Oak Orient

3-Axes Accelerometer
&
3-Axes Magnetometer

Datasheet

Revision history

Date	Doc. Rev.	Changes
1-Sep-2011	Rev. 1.2	Fixed typo in sensor registers report
21-Jun-2011	Rev. 1.1	Disclaimer Update
18-Apr-2011	Rev. 1.0	Initial Release

Contents

1. Introduction

The Oak Orient is a USB attached precision 3-axes accelerometer and 3-axes magnetometer.

Applications range from compensated compassing, display orientation and motion-activated functions, through to gaming and virtual reality input devices, impact recognition and logging, as well as vibration monitoring.

The Oak Orient can be easily integrated in a custom application. 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_Orient/LSM303DLH.pdf

Application Note on using the LSM303DLH for a tilt compensated electronic compass:
http://files.toradex.com/Oak/Datasheets/Components/Oak_Orient/AN3192.pdf

Programming Guide for the Oak Sensor Family:
http://files.toradex.com/Oak/Oak_ProgrammingGuide.pdf

Oak Programming Tutorial for Windows:
http://wiki.toradex.com/index.php/Oak_Programming_Tutorial_for_Windows

2. Hardware Specifications

2.1 Sensor: LSM303DLH

The LSM303DLH sensor from STMicroelectronics is a system-in-package featuring a 3D digital linear acceleration sensor and a 3D digital magnetic sensor. The various sensing elements are manufactured using specialized micromachining processes, while the IC interfaces are realized using a CMOS technology that allows the design of a dedicated circuit which is trimmed to better match the sensing element characteristics.

2.2 Measurement Range

The Oak Orient has a linear acceleration full-scale of ±2 g / ±4 g / ±8 g and a magnetic field full-scale from ±1.3 up to ±8.1gauss, both fully selectable by the user.

Acceleration (x, y and z)	Magnitude:	±2.0 g	(Factory Default)
	Resolution:	1 mg	
	Magnitude:	±4.0 g	
	Resolution:	0.002 g	
	Magnitude:	±8.0 g	
	Resolution:	0.004 g	
Magnetic Field (x, y and z)	Magnitude:	±1.3 G	
	Magnitude:	±1.9 G	
	Magnitude:	±2.5 G	(Factory Default)
	Magnitude:	±4.0 G	
	Magnitude:	±4.7 G	
	Magnitude:	±5.6 G	
	Magnitude:	±8.1 G	

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

2.3 Supported Sensor Features

Read acceleration (3 axis)

Read magnetic field strength (3 axis)

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 / Picoblade 5 pin THT 1.25mm (see Paragraph 4.3)

Device Class: HID

Vendor ID: 0x1B67

Product ID: 0x0015

Sampling Rate: 10ms 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

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 x	10^{-3}	m/s^2
16 Bit	Acceleration y	10^{-3}	m/s^2
16 Bit	Acceleration z	10^{-3}	m/s^2
16 Bit	Magnetic Field x	10^{-4}	G*
16 Bit	Magnetic Field y	10^{-4}	G*
16 Bit	Magnetic Field z	10^{-4}	G*

* Only valid for the default magnetic range (±2.5 G). For other ranges the device must be set to raw magnetic measurement mode and the formatting performed by the user software according to the selected scale (in such case the raw data is provided on a 16 Bit word).

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 X)

3 = Channel 2 (Acceleration Y)
4 = Channel 3 (Acceleration Z)
5 = Channel 4 (Magnetic Field X)
6 = Channel 5 (Magnetic Field Y)
7 = Channel 6 (Magnetic Field Z)

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

3.2.7 Direct access to Sensor Registers

This command allows directly reading and writing 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 LSM303DLH datasheet for details)

RegValue: Register content (refer to the LSM303DLH datasheet for details)

3.2.8 Acceleration Measurement Range

The Oak Orient offers the possibility to select and pre-format measured accelerations in the three measurement ranges available in the LSM303DLH sensor.

Byte#	0	1	2	3	4	5
Content	GnS	Tgt	0x01	0x02	0x00	Range

GnS: 0 = Set
1 = Get

Tgt 0 = RAM
1 = Flash

Range: 0 = ± 2 g (Factory Default)
1 = ± 4 g
3 = ± 8 g
Other = discarded

3.2.9 Magnetic Measurement Mode

For the magnetic measurement, the Oak Orient provides a data formatting for its default range (+/-2.5 G). If any other measurement range is selected using direct access to the LSM303DLH internal registers, the Oak Orient reporting mode of the magnetic measurement must be switched to the raw output of the LSM303DLH (=value directly read from the sensor).

Byte#	0	1	2	3	4	5
Content	GnS	Tgt	0x01	0x03	0x00	Magnetic Mode

GnS: 0 = Set
1 = Get

Tgt 0 = RAM
1 = Flash

Magnetic Mode: 0 = ± 2.5 G range output scaling (Factory Default)
Other = Raw data from LSM303DLH

3.2.10 User Data Registers

The Oak Orient additionally provides 24 16 Bit registers to store user application data (typically calibration data that can for instance be stored within the device).

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

GnS: 0 = Set
1 = Get

Tgt 0 = RAM
1 = Flash

Index: Register address: 3 to 26

4. Technical Specifications

4.1 Current Consumption

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_q	Operating current				17	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.

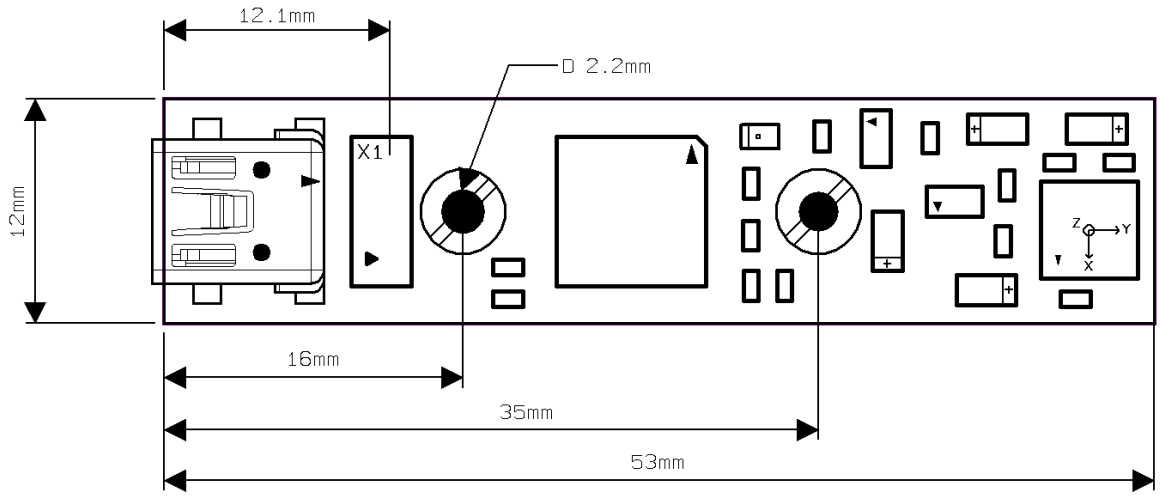

Figure 1: Mechanical dimensions of the Oak Orient sensor

4.3 Pin Assignment USB Connector

An additional crimped connector (X1) is provided for the USB interface. The connector is a 5 pin through-hole of the Picoblade family by Molex (www.molex.com), reference 53047-0510.

Pin	Name	Function
1	Shield	Connected to GND on pcb
2	GND	Ground reference
3	D+	Positive USB data
4	D-	Negative USB data
5	USB_VCC	5V USB Supply from host

4.4 RoHS Compliance

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