Software Defined Repeater Controller — Radio Interface Board

NOTES:
* This is an analog board that interfaces with two radios. A separate digital board based on the RP2040 is also required. A ribbon cable connects the two boards.
* The goal of this design is to do as little as possible in hardware.
* Many things that usually happen in hardware (or FPGA) will happen in software:
  - Audio routing between the two radios will happen in software.
  - Audio pre-emphasis/de-emphasis (if needed) will happen using DSP using digital filters.
  - CTCSS decoding (if needed) will happen in DSP.
  - CTCSS encoding (if needed) will happen in DSP.
  - DTMF decoding will happen in DSP.
  - CWID and other tone prompts will happen in DSP/software.
  - Voice IDs will happen in DSP/software.
  - Other digital audio interfaces like EchoLink (or DMR/D-Star in the future) will be directly integrated.

Audio In 0
File: audio_in_0.kicad_sch

Audio In 1
File: audio_in_1.kicad_sch

ADC
File: adc.kicad_sch

DAC
File: dac.kicad_sch

Audio Out 0
File: audio_out_0.kicad_sch

Audio Out 1
File: audio_out_1.kicad_sch

Controls 0
File: controls_0.kicad_sch

Controls 1
File: controls_1.kicad_sch

Connectors

Power
File: power.kicad_sch

H1 MountingHole

H2 MountingHole

H3 MountingHole

H4 MountingHole

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Sheet: /
File: if-2.kicad_sch

Title: Software Defined Repeater Controller

Size: USLetter	Date: 2025-06-21	**Rev: 3**
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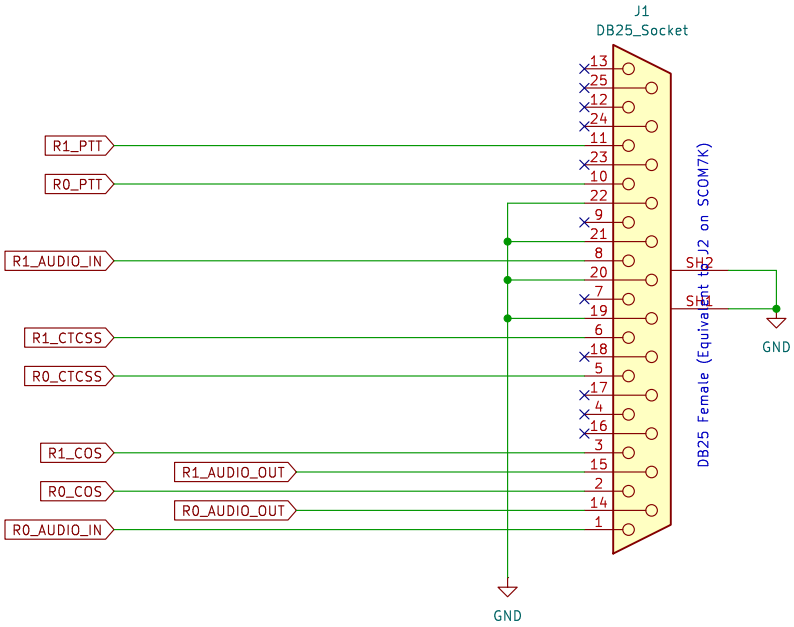
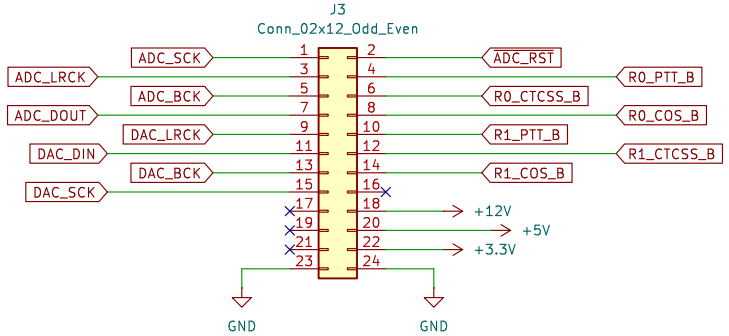
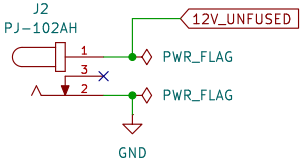


DB25 To Radios

See: AMP L77SDB25SA4CH4F



Ribbon Cable to Digital Board



5.5mm Power Connector
+12V on center pin

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Sheet: /Connectors/
File: connectors.kicad_sch

Title: Connectors

Size: USLetter	Date: 2025-06-21	**Rev: 3**
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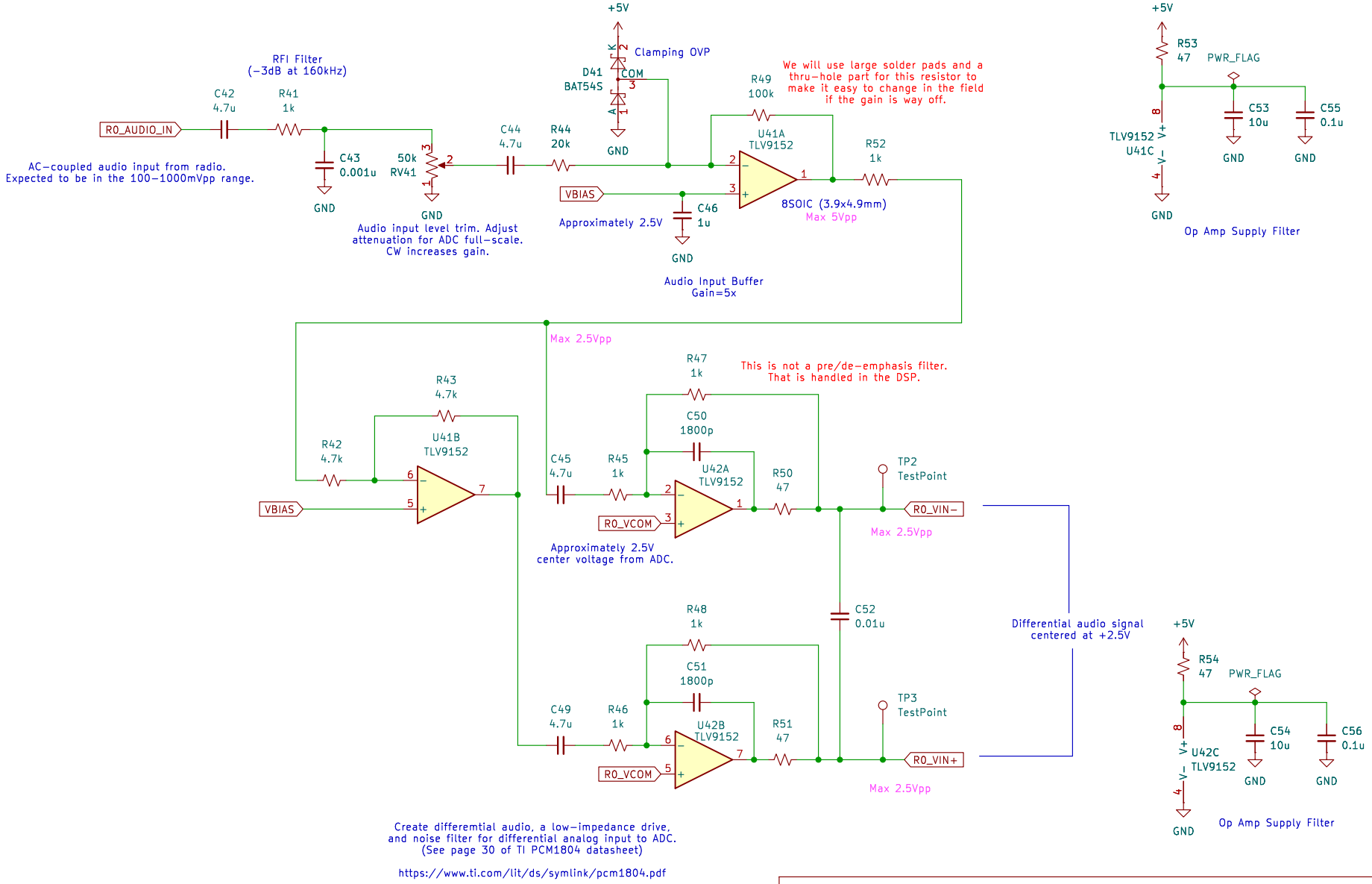

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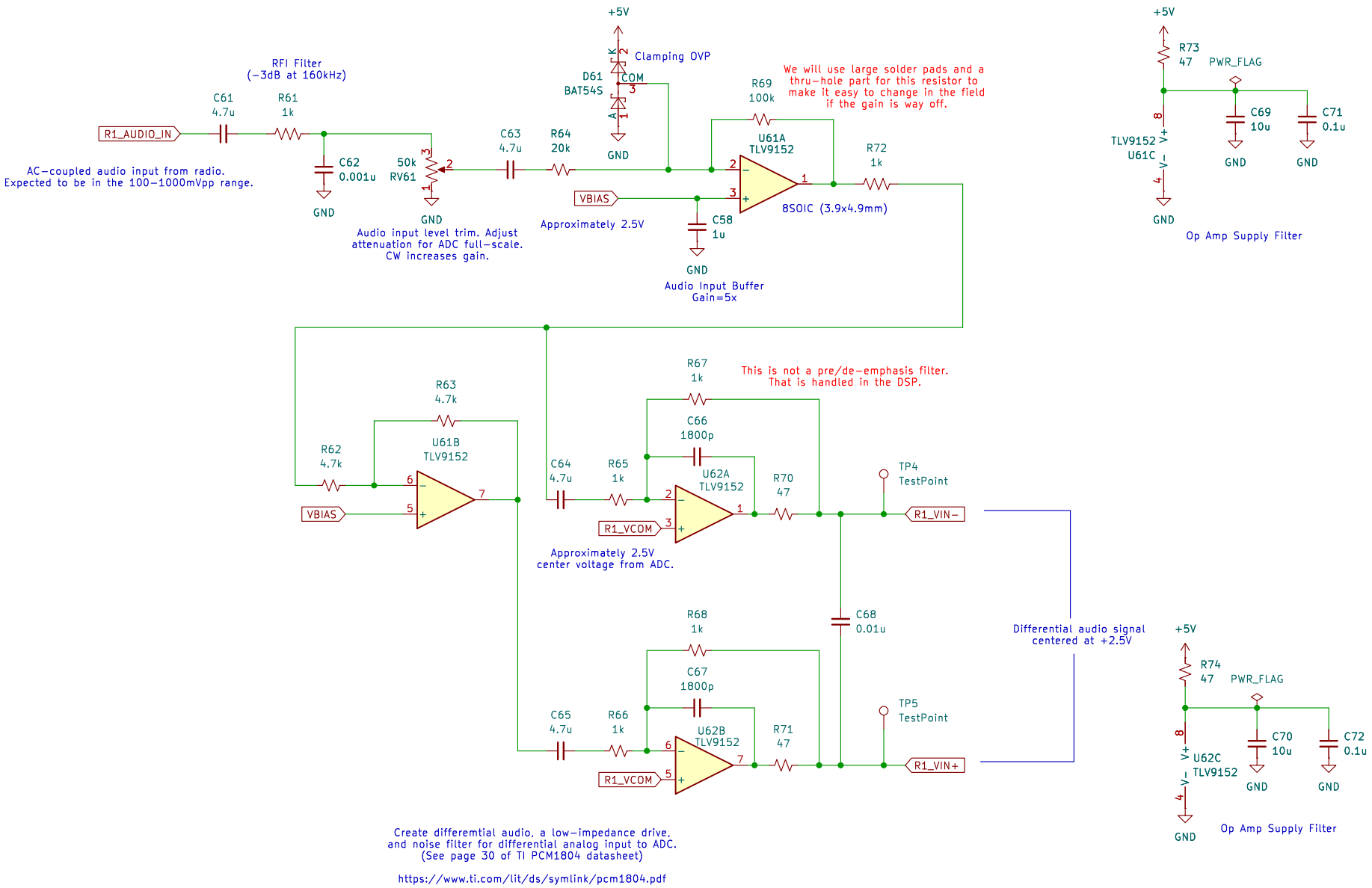
Sheet: /Audio In 0/
File: audio_in_0.kicad_sch

Title: Audio Input (Radio 0)

Size: USLetter	Date: 2025-06-21	**Rev: 3**
KiCad E.D.A. 9.0.0		Id: 3/11



(Should be a copy of R0 audio input)

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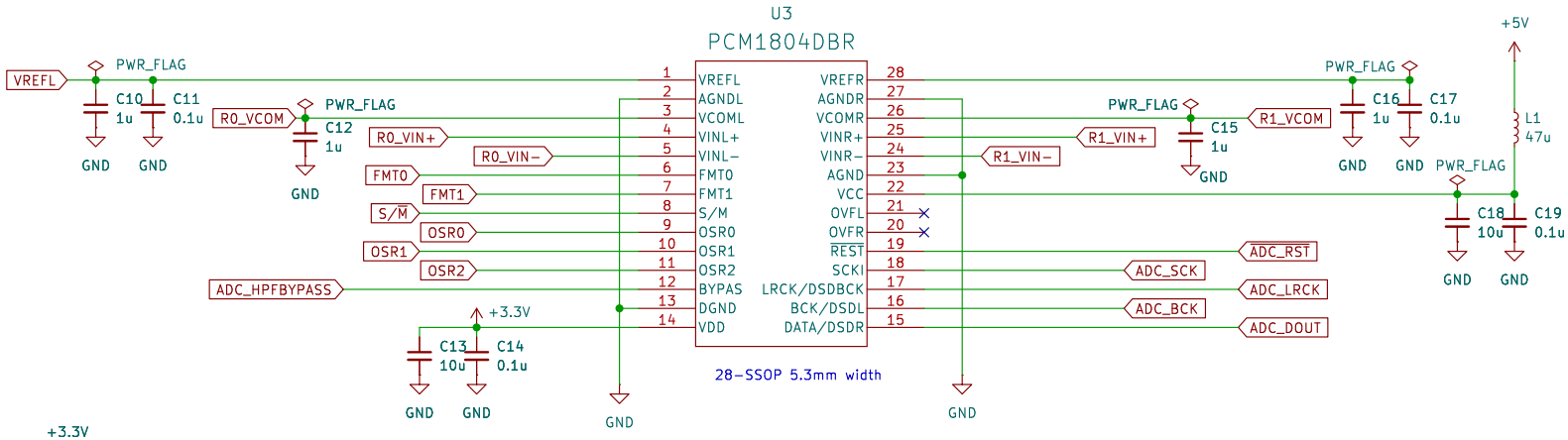
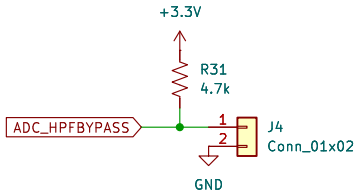
Sheet: /Audio In 1/
File: audio_in_1.kicad_sch

Title: Audio Input (Radio 1)

Size: USLetter	Date: 2025−06−21	**Rev: 3**
KiCad E.D.A. 9.0.0		Id: 4/11

The TI PCM1804 is a 24-bit stereo analog to digital converter designed for audio applications. It contains an integrated low-pass anti-aliasing filter on the front-end with a cut-off around 20 kHz. Sample rate (f_S) will be 48,000 samples/second. Narrower filtering will be achieved in DSP.





HPF enabled by default, can be disabled for testing using this jumper block. NOTE: When HPF is enabled it's not possible to test the ADC with DC levels.

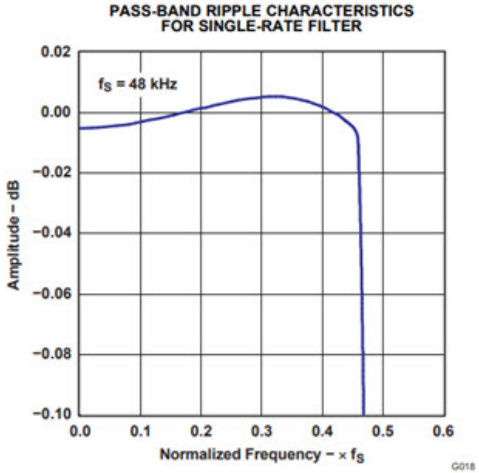
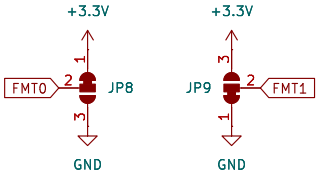
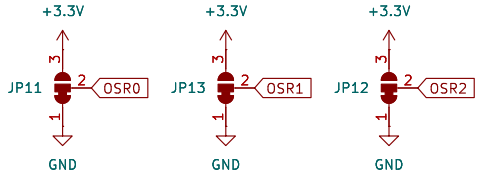


Figure 18.

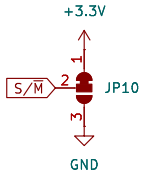
Configuration Solder Bridges



FMT=I2S by default



Slave Mode: OSR=000 (single rate x128 f_S) by default
Master Mode: OSR=010, 384*f_S



Slave by default

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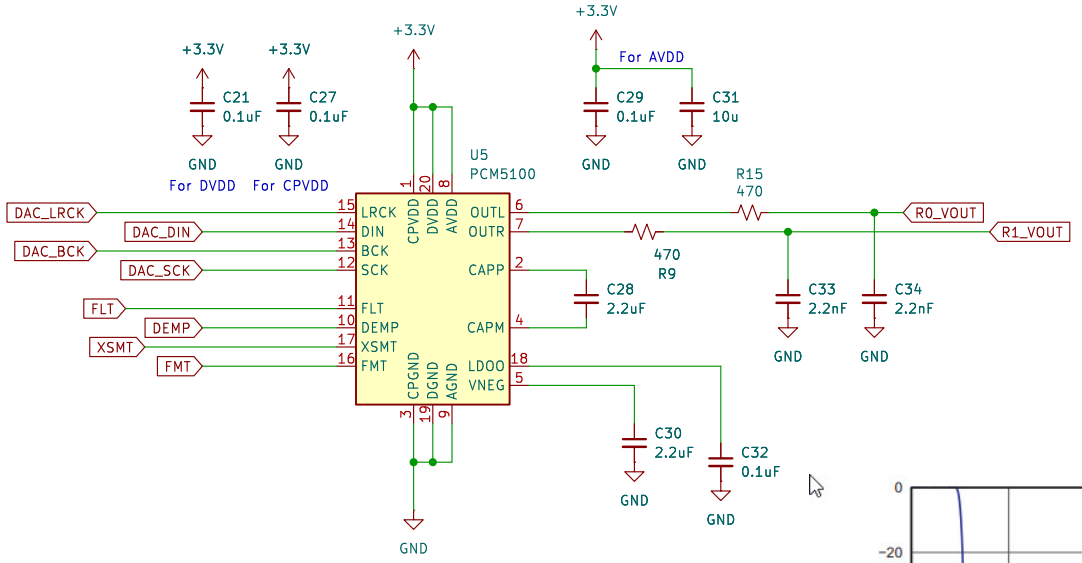
Sheet: /ADC/
File: adc.kicad_sch

Title: ADC

Size: USLetter	Date: 2025-06-21	**Rev: 3**
KiCad E.D.A. 9.0.0		Id: 5/11

The TI PCM5100 is a 24-bit stereo digital to analog converter designed for audio applications. It contains an integrated low-pass interpolation filter on the back-end with a cut-off around 20 kHz. Sample rate (f_S) will be 48,000 samples/second. Narrower filtering will be achieved in DSP.



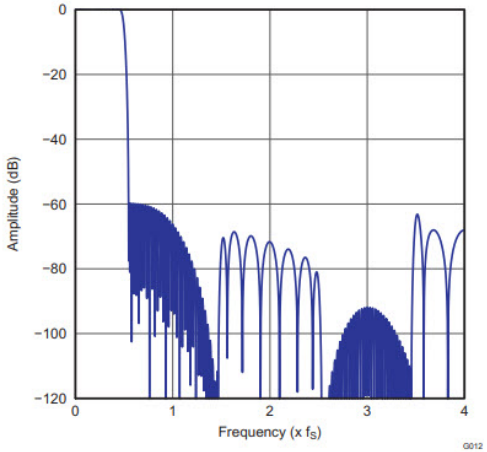
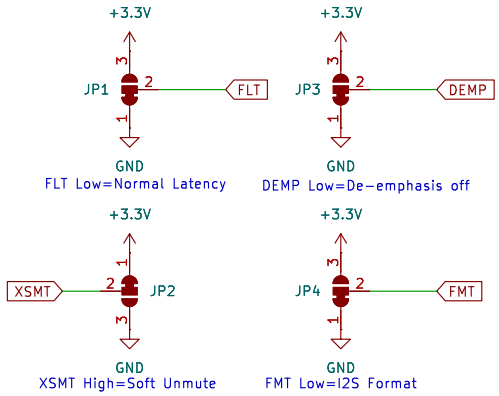


Figure 16. Normal x8 Interpolation Filter Frequency Response

Configuration Solder Bridges

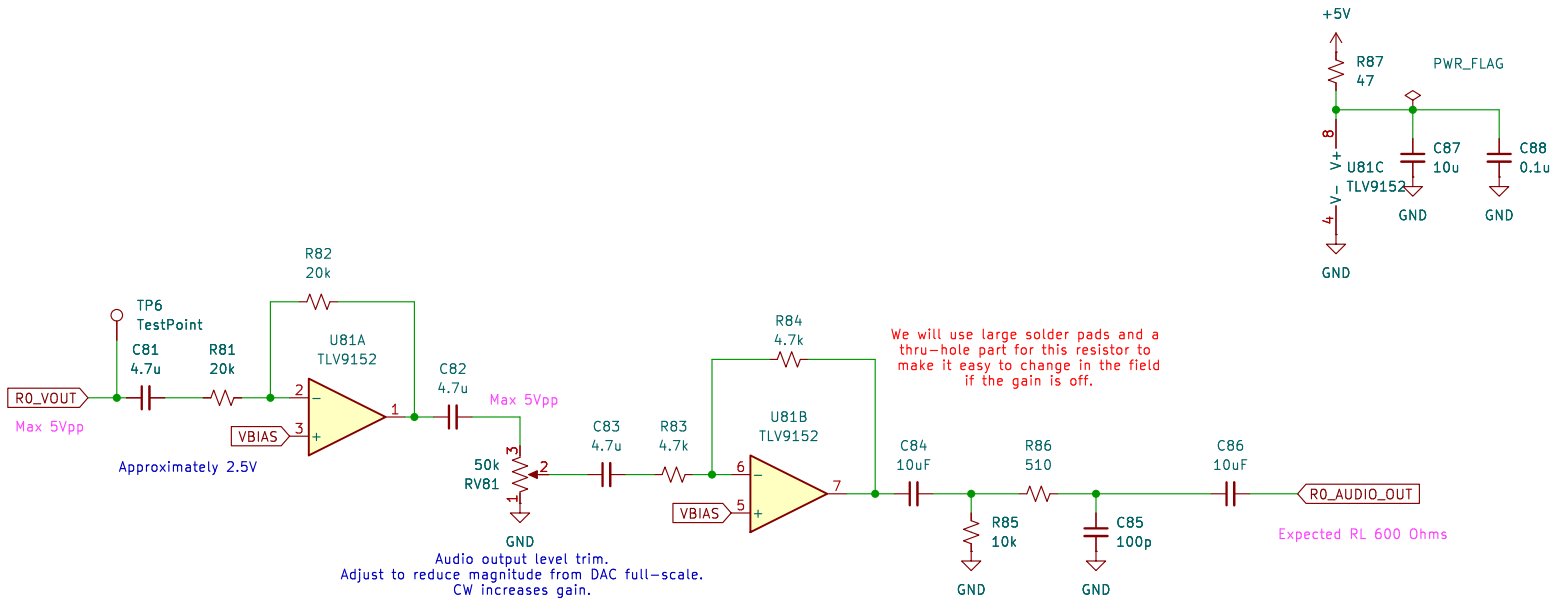


Bruce MacKinnon KC1FSZ

Sheet: /DAC/
File: dac.kicad_sch

Title: DAC

Size: USLetter	Date: 2025-06-21	**Rev: 3**
KiCad E.D.A. 9.0.0		Id: 6/11

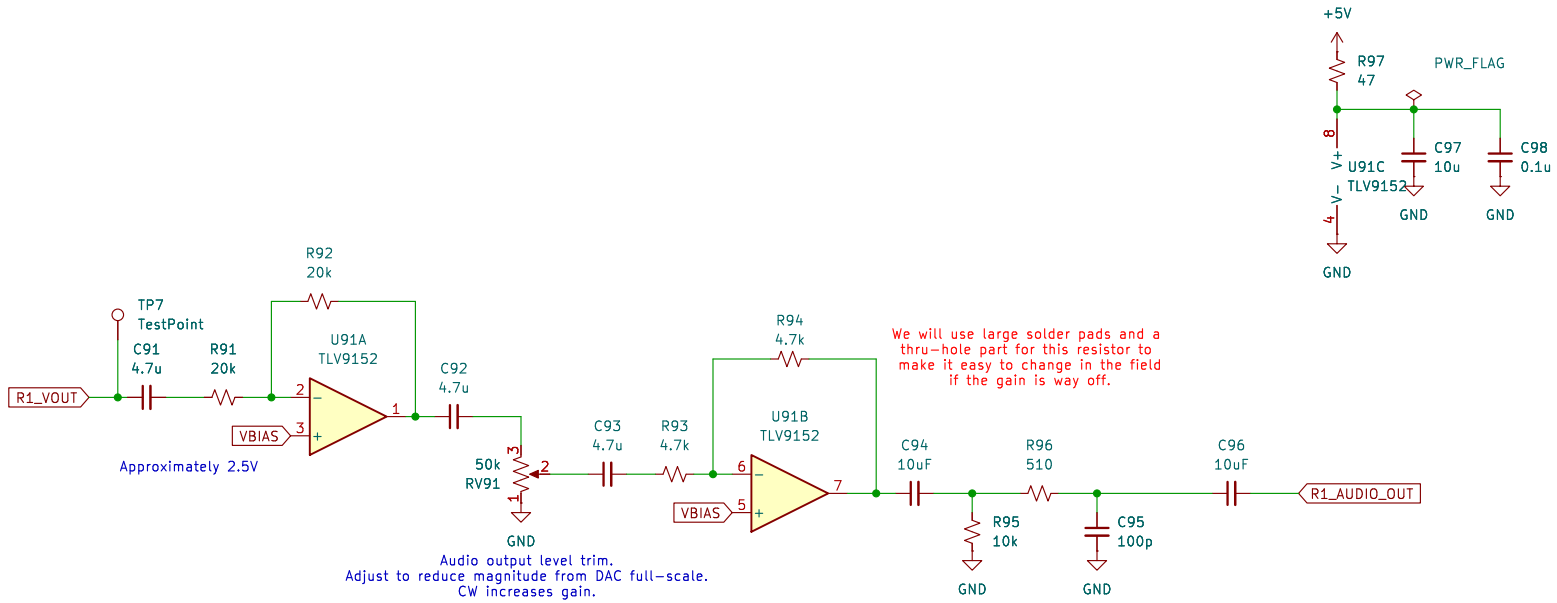


Bruce MacKinnon KC1FSZ

Sheet: /Audio Out 0/
File: audio_out_0.kicad_sch

Title: Audio Output (Radio 0)

Size: USLetter	Date: 2025-06-21	**Rev: 3**
KiCad E.D.A. 9.0.0		Id: 7/11



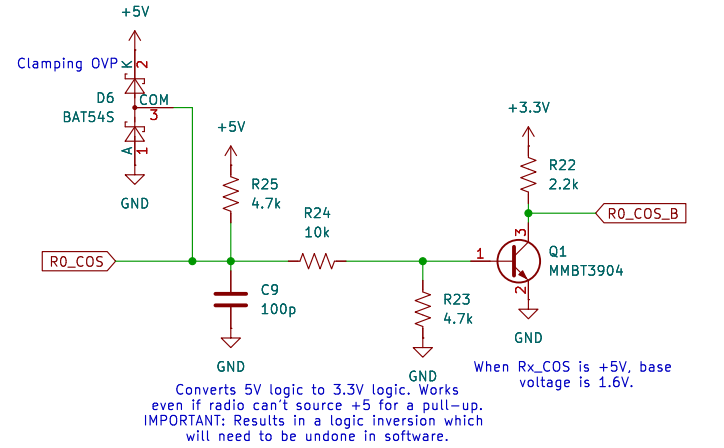
(Should be a copy of R0 audio output)

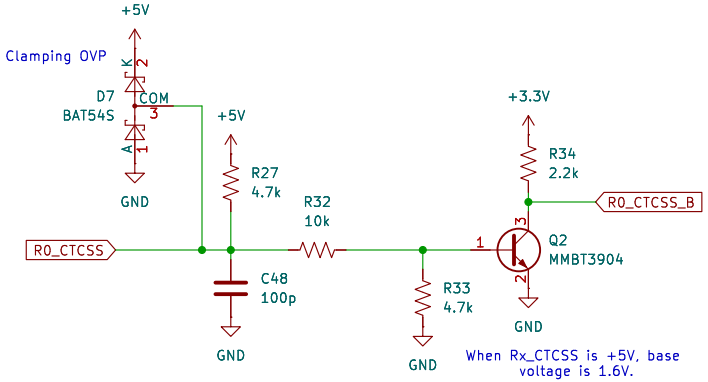
Bruce MacKinnon KC1FSZ

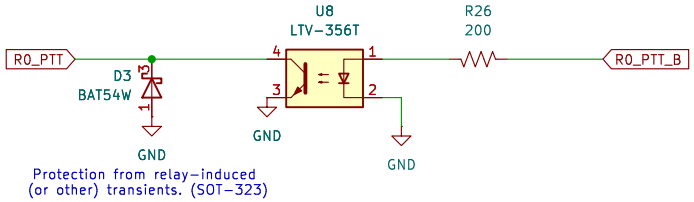
Sheet: /Audio Out 1/
File: audio_out_1.kicad_sch

Title: Audio Output (Radio 1)

Size: USLetter	Date: 2025-06-21	**Rev: 3**
KiCad E.D.A. 9.0.0		Id: 8/11







Radio Side

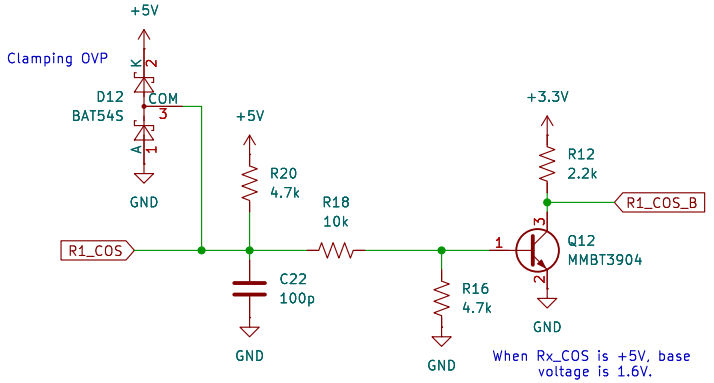
Controller Side

Bruce MacKinnon KC1FSZ

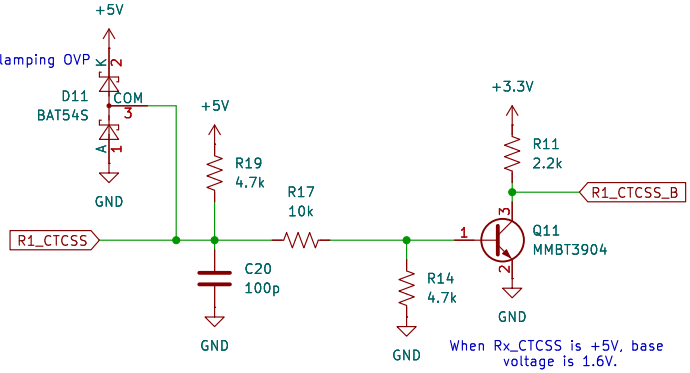
Sheet: /Controls 0/
File: controls_0.kicad_sch

Title: COS/CTCSS/PTT Controls (Radio 0)

Size: USLetter	Date: 2025-06-21	**Rev: 3**
KiCad E.D.A. 9.0.0		Id: 9/11

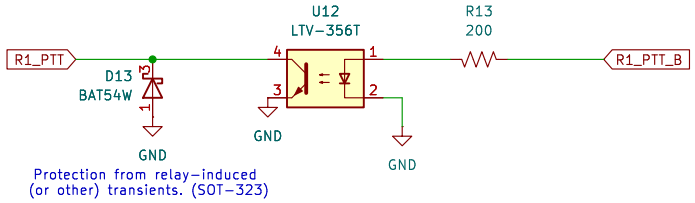


Converts 5V logic to 3.3V logic. Works even if radio can't source +5 for a pull-up. IMPORTANT: Results in a logic inversion which will need to be undone in software.



Radio Side

Controller Side



Converts 3.3V logic to pull PTT to ground.

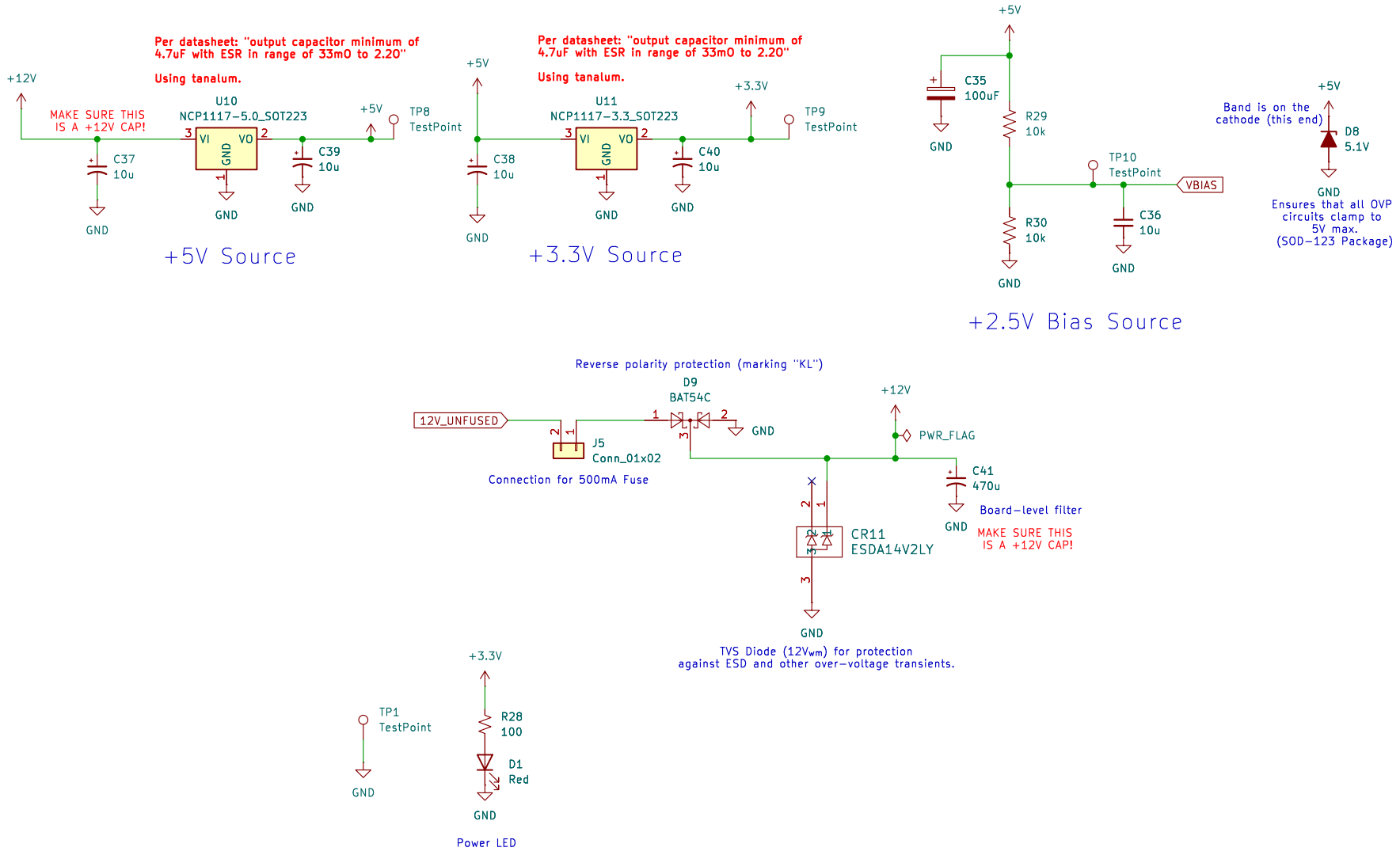
(Should be a copy of R0 controls)

Bruce MacKinnon KC1FSZ

Sheet: /Controls 1/
File: controls_1.kicad_sch

Title: COS/CTCSS/PTT Controls (Radio 1)

Size: USLetter	Date: 2025-06-21	**Rev: 3**
KiCad E.D.A. 9.0.0		Id: 10/11



Bruce MacKinnon KC1FSZ

Sheet: /Power/
File: power.kicad_sch

Title: Power

Size: USLetter	Date: 2025-06-21	**Rev: 3**
KiCad E.D.A. 9.0.0		Id: 11/11