AFE using MCP6002 op-amp - Design #5 #63

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fhdm-dev started this conversation in Scoppy Front end designs

fhdm-dev on May 17, 2022 Maintainer edited

영어로 된 원본 주석 - 한국어로 번역

Here's a super simple analog front end that uses the (cheap and available) MCP6002 R-to-R dual op-amp. This particular design uses one of the amps (and channels) for a +-7V input range and the other for a +-1V range. The design also incorporates under/overvoltage protection.

The schematic can be viewed in EasyEDA (no login required) here.

The 3 resistors on the input ensure the appropriate attenuation and also adds an offset. 1N4148 diodes on the non-inverting input ensure the voltage is clamped between approximately -0.55V and +3.85V which is well within the MCP6002's allowable range of Vss-1V and Vdd+1V.

Channel 2 has two extra resistors. These control the gain of the op-amp. Channel one is in unity gain configuration and so doesn't need these resistors.

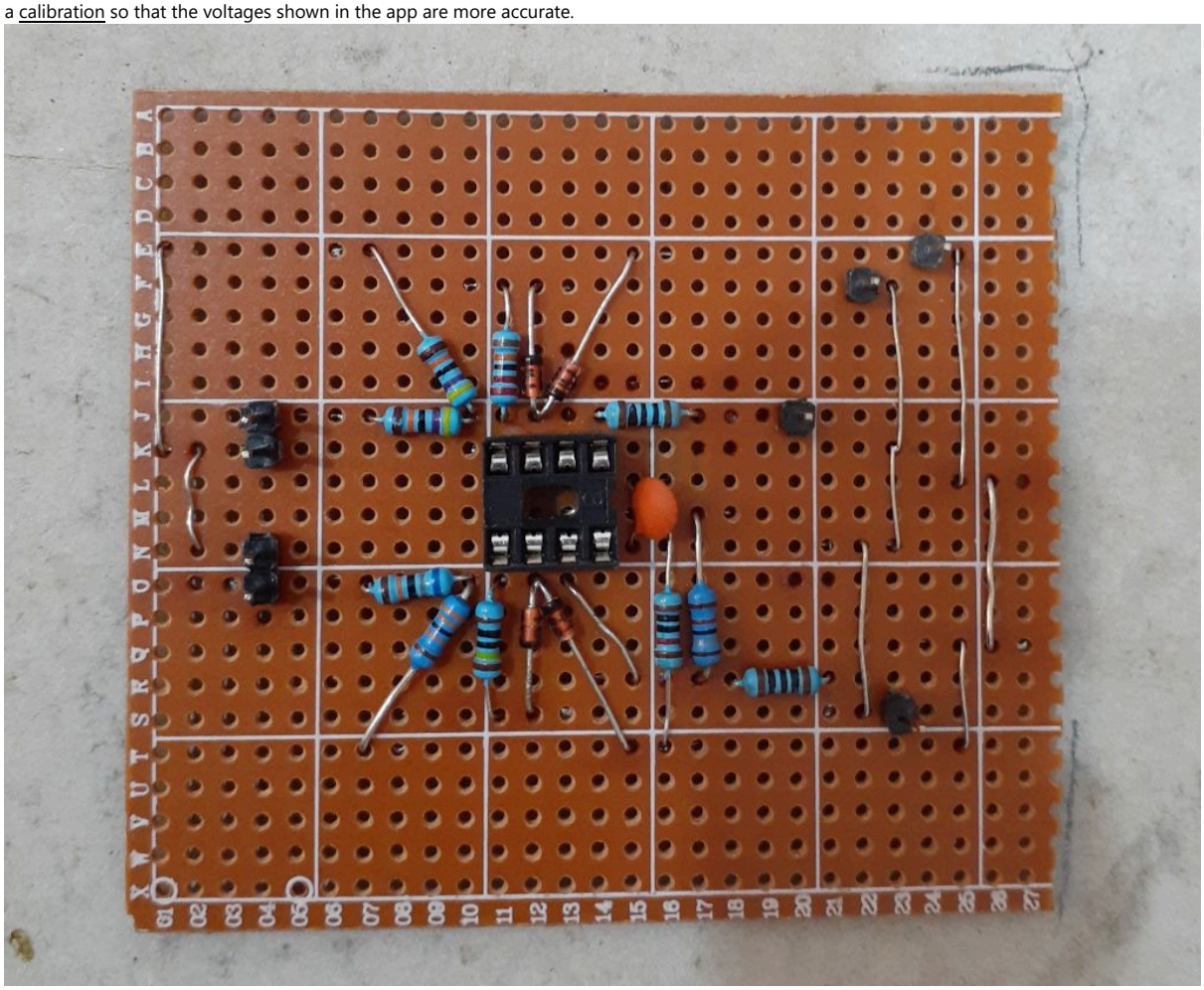
There is a 100 ohm resistor on the input of each ADC pins. These serve two purposes:

1. To stabilize the op-amp (the ADC is a capacitive load - though small)
2. To limit the current into the ADC in case of an unexpected over-voltage event

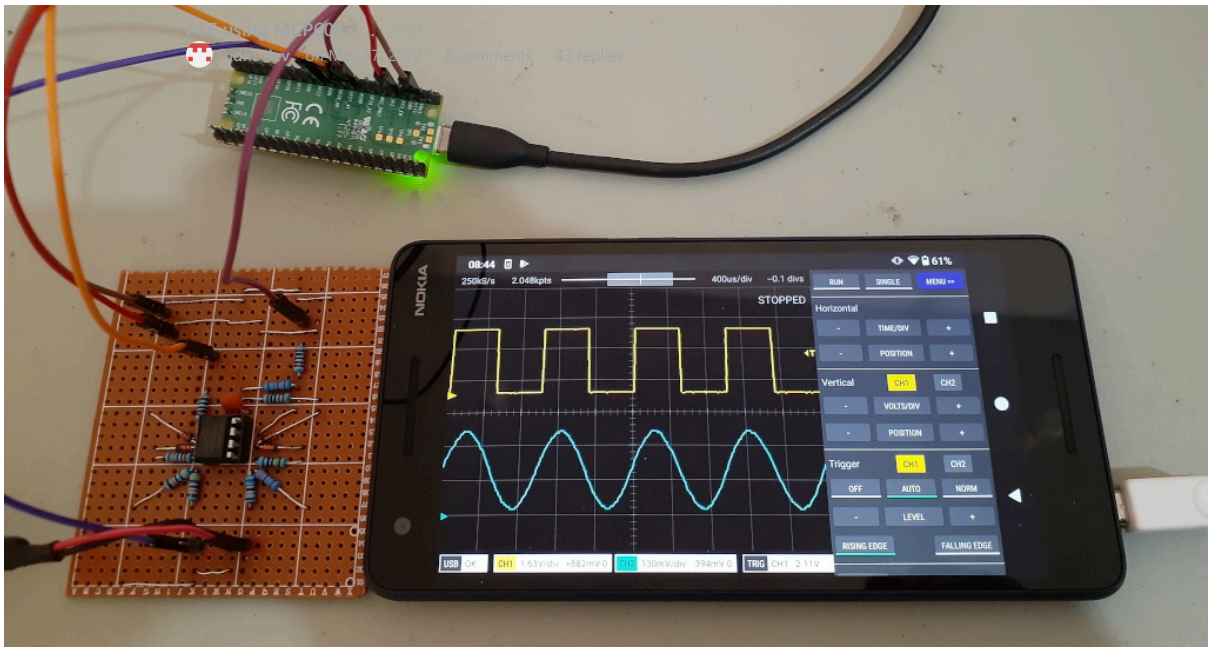
If you want to use this design but using different input voltage ranges then see here for the appropriate resistor values to use.

If building this design on a solderless breadboard the signal will probably appear quite noisy in the app. It should work better on prototyping board especially if the wires connected to the non-inverting input of the op-amp are kept as short as possible (this part of the circuit is very susceptable to picking up interference).

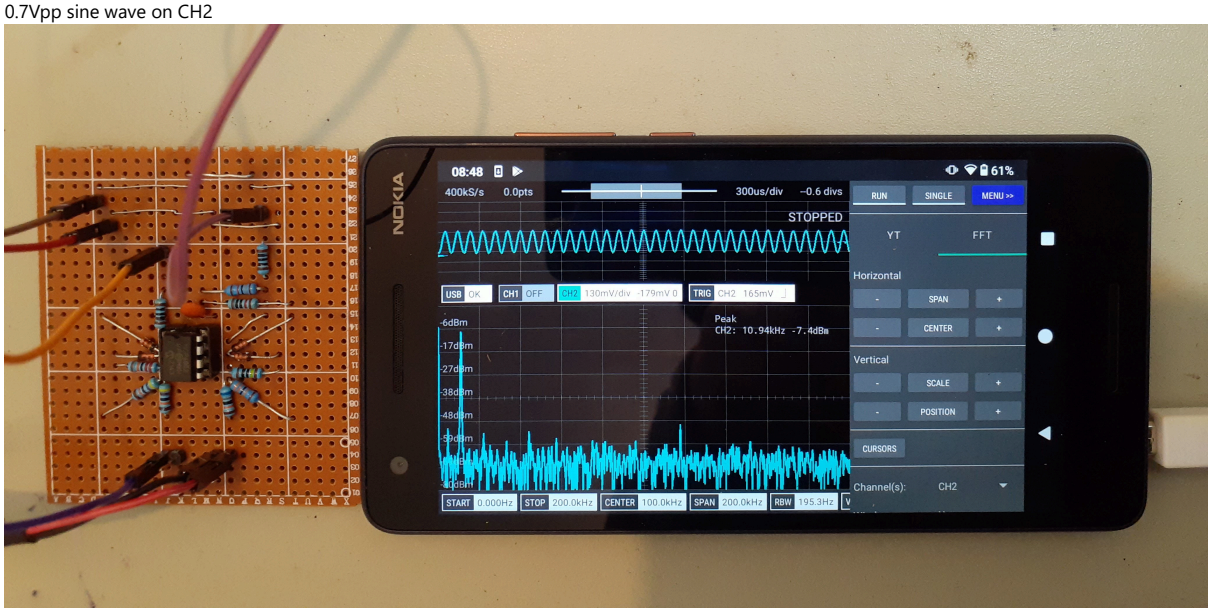
Once you've built the AFE you'll need to update the *Voltage range* settings in the app. To do this, tap the channel badge at the bottom of the screen, then tap *Settings* and then *Voltage ranges*. The values to enter can be found on the schematic. If you're fussy, then you can even do a calibration so that the voltages shown in the app are more accurate.



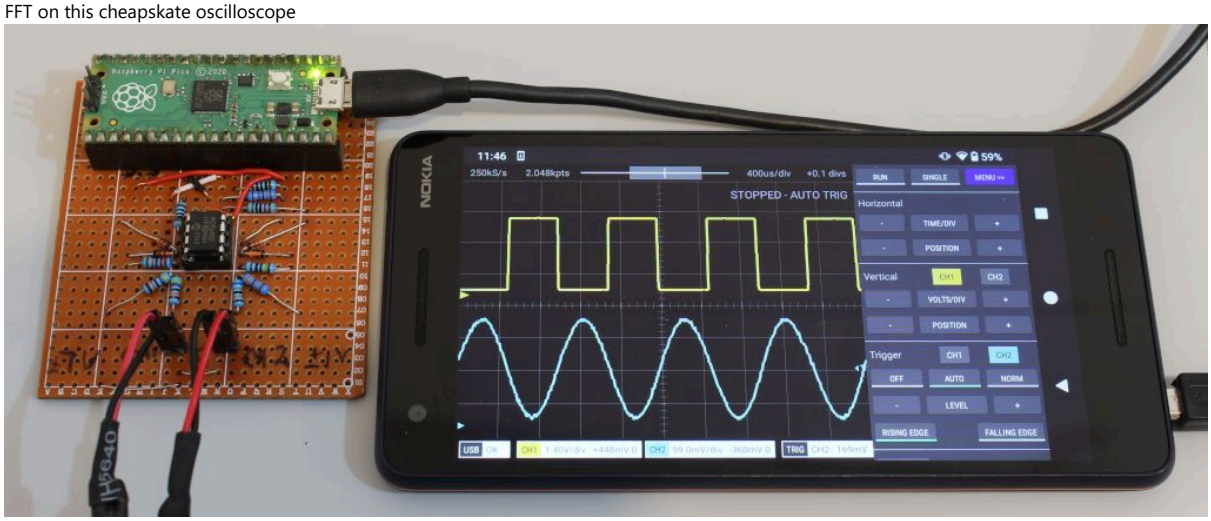
Two channel AFE on proto board. Just add MCP6002 op-amp.



3.3Vpp square wave on CH1
0.7Vpp sine wave on CH2



FFT on this cheapskate oscilloscope



.... and with the Pico attached to the board with headers. Looks much nicer.

7 👍 6 🚀 4

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paprika27 on Jun 23, 2022

영어로 된 원본 주석 - 한국어로 번역

Hi FHDM-dev, I just ordered the MCP6292 and RPu - I saw you pointed out for Design 1 how to change the resistors for 10x probes. Could you kindly point out for me, what I would need to change with this design? Many thanks for your awesome work!

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AFE using MCP6002 ... #63

fhdm-dev on May 17, 2022 · 8 comments · 43 replies

10 replies

fhdm-dev on Jun 26, 2022 Maintainer Author

영어로 된 원본 주석 - 한국어로 번역

That makes sense, though I think you should ignore the fact that there is a +/- 7V range on the schematic. You can choose whatever range you like and calculate the appropriate resistor values for that. Once you've entered the actual voltage range into the app it will show the correct value (ie. you don't need to wrongly configure it and you don't need to change the probe attenuation settings in the app). And for all the ranges you can choose to use either 10X or 1X probes when calculating the resistor values - you just can't switch between them.
Here's some examples:
approx. +/- 70V range using 10X probes:
R1_1=470k
R2_1=470k
RX_1=470k
Actual Input Range Min=-66.5V
Actual Input Range Max=+69.8V
+/- 70V range using 1X probes:
R1_1=1000k
R2_1=47k
RX_1=47k
Actual Input Range Min=-70.2V
Actual Input Range Max=+73.5V
+/- 32V range using 10X probes:
R1_1=220k
R2_1=1000k
RX_1=910k
Actual Input Range Min=-33.4V
Actual Input Range Max=+33.7V
+/- 32V range using 1X probes:
R1_1=1000k
R2_1=100k
RX_1=100k
Actual Input Range Min=-33.0V
Actual Input Range Max=+36.3V
In the examples above the 'Actual Input Range' values are the ones you enter into the app as 'Voltage range(s)'.
As for not breaking things, I've never worked with voltages that high so I can't guarantee anything.
All I do know is that applying 18+V to the input of the MCP6292 without limiting the current will destroy it. I learnt that the hard way 😄
So I would make sure that the attenuation and overvoltage protection is working correctly before attaching the MCP6292. That is, the voltage at the inputs of the op-amp shouldn't ever go below -1V or above 4.3V.