Product Specification

SpaceMouse® Module Serial

3DX-700039

www.3dconnexion.com/module

Table of Contents

1 Purpose

This document lists the product specification of 3Dconnexion's SpaceMouse® Module Serial. The purpose is to give a high level functional description of the sensor-module and to provide an overview of electrical and mechanical properties.
Furthermore this document outlines test conditions to ensure sustaining quality, reliability and specification conformity.

Figure 1: SpaceMouse® Module Serial

2 Abbreviations

In this document the following technical abbreviations are used:

PCB: Printed Circuit Board
RS232: Standard for computer serial port communication
IP: International Protection Rating
DoF: Degree of Freedom

3 Product Description

3.1 General

The 3DX-Sensor Module Serial is designed to be used as controller cap on a console.
With its round flange it is intended to fit into a hole in a substrate plate - i.e. the side of a console.

3.2 Components

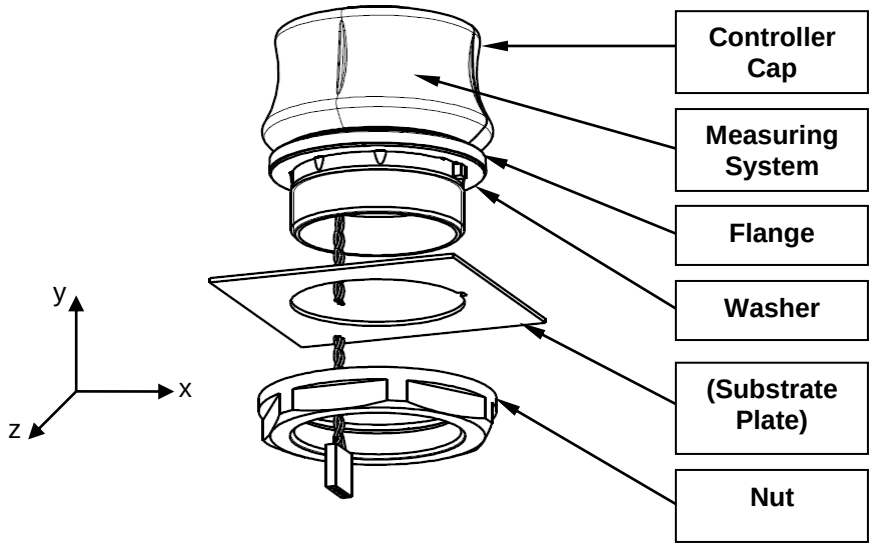


Figure 2: Components

3.2.1 Controller Cap

The shape of 3DX-Sensor cap meets the standard cap of 3DX-devices.
The cap is screwed on the upper PCB of the measuring system. The cap insert is glued and cannot be removed without damaging the device.

3.2.2 Measuring System

The movements of the cap in 6DOF are measured by an optoelectronic system. The system is protected from detrimental factors by a covering rubber seal.
Connector J1 has to be connected to the electronics of a console with a 4-core cable.

3.2.3 Flange Round

The flange is screwed to the main PCB of the measuring system.

3.3 Axis Orientation

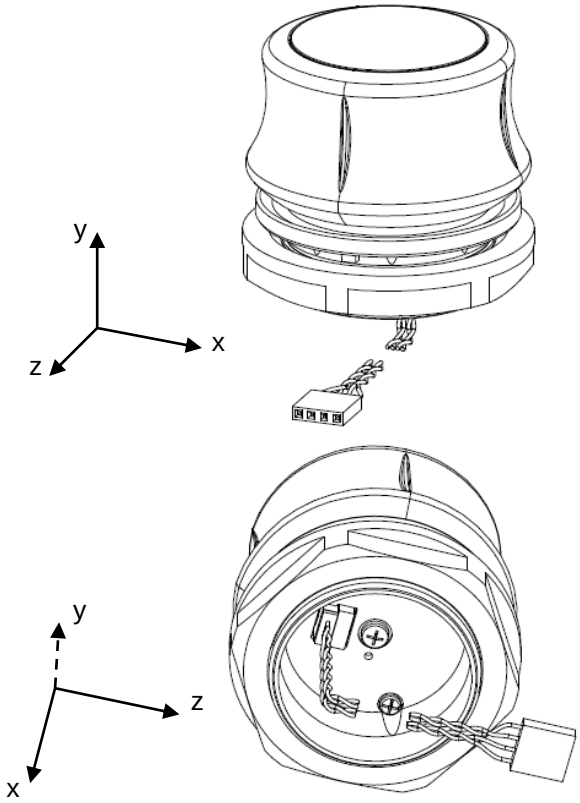


Figure 3: Default Axis Orientation

3.4 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.

4 Product Specification

4.1 Electrical

4.1.1 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

4.1.2 4 Pin Connector J1

The 3DX-Sensor Module Serial 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#	*connector*	*function color*
1	VCC +3.3V to +5.0V	red
2	TxD (output)	green
3	RxD (input)	orange
4	GND	black

4.1.3 Cable

For connector to 3DX-Sensor Module Serial refer to chapter 4.1.24 Pin Connector J1

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

Pin#	*connector*	*function color*
1	VCC +3.3V to +5.0V	red
2	GND	black
3	TxD (output)	green
4	RxD (input)	orange

4.2 Protocol

The 3DX Sensor Module Serial 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

4.2.1 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 3DX-Sensor is terminated by an end-byte **0x8D** (MSB is set).

4.2.2 3DX-Sensor 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 3DX-Sensor
Command: 172 (0xAC)
Returns: 16 bytes data
Structure: B1 B2 … B16

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)
Xvalue = (high byte (X) * 128 + low byte (X)) - 8192

Transmitted Checksum:
$Checksum_{trans}$ = (high byte ($Checksum_{trans}$) * 128 + low byte ($Checksum_{trans}$))

Calculating the Checksum:
$Checksum_{calc}$ = (Byte1 + Byte2 + … + Byte13) & 0x3FFF.
By masking the Checksum with 0x3FFF (logic AND operation), the value is reduced to a 14-Bit value.

4.3 Tracking

Tracking	*Typ*	*Comments*
Resolution Controller Cap		
Translation	250 inc/mm	Digital resolution: 10 bit
Rotation	170 inc/degree	Digital resolution: 10 bit

4.4 Physical

Physical	*Typical FO*	*Conditions /Comments*
Dimensions		
Height	52.5 mm	
Max. Ø Cap	Ø53.8 mm	
Max. Ø Flange	Ø50 mm	
Mounting		
Hole diameter	Ø40.2mm	Slot for Orientation Nose: 3mm x 1.4mm
Substrate/Plate thickness min / max	1mm / 5.5mm	
Counter Nut	M40 x 1.5	SW 50
Weight (without cable)	60 g	
Controller Cap		
Vertical actuation force	11.0 N	To force cap vertically from rest position to stop (up and down)
Horizontal actuation force	7.4 N	To force cap horizontally from rest position to stop (all horizontal directions)
Torque (around vertical axis)	171 Nmm	To twist cap form rest position to stop
Vertical displacement (up and down)	1.5 mm	From rest position to stop
Horizontal displacement (all directions)	1.5 mm	From rest position to stop
Twist and tilt angle (clockwise and counterclockwise)	6°	From rest position to stop
Cable		
Length	200 mm +/-10 mm	
Cable Configuration	See section 4.1.3 Cable	

4.5 Environmental Conditions

Environment	*Min*	*Max*	*Conditions/Comments*
Operating temperature	0 °C (32 °F)	50 °C (122 °F)	
Storage temperature	-30 °C(-22 °F)	70 °C (158 °F)	
Humidity (operating at T≤40°C)	10 %	85 %	Non condensing
Humidity (storage at T≤40°C)	10 %	95 %	Non condensing

4.6 Colors

Nr.	Component	Substrate		Paint/ Coating	Cosmetic treatment	Graphics
		Texture	Colour			
1	Cap	Micro-Matt	Midnight black	-	-	-
2	Cap Insert	Micro-Matt	Midnight black	-	-	-
3	Flange, Round	Micro-Matt	Midnight black	-	-	-
4	Nut	Micro-Matt	Midnight black	-	-	-
5	Washer	#1000	black	-	-	-
6	Label	-	-	-	-	PMS 877C

PBC Pantone Basic Colour
PMS Pantone Matching System

4.7 Compliance Specification & Certifications

This product is built with lead free solder process and all components are verified for RoHS compliance (Cd, Pb, CrVI, Hg, PBB & PBDE).

5 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)

5.1 Degrees of protection

5.1.1 Tightness

Protection Class at least IP54.

Item	Test Conditions		Specifications
First Digit: 5 (Dust protected)	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		
Second Digit: 4 (Splashing Water)	Test duration: Water volume: Pressure:	5 min. 10 l./ min. 80-100kNm2	Water splashing against the enclosure from any direction shall have no harmful effect.

Mounting conditions must be regarded for achieving this protection class.

5.1.2 PWIS

Cap with cosmetic treatment and complete 3DX-Device were tested. No paint wetting impairment substances detected. (PWIS – free).

Item	*Test Conditions*	*Specifications*
Blast Test	Test item is hanging free Indicating substrate: cleaned Al-sheet Gas medium: N_2 Blast time: 30 s 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

No PWIS test with chloroform solvent.

(German: LABS – frei: keine lackbenetzungsstörende Substanzen)

5.1.3 Fire Protection

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

5.2 Tolerance & Reliability

Item	*Test Conditions*	*Specifications*
Controller Cap lifetime	(1) Operating speed: 2-3 times/s (2) Force applied at center of cap-side: 7.4N ± 0.9N (740gf ±90gf)	Number of actuations: 1,000,000 times No functional defects for the cap actuation
Drop test (only for reference)	(1) Height: 100cm (2) Floor surface: Steel or concrete (3) Direction: 5 faces, except cable face (4) Number of drops: 5 (one drop per face)	No cracks or breakage (excl. cosmetic scratches). 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.

5.3 Life Test

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

6 Mechanical Drawing

6.1 Case Outline

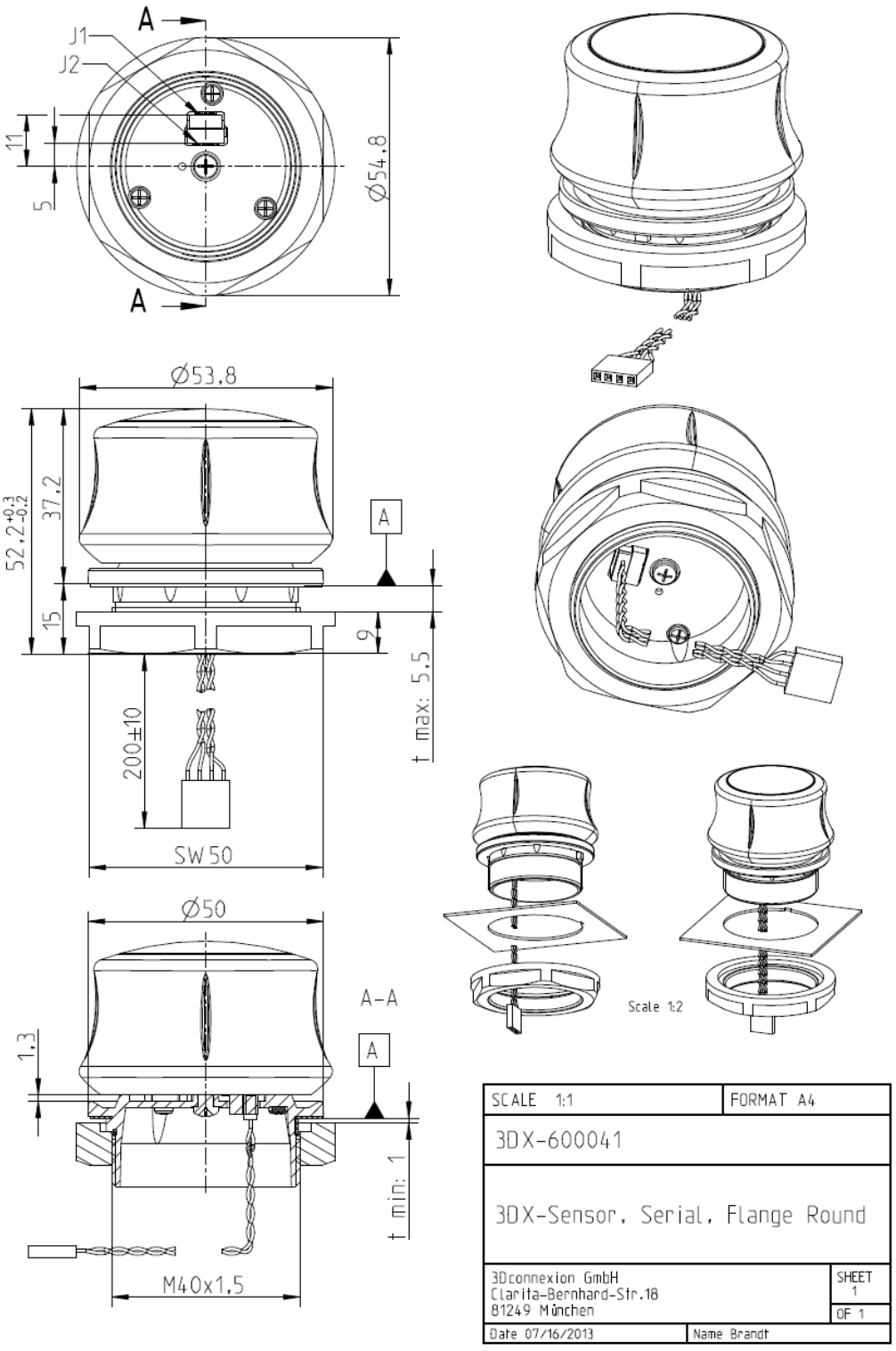
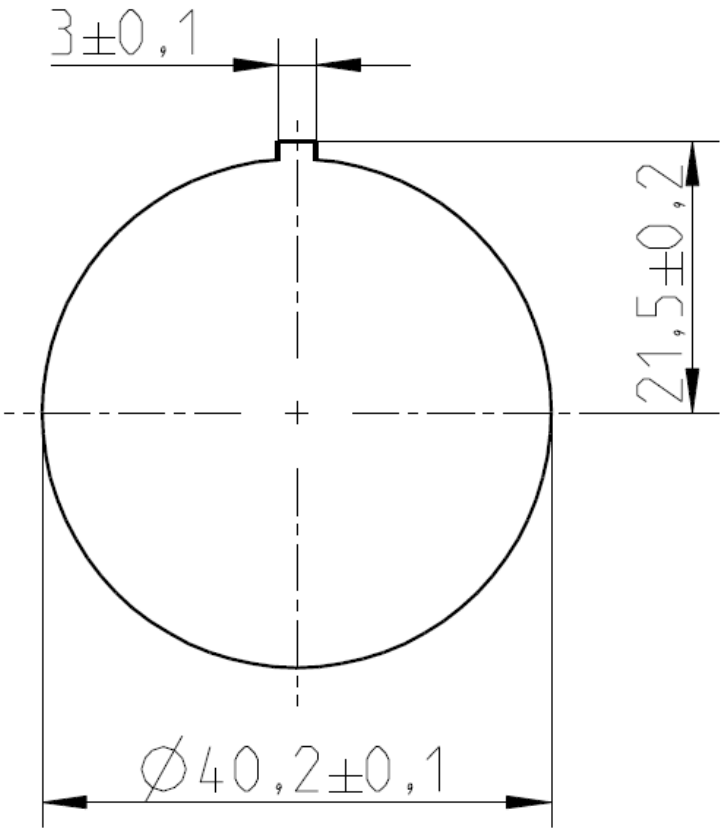


Figure 4

6.2 Mounting hole



6.3 Photos

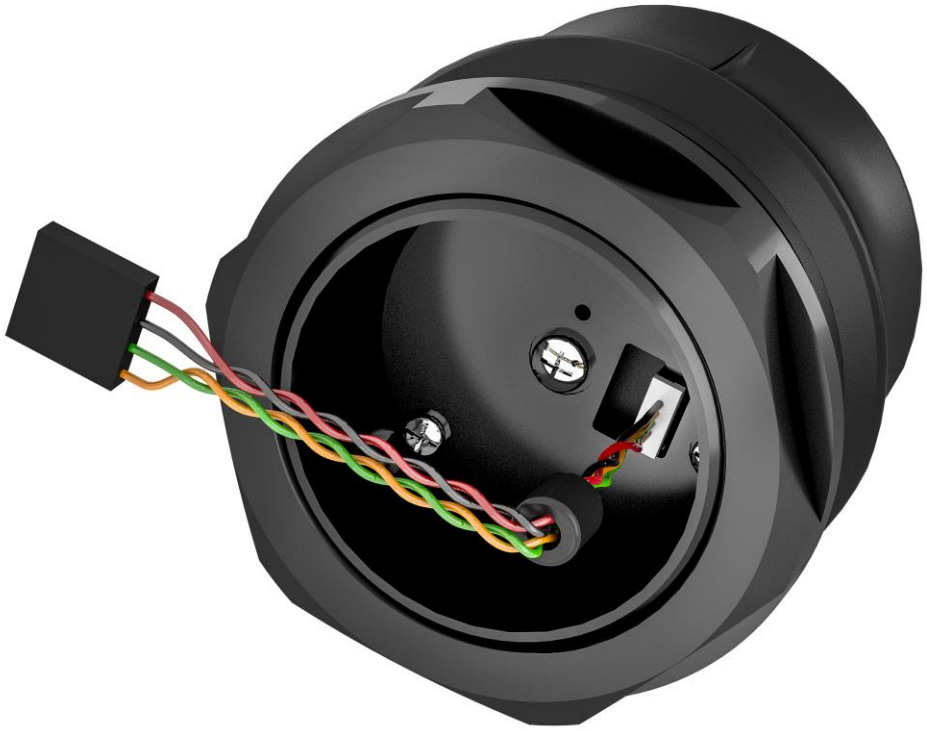


Figure 5