

# Data Sheet for Joysticks

## Synthesis of Joystick and Trackball

## SpaceMouse® Module



- Intuitive control of 3D-movements
- 6 degrees of freedom
- Optoelectronic sensors
- UART or USB interface

The high-precision SpaceMouse® Module is ideally suited for 3D manipulation of industrial applications. Due to its compact dimensions the module can be easily integrated into panels, armrests, desktop housings, and many more. While signals of the UART version can be individually interpreted to application needs, the USB version is recognized by the operating system as a standard joystick. Core of the module is an optoelectronic sensor from 3dconnexion, which is proving itself a million times worldwide inside 3D-mice.

| Technical Data                  | UART Interface (art.-nr. 131034)     | USB Interface (art.-nr. 131002)      |
|---------------------------------|--------------------------------------|--------------------------------------|
| <b>Electrical</b>               |                                      |                                      |
| Sensor                          | Optoelectronic                       | Optoelectronic                       |
| Digital Resolution              | 10 bit                               | 10 bit                               |
| Resolution Translation          | 250 Increments / mm                  | 250 Increments / mm                  |
| Resolution Rotation             | 170 Increments / degree              | 170 Increments / degree              |
| Data Rate                       | Max. 100 / s                         | Max. 100 / s                         |
| Supply Voltage                  | +3.3 bis +5.5 Volt                   | 5 Volt ±10%                          |
| Current Consumption             | Max. 10mA                            | Max. 20mA                            |
| <b>Physical</b>                 |                                      |                                      |
| Height                          | 52,2 mm                              | 52,2 mm                              |
| Max. Ø Cap                      | 53,8 mm                              | 53,8 mm                              |
| Weight                          | 60 g                                 | 60 g                                 |
| Ø Installation Cut-Out          | 40,2 mm                              | 40,2 mm                              |
| Thickness of Panel              | 1..5,5 mm                            | 1..5,5 mm                            |
| Installation Depth              | 15 mm                                | 15 mm                                |
| Vertical Actuation Force        | 11,0 N                               | 11,0 N                               |
| Horizontal Actuation Force      | 7,4 N                                | 7,4 N                                |
| Torque                          | 171 Nmm                              | 171 Nmm                              |
| Vertical Displacement           | 1,5 mm                               | 1,5 mm                               |
| Horizontal Displacement         | 1,5 mm                               | 1,5 mm                               |
| Twist & Tilt Angle (cw & ccw)   | 6°                                   | 6°                                   |
| Cable Length                    | 200 mm ±10mm                         | 1500 mm ±50mm                        |
| <b>Environmental Conditions</b> |                                      |                                      |
| Operating Temperature           | 0°..+50°C                            | 0°..+50°C                            |
| Storage Temperature             | -30°..+70°C                          | -30°..+70°C                          |
| Humidity (operating at T≤40°C)  | Min. 10% - Max. 85% (non condensing) | Min. 10% - Max. 85% (non condensing) |
| Humidity (storage at T≤40°C)    | Min. 10% - Max. 95% (non condensing) | Min. 10% - Max. 95% (non condensing) |
| Protection Class                | IP54                                 | IP54                                 |
| EMI                             | EN61000-4-3 (10V,10V/m)              | EN61000-4-3 (10V,10V/m)              |
| ESD                             | EN61000-4-2 / Level 4                | EN61000-4-2 / Level 4                |

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### 1 PRODUCT DESCRIPTION

#### 1.1 USAGE NOTES

The controller cap mounted on the measuring system can be moved in 6 degrees of freedom: Horizontal shift in x-direction and z-direction, vertical shift in y-direction, rotational tilt around x-axis and z-axis, plus twist around y-axis. Manipulation in several axes can be done simultaneously. For definition of axis orientation, please refer to chapter 1.3 „DEFAULT AXIS ORIENTATION“.



The SpaceMouse® Module **UART** communicates via serial interface (UART = Universal Asynchronous Receiver Transmitter). The signal levels are 0 Volt (logic 0) or VCC (logic 1), hence they are not RS232 compliant. For further details, please refer to chapter 5 „UART INTERFACE SPECIFICATION“.

The SpaceMouse® Module **USB** is recognized by the operating system as a standard joystick with 6 axes. The USB protocol follows the HID spec rev. 1.11, so no additional driver is needed.

The following operating systems are supported:

- Windows 10
- Windows 8
- Windows 7
- Windows Vista
- Windows XP SP2
- Linux with USB host support
- Other systems supporting USB joysticks

For further details, please refer to chapter 6 „USB INTERFACE SPECIFICATION“.

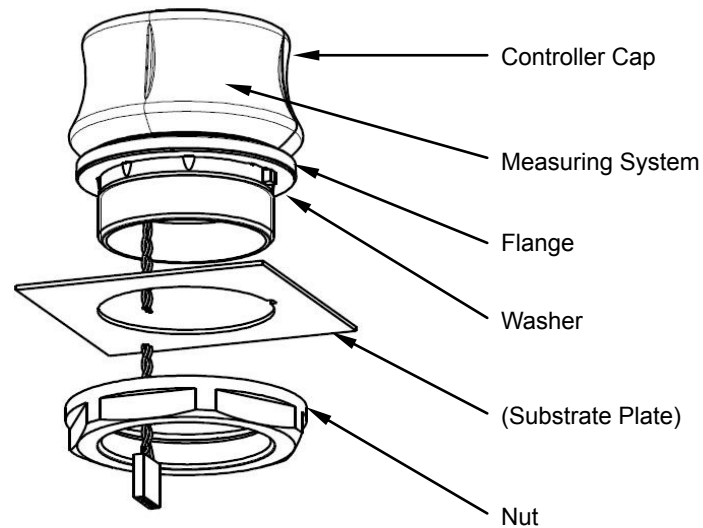
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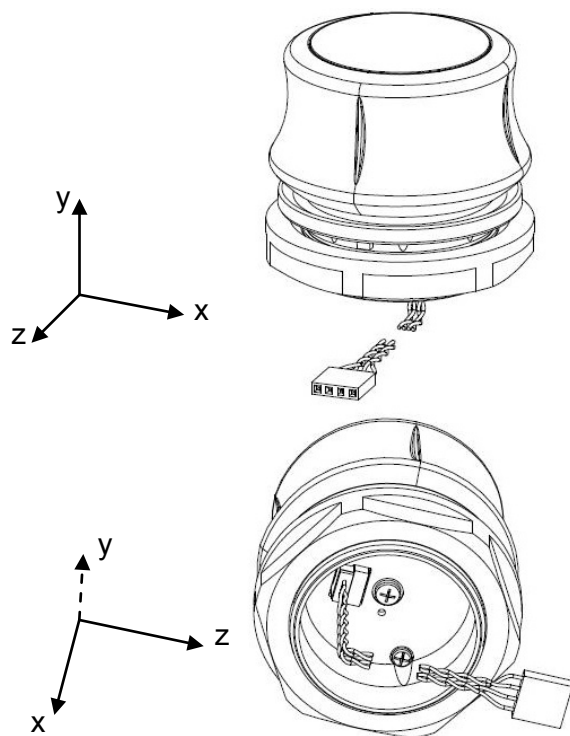
## SpaceMouse® Module

### 1 PRODUCT DESCRIPTION

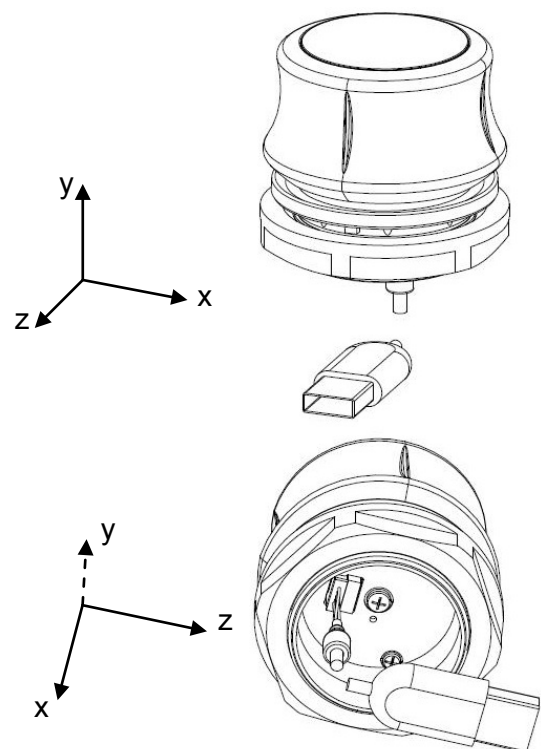
#### 1.2 COMPONENTS (shown for UART Module)



#### 1.3 DEFAULT AXIS ORIENTATION



UART Interface



USB Interface

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### 2 Tests

All tests and measurements were conducted under the following conditions unless otherwise specified:

- Temperature: 23°C (73.4°F) ± 10°C (50°F)
- Humidity: 65% ± 20%RH
- Atmospheric Pressure: 86kPa (860mBar) ~ 106kPa (1060mBar)

#### 2.1 DEGREES OF PROTECTION

##### 2.1.1 Tightness

Protection Class at least IP54

| Item   | Test Conditions  | Specifications   |
|--|--|--|
| <b>First Digit: 5<br/>(Dust protected)</b>   | Ingress of dust is not entirely prevented, but it must not enter in sufficient quantity to interfere with the satisfactory operation of the equipment; complete protection against contact |  |
| <b>Second Digit: 4<br/>(Splashing Water)</b> | Test duration: 5 min.<br>Water volume: 10 l/min.<br>Pressure: 80-100 kN/m <sup>2</sup>   | Water splashing against the enclosure from any direction shall have no harmful effect. |

Mounting conditions must be regarded for achieving this protection class.

##### 2.1.2 PWIS (paint-wetting impairment substances)

Cap with cosmetic treatment and complete SpaceMouse® Module were tested. No paint wetting impairment substances detected. (PWIS – free).

(German: LABS - frei: keine lackbenetzungsstörende Substanzen)

| Item              | Test Conditions   | Specifications   |
|-------------------|---|--|
| <b>Blast Test</b> | Test item is hanging free<br>Indicating substrate: cleaned Al-sheet<br>Gas medium: N2<br>Blast time: 30 s<br>Paint: Duplicolor 1-0400 | Blowing gas blast on test item. Indicating substrate is in discharged gas blast. After blast, indicating substrate is covered with paint. No crater or impurity on painted sheet are accepted. |

##### 2.1.3 Fire Protection

For plastic parts (Cap, Insert, Flange): Fire protection classification UL94: at least V1

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### 2 Tests

#### 2.2 TOLERANCE AND RELIABILITY

| Item                                  | Test Conditions  | Specifications   |
|---------------------------------------|--|--|
| <b>Controller Cap lifetime</b>        | (1) Operating speed: 2-3 times/s<br>(2) Force applied at center of cap-side:<br>7.4N ± 0.9N (740gf ± 90gf)   | Number of actuations: 1,000,000 times<br>No functional defects for the cap actuation   |
| <b>Drop test (only for reference)</b> | (1) Height: 100cm<br>(2) Floor surface: Steel or concrete<br>(3) Direction: 5 faces, except cable face<br>(4) Number of drops: 5 (one drop per face) | No cracks or breakage (excl. cosmetic scratches).<br>No functional defects for the buttons and Controller Cap actuation. Pop out of buttons and cap-insert is accepted when they can be pushed in again without impact to function |

#### 2.3 LIFE TEST

| Item                             | Test Conditions  | Specifications                                  |
|----------------------------------|--|---|
| <b>Burn-In Test</b>              | Expose device 24hrs to a temperature of 45°C   | No functional defects, no cosmetic degeneration |
| <b>Mean Time Between Failure</b> | 30 EA for 84 day burn-in at 45°C<br>(can differ depending on the available resources at test lab.) | Confidence Level 80%<br>MTBF = 150.000 hours    |

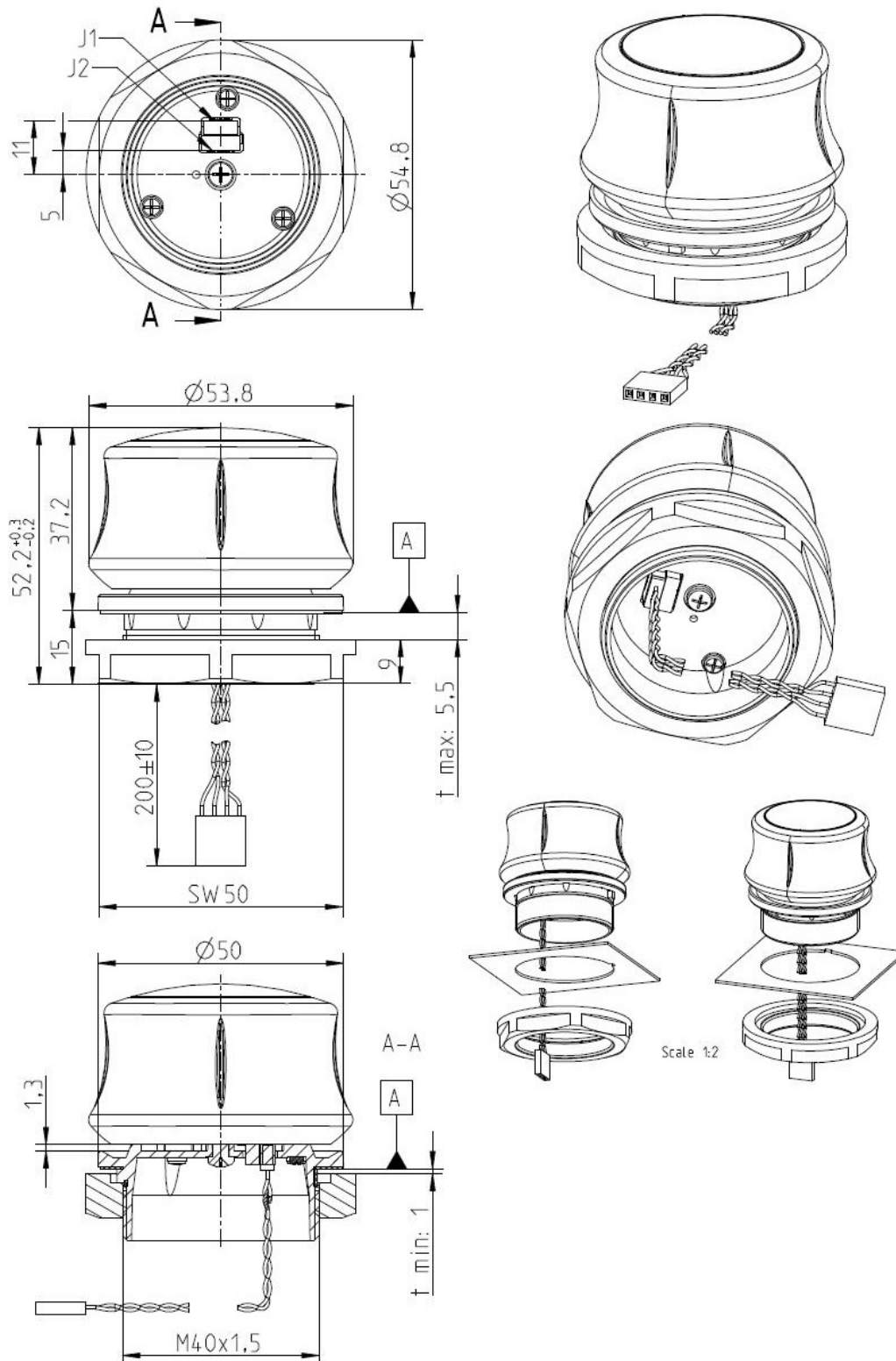
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### 3 Technical Drawing

#### 3.1 CASE OUTLINE - UART Interface



All dimensions in mm



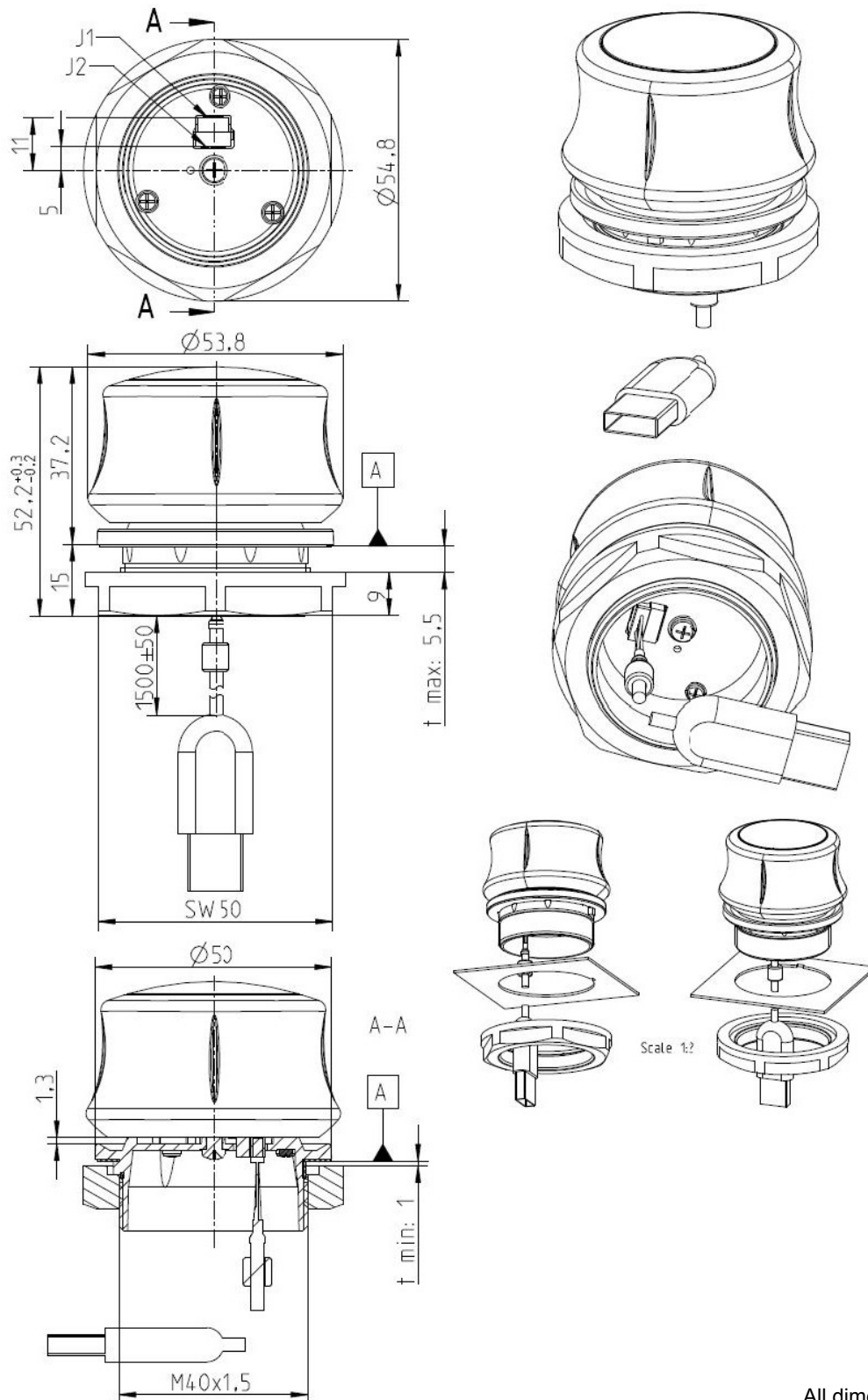
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### 3 Technical Drawing

#### 3.2 CASE OUTLINE - USB Interface



All dimensions in mm



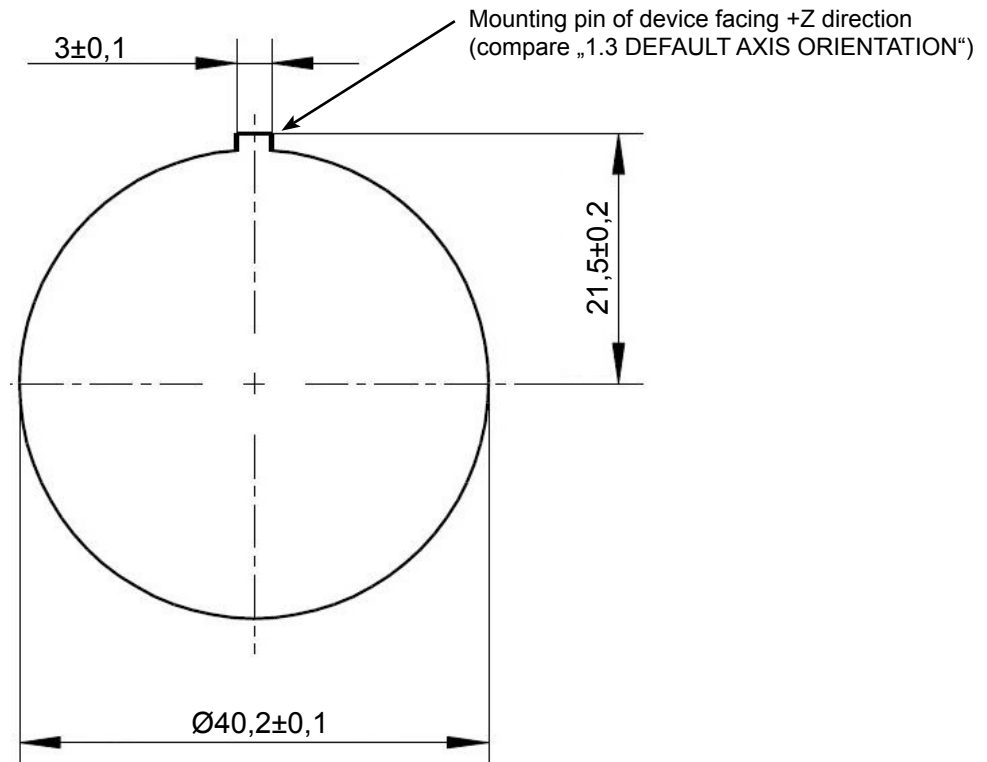
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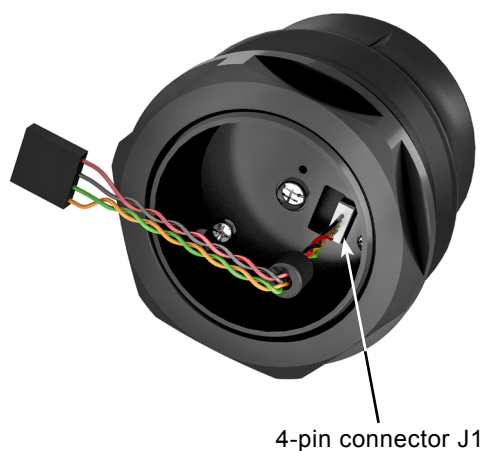
## 3 Technical Drawing

### 3.3 MOUNTING HOLE



All dimensions in mm

SpaceMouse®Module UART Interface  
Article number 131034



SpaceMouse®Module USB Interface  
Article number 131002



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### 5 UART INTERFACE SPECIFICATION

#### 5.1 ELECTRICAL

##### 5.1.1 Data interface (UART) settings

The device communicates via serial interface (UART = Universal Asynchronous Receiver Transmitter). The signal levels are 0 Volt (logic 0) or VCC (logic 1), hence they are not RS232 compliant.

##### UART settings

|           |              |
|-----------|--------------|
| Baud rate | 38400        |
| Data bits | 8            |
| Parity    | none         |
| Stop bits | 1            |
| Data rate | max. 100 / s |

##### 5.1.2 4-Pin Connector J1

The UART Module has a 4-pin male connector with 1,0mm grid pattern.  
Cable connector: JST SHR-04V-S-B with crimp contact SSH-003T-P0.2  
Connector on the module: JST BM04B-SRSS-TB

| Pin | Function           | Wire Color |
|-----|--------------------|------------|
| 1   | VCC +3.3V to +5.0V | red        |
| 2   | TxD (output)       | green      |
| 3   | RxD (input)        | orange     |
| 4   | GND                | black      |

##### 5.1.3 Cable

For connector to UART Module, please refer to chapter 5.1.2 „4 Pin Connector J1“

The connection to a console is achieved by a 4-pin female connector with 2.54mm grid pattern.

| Pin | Function           | Wire Color |
|-----|--------------------|------------|
| 1   | VCC +3.3V to +5.0V | red        |
| 2   | GND                | black      |
| 3   | TxD (output)       | green      |
| 4   | RxD (input)        | orange     |

### 5 UART INTERFACE SPECIFICATION

#### 5.2 PROTOCOL

The UART Module listens to the following commands:

| Function             | Command           | Answer |
|----------------------|-------------------|--------|
| Data request command | REQUEST_DATA      | 0xAC   |
| Zero command         | SET_ZERO_POSITION | 0xAD   |
| Start auto-data      | AUTO_DATA_ON      | 0xAE   |
| Stop auto-data       | AUTO_DATA_OFF     | 0xAF   |

##### 5.2.1 Command structure

All commands are single byte commands with MSB set to logic 1.

| Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|------|------|------|------|------|------|------|------|
| 1    | X    | X    | X    | X    | X    | X    | X    |

Each command is acknowledged by a response, each response of the 3D-Sensor is terminated by an end-byte 0x8D (MSB is set).

##### 5.2.2 UART commands

###### SET\_ZERO\_POSITION

Function: sets the current position of the device as zero-position

Command: 173 (0xAD)

Returns: 0xAD 0x8D

During power-up of the device, the current position of the device is also set as the zero-position.

###### AUTO\_DATA\_ON

Function: starts automatic transmission of data (30ms intervals)

Command: 174 (0xAE)

Returns: 0xAE 0x8D

###### AUTO\_DATA\_OFF

Function: stops automatic transmission of data

Command: 175 (0xAF)

Returns: 0xAF 0x8D

###### REQUEST\_DATA

Function: requests position data from the 3D-Sensor

Command: 172 (0xAC)

Returns: 16 bytes data

Structure: B1 B2 ... B16

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### 5 UART INTERFACE SPECIFICATION

Byte 1: start-byte 0x96 (150 decimal); every data set starts with this byte

Byte 2: high byte of X value

Byte 3: low byte of X value

Byte 4: high byte of Y value

Byte 5: low byte of Y value

Byte 6: high byte of Z value

Byte 7: low byte of Z value

Byte 8: high byte of A value

Byte 9: low byte of A value

Byte 10: high byte of B value

Byte 11: low byte of B value

Byte 12: high byte of C value

Byte 13: low byte of C value

Byte 14: high byte of Checksum

Byte 15: low byte of Checksum

Byte 16: end-byte 0x8D; every response ends with this byte

X, Y, Z, A, B, C values and the Checksum are transmitted as unsigned 14-Bit values. This is due to the fact, that the MSB of payload data is always cleared (logic 0).

#### Calculating a value:

high byte (X) low byte (X)

14-bit value (unsigned)

$X_{\text{value}} = (\text{high byte (X)} * 128 + \text{low byte (X)}) - 8192$

#### Transmitted Checksum:

$\text{Checksumtrans} = (\text{high byte (Checksumtrans)} * 128 + \text{low byte (Checksumtrans)})$

#### Calculating the Checksum:

$\text{Checksumcalc} = (\text{Byte1} + \text{Byte2} + \dots + \text{Byte13}) \& 0x3FFF$

By masking the Checksum with 0x3FFF (logic AND operation), the value is reduced to a 14-Bit value.

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### 6 USB INTERFACE SPECIFICATION

#### 6.1 ELECTRICAL & PROTOCOL

##### 6.1.1 Data interface & Protocol

The SpaceMouse® Module USB is designed for USB 1.1 and 2.0. No additional power source is needed. The module acts like a standard USB joystick with 6 axes.

##### 6.1.2 5-Pin Connector J1

The USB Module has a 5-pin male connector with 1,0mm grid pattern.  
Cable connector: JST SHR-05V-S-B with crimp contact SSH-003T-P0.2  
Connector on the module: JST BM05B-SRSS-TB

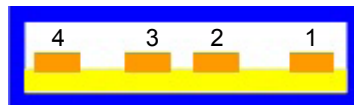
| Pin | Function  | Wire Color |
|-----|-----------|------------|
| 1   | Shield    | black      |
| 2   | GND       | black      |
| 3   | VCC +5.0V | red        |
| 4   | D-        | white      |
| 5   | D+        | green      |

##### 6.1.3 Cable

For connector to USB Sensor Module, please refer to chapter 6.1.2 „5-Pin Connector J1“.

| Electrical      | Min  | Typ  | Max   |
|-----------------|------|------|-------|
| Supply voltage  | 4.4V | 5.0V | 5.25V |
| Supply current  |      |      | 60mA  |
| Suspend current |      |      | 0.5mA |

Pin-out of USB connector



Pin-out of USB cable

| USB Plug | Wire Color | Pin Assigned in PCB | Signal             |
|----------|------------|---------------------|--------------------|
| 1        | red        | 3                   | VCC                |
| 2        | white      | 4                   | D- (inversed DATA) |
| 3        | green      | 5                   | D+ (DATA)          |
| 4        | black      | 2                   | GND                |
| Shell    | drain wire | 1                   | Shield             |

With Art.nr. 131002 a USB cable (length 1,5m) with type A connector is included