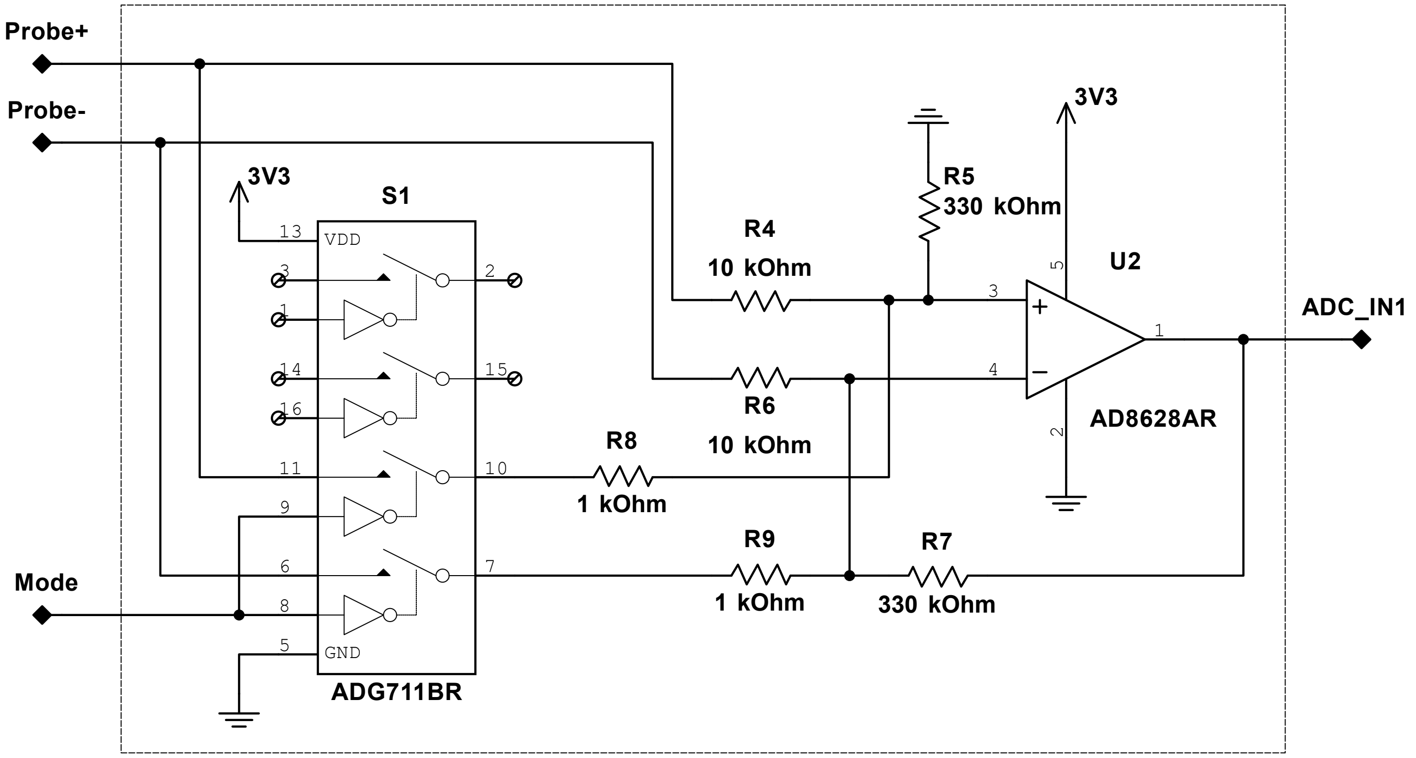
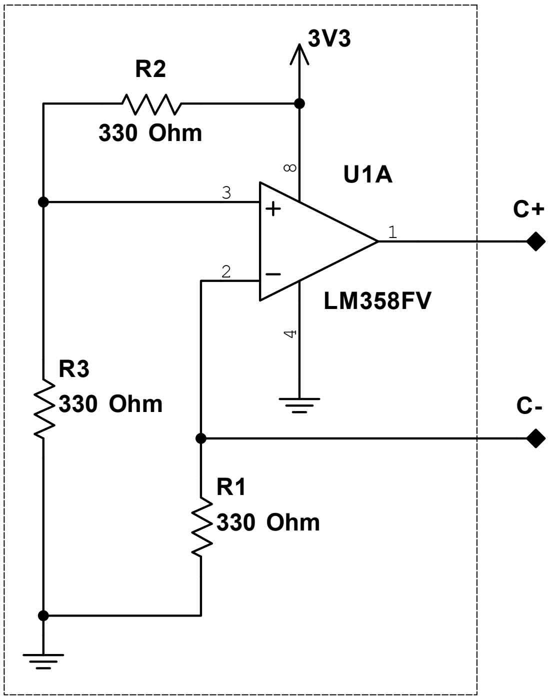
Precision ohmmeter

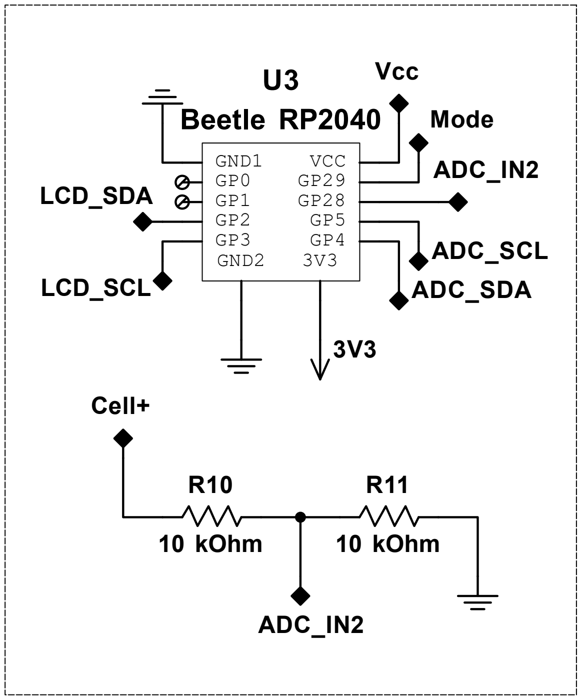
Diff. amplifier (Gain: 33 OR 363)



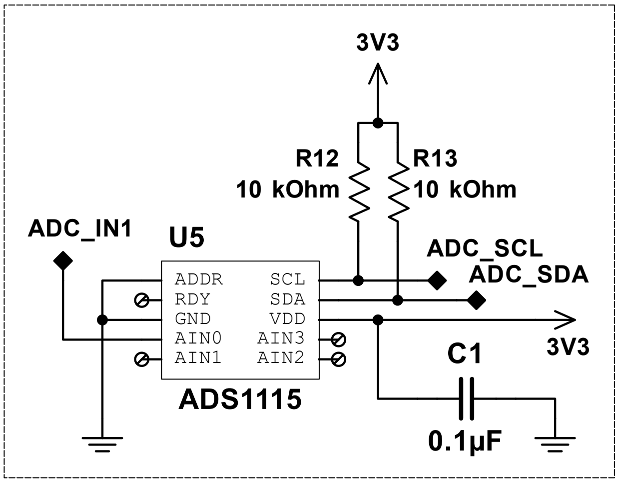
Current source (5mA)

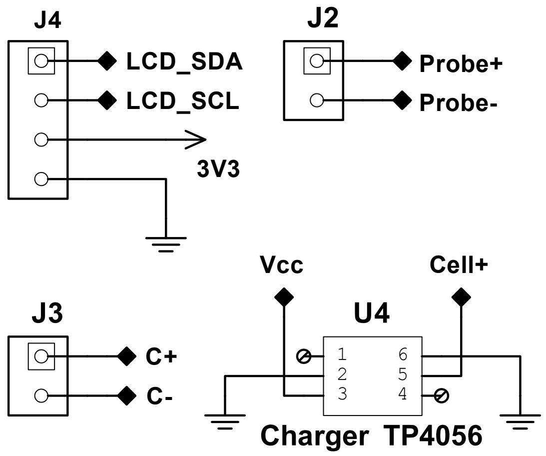


Microcontroller



ADC

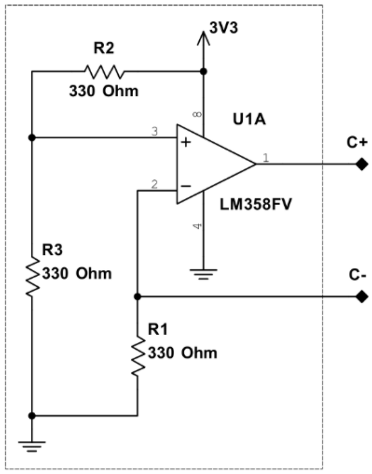




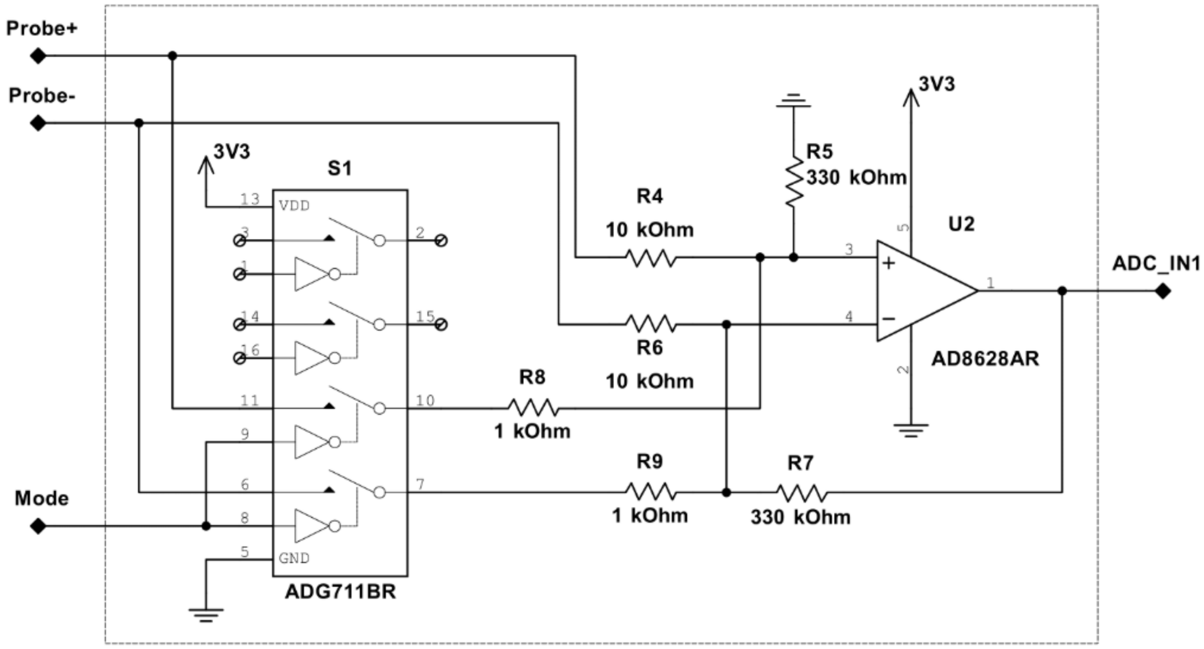
Current source

$$V_{REF} = \frac{R3}{R2 + R3} \cdot 3{,}3V = \frac{330\Omega}{330\Omega + 330\Omega} \cdot 3{,}3V = 1{,}65V$$

$$I = \frac{V_{REF}}{R1} = \frac{1{,}65V}{330\Omega} = 0{,}005A = 5mA$$



Differential amplifier



$$R5 = R7, \qquad R4 = R6, \qquad R8 = R9$$

$$ADC\_IN1 = (Probe^{+} - Probe^{-}) \cdot gain$$

Mode 1

$$gain = \frac{R5}{R4} = \frac{330k\Omega}{10k\Omega} = 33\,V/V$$

Mode 2

$$gain = \frac{R5}{R4 \cdot R6} \cdot (R4 + R6) =$$
$$= \frac{330k\Omega}{10k\Omega \cdot 1k\Omega} \cdot (10k\Omega + 1k\Omega) =$$
$$= 363\,V/V$$

Analog-to-digital converter

When supplied at $3{,}3V$, and FSR (full-scale range) set to $\pm 4{,}096V$ least significant bit corresponds to $125\mu V$ of the input voltage. Schematic denotes op-amp supplied at $3{,}3V$, consequently ADC range $[-4{,}096; 0) \wedge (3{,}3; 4{,}096]\ V$ is not used.

Given $5mA$ current applied to the measured object, we can calculate the resistance corresponding to the LSB for each gain mode:

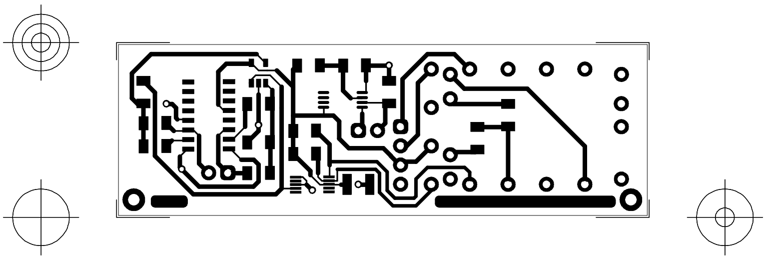
Mode 1 (gain 33)

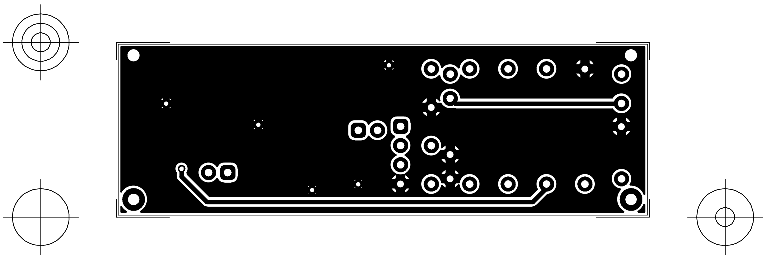
$$LSB = \frac{125\mu V}{33 \cdot 5mA} = \frac{25m\Omega}{33} \approx 758\mu\Omega$$

Mode 2 (gain 363)

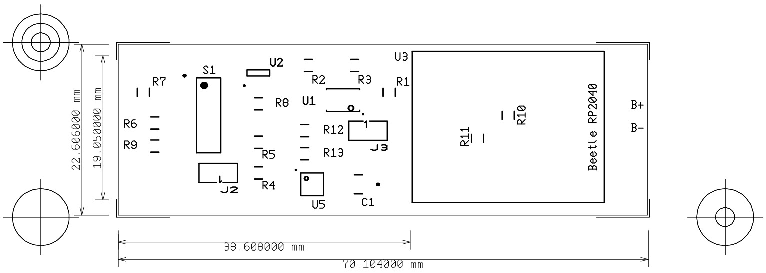
$$LSB = \frac{125\mu V}{363 \cdot 5mA} = \frac{25m\Omega}{363} \approx 69\mu\Omega$$

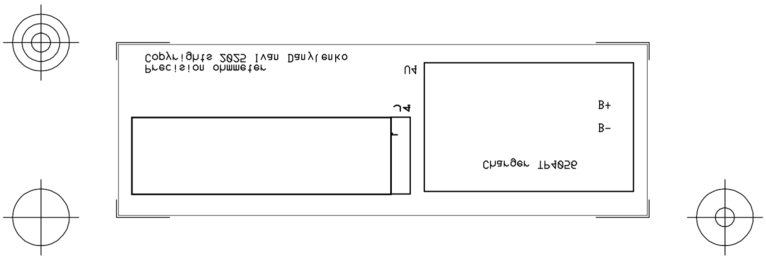
At this setting ADC has output noise (accordingly to the datasheet) of $125\mu V$ or $0{,}5LSB$.





Ultiboard-Precision ohmmeter - Copyrights 2025 Ivan Danylenko - 8/29/2025 - 09:12:58 Silkscreen Top

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Precision ohmmeter
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B+
B-
Charger TP4056