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TECHNICAL NOTE

Designing an Evaluation Board for Series 1000

Product: VS1000

The purpose of this document is to describe the realization of an evaluation board for Colibrys' VS1000 accelerometer. Customers may use it to manufacture a board to test the VS1000 or it may serve as a starting point for designing custom electronic boards.

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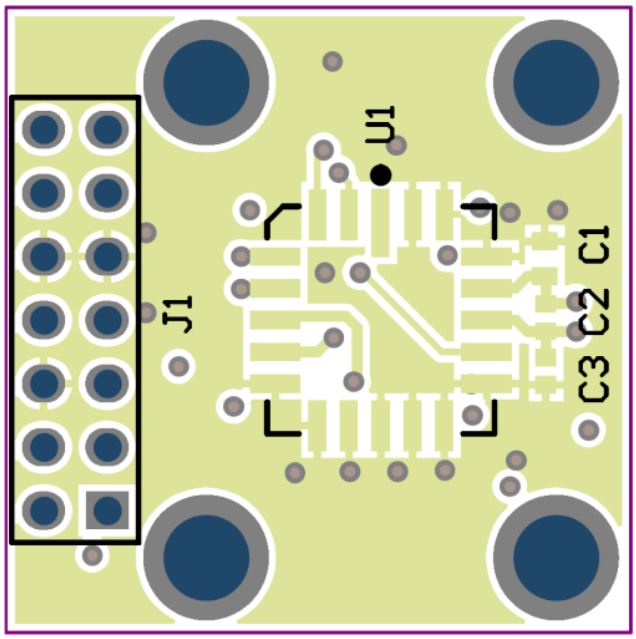

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Recommended Circuit

In order to obtain the best device performance, particular attention must be paid to the proximity analog electronics. A proposed circuit that includes a reference voltage, the sensor, decoupling capacitors and output buffers is shown in Figure 1.

Optimal acceleration measurements are obtained using the differential output (OUTPB – OUTNB). If a single-ended acceleration signal is required, it must be generated from the differential acceleration output in order to remove the common mode noise.

Block Diagram & Schematic

The main blocks that require particular attention are the power supply management, the accelerometer sensor electronic and the output buffer. The following schematic shows an example of VS1000 implementation.

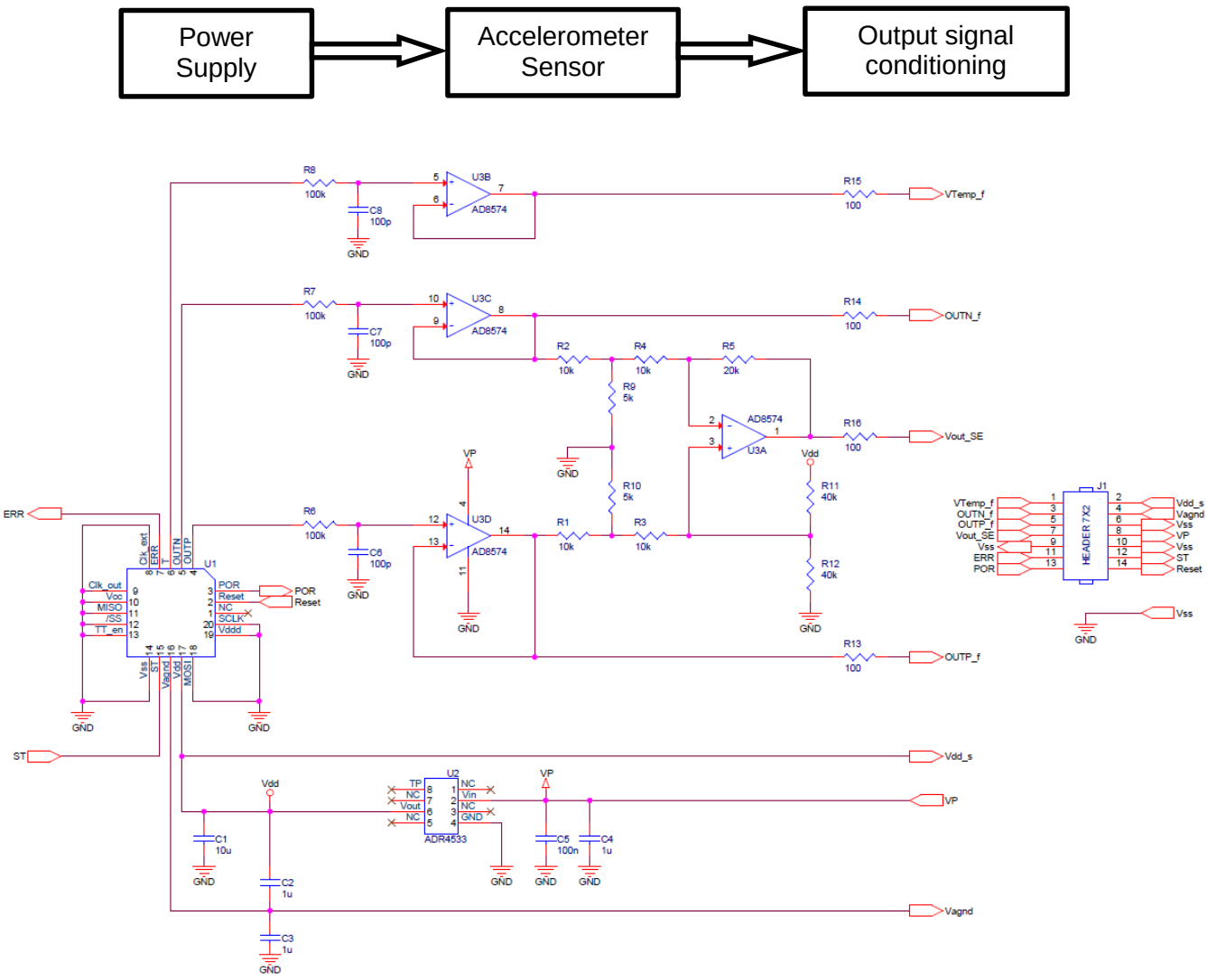


Figure 1: Recommended Circuit

Power Supply

The accelerometer output is ratiometric to the power supply voltage and its performance will directly impact the accelerometer bias, scale factor, noise or thermal performance. Therefore, a low-noise, high-stability and low-thermal drift power supply is recommended. Key performance should be:

- Output noise < 1µV/√Hz
- Output temperature coefficient < 10ppm/°C

The power supply can be used as an output signal (VDD_S) in order to compensate any variation on the power supply voltage that will impact the accelerometer signal (ratiometric output).

The electronic circuit within the accelerometer is based on a switched-capacitor architecture clocked @ 200 KHz. High-frequency noise or spikes on the power supply will affect the outputs and induce a signal within the device bandwidth.

The selected accelerometer, ADR4533, requires two decoupling capacities C4 (1 µF) and C5 (0.1 µF) .

Accelerometer sensor

The sensor block is composed of the VS1000 accelerometer and three capacitors C1 (10 µF), C2 (1 µF) and C3 (1 µF). These capacitors are required as decoupling capacitors and for a proper sensor startup. They are mandatory for the proper operation and full performance of the accelerometer. We recommend placing them as close as possible to the VS1000 package on the printed circuit board. COG or X7R capacitors @ 5 % are recommended.

Output signal conditioning

The output buffer must be correctly selected in order to match the VS1000 output impedance and signal bandwidth. The AD8574 is proposed for the acceleration output (OUTP & OUTN) and the temperature output (TEMP).

The operational amplifiers are preceded by low-pass filters R6/C6, R7/C7 and R8/C8 with a cutting frequency of 16 kHz. The attenuation at 1500Hz is less than 0.5%, allowing the use of the full bandwidth of the sensor. These filters may be adapted to customers' requirements.

They are followed by resistors R14, R15 and R16 (all 100 Ω) because the chosen amplifiers have open-loop gain: Open-loop gain decreases with smaller load resistances (please refer to the AD8574 datasheet for additional information).

Differential to Single Output

The fourth amplifier of the AD8574 may be used to generate a single ended output if required. A set of resistances is used to divide the voltages and add an offset to avoid saturation of the amplifier:

$$V_{Out\_SE} = \frac{V_{Out\_P} - V_{Out\_N}}{2} + \frac{V_{DD}}{2}$$

Note:

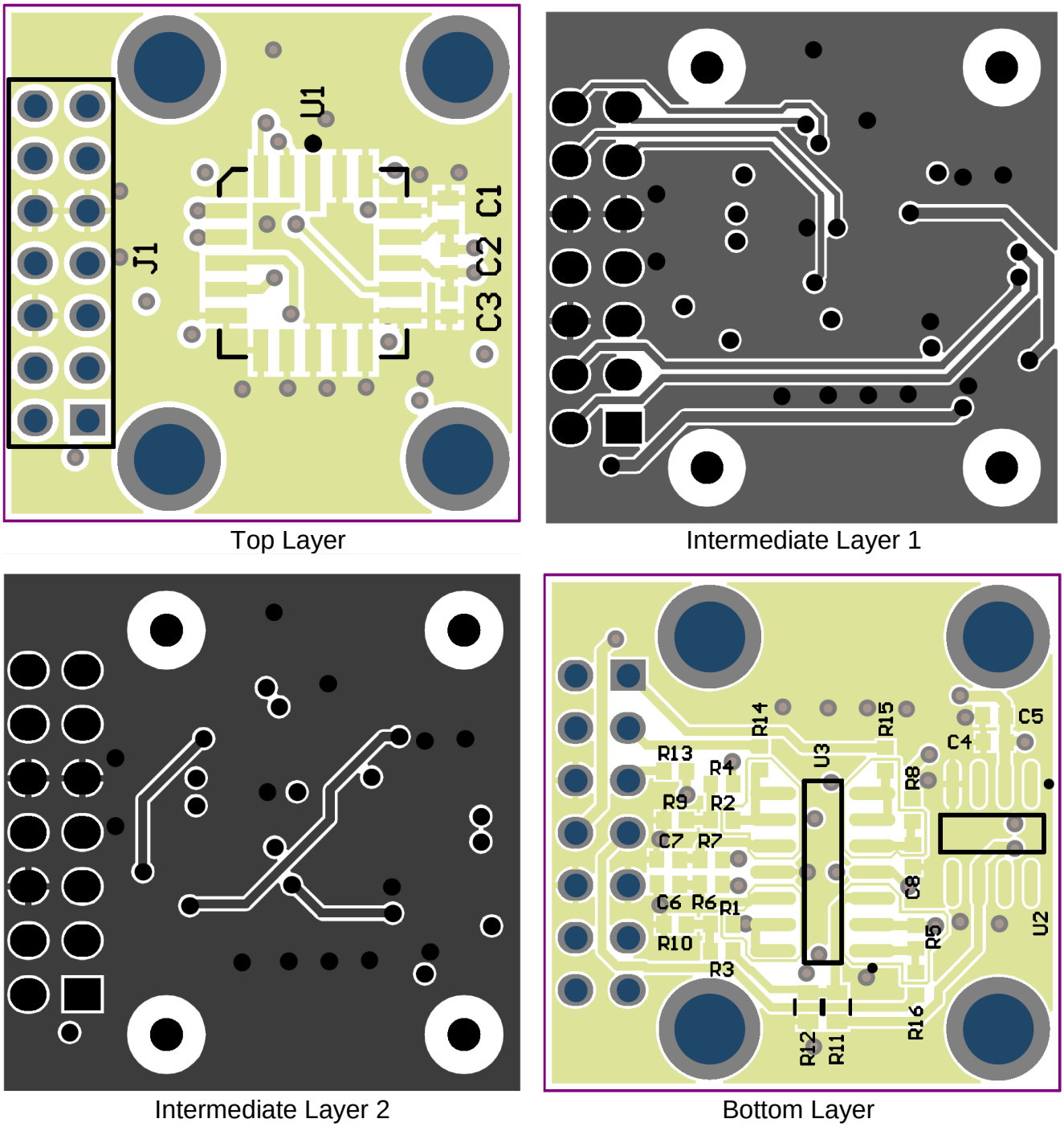
- The scale factor of the single ended output is only half that of the differential output.
- The common mode noise is not canceled when using a single ended output.

If a single ended output is required by the customer, we recommend a specific schematic, with the use of an embedded instrumentation amplifier. (Please refer to technical note ref: *30N.SINGLE VS1000.A*)

Layout

The layout presented in this document was realized with the usual guidelines and the following three rules:

- Place the capacitors C1, C2 and C3 as close as possible to the VS1000,
- Have a ground plane to shield the sensor,
- Route no signal between the sensor and the ground plane.



Top Layer

Intermediate Layer 1

Intermediate Layer 2

Bottom Layer

Figure 2: Recommended Layout

Bill of material (BOM)

The following table lists all components used for the presented design:

Component	Value	Function
U1	VS1000	Colibrys Accelerometer
U2	ADR4533	3V3 Voltage Reference – Analog Devices ADR4533BRZ
U3	AD8574	Quad Operational Amplifier – Analog Devices AD8574ARZ
R1, R2, R3, R4	10 kΩ	Voltage divider – 0402 resistor
R5	20 kΩ	Voltage divider – 0402 resistor
R6, R7, R8	100 kΩ	Low pass filter – 0402 resistor
R9, R10	5 kΩ	Voltage divider – 0402 resistor
R11, R12	40 kΩ	Voltage divider – 0603 resistor
R13, R14, R15, R16	100 Ω	Output load – 0402 resistor
C1	10 µF	Decoupling – 0603 capacitor
C2, C3, C4	1 µF	Decoupling – 0402 capacitor
C5	100 nF	Decoupling – 0402 capacitor
C6, C7, C8	100 pF	Low pass filter – 0402 capacitor
J1	HEADER 7X2	Connector (if required*)

*The wires may also be soldered directly on the board.

Mechanical dimension

The previously presented layout uses a board with following mechanical dimensions:

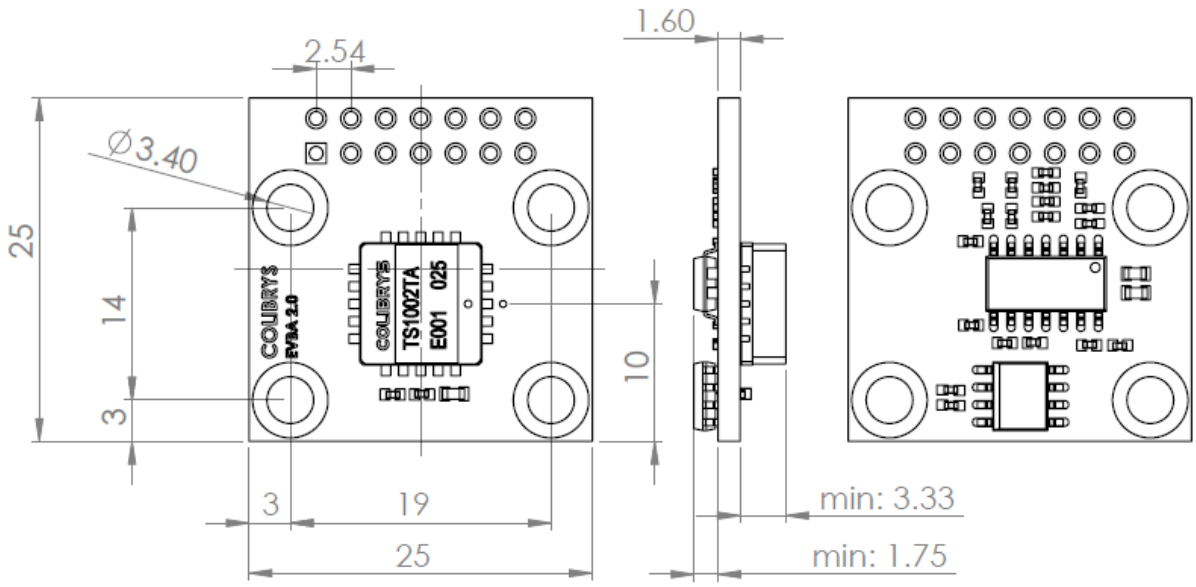


Figure 3: Mechanical Dimensions