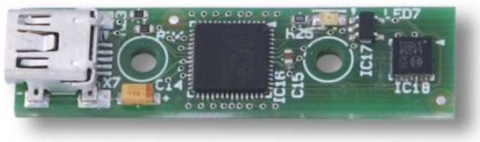
Oak Tilt

3-Axes Inclination Sensor

Datasheet



Revision history

Date	Doc. Rev.	Changes
21-Jun-2011	Rev. 1.5	Disclaimer update
17-Jan-2011	Rev. 1.4	Minor Edits
29-Oct-2010	Rev. 1.3	Added Operating Temperature Range
29-Sep-2010	Rev. 1.2	Added USB Vendor ID and Product ID
06-Mar-2008	Rev. 1.1	Minor Edits (section 3.2.6 and 3.1)
12-Sep-2007	Rev. 1.0	Programming Guide, Input Report, Access to Sensor Registers
21-May-2007	Rev. 0.9	Preliminary Release

Contents

1. Introduction

The Oak Tilt is a USB attached precision 3-axis inclination sensor. It is targeted for products requiring high performance with low power consumption. A signal conditioning ASIC and the 3D-MEMS sensing element share the same package, thus providing the lowest possible noise and highest signal quality.

The Oak Tilt can be integrated in a custom application very easily. The operating power as well as real time sensor data and uncritical sensor configuration data are all transferred through a simple USB cable. The very low power consumption, including automatic entering into sleep mode, allows using the device not only in fixed installations, but also in mobile applications.

1.1 Reference Documents

Sensor Datasheet:
http://files.toradex.com/Oak/Datasheets/Components/Oak_G_Tilt/SCA3000-D01.pdf

Programming Guide to the Oak Sensor Family
www.toradex.com/downloads/Oak_ProgrammingGuide_V0100.pdf

2. Hardware Specifications

2.1 Sensor: VTI SCA3000-D01

The SCA3000's sensing element is manufactured using the proprietary bulk 3D-MEMS process, which enables robust, stable and low noise & power capacitive sensors.
The sensing element consists of three acceleration sensitive masses. Acceleration will cause a capacitance change that will be then converted into a voltage change in the signal conditioning ASIC.

2.2 Measurement Range

Sensor data are provided in spherical coordinates:

Acceleration	Magnitude:	0 – 19.61 m/s^2 (0 – 2 g)
	Resolution:	0.0074 m/s^2
	(For higher quantities, there are also versions with a 0-29, 0-39, 0-59 or 0-177 m/s^2 Range available)	
Zenith:	0 - π rad	(0 – 180°)
	Resolution:	0.00075 rad (0.043°)
Azimuth:	0 - 2π rad	(0 – 360°)
	Resolution:	0.00075 rad (0.043°)

For more details, please refer to the sensor datasheet (link in chapter 1.1)

2.3 Supported Sensor Features

Read acceleration in spherical coordinates

Change measurement mode (sensor bandwidth)

Sample rate adjustable

Direct access to sensor specific registers

2.4 USB Interface

Interface:	USB 2.0 Full Speed (12Mbits/s)
Connector:	Standard USB Mini-B
Device Class:	HID
Vendor ID:	0x1B67
Product ID:	0x0004
Sampling Rate:	6ms to 65s, user adjustable
Report Rate:	1ms to 65s, user adjustable

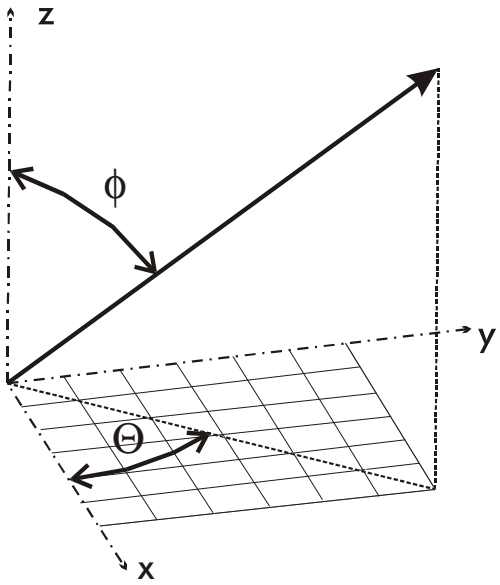
2.5 Operating Temperature Range

Minimum Operating Temperature: -10°C

Maximum Operating Temperature: +85°C

2.6 Spherical Coordinates

The Oak Tilt sensor provides its data in spherical coordinates. This is



- Absolute length of the acceleration vector
- Zenith Φ: the angle between the positive z-axis and acceleration vector
- Azimuth Θ: the angle between the positive x-axis and the line from the origin to the acceleration vector projected onto the xy-plane.

3. Software Specifications

All Oak Sensors are implemented as HID devices. Thus driver support is built into all major operating systems.

Captured sensor Data is transmitted through an INTERRUPT IN reports. Therefore real time processing can be guaranteed. This data can be received by the host using regular file read operations. Chapter 3.1 describes the contents of this report.

On an independent communication channel, sensor configuration is done using FEATURE reports that are 32 Bytes in length. Special operating system calls exist to transmit / receive feature reports. Chapter 3.2 shows the structure of a feature report for each supported command.

Please refer also to the document "Programming Guide to the Oak Sensor Family" for more details.

3.1 INTERRUPT IN Report Contents (Real time data)

16 Bit	Frame Number	10^{-3}	s
16 Bit	Acceleration magnitude	10^{-3}	m/s^2
16 Bit	Zenith angle	10^{-4}	rad
16 Bit	Azimuth angle	10^{-4}	rad

3.2 FEATURE Report Commands

3.2.1 Report Mode

Byte#	0	1	2	3	4	5
Content	GnS	Tgt	0x01	0x00	0x00	RPTMODE

GnS: 0 = Set
1 = Get

Tgt 0 = RAM
1 = Flash

RPTMODE: 0 = After Sampling (Factory Default)
1 = After Change
2 = Fixed Rate

3.2.2 LED Mode

Byte#	0	1	2	3	4	5
Content	GnS	Tgt	0x01	0x01	0x00	LEDMODE

GnS: 0 = Set
1 = Get

Tgt 0 = RAM
1 = Flash

LEDMODE: 0 = Off (Factory Default)
1 = On
2 = Blink Slowly
3 = Blink Fast
4 = Blink 4 pulses

3.2.3 Report Rate

Number of milliseconds between two IN reports. This parameter will only be regarded if Report Mode = 2 (fixed rate)

Byte#	0	1	2	3	4	5	6
Content	GnS	Tgt	0x02	0x00	0x00	RptRate LSB	RptRate MSB

GnS: 0 = Set
1 = Get

Tgt 0 = RAM
1 = Flash

RptRate: Report Rate [ms]

3.2.4 Sample Rate

This is the actual sample rate the sensor is working on. If Report Mode = 0 (After Sampling) this is also the rate at which the device reports values to the host PC.

Byte#	0	1	2	3	4	5	6
Content	GnS	Tgt	0x02	0x01	0x00	SampRate LSB	SampRate MSB

GnS: 0 = Set
1 = Get

Tgt 0 = RAM
1 = Flash

SampRate: Sample Rate [ms]

3.2.5 User Device Name

Byte#	0	1	2	3	4	5-25
Content	GnS	Tgt	0x15	0x00	0x00	UsrDevName

GnS: 0 = Set
1 = Get

Tgt 0 = RAM
1 = Flash

UsrDevName: User defined name for the whole device
Null-terminated string, max. 20+1 characters

3.2.6 User Channel Name

Byte#	0	1	2	3	4	5-25
Content	GnS	Tgt	0x15	ChP1	0x00	UsrChName

GnS: 0 = Set
1 = Get

Tgt 0 = RAM
1 = Flash

ChP1 1 = Channel 0 (Frame Number)
2 = Channel 1 (Acceleration magnitude)
3 = Channel 2 (Zenith angle)
4 = Channel 3 (Azimuth angle)

UsrChName: User defined name for the channel
Null-terminated string, max. 20+1 characters

3.2.7 Direct access to Sensor Registers

This command allow to directly read and write registers of the sensor. This can be used for example to change the measurement mode (sensor bandwidth).

Byte#	0	1	2	3	4	5
Content	GnS	0x03	0x01	RegAddr	0x00	RegValue

GnS: 0 = Set
1 = Get

RegAddr: Register Address (refer to the SCA3000 datasheet for details)

RegValue: Register content (refer to the SCA3000 datasheet for details)

4. Technical Specifications

4.1 Current Consumption

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_q [1)]	Operating current				20	mA
I_{Stby}	Standby current	No USB activity			500	µA

4.2 Mechanical Dimensions

The PCB is designed to be mounted using two standard M2 screws. There are no components on the back side of the pcb.

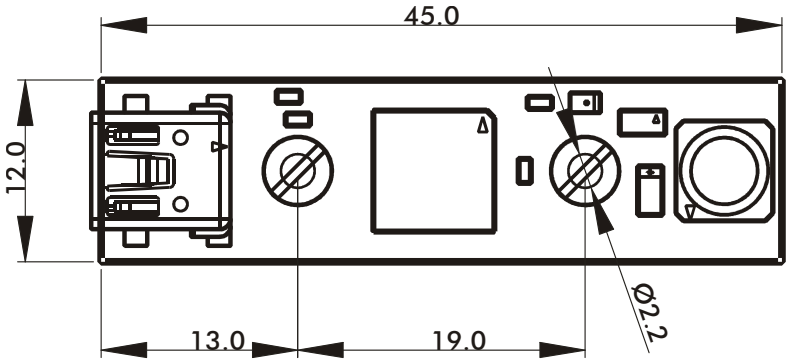


Figure 1: Mechanical dimensions of the Oak Tilt sensor

4.3 RoHS Compliance

Unless otherwise stated, all Toradex products comply with the European Union's Directive 2002/95/EC: "Restrictions of Hazardous Substances".