# PBx-A1 Positioning Box
# Datasheet

# Product summary

The PBx-A1 positioning box comes with two triple-band GNSS receivers, an IMU, two camera ports, and outputs position, velocity, and orientation information. Fixposition's unique sensor fusion xFusion enables high precision positioning and highly reliable performance, even in areas with limited GNSS/RTK and coverage. This combination of technologies significantly increases reliability and expands the availability of precise positioning in a compact module. With dimensions of 180 x 105 x 51 $mm^3$ and a weight of 623g, it is compatible with platforms of many sizes, from small outdoor AV systems and asset-tracking devices to mid-and large-sized ground robots.

# Document Information

| Title | Datasheet |
|---|---|
| **Subtitle** | Fixposition PBx-A1 Positioning Box |
| **Document type** | Datasheet |
| **Document name** | FP_PBxA1_DS_v1.1_12-06-2026 |
| **Revision** | V1.1 |
| **Date** | June 12, 2026 |
| **Disclosure restriction** | Confidential |
| **Product status** | Production |

# Contents

# 1 Sensor fusion engine

The PBx-A1 incorporates the following sensors:

- Triple-band RTK GNSS Receiver (2x)
- Accelerometer
- Gyroscope

The xFusion algorithm makes use of each individual sensor to estimate position, velocity, acceleration and orientation at specific update rates. Figure 1 summarizes the main components of the sensor:

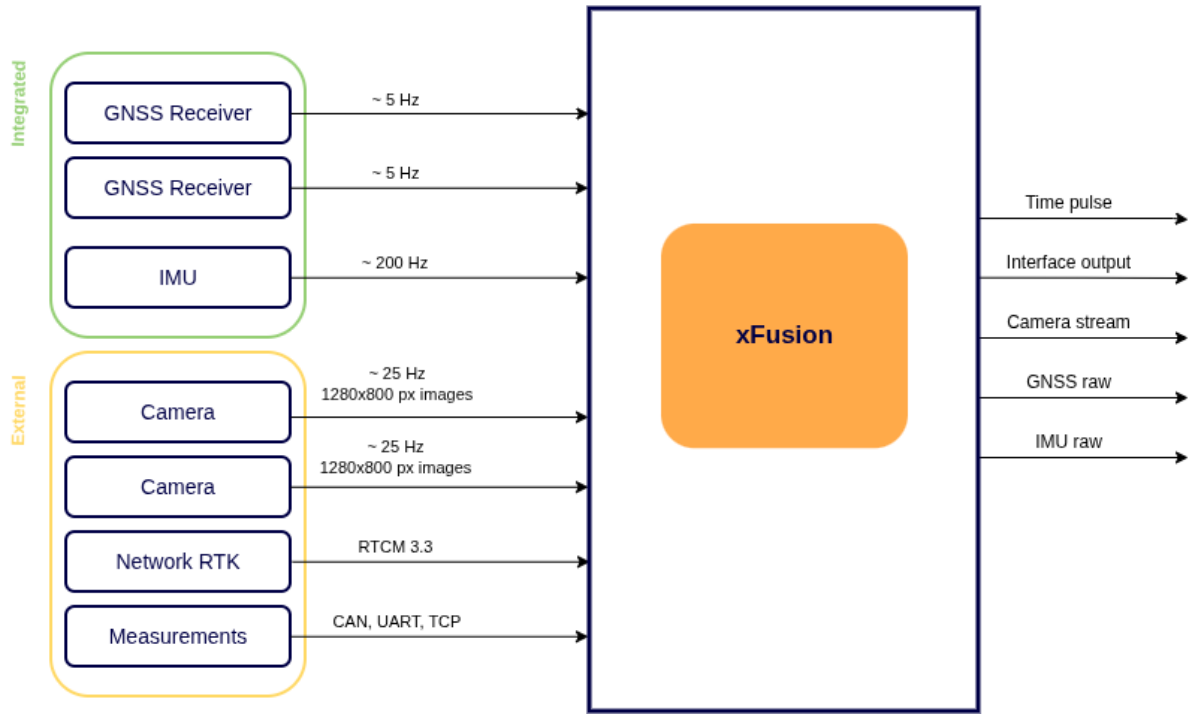


**Figure 1** xFusion schematic for PBx-A1

# 2 Positioning performance specification

| Parameters | Condition | Value |
|---|---|---|
| **Solution latency** | - | 50 ms |
| **Horizontal position accuracy** | At maximum performance | 1.0 cm + 1 ppm |
| **Vertical position accuracy** | At maximum performance | 1.0 cm + 1 ppm |
| **Velocity with GNSS signal** | Maximum operational | 30 m/s |
| **Velocity in GNSS outages** | Maximum operational | 20 m/s |
| **Attitude accuracy**[1] | - | < 0.4° |
| **Acquisition time**[2] | Cold start<br>Hot start/reacquisition<br>Aided start | 25 s<br>2 s<br>2 s |
| **UDR** | Described as a percentage of distance travelled without GNSS, with wheel speed data | <0.75%[4] |
| **ADR** | Described as a percentage of distance travelled without GNSS, with wheel speed data | <0.4%[4] |
| **HDR** | Described as a percentage of distance travelled without GNSS, with wheel speed data | <0.05%[4] |
| **Velocity accuracy**[4] | Average of GNSS outage and non-outage | 0.1 m/s |

**Table 1a** Positioning performance of xFusion on PBx-A1

| Parameters | Condition | Value |
|---|---|---|
| **Horizontal position accuracy (RMS)** | - | 0.6 cm + 1 ppm |
| **Velocity accuracy** | - | ±0.03 m/s |
| **Heading accuracy** | At 4m baseline<br>At 1m baseline | < 0.05°<br>< 0.15° |

**Table 1b** Positioning performance of xRTK on PBx-A1

[1] Setup with 1m antenna baseline.
[2] All satellites at -130 dBm.
[3] Position/heading offset with respect to distance travelled.

[4] Average values taken from datasets of thousands of kilometers of test data. This data was recorded following the defined best practices, i.e., using proper and rigid mounting with very accurately measured extrinsics. Furthermore, this data assumes the camera has a good unobstructed view, and the lighting conditions are sufficient for features to be apparent. The probability of an error below 5% is 99% with wheelspeed and 98% without, the probability of an error below 2% is 98% with wheelspeed and 79% without, the probability of an error below 1% is 78% with wheelspeed and 52% without. These numbers assume the correct implementation of the sensor.

# 3 GNSS specifications

The PBx-A1 module includes two multiband GNSS receivers. All four major GNSS constellations (GPS, GLONASS, Galileo and BeiDou) plus QZSS satellites can be received concurrently on both receivers. The RTK positioning output is available when combining GNSS correction data and the received satellite signals.

| | |
|---|---|
| **GPS/QZSS** | L1 C/A, L2C, L5 |
| **GLONASS** | L1, L2 |
| **Galileo** | E1 B/C, E5a, E6 |
| **BeiDou** | B1I, B1C, B2a, B3I |
| **SBAS** | L1C/A |

**Table 2** Available GNSS constellation and signals

# 4 Camera specifications

**GMSL2 camera interface**

The PBx-A1 uses twos for visual odometry with a 2064x1552 resolution image array. In addition, the Auto Exposure Control (AEC) and Auto Gain Control (AGC) are constantly enabled to maintain the image quality regardless of the lighting changes in the scene.

| Parameter | Value |
|---|---|
| **Active array size** | 1280 × 800 px |
| **Shutter type** | Global Shutter |
| **Sensor type** | CMOS |
| **Mono/color** | RGB |
| **Diagonal field of view** | 128° |
| **Vertical field of view (FOV)** | 122° |
| **Horizontal field of view (FOV)** | 90° |

**Table 3** Camera specifications

# 5 Inertial measurement unit

The PBx-A1 incorporates an inertial measurement unit (IMU) that combines a 3-axis gyroscope and a 3-axis accelerometer.

| Parameter | Value |
|---|---|
| **Gyroscope dynamic range** | ±327.68 °/s |
| **Gyroscope sensitivity scale factor** | 100 LSB/°/s |
| **Gyroscope noise density** | 0.0005 °/s /√Hz |
| **Accelerometer full scale range** | ±16.7 g |
| **Accelerometer bias instability** | 0.15 mm/s2 |
| **Accelerometer velocity random walk** | 30 (mm/s)/√h |

**Table 4** IMU specifications

# 6 Electrical specifications

## 6.1 Absolute maximum ratings

| Parameter | Symbol | Min | Max | Units |
|---|---|---|---|---|
| **Power supply voltage**[5] | $V_{CC}$ | -0.3 | 40 | V |
| **Digital IO pin voltage** | $V_{IO}$ | -0.3 | 3.6 | V |
| **CAN bus voltage (CANH or CANL)** | $V_{CAN}$ | -42 | 42 | V |
| **PWR_SW control pin voltage** | $V_{PWR\_SW}$ | -0.3 | $V_{CC}$ | V |
| **GNSS antenna output current of** | $I_{CC\_RF}$ | - | 100 | mA |
| **GNSS antenna input power** | $P_{IN\_RF}$ | - | 10 | dBm |
| **GMSL2 camera voltage** | $V_{CAM}$ | -0.3 | 20 | V |
| **GMSL2 camera continuous output current** | $I_{CAM}$ | - | 1 | A |
| **RS-232 input voltage** | $V_{RS-232\_SIN}$ | -25 | 25 | V |
| **RS-232 output voltage** | $V_{RS-232\_SOUT}$ | -13.2 | 13.2 | V |
| **Maximum continuous output supply current** | $I_{5V\_OUT}$ | - | internal limited | mA |

**Table 5a** Absolute minimum and maximum ratings of electrical specifications[6]

| Parameter | Symbol | Min | Max | Units |
|---|---|---|---|---|
| **Storage temperature range** | $T_{STG}$ | -40 | 90 | °C |
| **Operating temperature range (non-condensing)** | $T_{ST}$ | -40 | 85 | °C |
| **Performance guarantee temperature range** | $T_{STP}$ | 0 | 50 | °C |
| **Humidity non-condensing** | %RH | - | 95 | % |
| | **Type of compliance** | | | |
| **Vibration** | Random12 MIL-STD-810G (CH1) Method | | | |
| | 514.7 (Cat 24, 20 g RMS) | | | |
| | Sinusoidal IEC 60068-2-6 | | | |

**Table 5b** Absolute minimum and maximum ratings of environmental specifications[6]

[5] Reverse polarity protected.

## 6.2 Recommended operating conditions

All typical measurements are performed with $V_{CC}$ = 12.0 V, $V_{IO}$ = 3.3 V and T = 25 °C, unless otherwise indicated.

| Parameter | Conditions | Symbol | Min | Typical | Max | Units |
|---|---|---|---|---|---|---|
| **Supply voltage** | - | $V_{CC}$ | 9 | - | 36 | V |
| **Supply current**[7] | GNSS acquisition and sensor fusion | $I_{CC}$ | 550 | 750 | 950 | mA |
| **Input pin voltage range**[8] | - | $V_{IN}$ | 0 | - | 3.3 | V |
| **Digital IO pin high level input voltage**[8] | - | $V_{IH}$ | 2.45 | - | 3.3 | V |
| **Digital IO pin low level input voltage**[8] | - | $V_{IL}$ | 0 | - | 0.8 | V |
| **Digital IO pin high level output voltage**[8] | - | $V_{OH}$ | 2.8 | - | - | V |
| **Digital IO pin low level output voltage**[8] | - | $V_{OL}$ | - | - | 0.7 | V |
| **GNSS antenna voltage** | - | $V_{CC\_RF}$ | | 5.0 | | V |
| **GNSS receiver chain noise figure**[9] | - | $NF_{TOT}$ | - | 6.5 | - | dB |
| **GMSL2 camera voltage** | - | $V_{CAM}$ | - | 12.0 | - | V |
| **GMSL2 camera output current limit** | - | $I_{CAM}$ | 552 | 600 | 648 | mA |
| **GMSL2 camera short detection time**[10] | - | $ST_{CAM}$ | - | 10 | - | ms |
| **GMSL2 camera shorted retry time**[10] | - | $STR_{CAM}$ | 225 | 250 | 275 | ms |
| **Output supply current** | - | $I_{5V\_EXT}$ | | | 500 | mA |
| **Real-time clock backup battery voltage**[11] | - | $V_{V\_BCKP\_RTC}$ | 1.2 | 3.0 | 5.5 | V |
| **Real-time clock backup battery current** | $V_{V\_BCKP\_RTC}$ = 3.0V | $I_{V\_BCKP\_RTC}$ | - | 40 | - | nA |
| **CAN Common Mode Range: normal and silent modes** | - | $V_{CM}$ | -12 | | 12 | V |
| **RS-232 output voltage low** | $I_{OUT}$ = 1.6mA | $V_{RS\text{-}232\_SOUT\_L}$ | - | - | 0.4 | V |
| **RS-232 output voltage high** | $I_{OUT}$ = 1.0mA | $V_{RS\text{-}232\_SOUT\_H}$ | 4.4 | 4.9 | - | V |
| **RS-232 input voltage range** | - | $V_{RS\text{-}232\_SIN}$ | -15 | - | 15 | V |
| **RS-232 input threshold low** | - | $V_{RS\text{-}232\_THR\_L}$ | 0.8 | 1.5 | - | V |

| | | | | | | |
|---|---|---|---|---|---|---|
| **RS-232 input threshold high** | - | $V_{RS-232\_THR\_H}$ | - | 1.8 | 2.4 | V |
| **RS-232 input hysteresis** | - | $V_{RS-232\_HYS}$ | - | 0.3 | - | V |
| **RS-232 input resistance** | - | $V_{RS-232\_RES}$ | 3 | 5 | 7 | kΩ |
| **RS-232 data rate** | - | $DR_{RS-232}$ | 1000 | - | - | kbps |
| **Reset voltage threshold** | Drive low to shutdown | $V_{PWR\_SW\_THR}$ | 0 | 0.8 | - | V |

**Table 6** Electrical specifications

[6] Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under Operating Conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
[7] The listed power requirements can vary depending on the firmware version, external circuitry, and operating conditions.
[8] Holds for the following pins: COM_SOUT, COM_SIN, GPIO1-6, WAKE-UP, GNSS1_PPS1, GNSS2_PPS1, GNSS2_EXTINT. All digital IOs have internal pull-down resistors.
[9] Only valid for the GPS L1 band.
[10] PBx-A1 GMSL2 camera ports feature current limit that protects the device and remote camera module against short-circuit and overload conditions. The port is reenabled after 250ms.
[11] Internal trickle charger allows recharging (for rechargeable 3V Lithium cells only).

# 7 Interfaces

The following interface communication options are possible:

- UART: RS232, 3.3V TTL
- Ethernet 1 GbE: TCP/IP, UDP, NTP, EtherCAT
- CAN: CANopen, ISObus, J1939, NMEA 2000, CAN FD
- Time pulse (PPS), time mark (EXTINT)
- 6x GPIOs

## 7.1 Time pulse

The time pulse function provides a one pulse per second (PPS) signal. Once the sensor has received any GNSS signals information, the 1 pps signal will adjust itself to each second in time. The raised edge of each pulse will be aligned to the top of GPS time seconds. The duty cycle is 10 %, meaning that the pulse width is 100 ms.

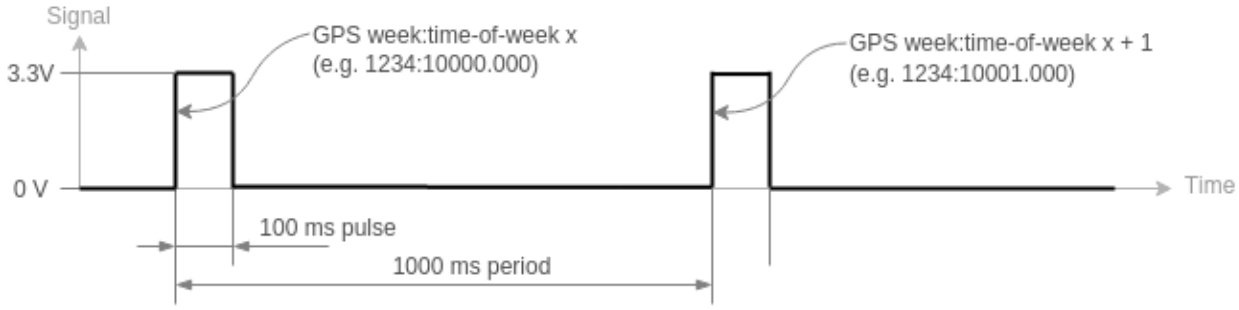


**Figure 2** Time pulse signal

## 7.2 UART

The UART1 port outputs the TTL signal level data from the COM1 connector. The UART2 port outputs the RS232 data from the COM2 connector. Both have the following baudrate limits:

| Parameter | Symbol | Min | Max | Units |
|---|---|---|---|---|
| **Baudrate** | $F_{baud\_rate}$ | 9600 | 4000000 | bit/s |

**Table 7** PBx-A1 UART specifications

## 7.3 Ethernet

The Ethernet MAC interface is provided via a M12 X-coded connector. The RTL8211FS-VS Ethernet transceiver supports IEEE 1588v1, v2, and 802.1AS standard.

| Parameter | Condition |
|---|---|
| **Speed** | 10BASE-Te/100BASE-TX/1000BASE-T IEEE 802.3 |
| **Communication** | Full-duplex |
| **Cable Discharge Event** | ±30 kV CDE protection |
| **Operation** | Limited to 140 meters of CAT5 cable |

**Table 8** PBx-A1 Ethernet specification

## 7.4 Supported Protocols

### Supported message types

The PBx-A1 supports like all Fixposition devices the following message types:

- FP_A (output)
- FP_B (input and output)
- NMEA 0183 (output)
- NOV_B (output)
- RTCM3.x (input)

### Message structure

The Fixposition ASCII messages use the following framing format and general structure. Note that all the fields are separated by an ASCII 44 character ",".

| $FP,msg_type,msg_version,field$_3$,field$_4$,…,field$_N$*CC\r\n | |
|---|---|
| $ | Start character (ASCII 36). |
| FP | Fixposition ASCII message identifier (ASCII 70 + 80). |
| (field$_1$) | Message type, all capital letters (ASCII 65–90). |
| (field$_2$) | Message version, decimal number (numbers 0–9, ASCI 48–57). |
| field$_3$ | The structure of the message data is defined by the msg_type and msg_version fields.<br>Each field can contain all printable 7-bit ASCII characters (ASCII 32–126), excluding the reserved characters '!' (ASCII 33), '$' (ASCII 36), '*' (ASCII 42), ',' (ASCII 44), '\' (ASCII 92) and '~' (ASCII 126).<br>Fields can be null (the empty string) to indicate absence or unavailability of data. |
| field$_4$ | |
| … | |
| field$_N$ | |
| *CC | Checksum value obtained by applying XOR to all characters in the message. The value starts with a * (ASCII 42) and is followed by the checksum value in capital hexadecimal notation (numbers 0– 9 and letters A–F, ASCI 48–57 and 65–70). |
| \r\n | Message termination characters, CR an LF (ASCII 13 and 10). |

**Table 9** Fixposition ASCII message structure

The data fields can be of the following type:

| Type | Description |
|---|---|
| **Numeric** | Decimal integer number, one of more digits (`0–9`) and optional leading '-' sign. |
| **Float (.*x*)** | Decimal floating-point number with *x* digits fraction part. One or more digits (`0–9`) , with fractional part separated by a dot ('`.`') and optional leading '-' sign. |
| **Float (*x*)** | Decimal floating point with *x* significant digits. One or more digits (`0–9`) with optional fractional part separated by a dot ('`.`') and optional leading '-' sign. |
| **String** | String consisting of allowed field characters. |

**Table 10** Fixposition ASCII message field types

# 8 Physical connectors

## 8.1 Connectors

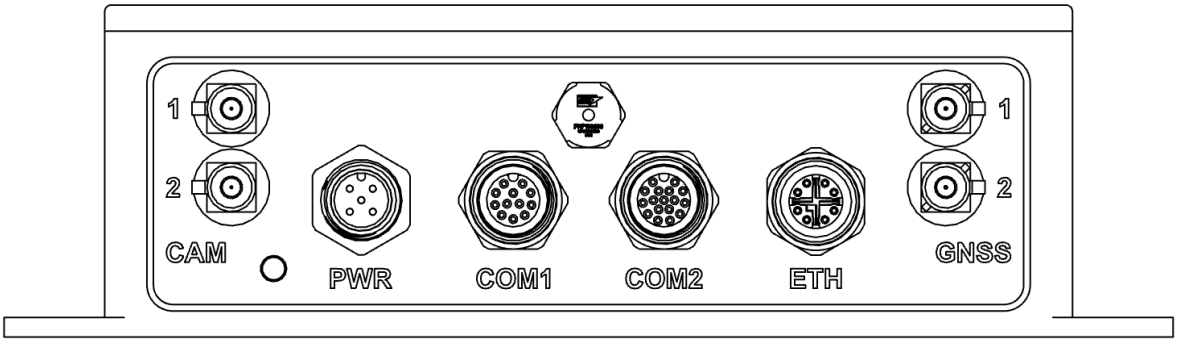


**Figure 3** PBx-A1 connectors overview

## 8.2 Ethernet

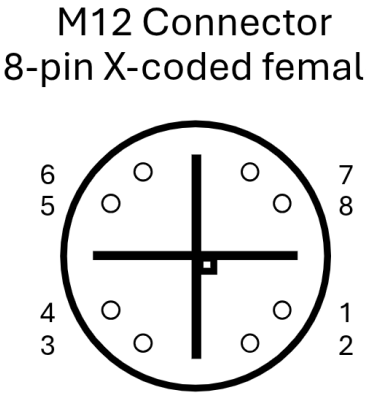


**Figure 4** Ethernet connector and cable pin overview

| Pin | Signal Name | Functionality |
|---|---|---|
| 1 | MDX0_P1 | D1+ |
| 2 | MDX0_N1 | D1- |
| 3 | MDX1_P1 | D2+ |
| 4 | MDX1_N1 | D2- |
| 5 | MDX3_P1 | D4+ |
| 6 | MDX3_N1 | D4- |
| 7 | MDX2_P1 | D3+ |
| 8 | MDX2_N1 | D3- |

**Table 11** Ethernet pin definition

## 8.3 COM1 connector

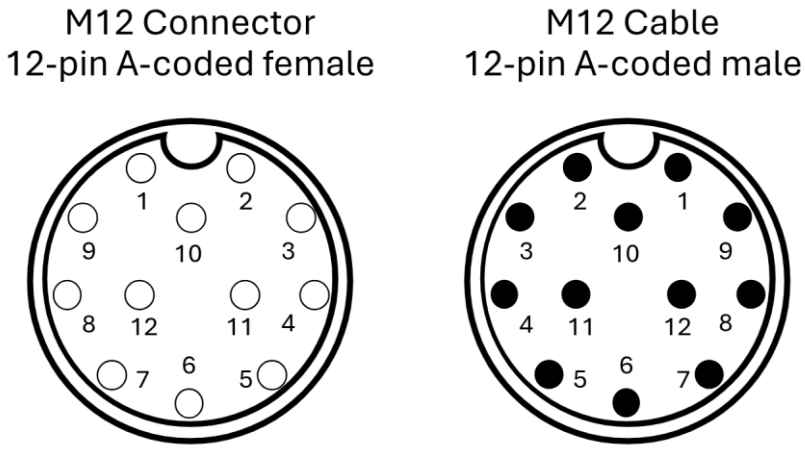


**Figure 5** COM1 connector and cable pin overview

| Pin | Wire color | Symbol | Description |
|---|---|---|---|
| **1** | Brown | 5V_OUT | Switchable 5V power supply for external peripherals |
| **2** | Blue | GND | Ground |
| **3** | White | CAN_H | CAN High |
| **4** | Green | GND_CAN | CAN Ground |
| **5** | Pink | COM_SOUT | UART1 Tx TTL 3.0V signal |
| **6** | Yellow | COM_SIN | UART1 Rx TTL 3.0V signal |
| **7** | Black | GNSS1_1PPS | PPS signal from GNSS1 receiver |
| **8** | Grey | GPIO3 | General purpose IO |
| **9** | Red | GPIO2 | General purpose IO |
| **10** | Violett | GPIO1 | General purpose IO |
| **11** | Orange | CAN_L | CAN Low |
| **12** | Light Blue | GPIO4 | General purpose IO |

**Table 14** COM1 pin definition

## 8.4 COM2 connector

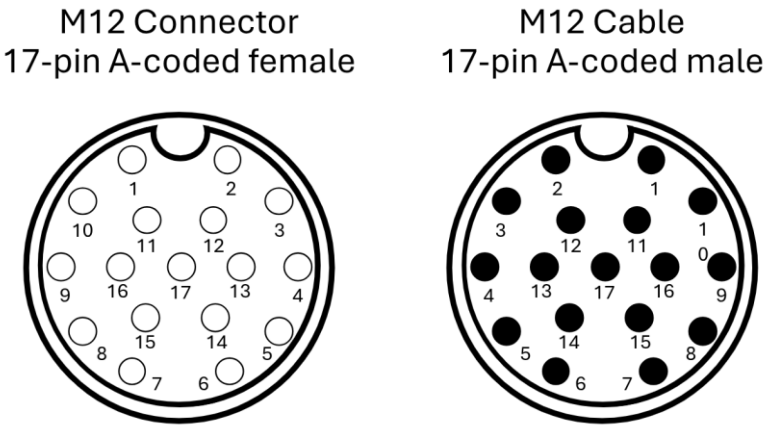


**Figure 6** COM2 connector and cable pin overview

| Pin | Wire color | Symbol | Description |
|---|---|---|---|
| 1 | Brown | 5V_OUT | Switchable 5V power supply for external peripherals |
| 2 | Blue | GND | Ground |
| 3 | White | PWR_SW | Drive low to power off the board |
| 4 | Green | GNSS2_1PPS | PPS signal from GNSS2 receiver |
| 5 | Pink | GND | Ground |
| 6 | Yellow | GPIO6 | General purpose IO |
| 7 | Black | - | Reserved |
| 8 | Grey | - | Reserved |
| 9 | Red | GND | Ground |
| 10 | Violett | RS-232_SIN | UART2 RS-232 Rx signal |
| 11 | Orange | RS-232_SOUT | UART2 RS-232 Tx signal |
| 12 | Red/White | - | Reserved |
| 13 | Green/White | GNSS2_EXTINT | External interrupt signal to GNSS2 |
| 14 | Black/White | GPIO5 | General purpose IO |
| 15 | Orange/White | - | Reserved |
| 16 | Brown/White | - | Reserved |
| 17 | Yellow/White | - | Reserved |

**Table 15** COM2 pin definition

## 8.5 Power connector

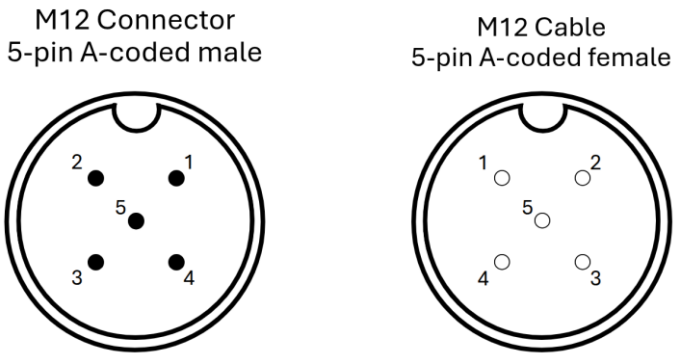


**Figure 7** Power connector and cable pin overview

| Pin | Wire color | Symbol | Description |
|---|---|---|---|
| **1/2** | Red | VCC | Main power input |
| **3/4** | Black | GND | Ground |
| **5** | | SHIELD | Shield |

**Table 16** Power pin definition

It is recommended to install a fuse on the power supply line between the user's platform and the PBx-A1.

## 8.6 GNSS antenna connectors

The PBx-A1 is equipped with two different triple-band GNSS receivers which can be connected to antennas via the male Fakra connectors labelled as GNSS 1 and GNSS 2.

| Pin | Symbol | Description |
|---|---|---|
| 1 | GMSL_RF | GNSS signal and antenna power supply |
| 2 | GND | Cable shield |

**Table 17** GNSS connector pin definition

## 8.7 GMSL camera connectors

The PBx-A1 is equipped with two GMSL camera Fakra connectors.

| Pin | Symbol | Description |
|---|---|---|
| 1 | GMSL_CAM | Camera power supply |
| 2 | GND | Cable shield |

**Table 18** GMSL Camera pin definition

# 9 Mechanical Specifications

## 9.1 Enclosure Dimensions

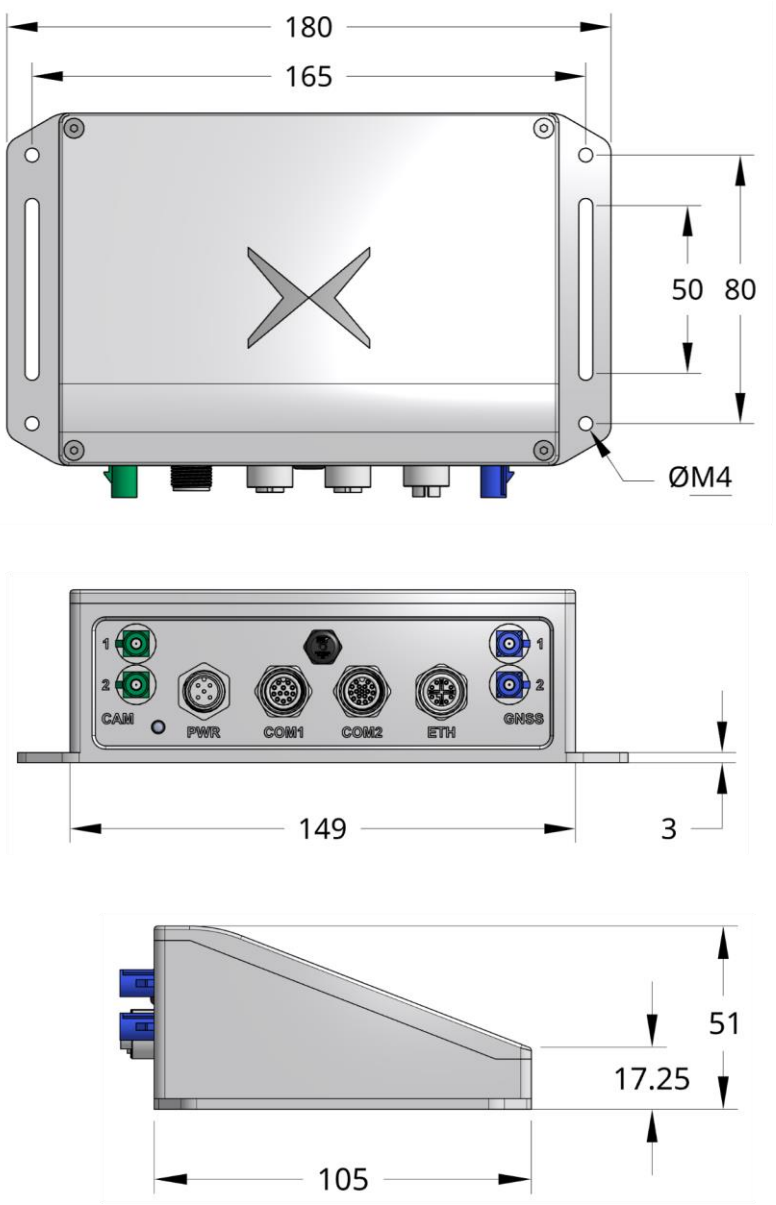


**Figure 8** PBx-A1 outer dimensions

| Mechanical characteristics | |
|---|---|
| Weight | 623 g |
| Dimensions | 180 mm x 105 mm x 51 mm |
| Mounting | Flange mount points |

**Table 17** PBx-A1 weight and dimensions

## 9.2 Sensor Frame

The origin of the sensor's reference frame is marked on the body of the device. The reference frame components are shown in the picture below. Note that all the functionalities and messages of the sensor use this as their default reference frame. Also, all extrinsics, i.e., GNSS and wheelspeed extrinsics should be measured from this point.

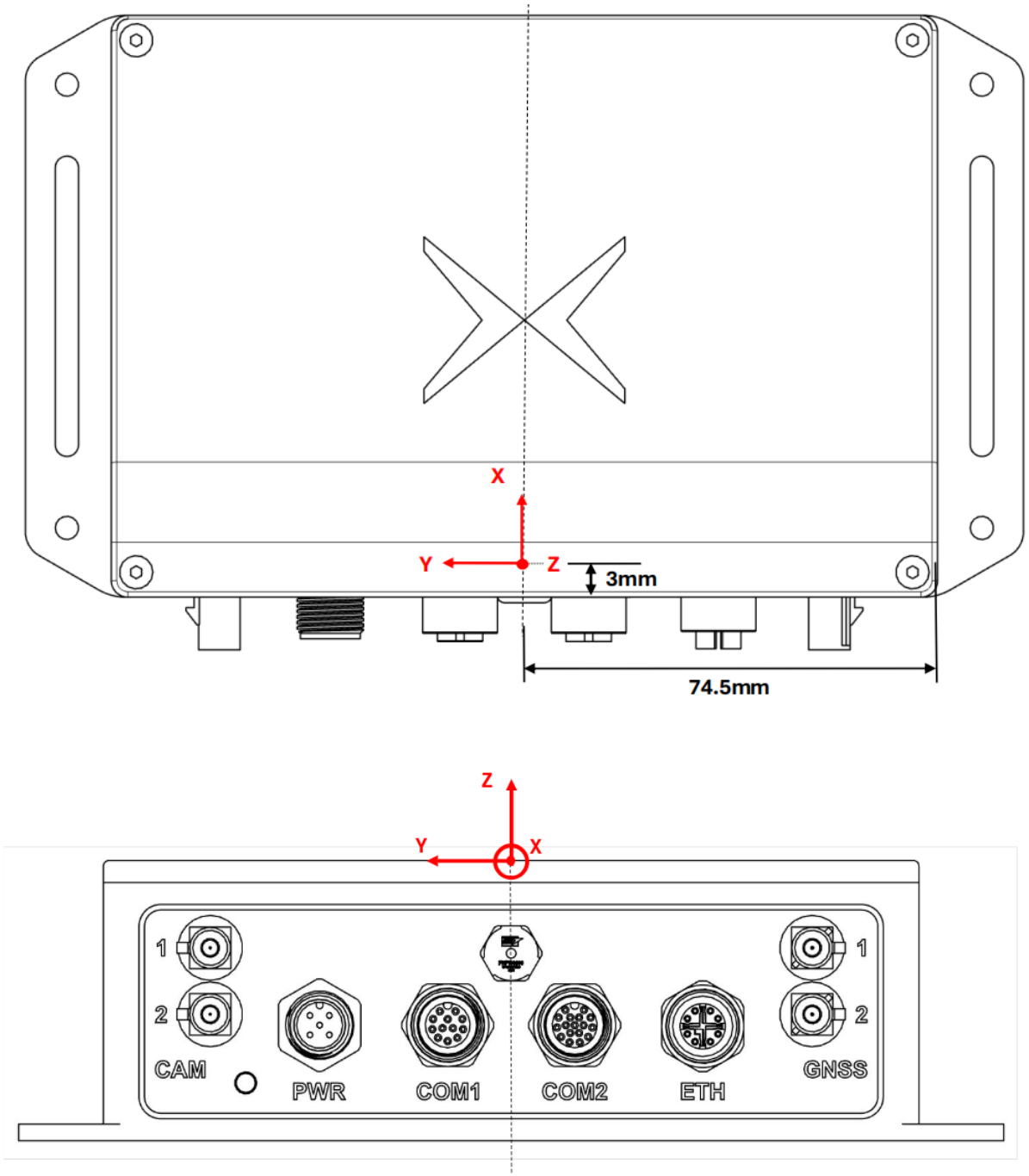


**Figure 9** PBx-A1 sensor frame

# 10 Related Documents

- PBx-A1 Integration Manual
- PBx-A1 Product Flyer.
- Quick Start Guide.

# 11 Disclaimer

Absolutely confidential, Fixposition proprietary information. All information declared herein are intended as indicative only. Only non-guaranteed, target specifications are listed. The PBx-A1 item is not a qualified engineering part, and is provided “as is”. Any express or implied warranties, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose are disclaimed. In no event shall Fixposition be liable for any direct, indirect, incidental, special, exemplary or consequential damages or injuries (including, but not limited to, procurement of substitute goods or services, loss of use, data, profits or business interruption) however caused and on any theory of liability, whether in contract, strict liability or tort (including negligence or otherwise) arising in any way of the use of the PBx-A1, even if advised of the possibility of such damage. Use under own responsibility.

# 12 Compliance

- RoHS compliant (lead-free, 2015/863/EU)
- Green (halogen-free)
- EU Radio Equipment Directive compliant 2014/53/EU
- Qualification according to ISO 16750
- Manufactured and fully tested in ISO/TS 16949 certified production sites
- CE, WEEE, FCC, UKCA

# 13 Contact

Further information on the product and its application can be obtained by contacting support@fixposition.com or by visiting the webpage https://www.fixposition.com/ and the web documentation https://docs.fixposition.com/

Fixposition AG
Rütistrasse 14
CH-8952 Schlieren, Switzerland
E-mail: support@fixposition.com