Ghost Fader

USB-MIDI-controlled volume and pan for two balanced 1/4" line channels. Bus powered, no external supply.
Sheets: 1 input, 2 matrix, 3 output, 4 control, 5 power. Nets between sheets are global labels; rails are power symbols.
Two grounds: GND_USB (XIAO, USB) and GND (audio). Only PS1 (power) and U8 (control) cross between them, plus C45 / R17.

Balanced inputs

File: input.kicad_sch

2x2 gain matrix and summers

File: matrix.kicad_sch

Balanced outputs

File: output.kicad_sch

Control

File: control.kicad_sch

Power

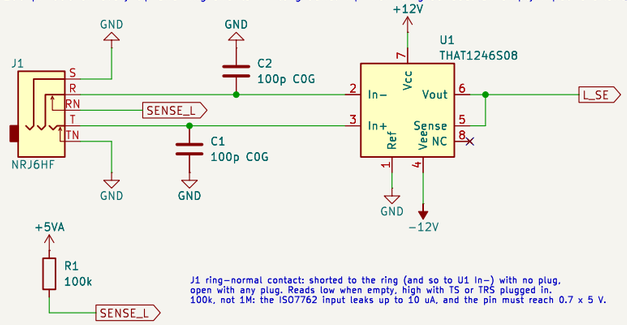
File: power.kicad_sch

Signal flow: J1/J2 -> U1/U2 THAT1246 (-6 dB) -> C3-C6 -> U3/U4 PGA2310 2x2 matrix -> R2-R9 + U5 OPA2134 summers (x2) -> U6/U7 THAT1646 (+6 dB) -> J3/J4
Control: XIAO RP2040 USB MIDI -> U8 ISO7762F -> SPI (SCLK, SDI, /CS) + /MUTE -> U3 -> U4. Plug sense from J1/J2 ring-normal contacts, back through U8.
Power: XIAO 5V pin (USB 5 V) -> FB1 -> PS1 TBA 2-0522 -> +/-12 V (audio ground). +12 V -> U10 78L05 -> +5VA for PGA logic and U8 side 2.

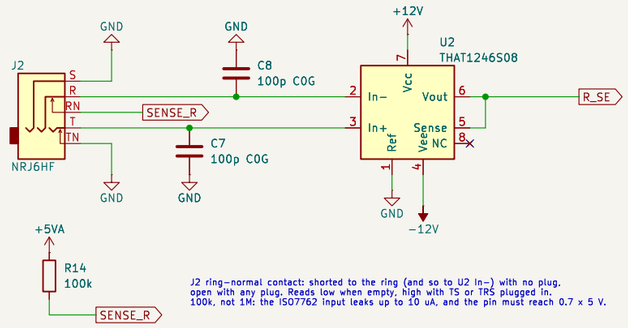
https://chris-albert.github.io/ghost-fader/
USB-MIDI volume and pan for two balanced line channels
Ghost Fader

Sheet: /		
File: ghost-fader.kicad_sch		
Title: Ghost Fader — Rev D		
Size: A4	Date: 2026-10-18	**Rev: D**
KiCad E.D.A. 9.0.6		Id: 1/6

Balanced inputs. A TS plug grounds the ring, so unbalanced sources need no switch.
THAT 1246 = −6 dB, so +22 dBu peak (9.75 Vrms) becomes 4.9 Vrms, inside the PGA2310 9.5 Vrms full scale.
100 pF C0G on every tip and ring shunts RF to ground. Tip−normal grounded: an empty input is silent, not noisy.

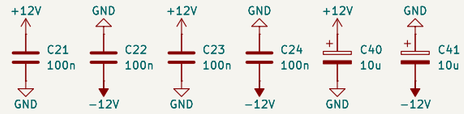


J1 ring−normal contact: shorted to the ring (and so to U1 In−) with no plug,
open with any plug. Reads low when empty, high with TS or TRS plugged in.
100k, not 1M: the ISO7762 input leaks up to 10 uA, and the pin must reach 0.7 x 5 V.



J2 ring−normal contact: shorted to the ring (and so to U2 In−) with no plug,
open with any plug. Reads low when empty, high with TS or TRS plugged in.
100k, not 1M: the ISO7762 input leaks up to 10 uA, and the pin must reach 0.7 x 5 V.

Bypass, one per supply pin, within 5 mm of U1 / U2. C40, C41 bulk for the input side.

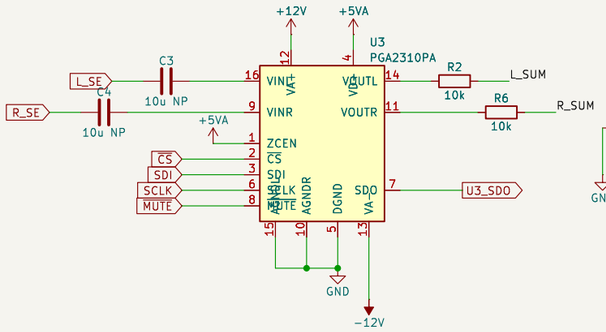


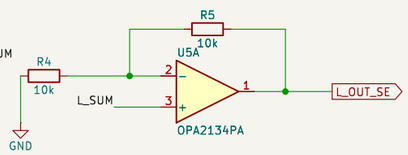
https://chris−albert.github.io/ghost−fader/
THAT 1246 receivers, plug sense
Ghost Fader

Sheet: /Balanced inputs/
File: input.kicad_sch

Title: Ghost Fader − Sheet 1: Balanced inputs

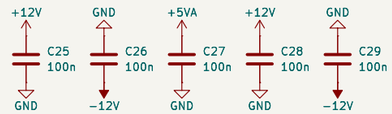
Size: A3	Date: 2026−10−18	**Rev: D**
KiCad E.D.A. 9.0.6		Id: 2/6

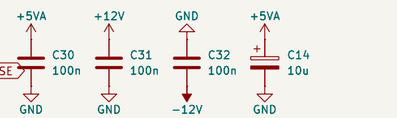


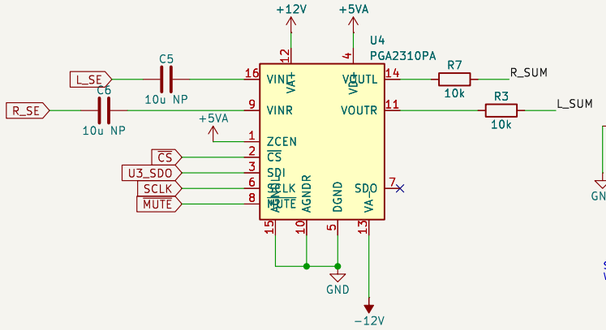


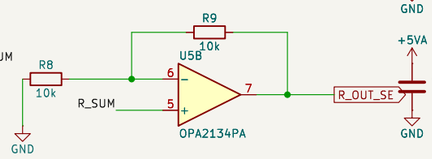


Bypass, one per supply pin: U3 / U4 VA+, VA−, VD+; U5 V+, V−. C14 bulk on the +5VA logic rail beside U3.









Summers: two 10k resistors into the + input make a passive 1/2 mix; the non-inverting x2 stage restores unity.
When one path is muted its PGA output sits at 0 V, so the other still comes through at unity.

U3 = direct paths (L->L on its left channel, R->R on its right). U4 = cross paths (L->R on its left channel, R->L on its right).
SPI chain: XIAO MOSI (D10) -> U8 isolator -> U3 SDI, U3 SDO -> U4 SDI. 32 clocks per update: U4 word first, then U3; each word is right byte then left byte, MSB first.
ZCEN high: gain changes wait for a zero crossing. Code 192 = 0 dB, 0 = mute. Logic supply is +5VA from U10 (sheet 5), on the audio ground; SDO stays on this side.

https://chris-albert.github.io/ghost-fader/
PGA2310 pair, OPA2134 summers

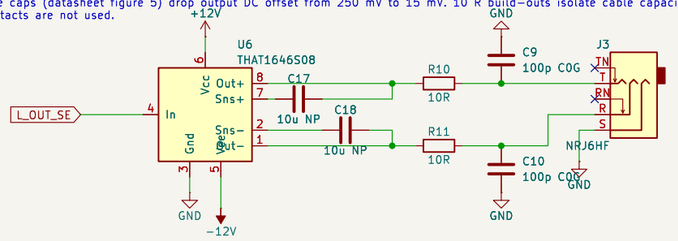
Ghost Fader

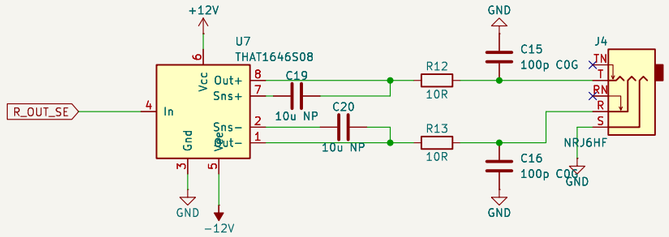
Sheet: /2x2 gain matrix and summers/
File: matrix.kicad_sch

Title: Ghost Fader — Sheet 2: 2x2 gain matrix and summers

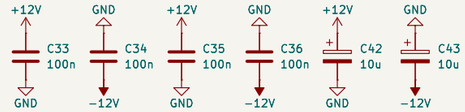
Size: A3	Date: 2026-10-18	**Rev: D**
KiCad E.D.A. 9.0.6		Id: 3/6

THAT 1646 = +6 dB cross-coupled driver. A TS plug on the output shorts Out- to ground; OutSmarts keeps the full signal on the tip.
10 uF non-polar sense caps (datasheet figure 5) drop output DC offset from 250 mV to 15 mV. 10 R build-outs isolate cable capacitance.
Output jack switch contacts are not used.





Bypass, one per supply pin, within 5 mm of U6 / U7. C42, C43 bulk for the output side.



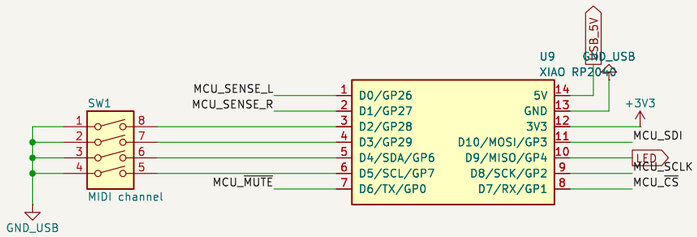
https://chris-albert.github.io/ghost-fader/
THAT 1646 cross-coupled drivers
Ghost Fader

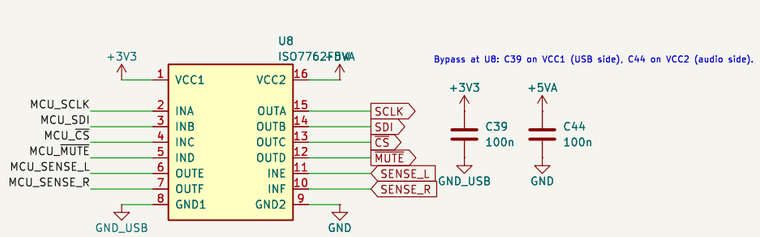
Sheet: /Balanced outputs/
File: output.kicad_sch

Title: Ghost Fader — Sheet 3: Balanced outputs

Size: A3	Date: 2026-10-18	**Rev: D**
KiCad E.D.A. 9.0.6		Id: 4/6

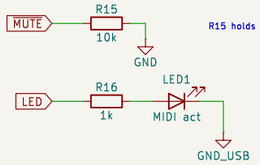
U9 is a Seeed XIAO RP2040 on header pins. Pin numbers are Seeed's: 1–7 down the left row from the USB end, 8–14 up the right row.
Its USB-C is the only connector: class-compliant MIDI in (TinyUSB), 5 V in. The 5V pin is USB VBUS straight through, so it feeds the board.
SPI0: D8 (GP2) SCK, D10 (GP3) MOSI, D7 (GP1) /CS, D6 (GP0) /MUTE. D9 (GP4, the MISO pin) drives the LED: bit-bang the 32-bit frame or leave SPI RX unassigned.
Nothing on the XIAO touches the audio ground: the four control lines and two sense lines cross U8, power crosses PS1. GND_USB is the USB-side ground.
DIP switch on D2–D5 (GP28, GP29, GP6, GP7), closed = 0, internal pull-ups on. Plug sense on D0, D1 (GP26, GP27), internal pull-ups off (100k to +5VA on sheet 1).





Bypass at U8: C39 on VCC1 (USB side), C44 on VCC2 (audio side).

U8 ISO7762F: channels A–D carry SCLK, SDI, /CS, /MUTE from the XIAO (3.3 V) to the PGAs (5 V);
E and F bring the plug-sense lines back. Side 1 runs from the XIAO 3V3 pin, side 2 from +5VA.
F suffix = outputs fall to 0 when the other side is unpowered: the PGAs stay muted until the XIAO is up.
The RP2040 pins are not 5 V tolerant, so side 1 must stay on 3.3 V.



R15 holds both PGA2310s muted until the firmware writes its first gains: no power-on thump. Audio side, after U8.

MIDI activity LED on D9 (GP4), about 2 mA. USB side.

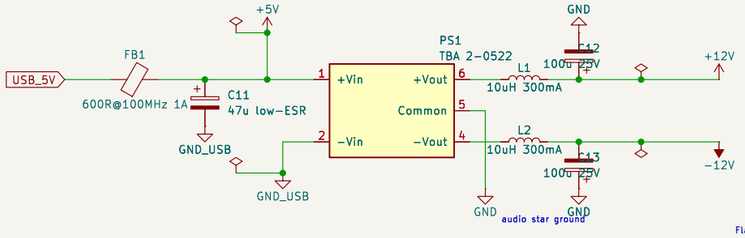
https://chris-albert.github.io/ghost-fader/
XIAO RP2040, USB MIDI, ISO7762F isolator, plug sense, SPI
Ghost Fader

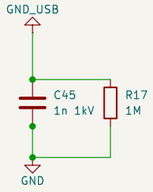
Sheet: /Control/
File: control.kicad_sch

Title: Ghost Fader — Sheet 4: Control

Size: A3	Date: 2026-10-18	**Rev: D**
KiCad E.D.A. 9.0.6		Id: 5/6

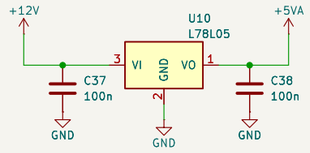
No external power supply. Everything runs from the USB 5 V that the XIAO passes out on its 5V pin (sheet 4).
PS1 is a board-mounted isolated 2 W DC-DC module: 5 V in, +/-12 V 80 mA out. Unregulated: the rails follow USB voltage and load,
about +/-11 V on a sagging port and up to +/-14 V at 5.25 V and light load; every part on the rails is rated for that (PGA2310 max 16 V).
Rails: +12 V -55 mA (analog -40 mA plus U10 -15 mA), -12 V -40 mA; the TBA 2 gives 80 mA per rail. Budget at 5 V: XIAO -30 mA, PS1 -230 mA, LED 2 mA;
-260 mA typical, 330 mA worst case; USB 2.0 allows 500 mA. PS1 is the only power path across the ground barrier: its 1.5 kV isolation is what floats the audio side.
Audio grounds meet once at PS1 Common. Keep PS1 at the far end of the board from J1 / J2. Total rail capacitance stays under the 220 uF the TBA 2 allows.





Flags (unlabelled) mark +12V, -12V, GND_USB, GND, audio star ground, and +5VA for readability.

Ground split: GND_USB (USB 5 V return) is isolated from GND (audio ground) by PS1's internal barrier. The two meet only at PS1 pin 5 (Common). Keep PS1 at the far end of the board from J1 (USB) and J2 (audio) so return currents from both sides flow through PS1 and not through the other side's ground. Crossings: the only signal that crosses the split is the I2C pair (SCL, SDA) between U8 (audio side) and the XIAO (USB side); it is level-shifted by the bidirectional I2C translator on sheet 4, with pull-ups on each side. Power crosses only through PS1 (+12 V, -12 V, +5VA on the audio side; +5V on the USB side).
PS1 output) meet only here: C45 gives the converter's switching noise a local return so it does not
radiate as common mode. R17 stops the audio side floating away when nothing is plugged in.
Place both at PS1, on the 2 mm gap in the ground pours. No other copper crosses the gap.



U10 78L05: +5VA for the PGA2310 logic, U8 side 2 and the plug-sense pull-ups, about 15 mA.
On the audio ground, so the 5 V logic never references USB. Input up to +14 V, 0.15 W in the TO-92.

https://chris-albert.github.io/ghost-fader/
USB 5 V in, isolated +/-12 V and +5VA, USB ground split from audio ground

Ghost Fader

Sheet: /Power/
File: power.kicad_sch

Title: Ghost Fader - Sheet 5: Power

Size: A3	Date: 2026-10-18	**Rev: D**
KiCad E.D.A. 9.0.6		Id: 6/6