **J7**.8
Using UART2

If the station body (brick) is connected to a PMLN4908 "data expansion head", then the PEI interface is redirected to the front DB9 on the data expansion head. (MTM5500). It complies with RS232 V24 standards and can be connected to a serial COM port to a PC directly.

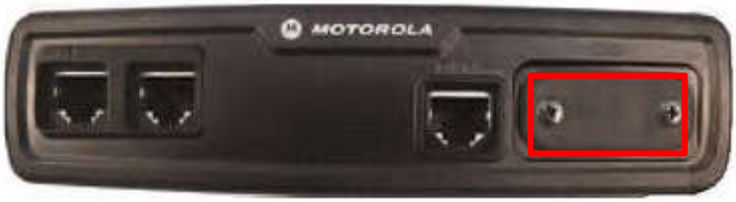
Data expansion head
PMLN4908



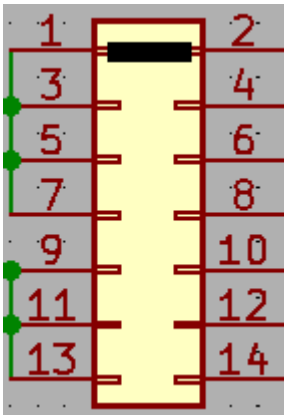
Strap position for
J6 et **J7 :**
J6.1 - J**6**.2
J7.1 - **J7**.2

MTM5500

The station body (brick) is to be connected to an "ethernet expansion control head" PMLN7009 and the PEI interface is redirected to the front DB9 on the ethernet remote control head. It complies with RS232 V24 standards and can be connected to a COM port to a PC directly.

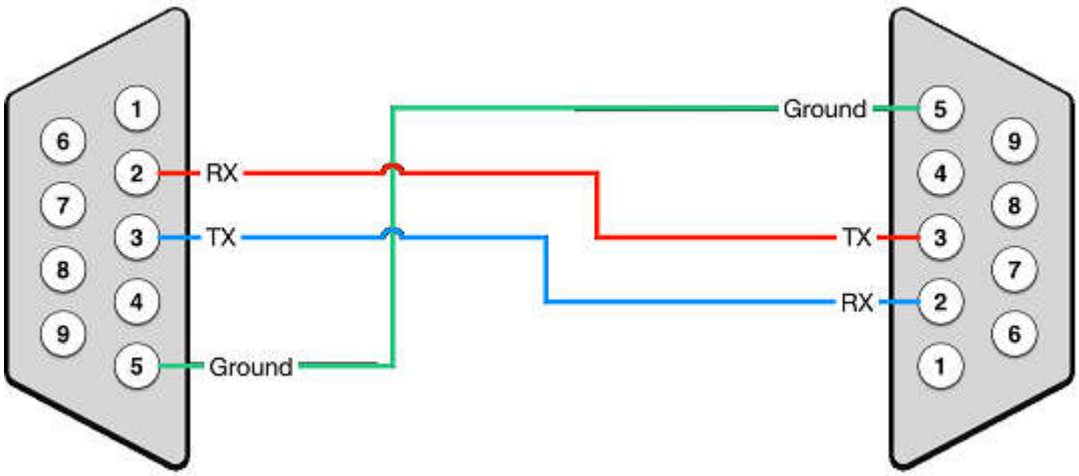


Ethernet expansion control head PMLN7009



Strap position for **J6** et **J7 :**
J6.1 - J**6**.2
J7.1 - **J7**.2

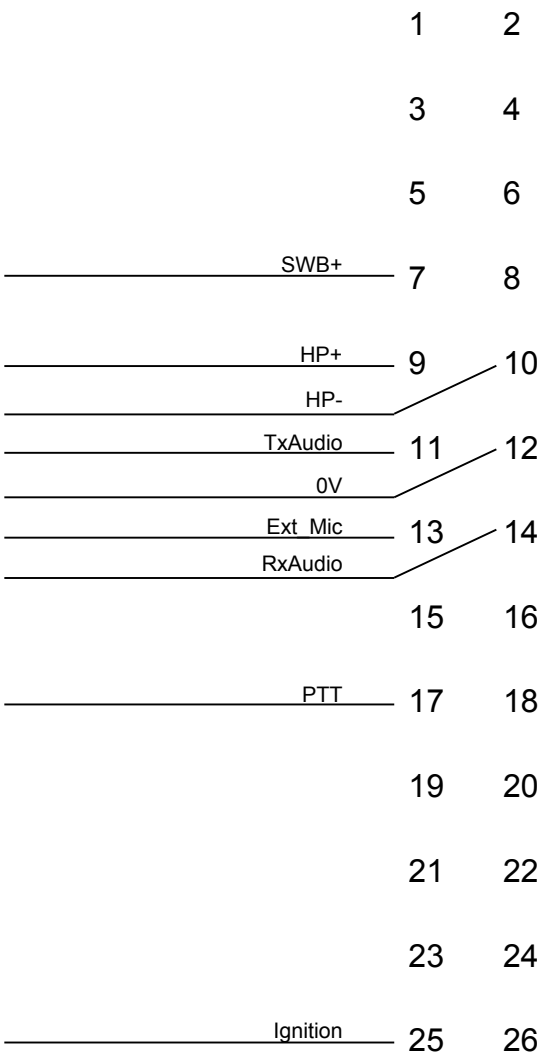
To link the TetraLink board, you need to use a RS232 cross cable from the DB9 from the data expansion head (MTM5400) or from the Ethernet expansion head (MTM5500) to the DB9 (J5) tetralink board, for the PEI connection. Does not apply to MTM800E.



Straight cable between MTM5400 pmln4908 or MTM5500

Use this cable between :

- J8 board and MTM5400 with data expansion head PMLN4908
- J8 board and MTM5500.



Components list, values and footprints

C1,C2	10µF	Capacitor_THT:CP_Radial_D5.0mm_P2.50mm
C10,C11	100nF	Capacitor_THT:C_Rect_L7.0mm_W2.5mm_P5.00mm
C12,C13	10µF	Capacitor_THT:CP_Radial_D4.0mm_P2.00mm
C14	4,7µF	Capacitor_THT:CP_Radial_D4.0mm_P2.00mm
C3,C4,C5,C6,C7	100nF	Capacitor_SMD:C_0805_2012Metric
C8,C9,C15,C16, C17	1µF	Capacitor_THT:CP_Radial_D4.0mm_P2.00mm
D1,D2,D3	LED	LED_THT:LED_D3.0mm
D4	1N4004	Diode_THT:D_A-405_P5.08mm_Vertical_AnodeUp
J1	Raspberry_Pi3B+	Raspberry-Pi-3-library-for-kicad-master:raspberrypi2
J10,J11,J16	Conn_01x01	TestPoint:TestPoint_Loop_D2.50mm_Drill1.0mm
J12,J13,J15	Screw_Terminal_01x02	TerminalBlock:TerminalBlock_bornier-2_P5.08mm
J2	Conn_01x01_Male	Connector_PinHeader_2.54mm:PinHeader_1x06_P2.54mm_Vertical
J3	Conn_02x10_Odd_Even	Connector_PinHeader_2.54mm:PinHeader_2x10_P2.54mm_Vertical
J4, J6,J7	Conn_01x03 Conn_02x06	Connector_PinHeader_2.54mm:PinHeader_1x03_P2.54mm_Vertical Connector_PinHeader_2.54mm:PinHeader_2x06_P2.54mm_Vertical
J5	DB9_Female	Connector_Dsub:DSUB-9_Female_Horizontal_P2.77x2.84mm_EdgePinOffset9.90mm_Housed_MountingHolesOffset11.32mm
J8	Conn_02x13_Odd_Even	Connector_PinHeader_2.54mm:PinHeader_2x13_P2.54mm_Vertical
J9,J14	Conn_01x02	Connector_PinHeader_2.54mm:PinHeader_1x02_P2.54mm_Vertical
JP1,JP2	Jumper_2_Bridged	Jumper:SolderJumper-2_P1.3mm_Open_TrianglePad1.0x1.5mm
Q1,Q2	BC548	Package_TO_SOT_THT:TO-92_Inline_Wide
R10	10k	Resistor_THT:R_Axial_DIN0204_L3.6mm_D1.6mm_P2.54mm_Vertical
R13	47k	Resistor_THT:R_Axial_DIN0207_L6.3mm_D2.5mm_P7.62mm_Horizontal
R14	100k	Resistor_THT:R_Axial_DIN0204_L3.6mm_D1.6mm_P2.54mm_Vertical
R15	100k	Resistor_THT:R_Axial_DIN0207_L6.3mm_D2.5mm_P7.62mm_Horizontal
R16	600	Resistor_THT:R_Axial_DIN0207_L6.3mm_D2.5mm_P7.62mm_Horizontal
R18	4,7k	Resistor_THT:R_Axial_DIN0207_L6.3mm_D2.5mm_P7.62mm_Horizontal
R3	4.7k	Resistor_THT:R_Axial_DIN0207_L6.3mm_D2.5mm_P7.62mm_Horizontal
R1,R2,R4,R17	1,2k	Resistor_THT:R_Axial_DIN0207_L6.3mm_D2.5mm_P7.62mm_Horizontal
R5	10k	Resistor_THT:R_Axial_DIN0207_L6.3mm_D2.5mm_P7.62mm_Horizontal
R6,R7	330	Resistor_THT:R_Axial_DIN0207_L6.3mm_D2.5mm_P7.62mm_Horizontal
R8,R11,R12	1k	Resistor_THT:R_Axial_DIN0204_L3.6mm_D1.6mm_P2.54mm_Vertical
R9	1k	Resistor_THT:R_Axial_DIN0207_L6.3mm_D2.5mm_P2.54mm_Vertical
RV1,RV2	47k	Potentiometer_THT:Potentiometer_Bourns_3296W_Vertical
RV3	10k	Potentiometer_THT:Potentiometer_Bourns_3296W_Vertical
RV4,RV6	47K	Potentiometer_THT:Potentiometer_Bourns_3296W_Vertical
U1	LM311	Package_DIP:DIP-8_W7.62mm_LongPads
U2	ST3232	Package_SO:SOIC-16_3.9x9.9mm_P1.27mm
U3	LD1117AV33	Package_TO_SOT_THT:TO255P1020X450X1968-3
U4	TL074	Package_SO:SOIC-14_3.9x8.7mm_P1.27mm
U5	L78L05_TO92	Package_TO_SOT_THT:TO-92L_Inline_Wide
U6	LMC7660	Package_SO:SOIC-8_3.9x4.9mm_P1.27mm
U8	LM386	Package_DIP:DIP-8_W7.62mm_LongPads

First, start soldering the SMDs (U2 U4 U6 and the SMD capacitors). Applying welding flux before soldering helps to ensure excellent results, clean with isopropylic alcohol or flux solvent after soldering.

There is a serigraphy error on the anode position for D4; position A is correct on the layout plan below.

The 2x20 pin GPIO connector of the raspberry is to be soldered on the opposite face to the components. For the V4 card, it is necessary to use a high profile 15mm connector, so that the V4 card overhangs the USB and Ethernet ports of the raspberry. Be careful when positioning, use spacers to sufficiently release the USB and Ethernet plugs from the pi. Do not solder the plate when it is against the connector but raised by a few millimeters to release the ethernet socket of the raspberry. The solder of this connector is to be done pluged into the GPIO of the pi and spacers in place. It is not necessary to cut the pins, this makes it possible to connect a stop button to control the pi, for example.

Kit ici : https://www.amazon.fr/Nrpfell-DEmpilage-Extra-Haut-Acrylique-Raspberry/dp/B08H5H6JGP/ref=sr_1_3?__mk_fr_FR=%C3%85M%C3%85%C5%BD%C3%95%C3%91&dchild=1&keywords=tete+d%27empilage+raspberry&qid=1600171156&sr=8-3
Ou
https://www.ebay.fr/itm/Gpio-Tete-Raspberrypi-Un-B-Pi-2-Pi-3-3B-4B-Grand-2x20-Femelle-Tete-/253520834066?gclid=EAIaIQobChMIxebXoY_r6wIVAbp3Ch1VMwnvEAYYAiABEgIHGPD_BwE&var=0&mkevt=1&mkcid=1&mkrid=709-53476-19255-0&campid=5338666530&toolid=10044&customid=EAIaIQobChMIxebXoY_r6wIVAbp3Ch1VMwnvEAYYAiABEgIHGPD_BwE

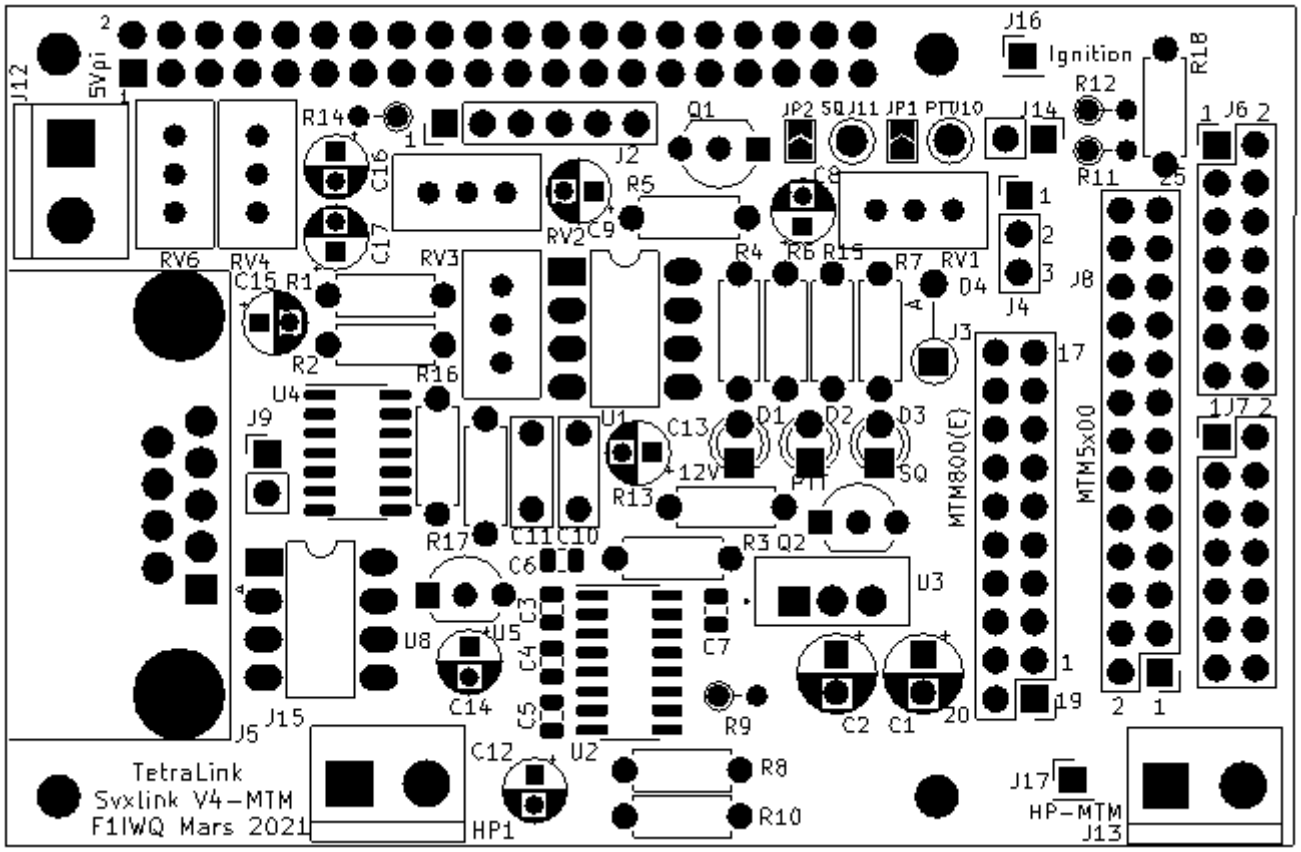
U3 can be replaced by a 78L33 (100mA), if you twist its legs for its adaptation.

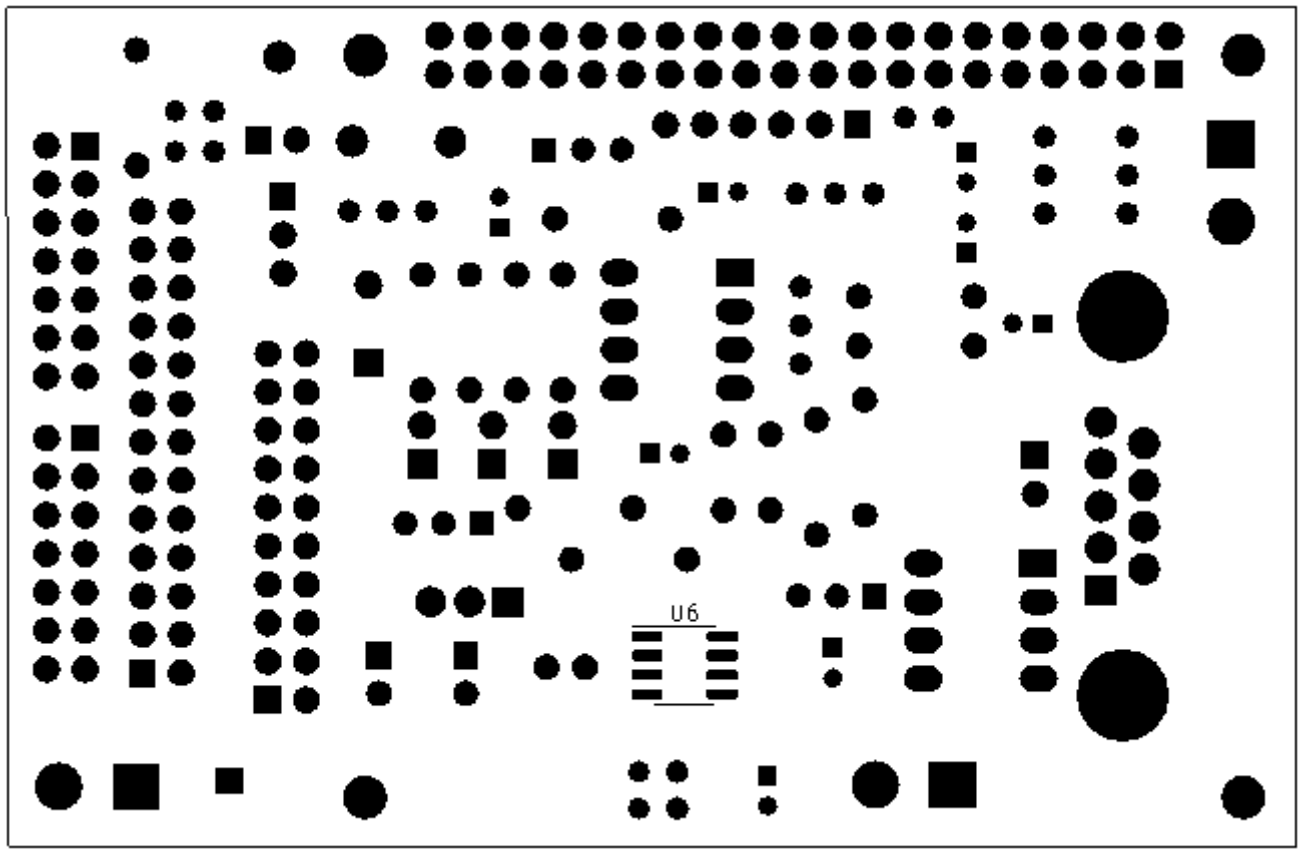
On the layout diagram, the square pads always shows pin 1 of a circuit (except for SMDs whose pin 1 is marked by the upper line shifted to the left)

Be careful when supplying the female DB9, there are several footprints. The reference below is correct.
https://fr.rs-online.com/web/p/connectors-sub-d/2395855/

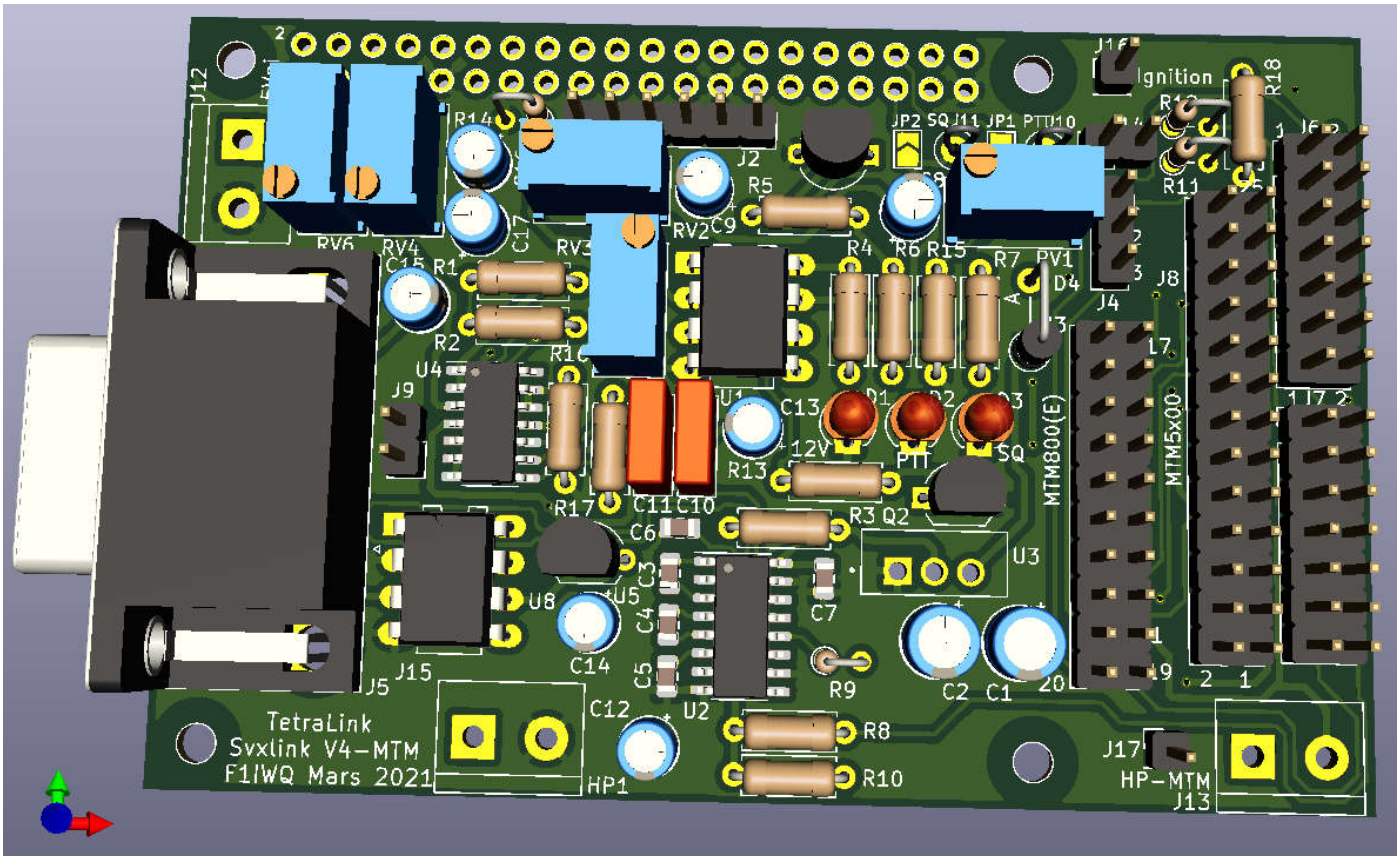
Beware, the chassis of U3 is at potential 3.3V! You can set an insulating tape on the frame to avoid accidental short circuits.

Implantation

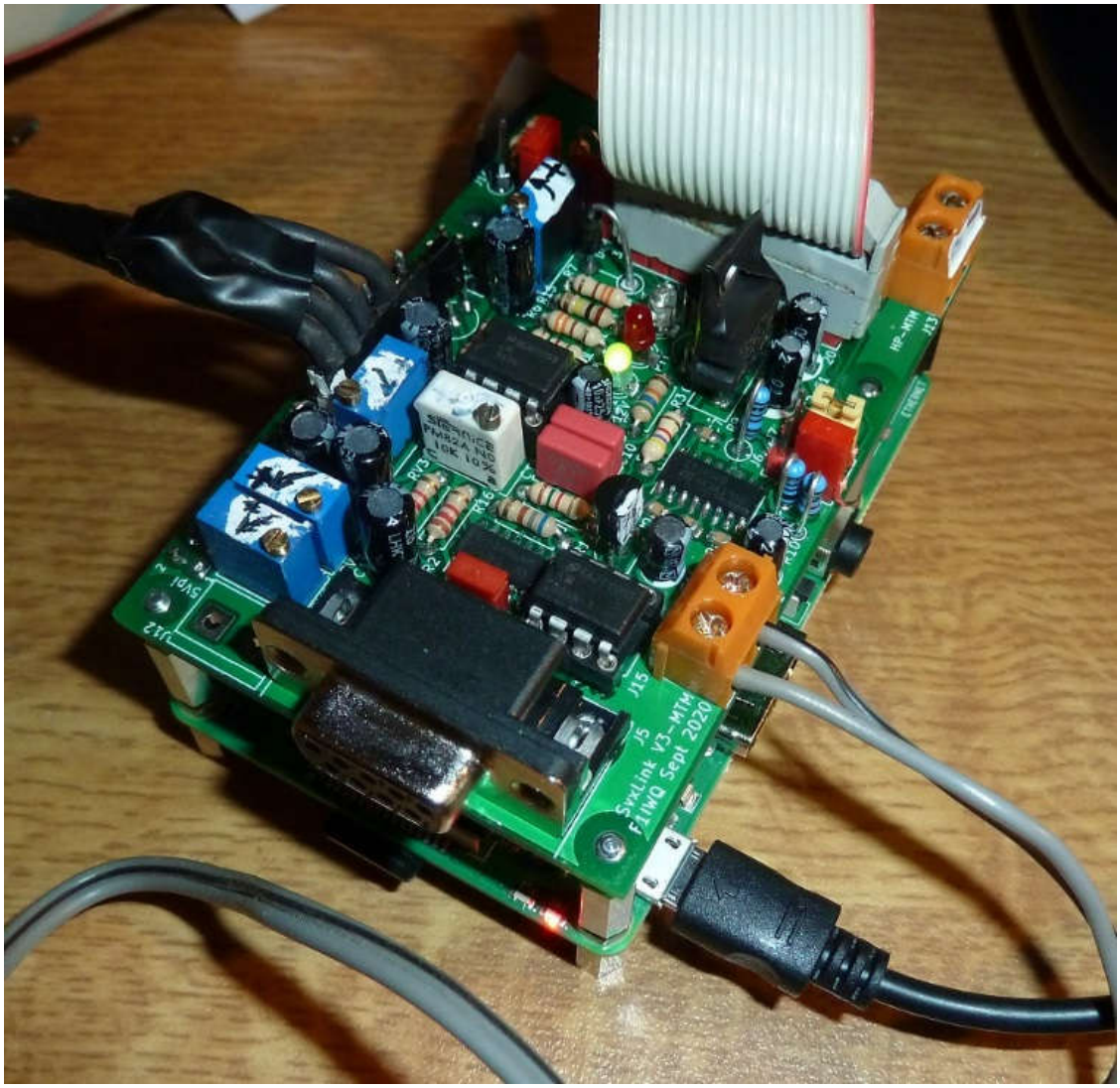


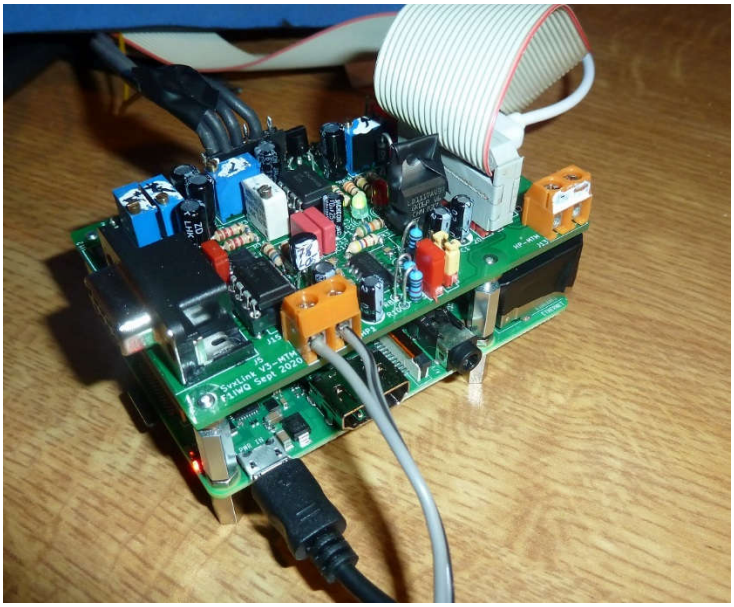


3D view

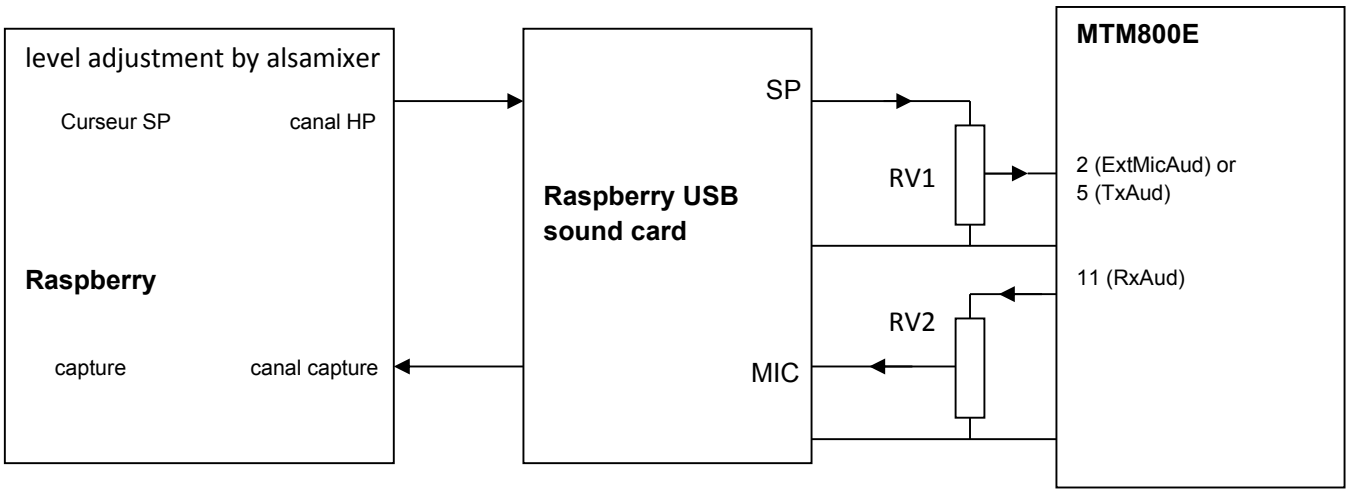

TetraLink
Svxlink V4-MTM
F1IWQ Mars 2021
Ignition
MTM800(E)
MTM5x00
HP1
HP-MTM
12V
PTT
SQ

Photos





Audio circuit



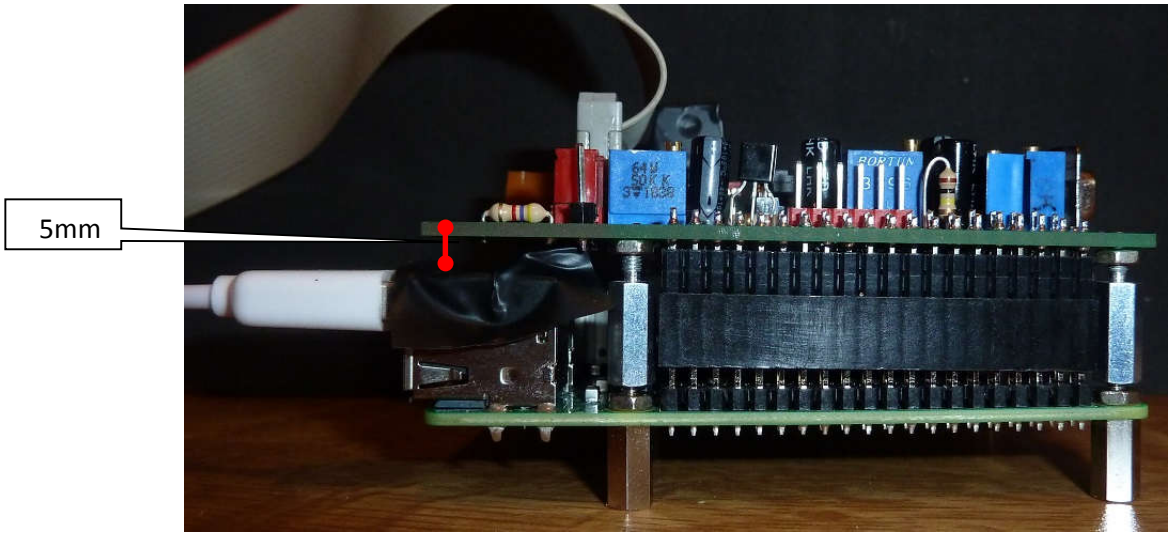
If the sound card has terminal socket jacks, it is strongly recommended to directly solder the wires on the sound card because of the bad contacts of the jacks.

In Alsamixer, automute control must be muted (type m with automute control enabled)

The external USB sound card used.

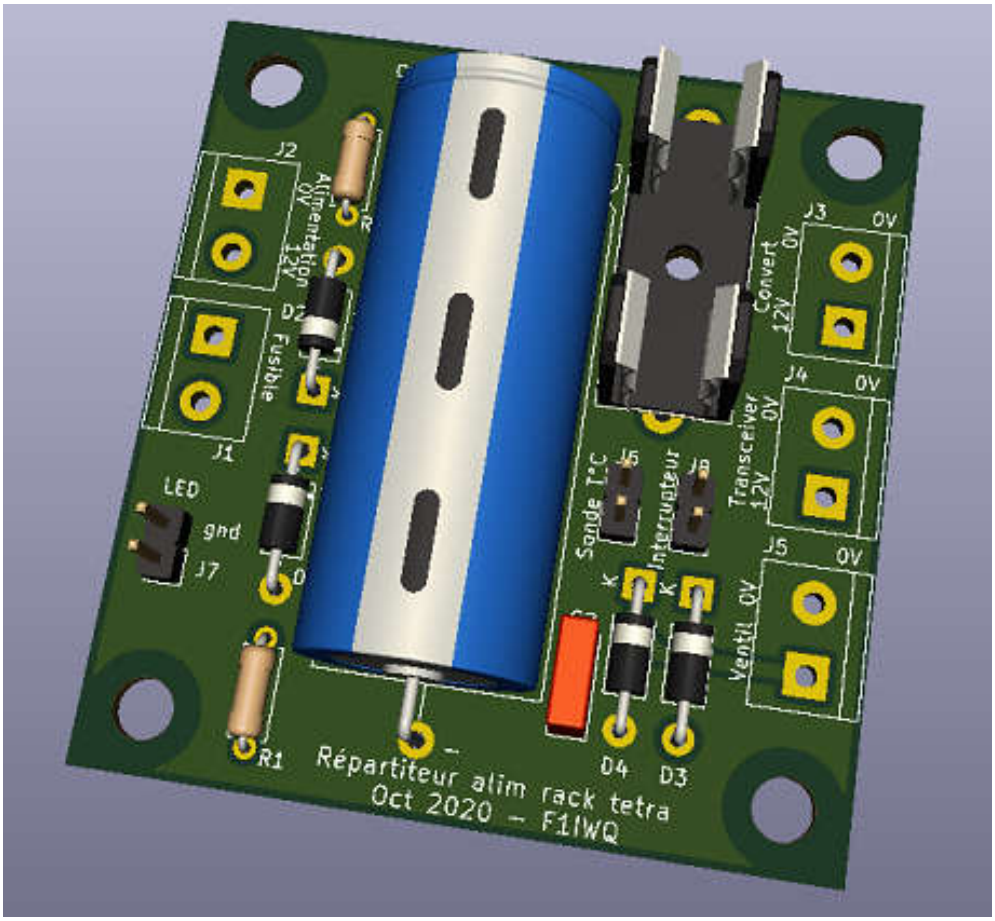
Pi integration

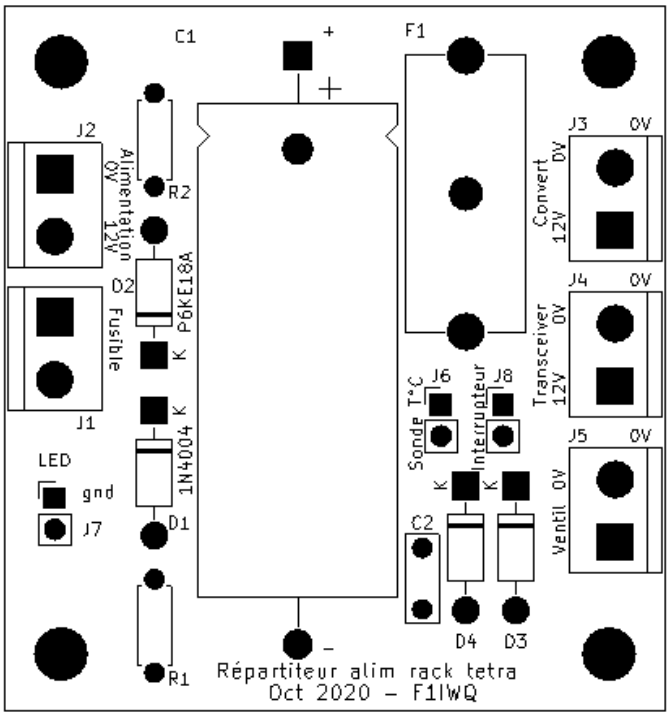
It is necessary to choose spacers high enough to free the board of the card from the metallic Ethernet / USB connectors of the raspberry. The thread of the spacers is 2.5 mm.



Wiring board

There is a wiring board to easy interfacing devices project (radio, fuses, power supplies, fan, temperature probe). It allows power, protection (reverse polarity and overvoltage), management of a cooling fan of the transmitter by a fan, MTM and the raspberry converter 12V / 5V power supplies.





D1 D3 D4	1N4004	Diode
D2	P6KE18A	Diode transil 18V
C1	2200 µF 18V mini	Radial (pas 7,6 mm) ou axial (pas 48 mm)
R1	1,2 kΩ	
R2	10 kΩ	
F1	Support fusible à souder	Pour fusible 5x20 2A
C2	100 nF plastique	
J1 J2 J3 J4	Bornier pas de 2,54 mm	Grande section de câble
J6 J7 J8	Bornier HE10	
Led	Présence tension	Externe
Sonde de température	KSD9700 45°C NO	Externe – normalement ouvert
Ventilateur	12V	Externe

The temperature probe for "dry contact" type is normally opened at 20°C and closes at 45°C. It must be inserted in the fins of the heatsink of the transmitter and glued with neoprene glue.

J1 is the terminal block to the front panel fuse. J3 is the terminal block towards the converter 12V 5V 3A power supply for the pi (Ref CPT)

There is 2 GND drills on the board for either a radial or an axial capacitor C1.