EULER-NAV BAHRS

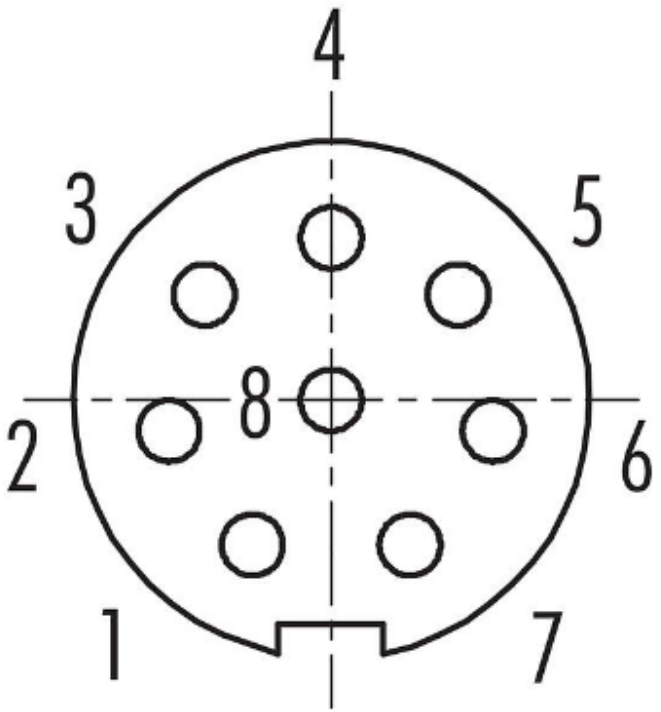
Miniature Baro-Inertial Attitude and Heading Reference System

- Output
  - Roll, pitch, magnetic heading
  - Pressure altitude, vertical speed
  - Angular rates, accelerations
- Size 40x40x25 mm
- IMU performance
  - Gyroscope: 0.1 deg/sqrt(h) angle random walk, 3 deg/h bias instability
  - Accelerometer: 0.04 m/s/sqrt(h) velocity random walk, 20 µg bias instability
- Sophisticated sensor fusion
- Sensor redundancy (3x IMU, 3x magnetometer, 3x barometer), fault detection and isolation capability
- Interfaces
  - CANaerospace
  - RS232 (3.3V UART variant on demand)
- Open software, including a free version

Electrical and environmental

- Supply voltage: 5 to 28 V
- Current consumption: 0.1 A
- Operating temperature: -40 to +80 °C
- Environmental protection: IP67 (provided that static pressure tube is properly connected)

Main connector



- Connector: Binder 09 0428 90 08
  - CAN Low
  - CAN High
  - SYNC input (low to high interrupt, V_IH = 2.0 … 3.3 V, V_IL = 0.8 V max)
  - GND
  - RS232 TX (output)
  - RS232 RX (input)
  - Input voltage (direct current, 5 to 28 V)
  - GND
- Mating connectors: Binder 99 0425 00 08, 99 0425 10 08, 99 0425 115 08, 99 0425 70 08, and more.

Serial Interface

- COM port settings
  - Baud rate 115200 bits per second
  - Word length 8 bits (including parity)
  - Parity bits: none
  - Stop bits: 1
- Protocol description
  - BAHRS Serial Protocol v1.0
  - Download here: https://euler-nav.com/bahrsdoc

CAN Interface

- General
  - Baud rate 500000 bits per second
  - Standard CAN IDs
- Protocol
  - CANaerospace version 1.7
  - Payload type is float

Provided frames

Frame ID	Data	Default output rate, [Hz]	Units
300	Body longitudinal acceleration	80	g
301	Body lateral acceleration	80	g
302	Body normal acceleration	80	g
303	Body pitch rate	80	deg/s
304	Body roll rate	80	deg/s
305	Body yaw rate	80	deg/s
311	Body pitch angle	80	deg
312	Body roll angle	80	deg
314	Altitude rate	80	m/s
1069	Magnetic heading	80	deg
322	Standard altitude	80	m
326	Static pressure	10	hPa

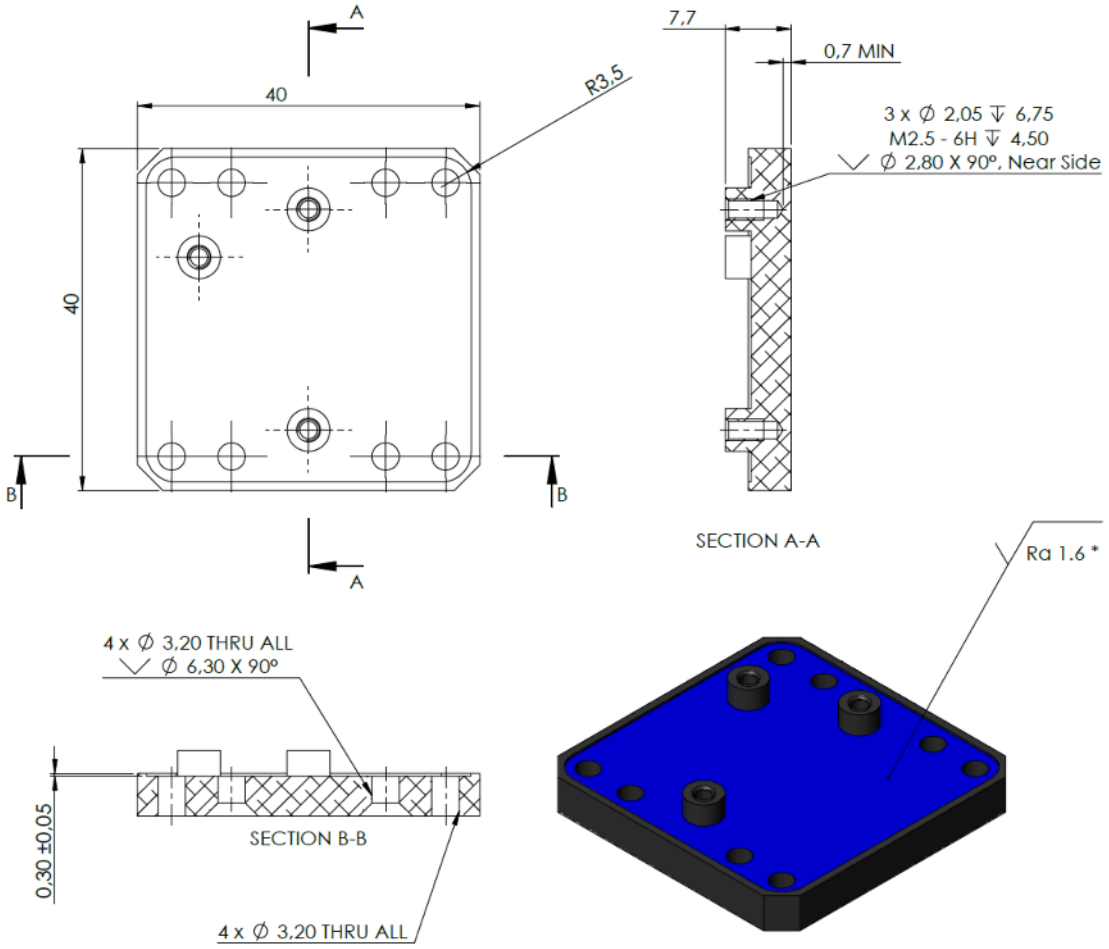
Device Configuration

Some features of the device are configurable. To modify the device's settings a user needs to change parameter values in the device's non-volatile memory (NVM).

- Configurable parameters:
  - Vehicle frame
  - Magnetometer calibration (hard- and soft-iron)
  - Output rate of CAN frames
- NVMManager GUI
  - Github: https://github.com/euler-nav/nvm-manager
  - Video tutorial: https://youtu.be/cvXY9bndH0I?feature=shared

Mounting

Base plate drawing



Re-programming

- Reprogramming via RS232
  - See manual on Github: https://github.com/euler-nav/bahrs-oss/tree/release/oss-public/00_Documentation#how-to-reprogramm-bahrs-via-rs232
  - Video tutorial: https://youtu.be/uZZKiqIUoDI?feature=shared
- Serial Wire Debug (SWD) Connector
  - Debugger connector schematics: https://github.com/euler-nav/bahrs-oss/tree/release/oss-public/00_Documentation#debug-connector-schematics

Design Insights

Sensors and MCU
HW revision 3

- Microcontroller: STM32F446ZE
- IMU
  - Murata SCHA63T (high-end)
  - STMicroelectronics ASM330LHH (high-end)
  - Bosch BMI270 (consumer)
- Barometer
  - Bosch BMP384 (consumer)
  - TDK ICP-20100 (consumer)
  - STMicroelectronics ILPS22QS (consumer)
- Magnetometer
  - MEMSIC MMC5983MA (automotive)
  - Bosch BMM350 (consumer)
  - STMicroelectronics LIS3MDL (consumer)

Design Insights

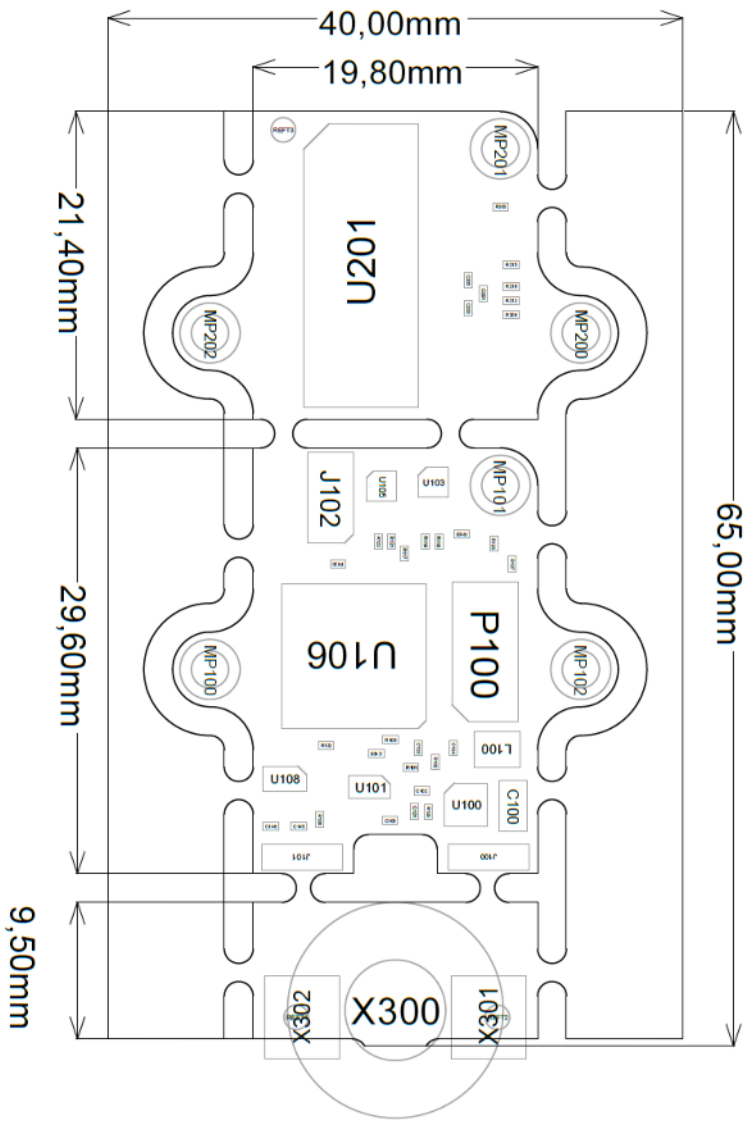
Sensors and MCU
HW revision 2

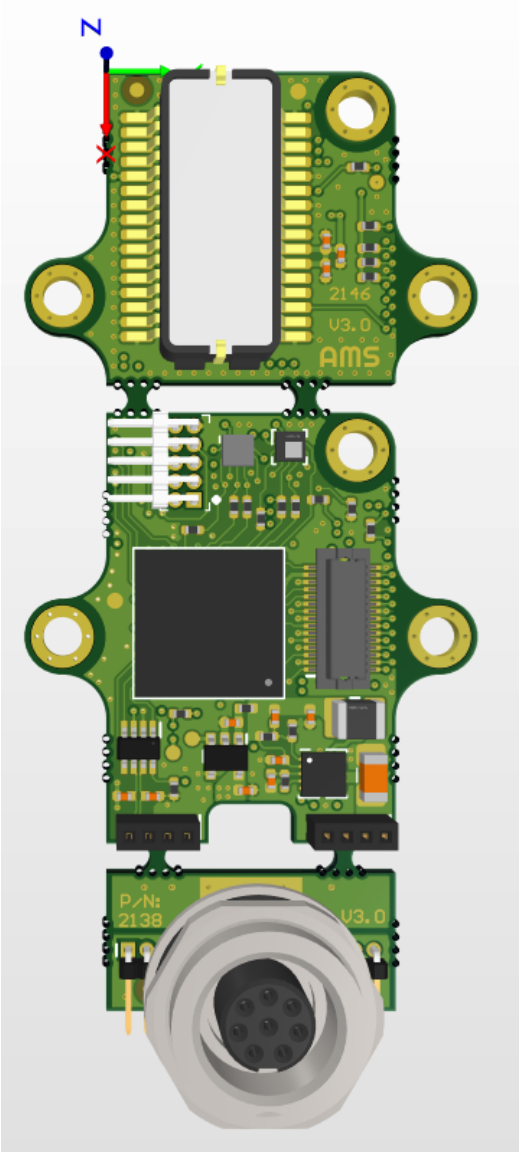
- Microcontroller: STM32F446RE
- IMU
  - 1x Murata SCHA63T (high-end)
  - 2x TDK Invensense ICM20789 (consumer)
- Barometer
  - 1x Bosch BMP384 (consumer)
  - 2x TDK Invensense ICM20789 (consumer)
- Magnetometer
  - 1x MEMSIC MMC5983MA (automotive)
  - 2x Bosch BMM150 (consumer)

Design Insights

Board dimensions

HW revision 3

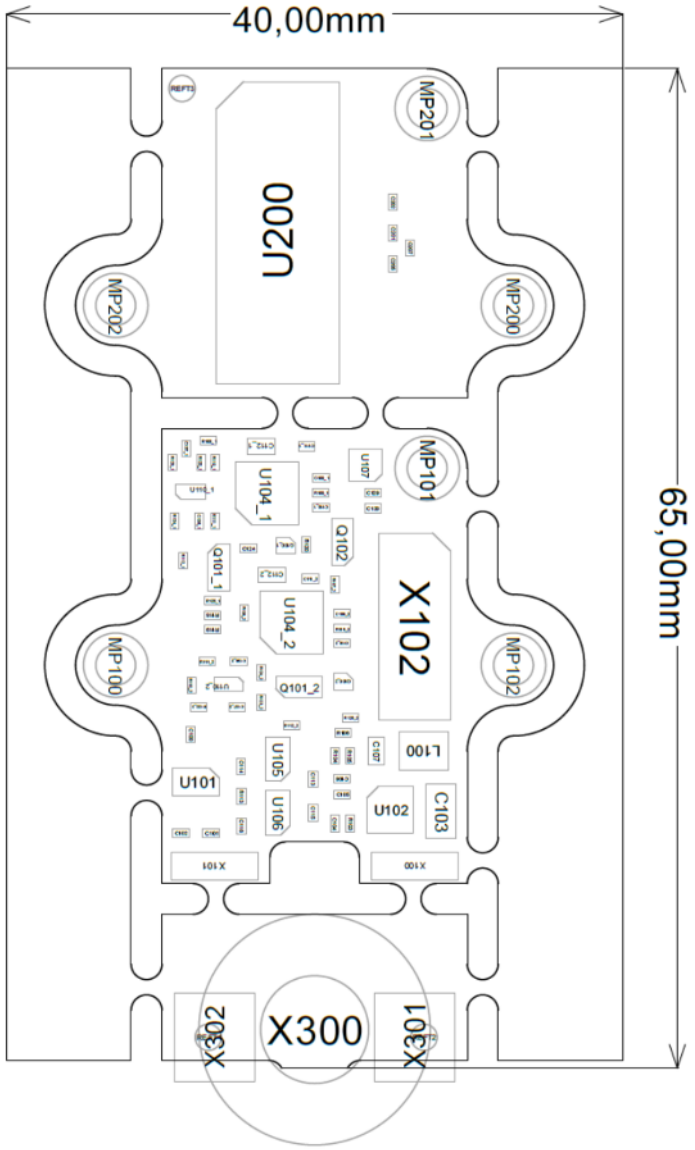


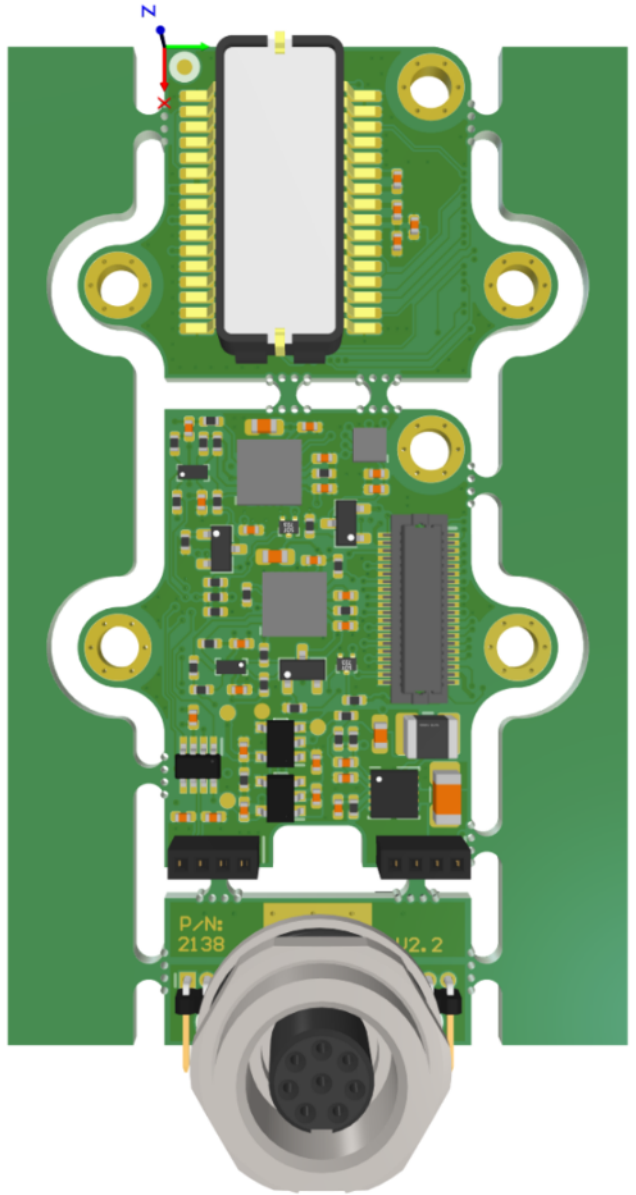


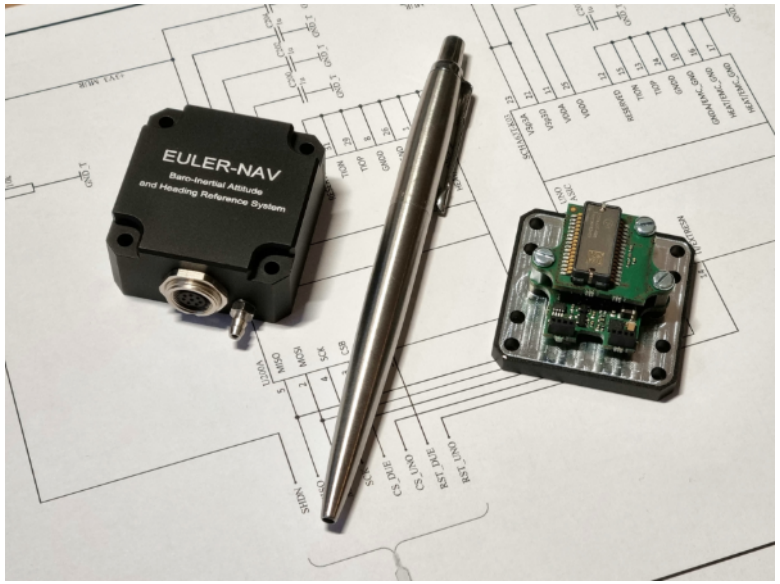
Design Insights

Board dimensions

HW revision 2







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