

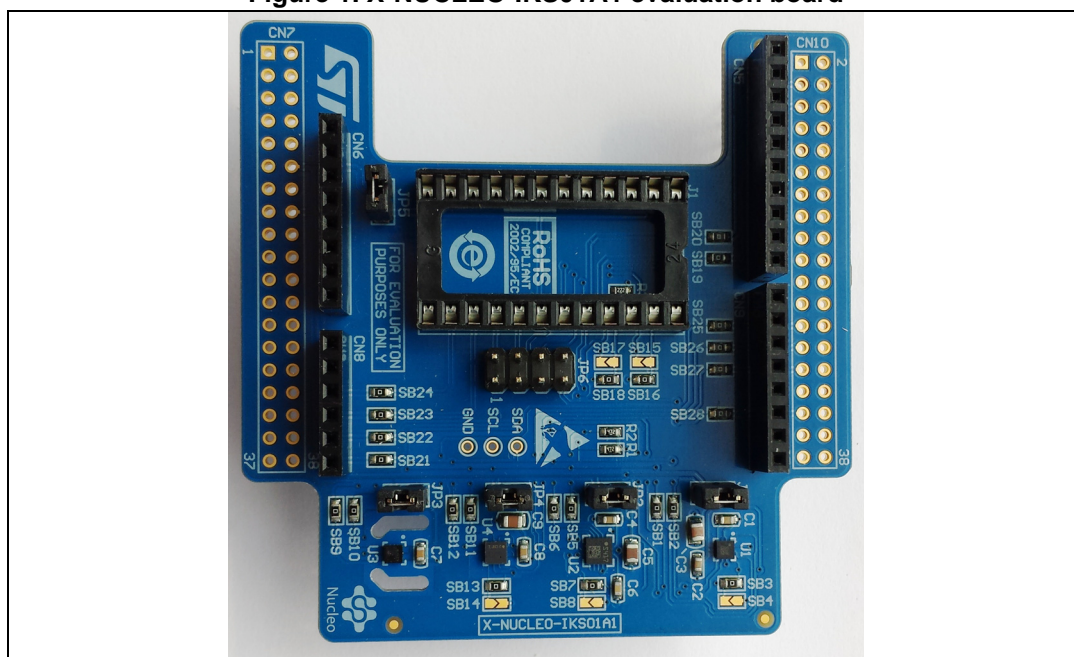
MEMS inertial and environmental sensor expansion board for STM32 Nucleo

Introduction

The X-NUCLEO-IKS01A1 is a MEMS inertial and environmental sensor evaluation board which can be used to expand the STM32 Nucleo system. It is also compatible with the Arduino UNO R3 connector layout and is designed around the STMicroelectronics 3-axis accelerometer plus 3-axis gyroscope (LSM6DS0), 3-axis magnetometer (LIS3MDL), humidity (HTS221) and pressure (LPS25H) sensors. The X-NUCLEO-IKS01A1 interfaces with the STM32 MCU via the I²C pin, and the user can change the default I²C port.

This document details the hardware requirements and board connections for the X-NUCLEO-IKS01A1 MEMS and environmental sensor expansion board for STM32 Nucleo.

Figure 1. X-NUCLEO-IKS01A1 evaluation board



Contents

1	Getting started	3
	1.1 Hardware requirements	3
2	System requirements	4
3	Hardware description	5
	3.1 Board block diagram	5
	3.2 Sensor I ² C address selection	5
	3.3 Sensor current consumption measurement	6
	3.4 Sensor disconnection	6
	3.5 DIP24 socket for adapter boards	6
	3.6 Connectors	7
4	Board schematic and bill of material	9
	4.1 Bill of material	9
	4.2 Schematic	11
5	Layout	12
6	Revision history	13

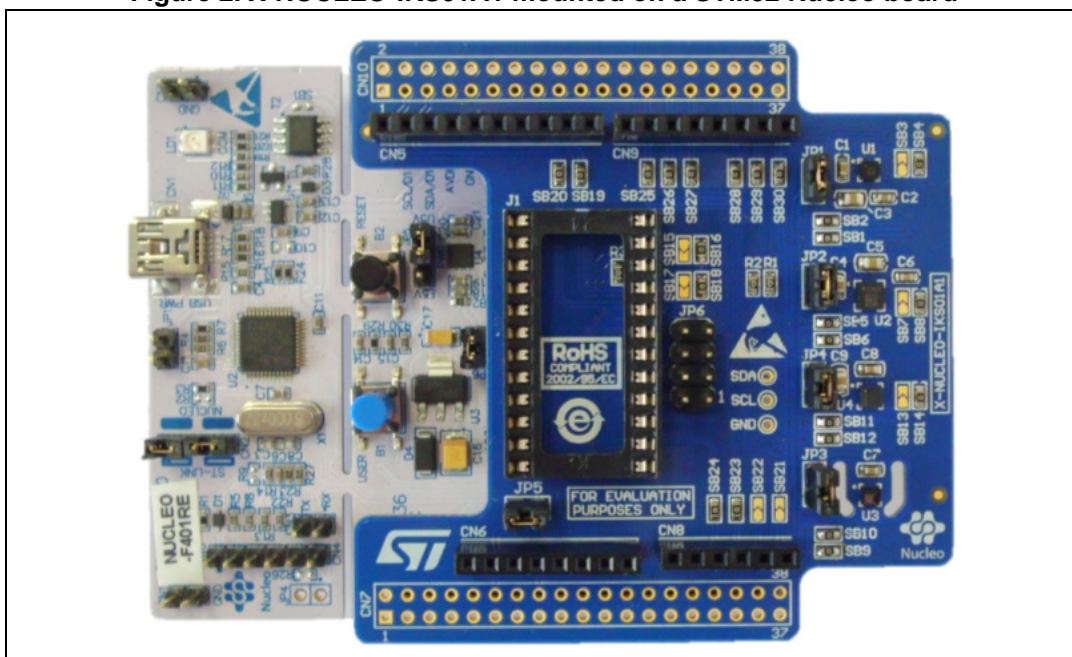
1 Getting started

This section describes the hardware requirements for the X-NUCLEO-IKS01A1 evaluation board.

1.1 Hardware requirements

The X-NUCLEO-IKS01A1 is an expansion board for use with STM32 Nucleo boards (please refer to UM1724 on www.st.com for further information). To function correctly, the STM32 Nucleo board must be connected to the X-NUCLEO-IKS01A1 board, as shown in [Figure 2](#).

Figure 2. X-NUCLEO-IKS01A1 mounted on a STM32 Nucleo board



The connection between the STM32 Nucleo and the X-NUCLEO-IKS01A1 is designed for use with any STM32 Nucleo board or Arduino UNO R3 platform.

When mounting the X-NUCLEO-IKS01A1 on the mainboard:

ensure that all the pins are aligned with their corresponding connector

It is very important to handle both boards carefully during this operation to avoid damaging or bending the male/female pins and connectors.

ESD prevention measures must also be implemented to avoid damaging any X-NUCLEO-IKS01A1 board components.

2 System requirements

Using the Nucleo boards with the X-NUCLEO-IKS01A1 expansion board requires the following software and hardware:

- a Windows[®] (XP, Vista, 7, 8) PC on which to install the software
- a USB type A to Mini-B USB cable to connect the Nucleo to the PC for installation of the board firmware package (order code: X-CUBE-IKS01A1). A utility running on the user's PC will complete the demo. The user's PC must have the following characteristics:
 - At least 128 MB of RAM
 - 40 MB of available hard disk space for the X-CUBE-IKS01A1 firmware package and relative documentation, available on www.st.com

3 Hardware description

The board allows the user to test the functions of the STMicroelectronics motion MEMS accelerometer, gyroscope, magnetometer and environmental sensors for humidity, temperature and pressure.

The devices used on the board are:

- LSM6DS0: MEMS 3D accelerometer ($\pm 2/4/8g$) + 3D gyroscope ($\pm 245/500/2000dps$)
- LIS3MDL: MEMS 3D magnetometer ($\pm 4/8/12/16$ gauss)
- LPS25H: MEMS pressure sensor, 260-1260 hPa absolute digital output barometer
- HTS221: Capacitive digital relative humidity and temperature sensor

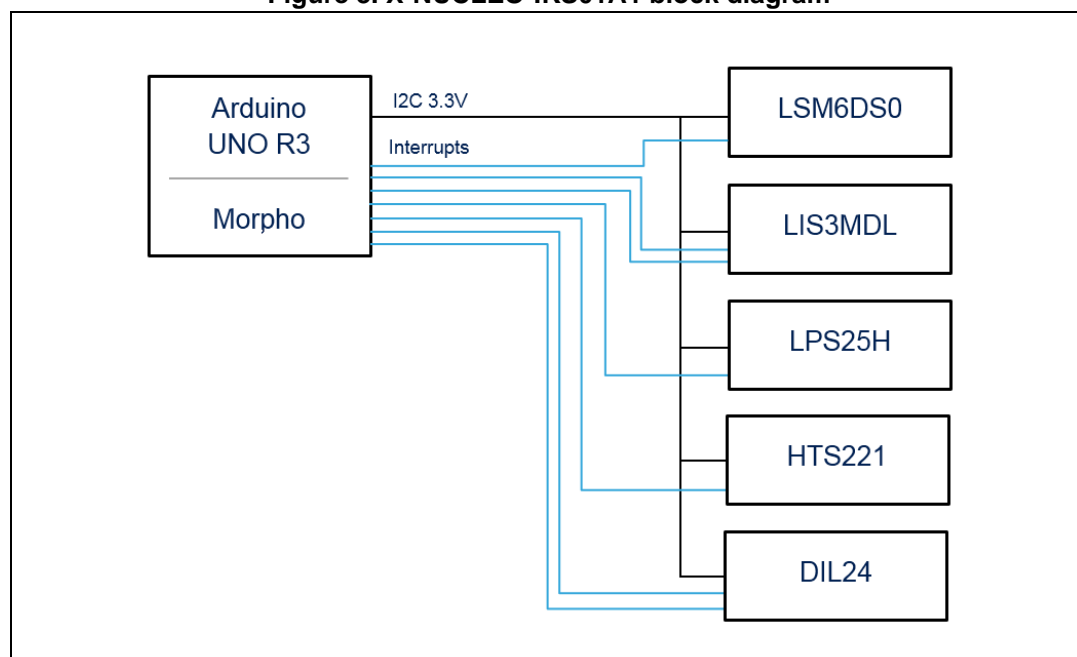
The X-NUCLEO-IKS01A1 also has a DIL24 socket to connect and test additional sensors (i.e. UVI sensors, other MEMS sensor, etc...).

The sensors are connected on a single bus via I²C and each device has a separate power supply to allow measurement of the power consumption of each single sensor.

3.1 Board block diagram

Figure 3 shows a block diagram of the X-NUCLEO-IKS01A1 board.

Figure 3. X-NUCLEO-IKS01A1 block diagram



3.2 Sensor I²C address selection

Most of the sensors allow selection of the LSB of the I²C address by pulling the SD0 pin low or high. The board has solder bridges to control the SD0 level.

Table 1. Solder bridges for SD0 level control

Sensor	SD0 High	SD0 Low
LIS3MDL (U1)	SB3 (default)	SB4
LSM6DS0 (U2)	SB7 (default)	SB8
LPS25H (U4)	SB13 (default)	SB14
DIL24 Adapter (J1)	SB15/SB17	SB16/SB18 (default)

3.3 Sensor current consumption measurement

To measure the individual current consumption of each sensor, connect the ammeter at the appropriate jumper points. Use an ammeter with a low burden voltage and set it to a suitable range as the sensor current consumption is typically very low.

Table 2. Jumpers for current consumption measurement

Sensor	Jumper
LIS3MDL (U1)	JP1
LSM6DS0 (U2)	JP2
HTS221 (U3)	JP3
LPS25H (U4)	JP4
DIL24 Adapter (J1)	JP5

3.4 Sensor disconnection

To disconnect a sensor, disconnect the I²C bus as well as the power supply. [Table 3](#) will help you identify the appropriate jumpers and solder bridges.

Table 3. Link between sensors, jumpers and I²C solder bridges

Sensor	Power	SDA	SCL
LIS3MDL (U1)	JP1	SB2	SB1
LSM6DS0 (U2)	JP2	SB6	SB5
HTS221 (U3)	JP3	SB9	SB10
LPS25H (U4)	JP4	SB12	SB11

3.5 DIP24 socket for adapter boards

Sensors can be added via adapter boards connected to the DIL24 socket J1. Please visit www.st.com to find other sensors that are available.

As there are various interrupt signal assignments to DIL24 pins, the appropriate pin can be selected using the JP6 header.

3.6 Connectors

The pin assignments for the Arduino UNO R3 and the Morpho connectors are shown in [Table 4](#) and [Table 5](#) respectively.

Table 4. Arduino UNO R3 connector table

Connector	Pin ⁽¹⁾	Signal	Remarks
CN5	7	GND	-
	9	I ² C SDA	
	10	I ² C SCL	
CN6	2	3.3V	-
	4	3.3V	
	6	GND	
	7	GND	
CN8	3	INT1 (DIL24)	-
	4	INT2 (DIL24)	
	5	LIS3MDL INT1	
	6	LIS3MDL DRDY	
CN9	3	USER INT (optional)	-
	5	LSM6DS0 INT1	
	6	LPS25H INT1	
	7	HTS221 DRDY	

1. Any unlisted pins are not connected.

Table 5. ST Morpho connector table

Connector	Pin ⁽¹⁾	Signal	Remarks
CN7	12	3.3V	-
	16	3.3V	
	20	GND	
	22	GND	
	32	INT1 (DIL24)	
	34	INT2 (DIL24)	
	36	LIS3MDL INT1	
	38	LIS3MDL DRDY	
	3	I ² C SCL	-
CN10	5	I ² C SDA	
	25	HTS221 DRDY	
	27	LPS25H INT1	
	29	LSM6DS0 INT1	
	33	USER INT (optional)	

1. Any unlisted pins are not connected.

4 Board schematic and bill of material

This section contains the bill of material, schematic and layout of the X-NUCLEO-IKS01A1.

4.1 Bill of material

Table 6. X-NUCLEO-IKS01 bill of material

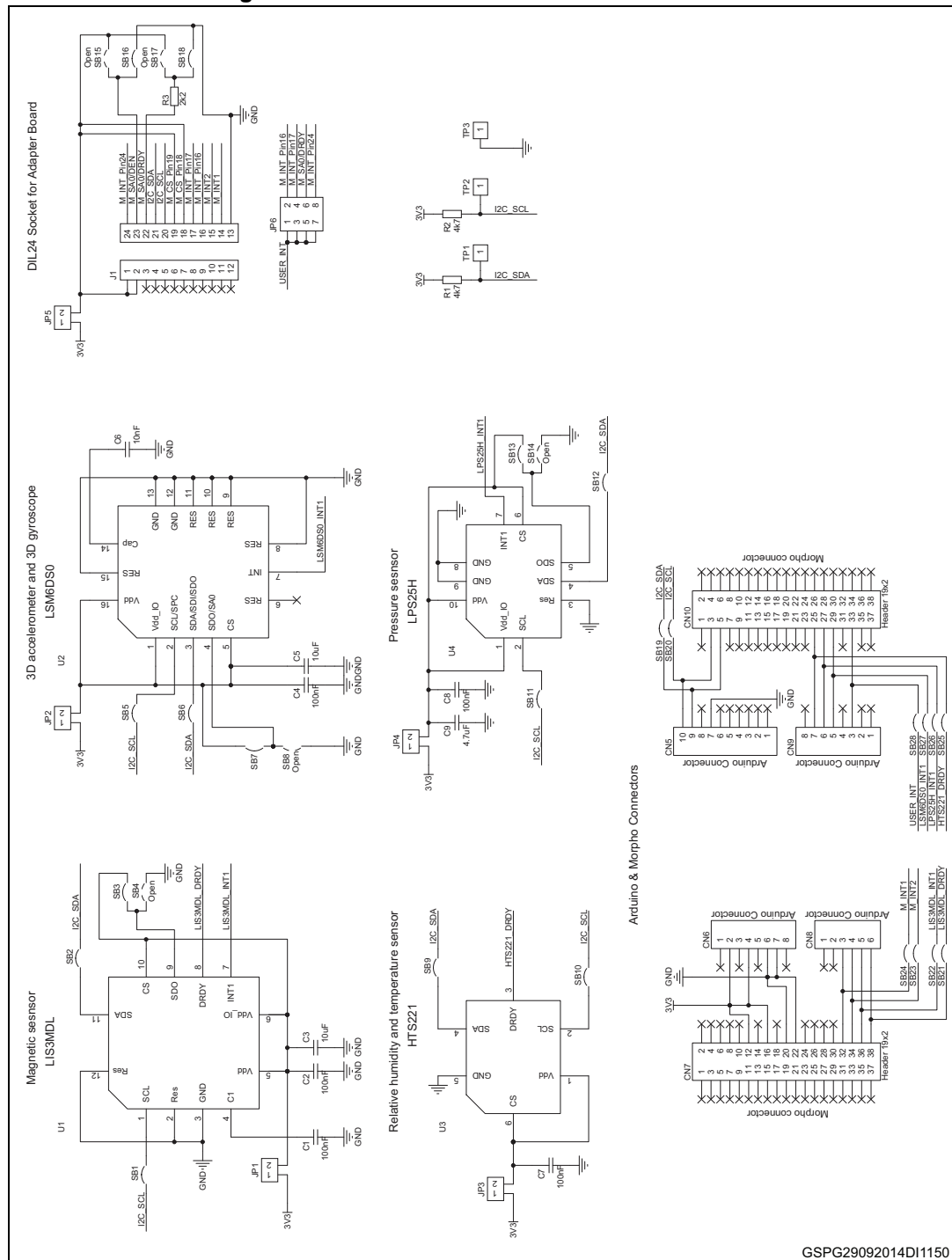
Quantity	Designator	Value	Part number	Comment	Package reference
5	C1, C2, C4, C7, C8	100nF	CAP CER 0603 100nF 25V X7R 10%		0603
2	C3, C5	10uF	CAP CER 0805 10uF 10V X7R 10%		0805
1	C6	10nF	CAP CER 0603 10nF 25V X7R 10%		0603
1	C9	4.7uF	CAP CER 0805 4.7uF 16V X7R 10%		0805
1	CN5	Header 10x1	Extra-long 10 pins female-male strip	Female side mounted to the top	HDR1X10
2	CN6, CN9	Header 8x1	Extra-long 8 pins female-male strip	Female side mounted to the top	HDR1X8
2	CN7, CN10	Header 19x2	Header, 19-Pin, Dual row	Not mounted	HDR2X19
1	CN8	Header 6x1	Extra-long 6 pins female-male strip	Female side mounted to the top	HDR1X6
1	J1	DIL24 Socket	DIL24 Socket		DIL24
5	JP1, JP2, JP3, JP4, JP5	Header 2x1	Header 1x2 pins, 2.54mm, straight		HDR1x2
1	JP6	Header 4x2	Header 2x4 pins, 2.54mm, straight		HDR2x4
2	R1, R2	4k7	RES 0603 4k7 1% 1/16W		0603
1	R3	2k2	RES 0603 2k2 1% 1/16W		0603

Table 6. X-NUCLEO-IKS01 bill of material (continued)

Quantity	Designator	Value	Part number	Comment	Package reference
23	SB1, SB2, SB3, SB5, SB6, SB7, SB9, SB10, SB11, SB12, SB13, SB16, SB18, SB19, SB20, SB21, SB22, SB23, SB24, SB25, SB26, SB27, SB28	Solder Bridge	R0603 0R	Close	0603
5	SB4, SB8, SB14, SB15, SB17	Solder Bridge		Open	0603
3	TP1, TP2, TP3	Header 1x1	Header 1x1 pins, 2.54mm, straight	Not mounted	
1	U1	LIS3MDL	LIS3MDL	ST-SUPPLY	LGA 2x2 12L
1	U2	LSM3DS0	LSM6DS0	ST-SUPPLY	LGA 3x3 16L
1	U3	HTS221	HTS221	ST-SUPPLY	HLGA 2x2 6L
1	U4	LPS25H	LPS25H	ST-SUPPLY	HCLGA 2.5x2.5 10L

4.2 Schematic

Figure 4. X-NUCLEO-IKS01A1 circuit schematic



5 Layout

Figure 5. X-NUCLEO-IKS01A1 top side layout

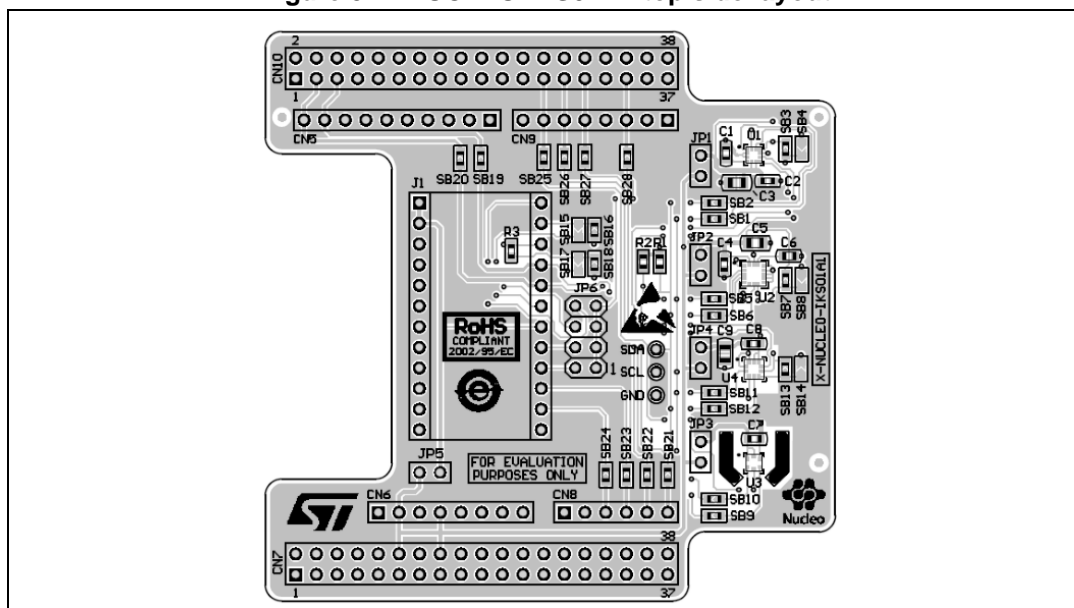
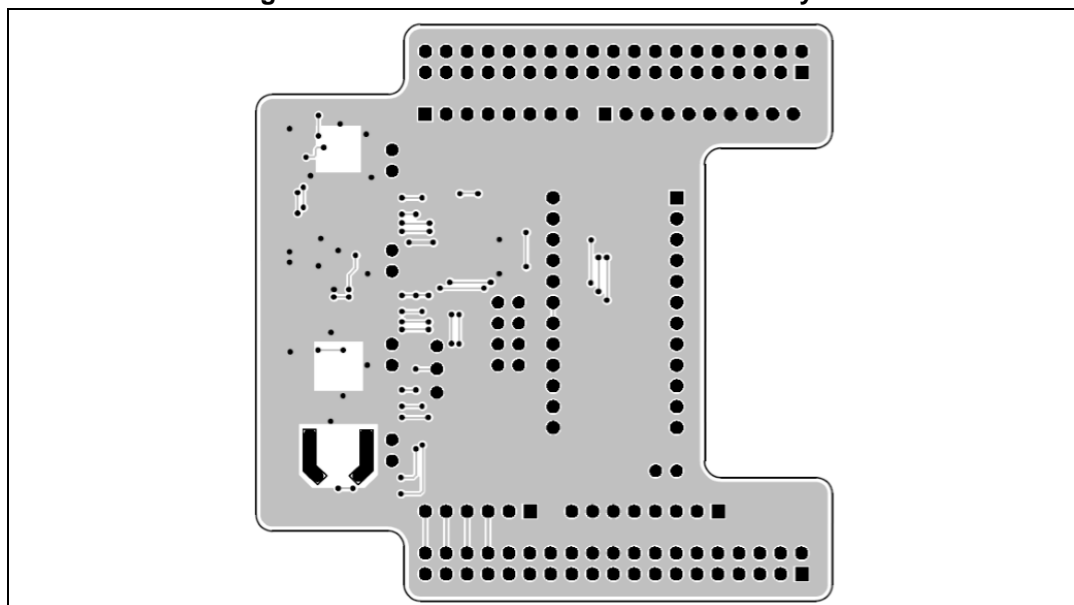


Figure 6. X-NUCLEO-IKS01A1 bottom side layout



6 Revision history

Table 7. Document revision history

Date	Revision	Changes
06-Nov-2014	1	Initial release.

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