Xtrinsic Sensor Platform for Windows 8 User's Guide

1 Overview

The Freescale Xtrinsic Sensor Platform for Windows 8 extends sensor fusion in tablets, slates, laptops and other portable devices. This complete hardware and software solution fuses accelerometer, magnetometer, and gyroscope data using a Freescale ColdFire+ MCU.

Optimal sensor fusion provides ease of integration for streamlined development including hardware and software that supports the Microsoft® Windows 8 operating system.

The Xtrinsic Sensor Platform for Windows 8 printed circuit board and block diagram is shown in Figure 1.

The board includes the following components from Freescale Semiconductor:

- ColdFire MCF51JU128 microcontroller
- MMA8451Q 3-axis accelerometer at 7-bit I^{2}C address 0x1C
- FXMS3110CDR1 3-axis magnetometer at 7-bit I^{2}C address 0x0F

Contents

- MPL3115A2 pressure sensor/altimeter at 7-bit I^{2}C address 0x60

The board also includes the following non-Freescale components:
- EWTZNA Panasonic 3-axis gyroscope at 7-bit I^{2}C address 0x68
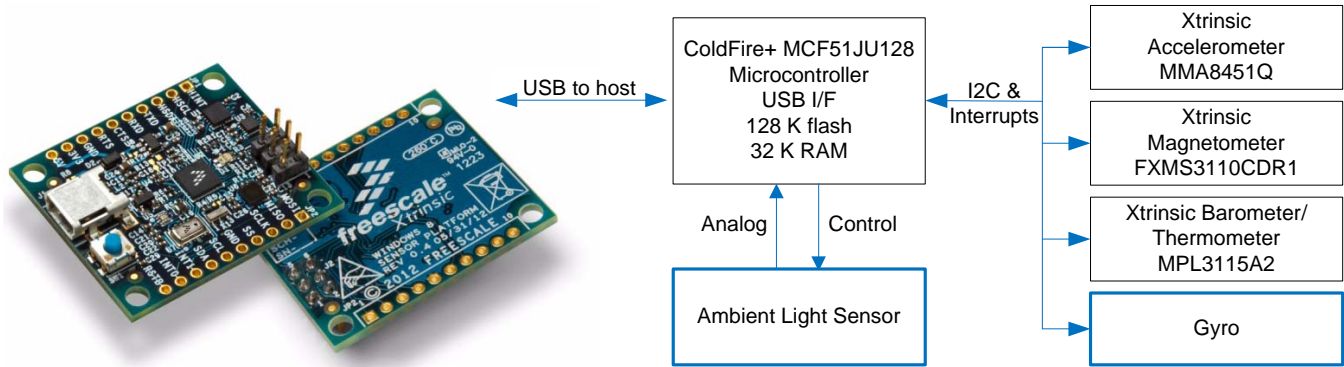- ROHM Semiconductor BH1620FVC ambient light sensor (feeds ADC input on the JU128)

Figure 1. Sensor Platform for Windows 8 board and block diagram

The Microsoft whitepaper, *Integrating Motion and Orientation Sensors*, includes the diagram provided in Figure 2.
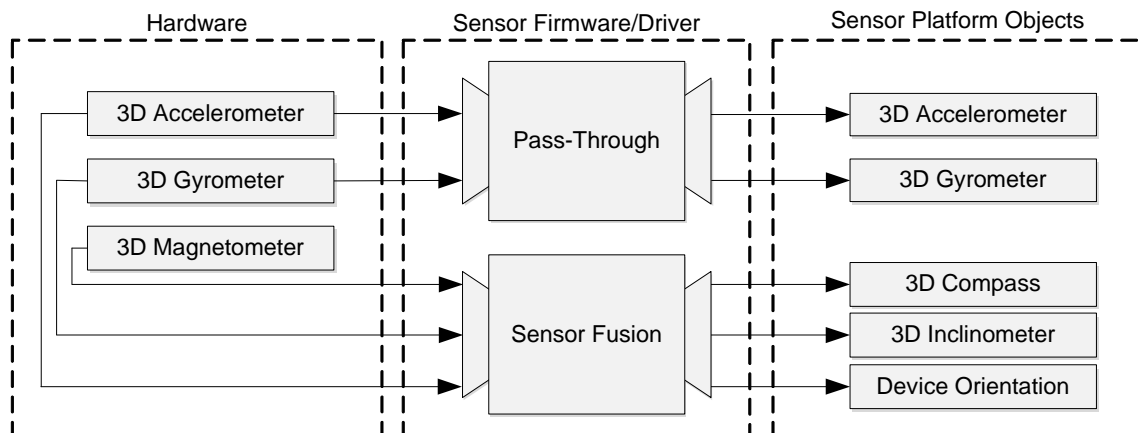

Figure 2. Integrating motion and orientation sensors

This represents a minimum baseline for Windows 8 sensor support for tablets and convertibles. The Freescale Sensor Platform for Windows 8 supports these functions as well as pressure, ambient light, and temperature.

2   Requirements

Because the Freescale Xtrinsic Sensor Platform board communicates to Windows® via a standard protocol, requirements are minimal:
- Any PC, slate, or convertible running Windows 8 and includes a USB port (not supplied), and .NET 4.0 installed

- Freescale Xtrinsic Sensor Platform for Windows 8, PCB (supplied, see Figure 1)
- Mini-USB cable (supplied)
- Xtrinsic Sensor Platform Viewer (supplied)
  - SpWin8View.exe

3 References

The reader may want to consult the following references for a more thorough understanding of the fusion concepts incorporated into this reference design.

1. Microsoft Corporation's Windows Certified Products List can be found at https://sysdev.microsoft.com/en-US/Hardware/lpl/. Set group = Device, OS = Windows 8 Client and product type = Sensors and click the search key to obtain a listing of certified products. The Freescale solution is the *12-axis Xtrinsic Sensor Hub Platform*.
2. *Introduction to Human Interface Devices - Part I*, Microsoft Corporation
3. *HID over USB*, Microsoft Corporation
4. *HID Sensor Usages*, Microsoft Corporation
5. *Integrating Motion and Orientation Sensors*, Microsoft Corporation
6. *Quaternions and Rotation Sequences*, Jack B. Kuipers, Princeton University Press, 1999

4 Installation

Installation of the Sensor Platform for Windows 8 is straightforward:

1. Connect the Xtrinsic Sensor Platform for Windows 8 PCB to your PCB via the supplied cable.
2. Copy the *SpWin8View.exe* to any desired location.

The PCB communicates with your PC or tablet via a standard mini-USB cable using the HID over USB protocol (see Section 3, "References" for details). It should become active immediately after connecting it to your machine. Windows 8 will rotate your screen to portrait/landscape mode based upon the orientation of the PCB. It will also adjust screen illumination based upon input from the ambient light sensor on the PCB. Experiment by rotating and/or shading the light sensor on the board.

If you are using a desktop or laptop computer, you may want to disable the Windows 8 screen auto-rotation feature via Settings→Screen, or by using the keyboard shortcut, Windows key + O (lock screen orientation).

NOTE

If your Windows 8 PC or tablet already has a sensor subsystem installed, you may need to disable it via the Control Panel→Device Manager prior to connecting the Xtrinsic Sensor Platform for Windows 8 PCB.

5   Xtrinsic Sensor Platform Viewer

Freescale has developed a simple demo program that shows the operation of the sensor platform on a Windows 8 PC.

The program displays:

- corrected accelerometer readings
- corrected gyro readings
- corrected magnetometer readings
- Euler angles in roll, pitch and yaw format
- Orientation in quaternion format
- Compass heading and graphical display

In addition, the program has two display modes that are selected by the radio buttons on the left side of the window. Wired mode works well when the sensor platform is connected to the PC by a cable and the PC remains stationary. In this mode the red button on the top of the gyroscope points in the direction of the top of the screen (+Y axis).
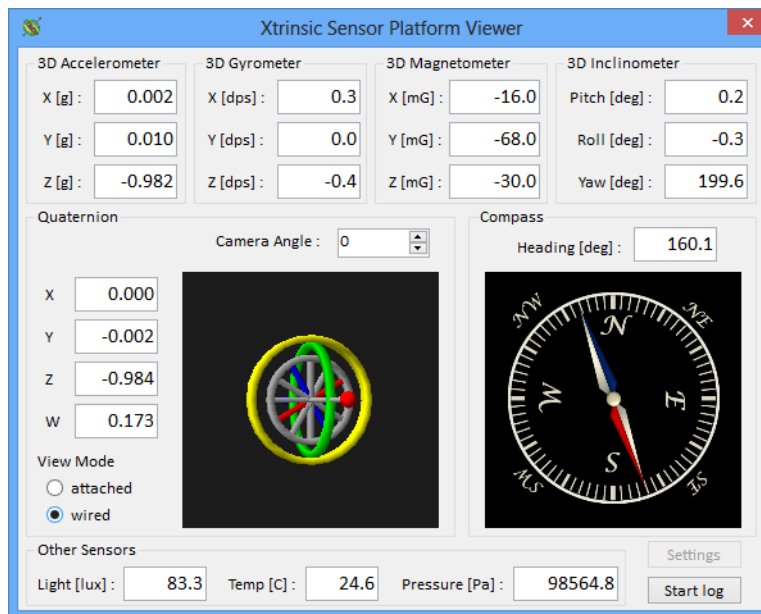

Figure 3. Wired mode when the sensor platform remains stationary

The second mode is attached mode, which is used when the sensor platform has been integrated directly into a Windows 8 tablet. In this case the gyroscope is replaced by the image of a room which appears as though looking through the screen of the tablet. When the tablet is vertical looking north you will see the door in the room. The compass rose direction changes to show which direction is north.

In the lower right of the application screen, there is a *Start log* button that can be used to initiate data logging to a text file. Clicking on that button will bring up a file selection dialog. After the output file location is specified, data logging will begin and remain running until terminated via the *Stop logging* function.
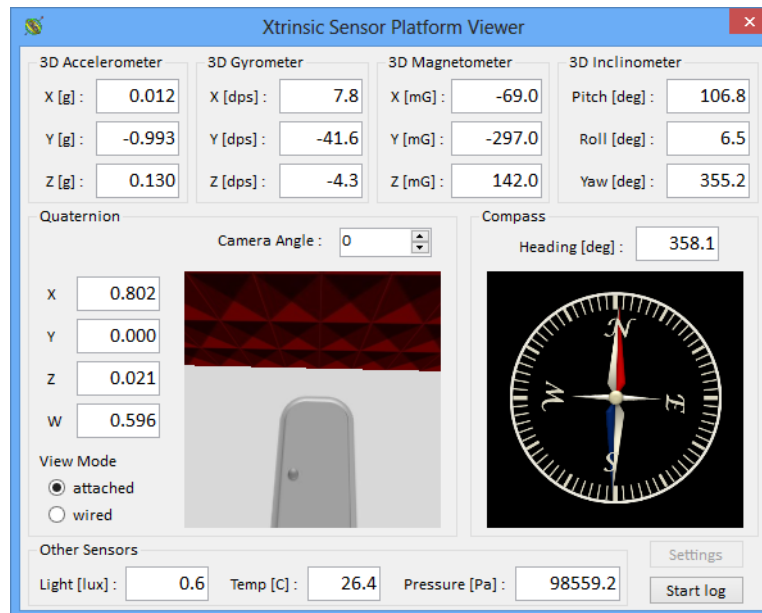
Figure 4. Attached mode when the sensor platform is integrated directly

6   Board Schematic

The Sensor Platform for Windows 8 printed circuit board schematic is provided as a separate attachment within this PDF document. In the lower left of the PDF window, click the paperclip icon to open the schematic.

NOTE

The sensors may be powered by the voltage regulator on the board (default) or an external source. If the board regulator is used, the current drawn from the USB may exceed maximum requirements (2.5 mA) during the USB suspend state.

7   Board Bill of Materials

Table 1 provides the bill of materials for the Sensor Platform for Windows 8.

Table 1. Sensor Platform for Windows 8 electrical bill of materials

Item	Quan	ASSY OPT	Reference	Value	Description	Mfg Name	Mfg Part Number	PCB Footprint
1	21		C1,C2,C3,C4,C5, C6,C7,C8,C10, C13,C14,C15, C17,C18,C20, C22,C25,C26, C27,C28,C12	0.1uF	CAP CER 0.1UF 16V 10% X5R 0402	TDK	C1005X5R1C104K	0402_CC
2	4		C9,C11,C19,C21	2.2UF	CAP CER 2.2UF 6.3V 20% X5R 0402	KEMET	C0402C225M9PACTU	0402_CC
3	1		C16	22UF	CAP CER 22UF 6.3V 20% X5R 0603	Samsung	CL10A226MQ8NRNE	0603_CC

Table 1. Sensor Platform for Windows 8 electrical bill of materials (Continued)

Item	Quan	ASSY OPT	Reference	Value	Description	Mfg Name	Mfg Part Number	PCB Footprint
4	2		C23,C24	10UF	CAP CER 10UF 6.3V 20% X5R 0603	TDK	C1608X5R0J106M	0603_CC
5	1		D1	APHBM2012SURKC GKC	LED RED/GRN DUAL 30MA SMT	KINGBRIGHT	APHBM2012SURKC GKC	led_dual_2x1p25mm_sm
6	1		D2	MBR0540T1G	DIODE PWR SCH RECT 0.5A 40V SOD-123	ON SEMICONDUCTOR	MBR0540T1G	SOD-123
7	2	DNP	JP1,JP2	HDR_1X10	HDR 1X10 TH 100MIL SP 375H AU	TYCO ELECTRONICS	1-826629-0	HDR110
8	1		J1	USB-MiniB	CON 5 USB2.0 MINI-B RA SHLD SKT SMT 0.8MM SP AU	HIROSE	UX60A-MB-5ST	con5_musb_b_skt_ra_sm
9	1		J2	HDR 2X3	HDR 2X3 TH 100MIL CTR 335H AU 95L	SAMTEC	TSW-103-07-S-D	HDR203
10	2		L1,L2	220OHM	IND FER 220OHM@100MHz 250MA 25% 0402	MURATA	BLM15HB221SN1D	0402_CC
11	5		R1,R2,R10, R11,R14	4.7K	RES MF 4.70K 1/16W 1% 0402	KOA SPEER	RK73H1ETTP4701F	0402_CC
12	1		R3	360	RES MF 360 OHM 1/16W 1% 0402	KOA SPEER	RK73H1ETTP3600F	0402_CC
13	1		R4	0	RES TF ZERO OHM 1/16W RC0402	VISHAY INTERTECHNOLOGY	CRCW04020000ZS	0402_CC
14	1	DNP	R5	1.0M	RES MF 1.0M 1/16W 5% 0402	VENKEL COMPANY	CR0402-16W-105JT	0402_CC
15	2		R6,R7	33	RES MF 33.0 OHM 1/16W 1% 0402	THYE MING TECH CO LTD	CR-02FL6---33R	0402_CC
16	1	DNP	R8	1.02M	RES MF 1.02M 1/16W 1% 0402	KOA SPEER	RK73H1ETTP1024F	0402_CC
17	1		R9	4.53K	RES MF 4.53K 1/16W 1% 0402	KOA SPEER	RK73H1ETTP4531F	0402_CC
18	1	DNP	R12	0	RES TF ZERO OHM 1/16W RC0402	VISHAY INTERTECHNOLOGY	CRCW04020000ZS	0402_CC
19	1	DNP	R13	0	RES MF ZERO OHM 1/10W—0603	VISHAY INTERTECHNOLOGY	CRCW06030000Z0EA	0603_CC
20	1		SW1	PB switch	SW SMT 4.0MM FMS 0.1A MAX 16V MAX ROHS COMPLIANT	BOURNS	7914J-1-000E	SW4_4MM
21	1		TP1	TP_35MIL	TEST POINT PAD .035 SMT, no part to order			testpoint_35mil
22	1		U1	MMA8451Q	IC 3-AXIS DIG ACCELEROMETER 14/8BIT 1.95V–3.6V QFN16	Freescale Semiconductor	MMA8451QT	QFN5X3_0P5_3X3
23	1		U2	PCF51JU128VHS	IC MCU COLDFIRE 32BIT 1.71V–3.6V LQFN44	Freescale Semiconductor	PCF51JU128VHS	LQFN44_0P65_5X5
24	1		U3	FXMS3110CDR1	IC 3-AXIS DIGITAL MAGNETOMETER 1.95V–3.6V DFN10 (Win8 Version)	Freescale Semiconductor	MAG3110FC	dfn_10_0p4_2x2
25	1		U4	SP0503B	DIODE TVS ARRAY 3CH –5V 0.225W SOT143	LITTELFUSE	SP0503BAHTG	sot_143
26	1		U5	BH1620FVC	IC AMBIENT LIGHT SENSOR 3V WSOF5	ROHM Semiconductor	BH1620FVC-TR	wsof5_0p5_1p65x1p25
27	1		U6	EWTZNA	IC 3-AXIS ANGULAR RATE SENSOR 2.4V–3.6V LGA16	PANASONIC	EWTZNA	lga16_0p5_3x3mm
28	1		U7	MPL3115A2	IC ALTIMETER I2C 50–115KPA 1.96V–3.6V LGA8	Freescale Semiconductor	MPL3115A2	LGA8_1P25_3X5_0P5
29	1		U8	LTC1844ES5-3.3	IC VREG LDO 3.3V 150MA 1.6-6.5V TSOT23-5	Linear Technology	LTC1844ES5-3.3#TRMPBF	tsot-23_0p95

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Table 1. Sensor Platform for Windows 8 electrical bill of materials (Continued)

Item	Quan	ASSY OPT	Reference	Value	Description	Mfg Name	Mfg Part Number	PCB Footprint
30	1		X1	8.00MHZ	XTAL 8.00MHZ RSN CERAMIC 0.1%–SMT	Murata	CSTCE8M00G15L99-R0	xtal3_3p35x1p45_sm

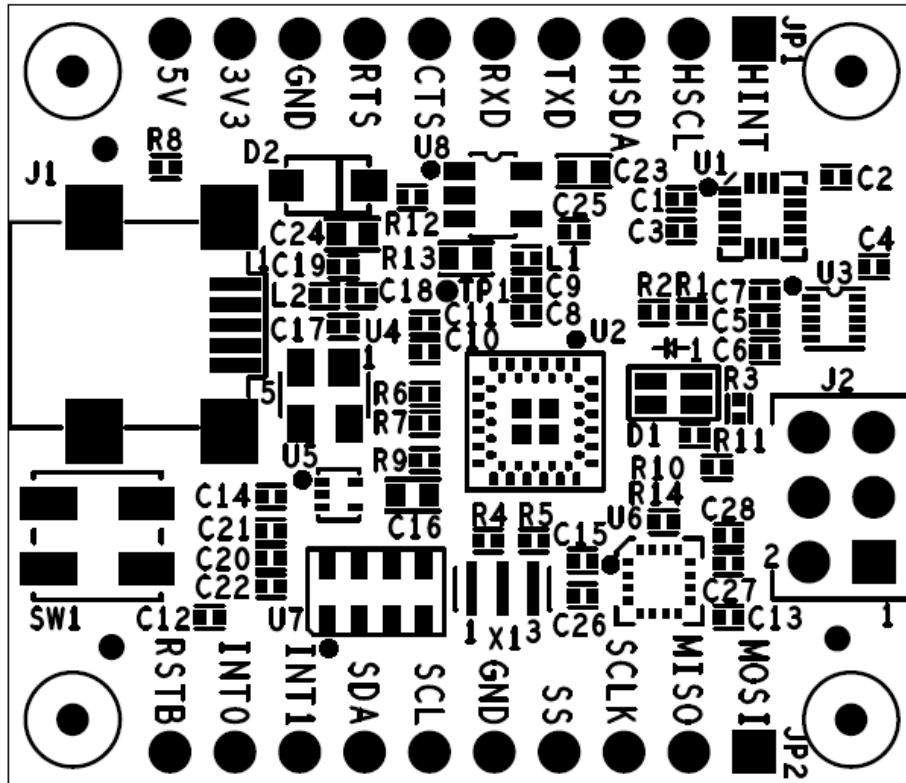# 8   Board Top View

Figure 5 shows the top view of the Sensor Platform for Windows 8 board.

Figure 5. Sensor Platform for Windows 8 board top view

9   Revision History

Revision 0 is the initial release of this document.