Ghost Fader

The same circuit split over two boards: a main board (jacks and the whole audio path) and a control board (XIAO, isolator, DC–DC, 78L05 and rail filters) on standoffs above it, joined by a 12-way ribbon, sheet 6.
Sheets 1–5 are shared with the single-board schematic ghost-fader.kicad_sch; only sheet 6 is new.

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

Board link

File: link.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.

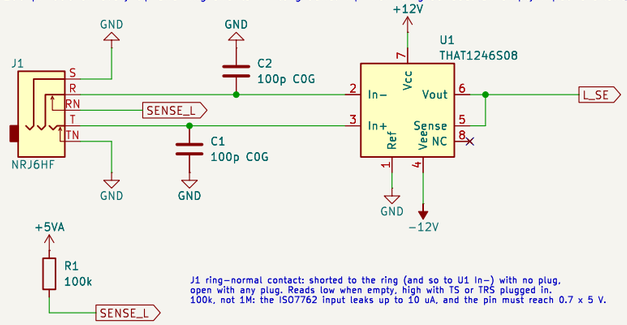
https://chris-albert.github.io/ghost-fader/
USB-MIDI volume and pan for two balanced line channels
Ghost Fader

Sheet: /
File: ghost-fader-stack.kicad_sch

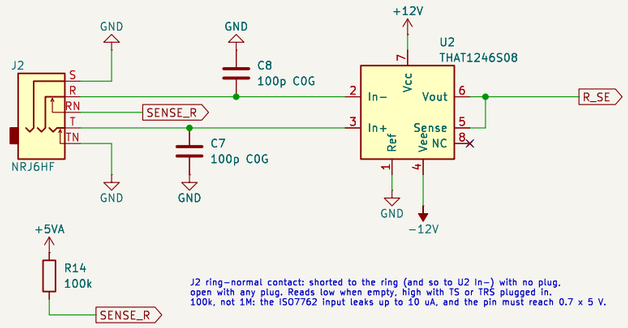
Title: Ghost Fader — Rev D, two-board stack

Size: A4	Date: 2026-10-18	**Rev: D**
KiCad E.D.A. 9.0.6		Id: 1/7

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.

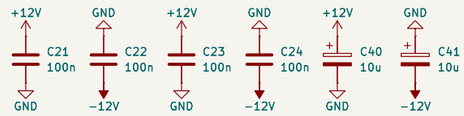


J1 ring−normal contact: shorted to the ring (and so to U1 In−) with no plug,
open with any plug. Reads low when empty, high with TS or TRS plugged in.
100k, not 1M: the ISO7762 input leaks up to 10 uA, and the pin must reach 0.7 x 5 V.



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.

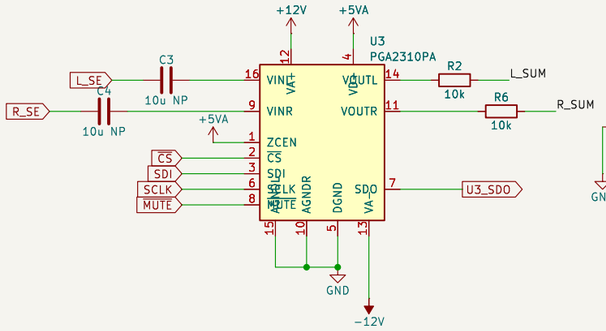


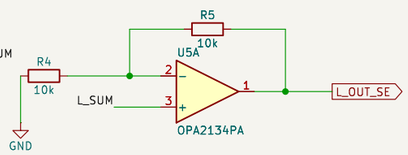
https://chris−albert.github.io/ghost−fader/
THAT 1246 receivers, plug sense
Ghost Fader

Sheet: /Balanced inputs/
File: input.kicad_sch

Title: Ghost Fader − Sheet 1: Balanced inputs

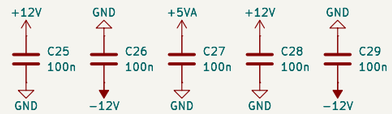
Size: A3	Date: 2026−10−18	**Rev: D**
KiCad E.D.A. 9.0.6		Id: 2/7

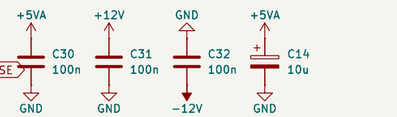


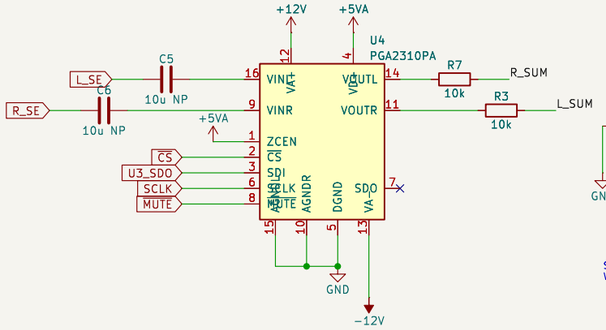


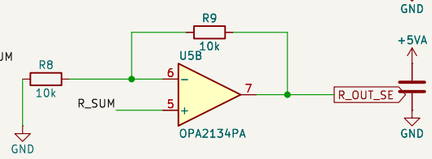


Bypass, one per supply pin: U3 / U4 VA+, VA−, VD+; U5 V+, V−. C14 bulk on the +5VA logic rail beside U3.









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.

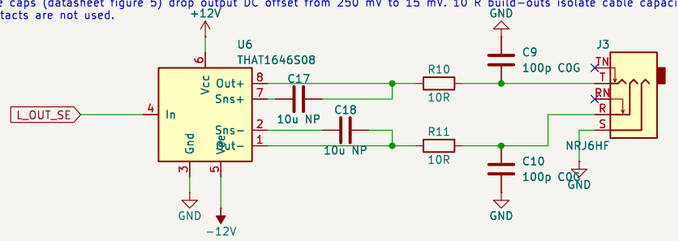
https://chris-albert.github.io/ghost-fader/
PGA2310 pair, OPA2134 summers
Ghost Fader

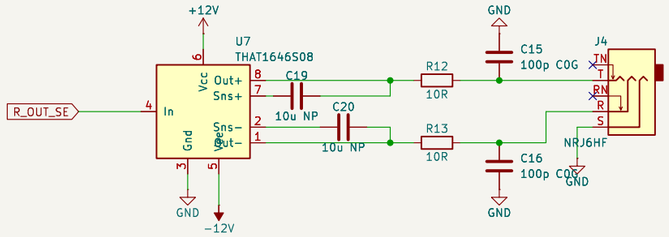
Sheet: /2x2 gain matrix and summers/
File: matrix.kicad_sch

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

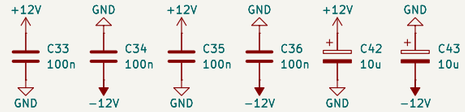
Size: A3	Date: 2026-10-18	**Rev: D**
KiCad E.D.A. 9.0.6		Id: 3/7

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.



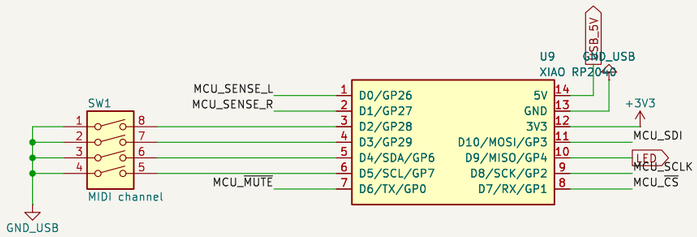
https://chris-albert.github.io/ghost-fader/
THAT 1646 cross-coupled drivers
Ghost Fader

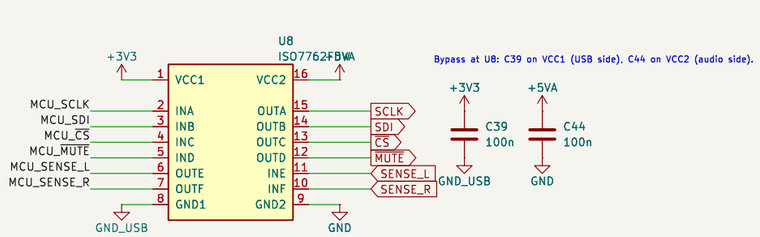
Sheet: /Balanced outputs/
File: output.kicad_sch

Title: Ghost Fader — Sheet 3: Balanced outputs

Size: A3	Date: 2026-10-18	**Rev: D**
KiCad E.D.A. 9.0.6		Id: 4/7

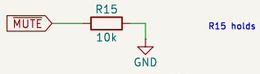
U9 is a Seeed XIAO RP2040 on header pins. Pin numbers are Seeed's: 1–7 down the left row from the USB end, 8–14 up the right row.
Its USB-C is the only connector: class-compliant MIDI in (TinyUSB), 5 V in. The 5V pin is USB VBUS straight through, so it feeds the board.
SPI0: D8 (GP2) SCK, D10 (GP3) MOSI, 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.



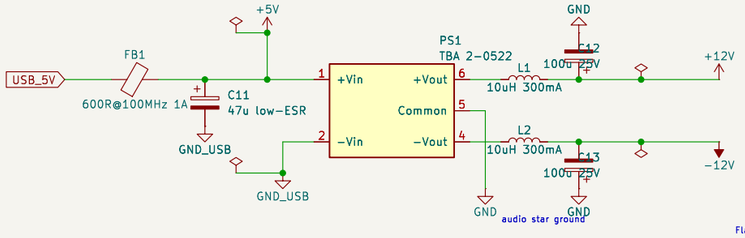
MIDI activity LED on D9 (GP4), about 2 mA. USB side.

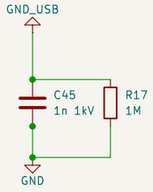
https://chris-albert.github.io/ghost-fader/
XIAO RP2040, USB MIDI, ISO7762F isolator, plug sense, SPI
Ghost Fader
Sheet: /Control/
File: control.kicad_sch

Title: Ghost Fader — Sheet 4: Control

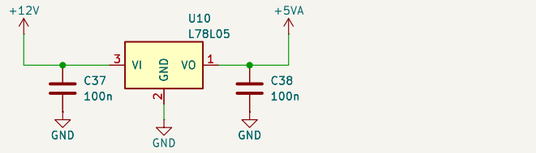
Size: A3	Date: 2026-10-18	**Rev: D**
KiCad E.D.A. 9.0.6		Id: 5/7

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 and GND. Crossing the PS1 pin 3 gap with GND1 (everything on the USB side 2, 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.

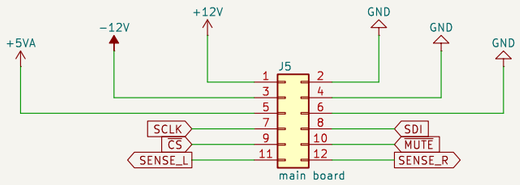
https://chris-albert.github.io/ghost-fader/
USB 5 V in, isolated +/-12 V and +5VA, USB ground split from audio ground
Ghost Fader

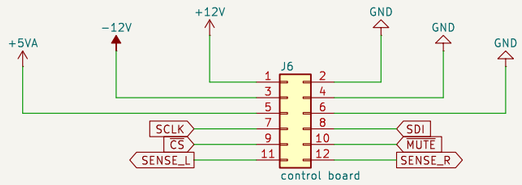
Sheet: /Power/
File: power.kicad_sch

Title: Ghost Fader - Sheet 5: Power

Size: A3	Date: 2026-10-18	**Rev: D**
KiCad E.D.A. 9.0.6		Id: 6/7

Two-board stack. J5 sits on the main board (jacks, receivers, PGA matrix, summer, drivers), J6 on the control board (XIAO, U8 isolator, PS1 DC-DC, U10 78L05, rail filters) mounted on 15 mm standoffs above it. A 12-way IDC ribbon joins them pin for pin, so electrically J5 and J6 are the same twelve nets. Everything that crosses is on the audio ground side of the barrier: the rails, +5VA, the four isolated control lines and the two plug-sense lines. Three GND pins: one next to each rail and one next to SCLK. The single-board layouts do not use this sheet.





Pinout: 1 +12V, 2 GND, 3 −12V, 4 GND, 5 +5VA, 6 GND, 7 SCLK, 8 SDI, 9 /CS, 10 /MUTE, 11 SENSE_L, 12 SENSE_R.

https://chris-albert.github.io/ghost-fader/
Two-board stack: J5 on the main board, J6 on the control board, 12-way ribbon
Ghost Fader

Sheet: /Board link/ File: link.kicad_sch		
Title: Ghost Fader — Sheet 6: Board link		
Size: A3	Date: 2026-10-18	**Rev: D**
KiCad E.D.A. 9.0.6		Id: 7/7