



USER MANUAL

SENSOR ARDUINO SHIELD

2501000101291

VERSION 1.1

OCTOBER 17, 2024

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

Revision history

Manual version	HW version	Notes	Date
1.0	2.2	<ul style="list-style-type: none">Initial version	November 2020
1.1	2.2	<ul style="list-style-type: none">New corporate design	October 2024

Software revision history

Manual version	SW version	Notes	Date
1.0	1.0	<ul style="list-style-type: none">Initial version	November 2020

* For detailed software version history see chapter [Software history](#)

Abbreviations

Abbreviation	Description
CS	SPI Chip select
GND	Ground
I ² C	Inter-Integrated Circuit
JTAG	Joint Test Action Group
MISO	Master in, slave out
MOSI	Master out, slave in
SCLK	Serial Clock
SDA	I ² C Serial data line
SPI	Serial Peripheral Interface
SWD	Serial Wire Debug
VDD	Supply voltage

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1 Supported products

The EV-Board described in this manual is a stackable extension board for the Arduino (UNO and DUE) board. It can be used to connect the following Sensor EVAL-Boards:

Sensor	EV-Board Order code	Sensor order code
Temperature sensor IC	2521020222591	2521020222501
Humidity sensor with integrated temperature sensor	2525020210091	2525020210001
3 axis acceleration sensor	2533203301691	2533020201601
Absolute pressure sensor	2511223013391	2511020213301
Differential pressure sensor	2513254510091	2513130810001
	2513254510191	2513130810101
	2513254510291	2513130810201
	2513254510391	2513130810301
	2513254510491	2513130810401

Table 1: Sensor shield compatibility

The following interfaces are supported by the sensors: The corresponding sensors that can be evaluated with this sensor shield are:

Sensors & Sensor Eval Board	Interface			
	3.3 V I ² C	3.3 V SPI	5 V I ² C	5 V SPI
Temperature sensor IC	x	x		
Humidity sensor with integrated temperature sensor	x	x		
3 axis acceleration sensor	x	x		
Absolute pressure sensor	x	x		
Differential pressure sensor			x	

Table 2: Supported sensor interface

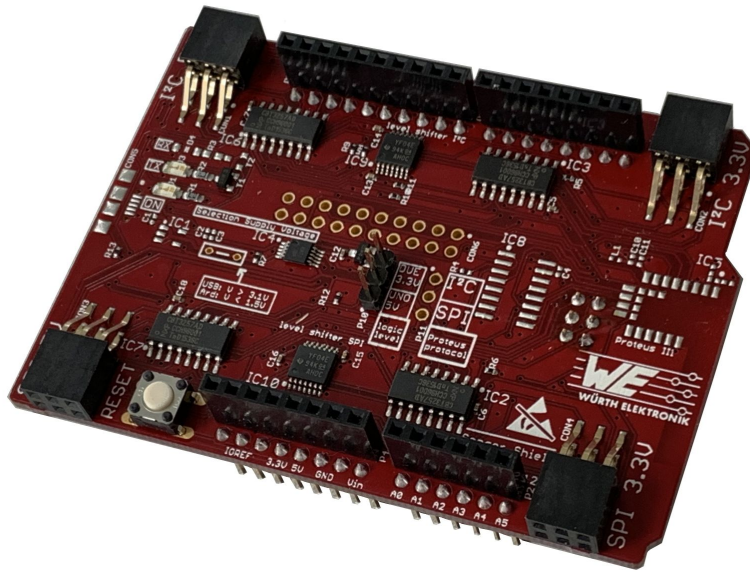


Figure 1: Sensor shield for Arduino

Order code:2501000101291 contents	Quantity
Sensor shield including needed jumpers	1
ESD safe packaging	1
Radio module with individualized firmware	0
Arduino board	0

Table 3: Contents sensor shield EV-kit

2 Overview

2.1 Block diagram

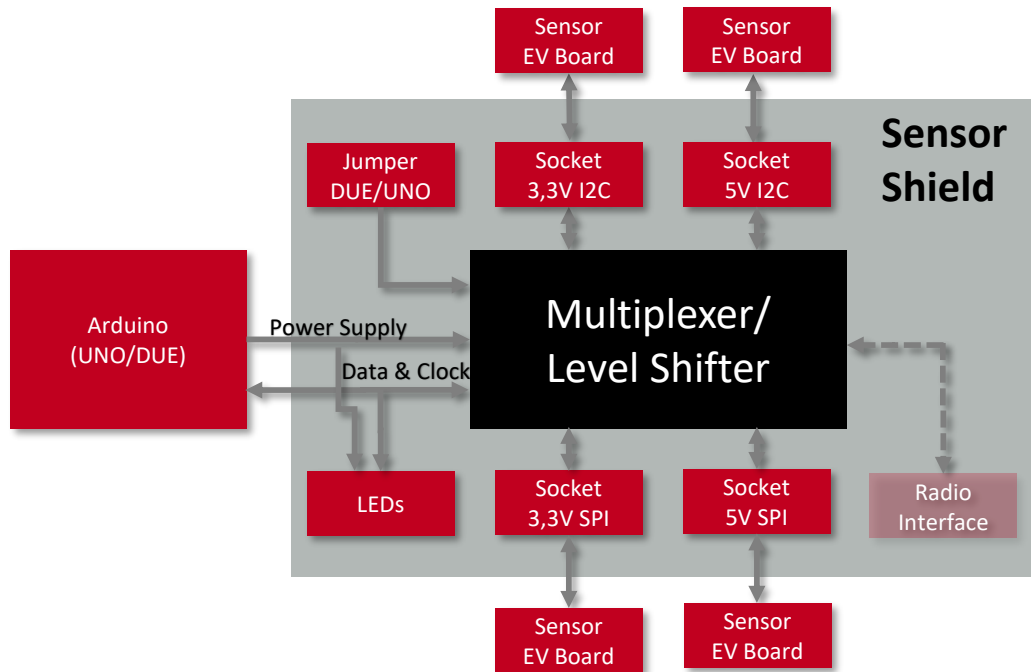


Figure 2: Block Diagramm

2.2 Functional description

The Sensor shield is an interface extension board for Arduino UNO and DUE. It offers the user the possibility to connect sensors with the two different logic levels of 3.3 V or 5 V to either an Arduino UNO or an Arduino DUE via SPI or I²C communication interface.

Software libraries for the Arduino platform are also provided for quick software applications. It implements the drivers and example codes to use the Sensor shield with the Würth Elektronik eiSos GmbH & Co. KG Sensor EV-Boards listed in chapter *Supported products*.

On demand there is also a possibility to add a radio module from the Proteus / Thyone family with individualized firmware instead of hosting the sensors with the Arduino. Additional information on the firmware individualisation can be found on the website *here*.

Feel free to check our YouTube channel:

www.youtube.com/user/WuerthElektronik/videos for video tutorials, hands-ons and webinars relating to our products.

2.3 Taking into operation

Sensor shield can either be mounted on Arduino UNO or DUE. For easy orientation of the shield on the Arduino board, it follows Arduino board's shape. Match the diagonal bulge one above the other as shown in Figure 12.

For the proper operation of the Sensor shield, place the jumper (P10) on the correct location based on the Arduino board variant in use (UNO or DUE). Further information can be found in the section 3.1

Connect external power supply to the Arduino board and make sure the VCC is stable and able to reliably supply the module's static and peak current consumption as specified by the Arduino UNO/DUE manual.

The next step is to connect the Arduino board along with the shield to the PC using a USB-cable. In that way a COM port can be detected. Check the device manager to acquire the COM port number of the EV-Board.

Plug in the sensor evaluation board that you need to take into operation to the appropriate 6-pin connector (CON1-CON4).

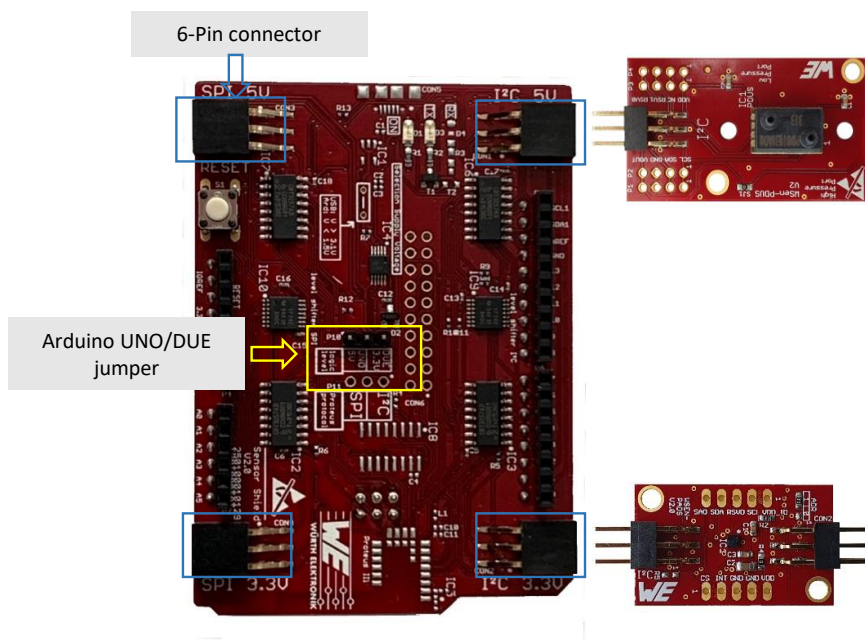


Figure 3: Sensor shield and WSEN-EVAL compatibility



Make sure to connect the sensor EV-Board to the correct connector on the Sensor shield according to the operating voltage and the communication interface of the sensor.



Connecting the sensor EV-Board to the wrong connector can cause permanent damage to the sensor.

2.4 Sensor libraries for Arduino

The Arduino libraries for I²C are delivered as a compressed zip-file. All codes related to a sensor supported by the Arduino libraries are placed under a sub directory named after the corresponding sensor. Each sensor directory contains three sub-directories, src, examples and Function_Test. The sub-directory src contain the Arduino platform dependent code. The examples folder contains sample applications that can run on the Arduino and the Function_test folder implements the functions to test the library.

2.5 Integration into Arduino IDE

The open-source Arduino IDE makes it easy to write code and upload it to the board. This software can be used with any Arduino board. For further information please refer to the installation guide on the Arduino official website: <https://www.arduino.cc/en/Guide>

The sensor libraries can be added in the Arduino IDE software directly as .ZIP file. Select the required sensor library from your PC.

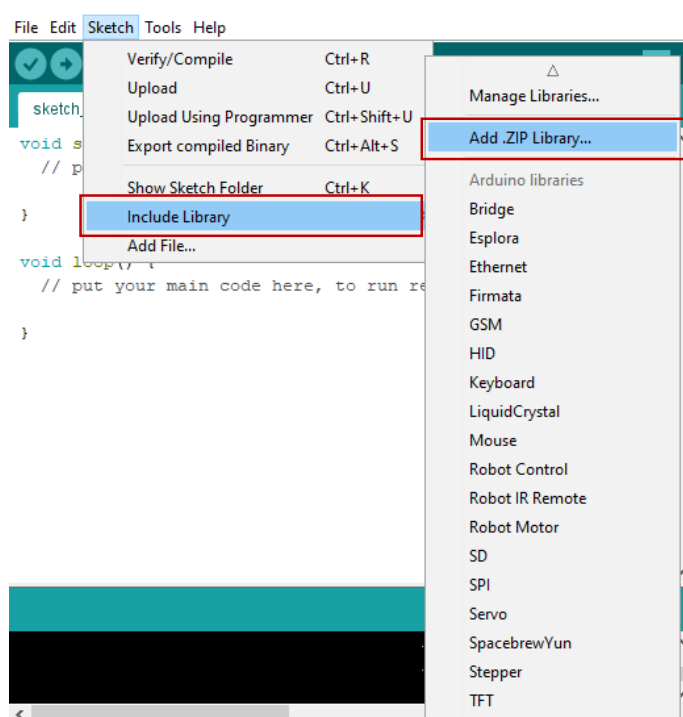


Figure 4: Add sensor libraries to the Arduino software

Successfully included libraries can be found under 'contributed libraries'.



Figure 5: Sensor libraries

The sensor libraries also include some examples for quick start. They are available under File>Examples>Examples from custom libraries.

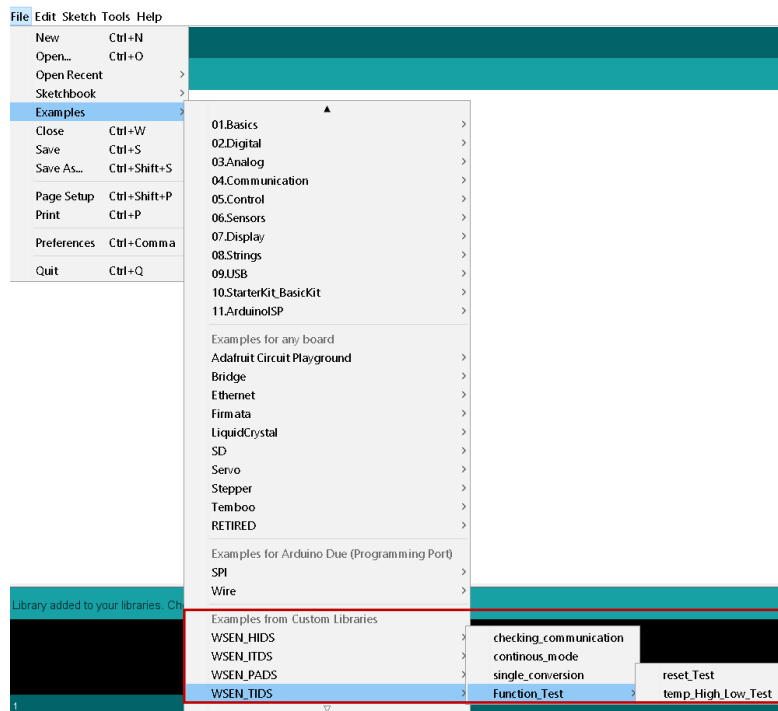


Figure 6: Examples from the sensor libraries

An example code for the temperature sensor WSEN-TIDS (Part number: 2521020222501) in continuous mode is shown in Figure 7



Temperature sensor EV-Board (part no. 2521020222591) must be connected to 3.3 V I²C pin header.



Make sure to place the Sensor shield jumper on the correct position based on the Arduino board variant in use. Further information is given in the section 3.1

```
File Edit Sketch Tools Help
continuous_mode $
#include "WSEN_TIDS.h"

Sensor_TIDS sensor;

//The Output Data Rate in Hz
int ODR = 25;

void setup()
{
  Serial.begin(9600);

  // Initialize the I2C interface
  sensor.init(TIDS_ADDRESS_I2C_1);

  // Set the free run mode with given ODR
  sensor.set_continuous_mode(ODR);
}

void loop()
{
  // Read and calculate the temperature
  int temperature = sensor.read_temperature();

  // Print the temperature on the serial monitor
  Serial.print(temperature);
  Serial.println(" Celsius");

  // Waiting time between measurement
  int waitMillis = 1000 / ODR;

  // Wait before continuing with the next measurement
  delay(waitMillis);
}
```

Figure 7: WSEN-TIDS example code (continuous mode)

After the Arduino is connected to the PC through the USB, a connected Arduino device should be visible on a COM port. Select the correct Arduino board, corresponding COM port and upload the code. Once the code is successfully uploaded, the output can be observed on the serial monitor.

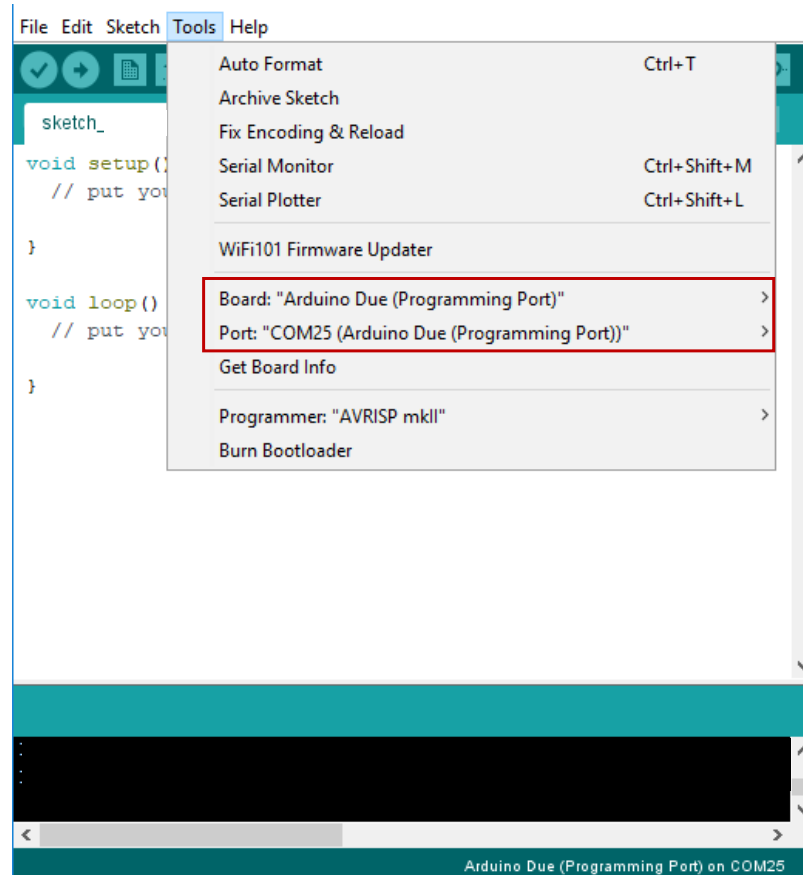


Figure 8: Select Arduino board, COM port and upload the code

Please refer to the module user manual to get the detailed module specific quick start instructions.

3 Sensor shield

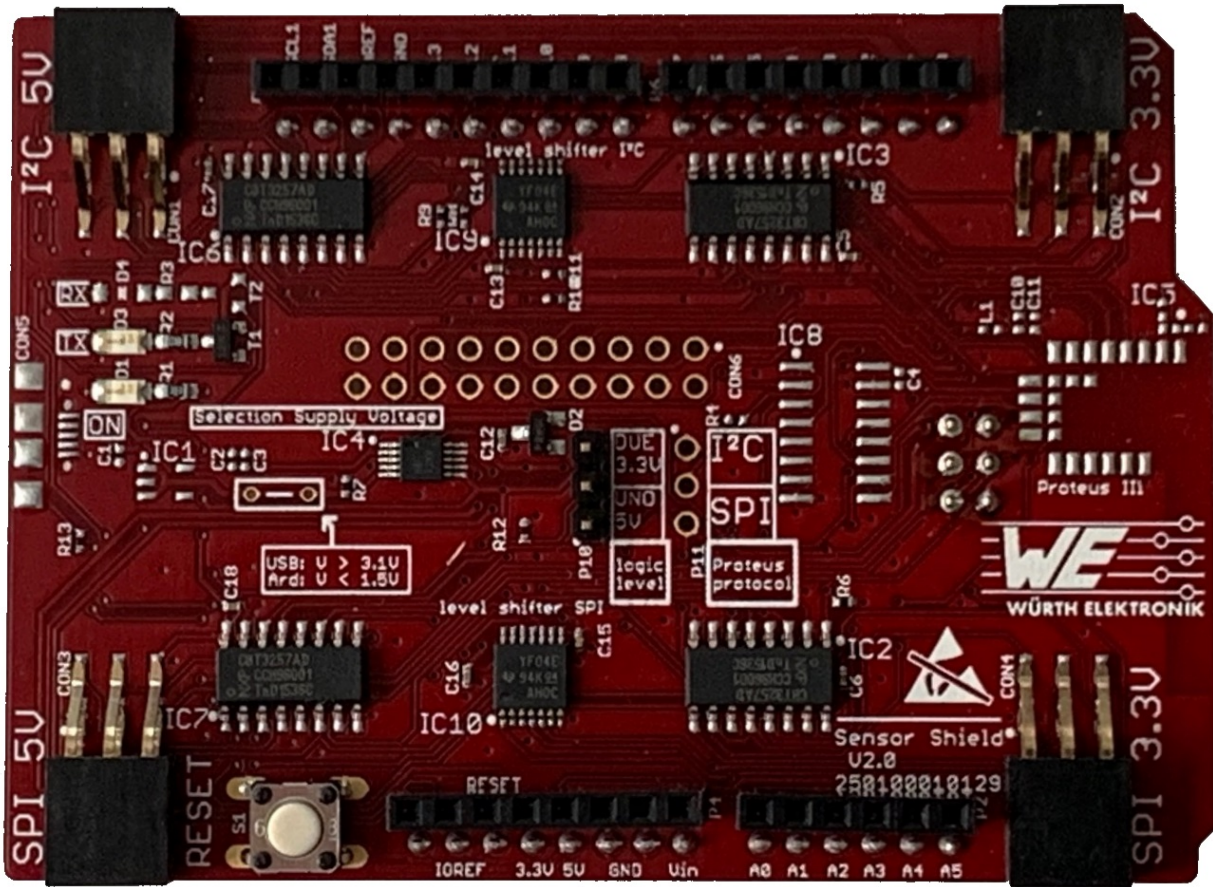


Figure 9: EV-Board top view

The EV-Board is provided with an informative silkscreen to ease its use.

3.1 Jumpers

Only one jumper is needed to decide about connecting either an Arduino UNO, switching the multiplexer and level shifter in the accordingly function for 5 V logic of the Arduino, or connecting an Arduino DUE, switching the multiplexer and level shifter accordingly for 3.3 V logic on the Arduino connector. The following figure shows the jumper position to use an Arduino DUE.

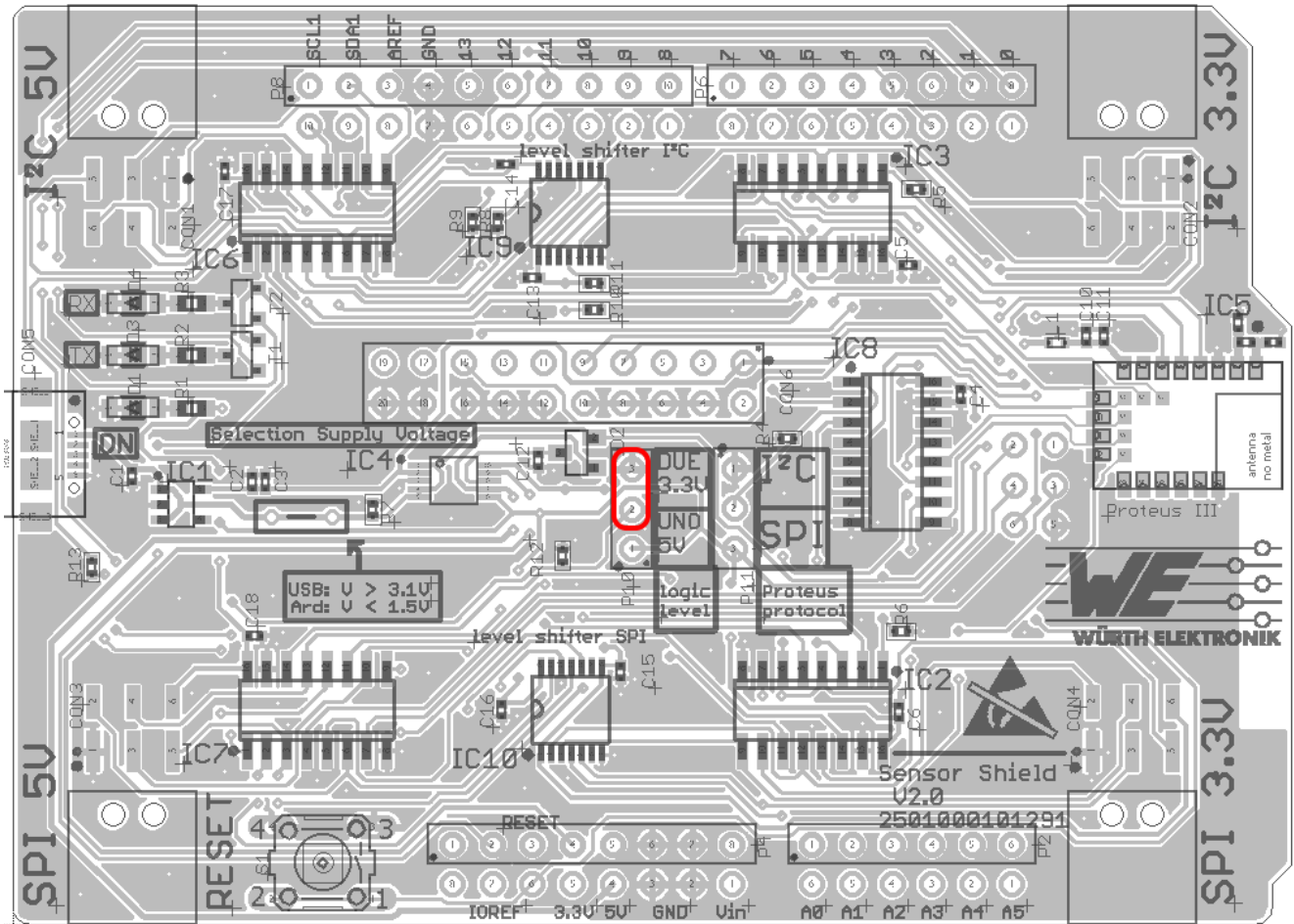


Figure 10: Jumper setting connecting Arduino DUE

3.2 Connectors and pin headers

There are several connectors on the top and bottom side of the sensor shield. They serve to connect the Arduino board, to stack other Sensor shields and to connect sensors via 2.54mm headers or to connect directly the Würth Elektronik eiSos GmbH & Co. KG Sensor EV-Boards.

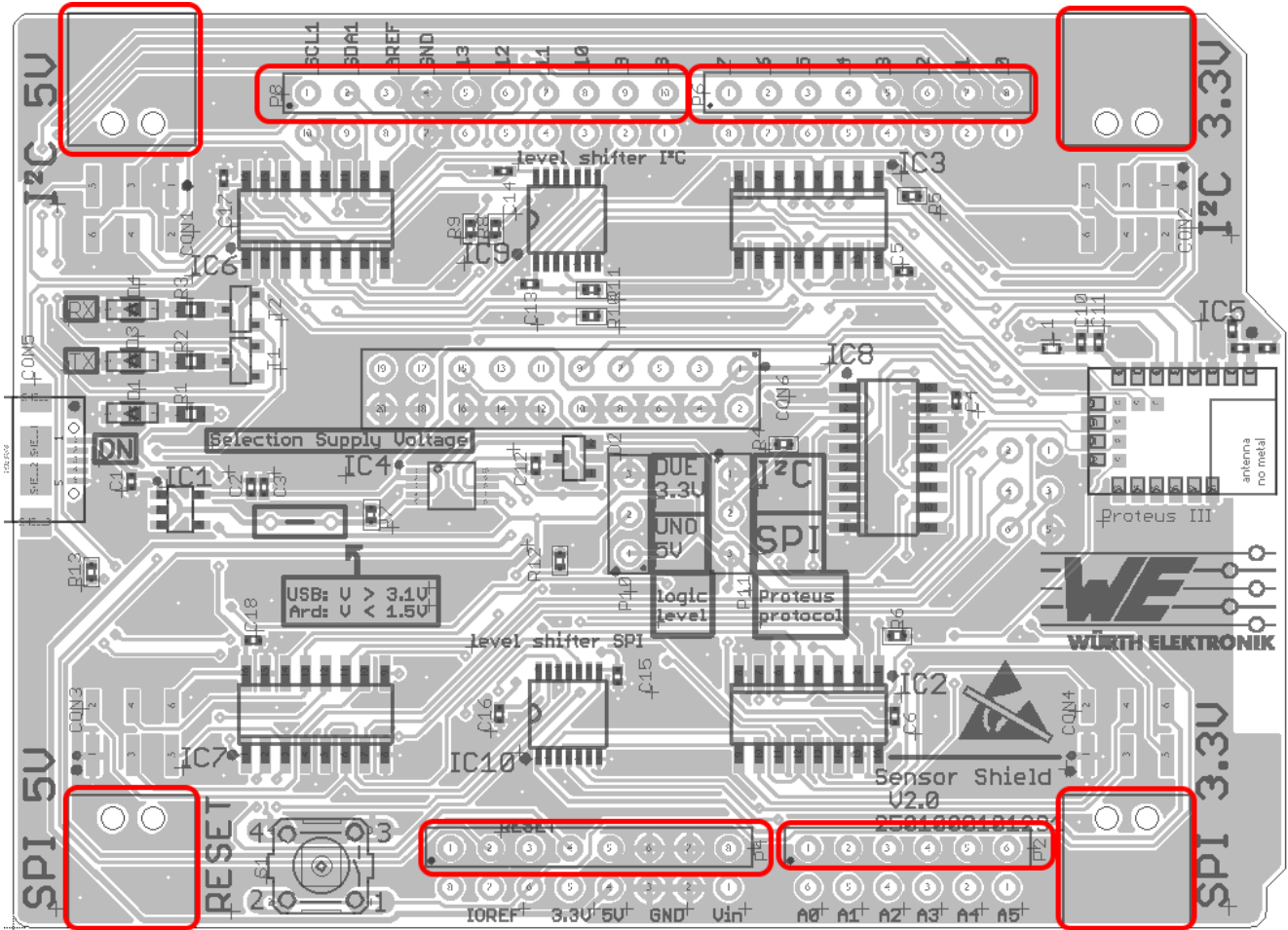


Figure 11: Connectors and pin headers top side

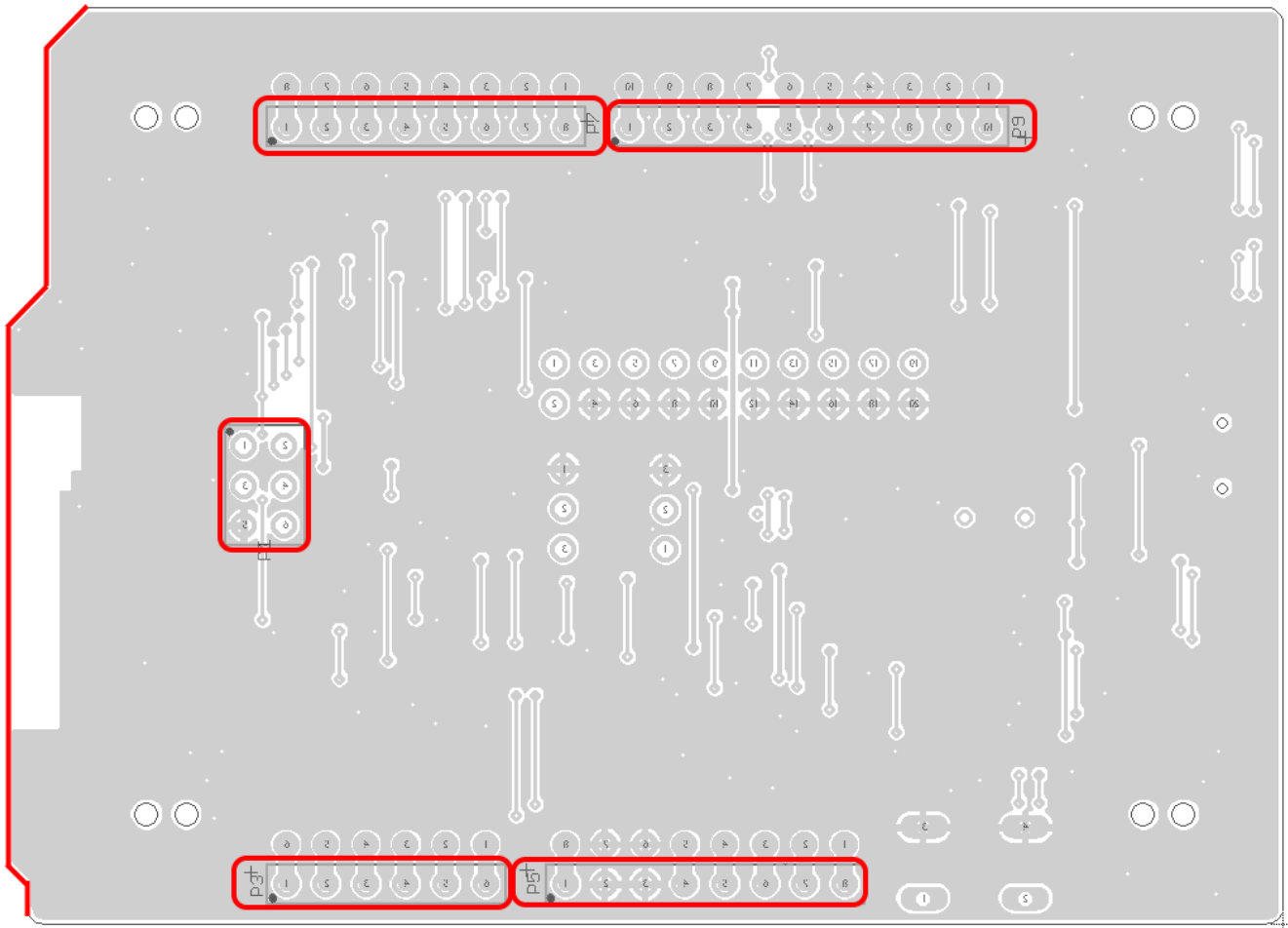


Figure 12: Connectors and pin headers bottom side

header / connector	Description
P2, P4, P6, P8	Socket to stack up another Sensor shield
CON1	I ² C 5 V connector
CON2	I ² C 3.3 V connector
CON3	SPI 5 V connector
CON4	SPI 3.3 V connector
P3, P5, P7, P9	header on bottom side to connect the Arduino board
P1	socket on bottom side to connect the Arduino board

Table 4: Connectors and pin headers



For easy orientation of the shield on the Arduino board, it follows Arduino board's shape. Match the diagonal bulge one above the other.

3.2.1 CON1 and CON2 I²C connectors

The pinning of connector CON1 and CON2 fits directly to the sensor EV-Boards mentioned in chapter Supported products. The connector on the shield is a 2.54mm pitch socket to have the possibility to connect any other I²C device with the most commonly used headers.

Pin	Description
1	GND
2	SCL
3	SDA
4	INT1
5	INT0
6	VDD

Table 5: Pinning I²C connector CON1 and CON2

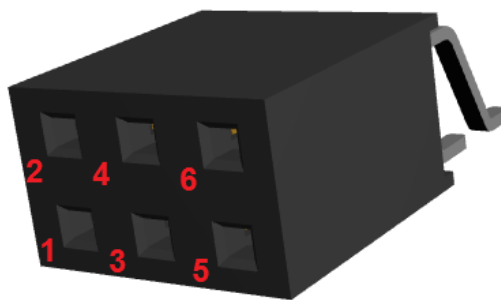


Figure 13: Pinning I²C connector CON1 and CON2

3.2.2 CON3 and CON4 SPI connectors

The pinning of connector CON3 and CON4 fits directly to the sensor EV-Boards mentioned in chapter Supported products. The connector on the shield is a 2.54mm pitch socket to have the possibility to connect any other SPI device with the most commonly used headers.

Pin	Description
1	GND
2	SCLK
3	MOSI
4	CS
5	MISO
6	VDD

Table 6: Pinning SPI connector CON3 and CON4

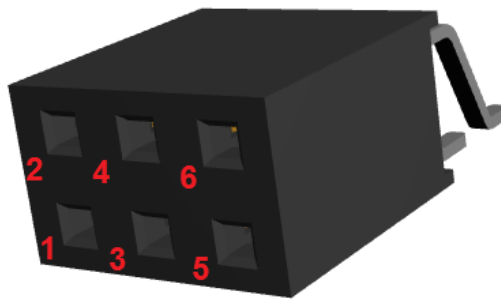


Figure 14: Pinning SPI connector CON3 and CON4

3.3 Buttons

3.3.1 Reset button

The reset button pulls the reset line low to trigger a reset. It is connected to the Arduino header to trigger a reset of the Arduino processor.

3.4 Function blocks

3.4.1 Power supply

The Sensor Arduino shield is powered from the Arduino board via the socket P5.



Powering the Sensor shield via an USB cable through on board USB connector (not mounted) will switch off the I²C/SPI signal lines between the sensor connectors (CON1-CON4) and the Arduino.

3.4.2 Level shifter

Two level shifters are used to change logic level between 5 V logic and 3.3 V logic. One IC is used for the SPI lines, the other for the I²C lines.

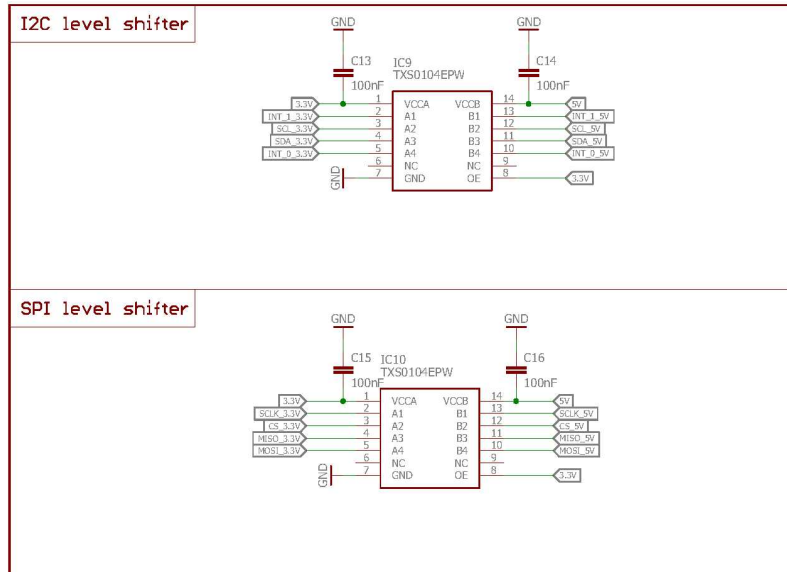


Figure 15: Level shifter

3.4.3 Multiplexer

The multiplexers serve the purpose of splitting the 3.3 V logic level signals from Arduino DUE towards connector CON2 and CON4 and through the level shifter towards CON1 and CON3. Similarly in case of Arduino UNO, the multiplexer split the 5 V logic level signals from the Arduino UNO directly toward CON1 and CON3 and through level shifter towards CON2 and CON4.

By setting the jumper based on the Arduino variant (UNO or DUE) on the three pin header P10 (as already described in section 3.1), the logic level on P1 - P9 can be selected.

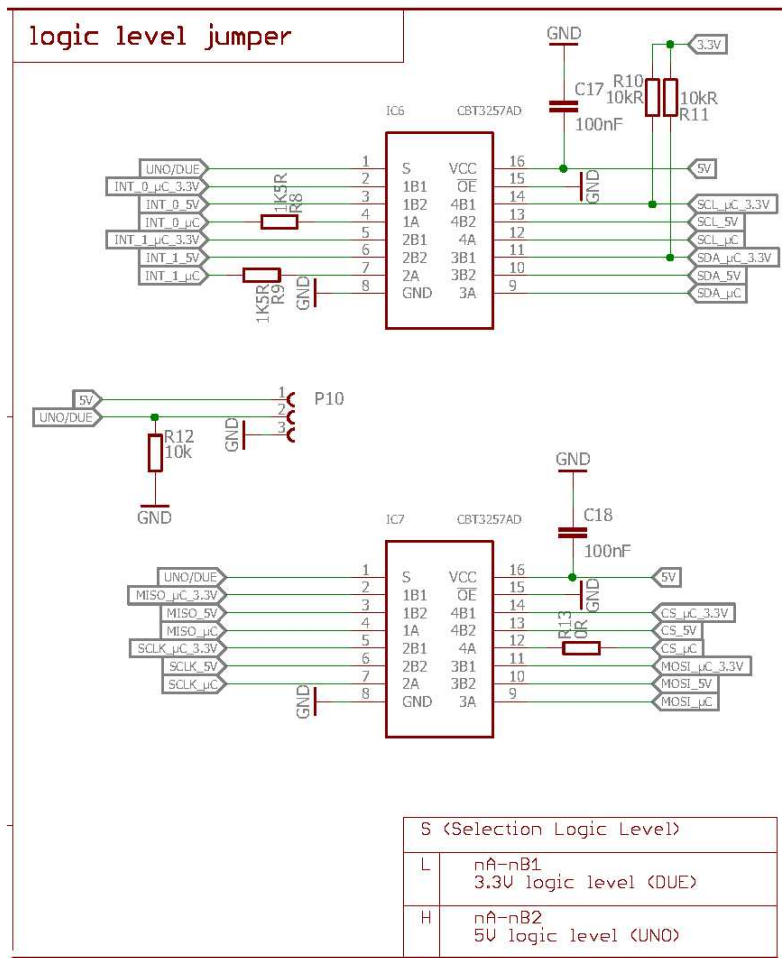


Figure 16: Multiplexer

3.4.4 Radio interface with firmware individualization on demand

There is a dedicated place holder for a radio module of the type Proteus or Thyone-I on the Sensor shield. With an individualized Firmware this radio module could independently collect sensor data and send them via radio protocol to a remote station. For this feature no Arduino board is used and the Sensor shield operates stand alone.

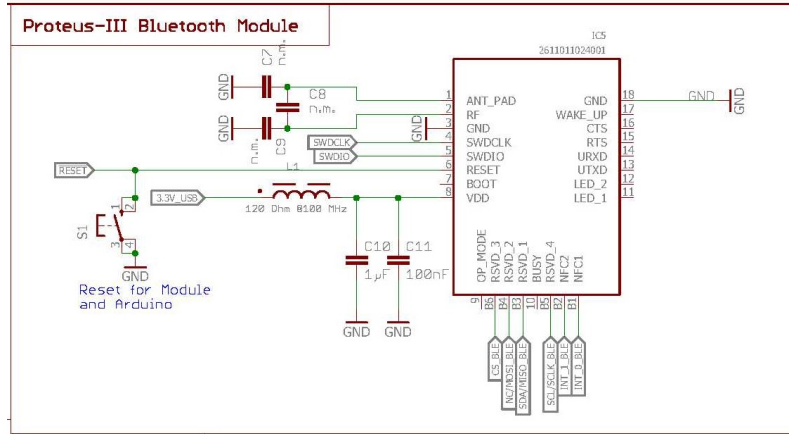


Figure 17: Radio module



The modules Proteus-I, Proteus-II, Proteus-III and Thyone-I standard firmware does not support this independent solution.



Please contact your Business Development Engineer (BDM) or WCS@we-online.com for further information.

3.4.4.1 Switching SPI and I²C interface to radio module

When connecting an USB cable directly to the Sensor shield, 5 V from the USB is used to switch on the IC2 and IC3 multiplexers to connect the interface from the sensor connectors to the radio module. Without USB connection, pull down resistors switch off the multiplexers so that the sensor connectors are connected to the Arduino.

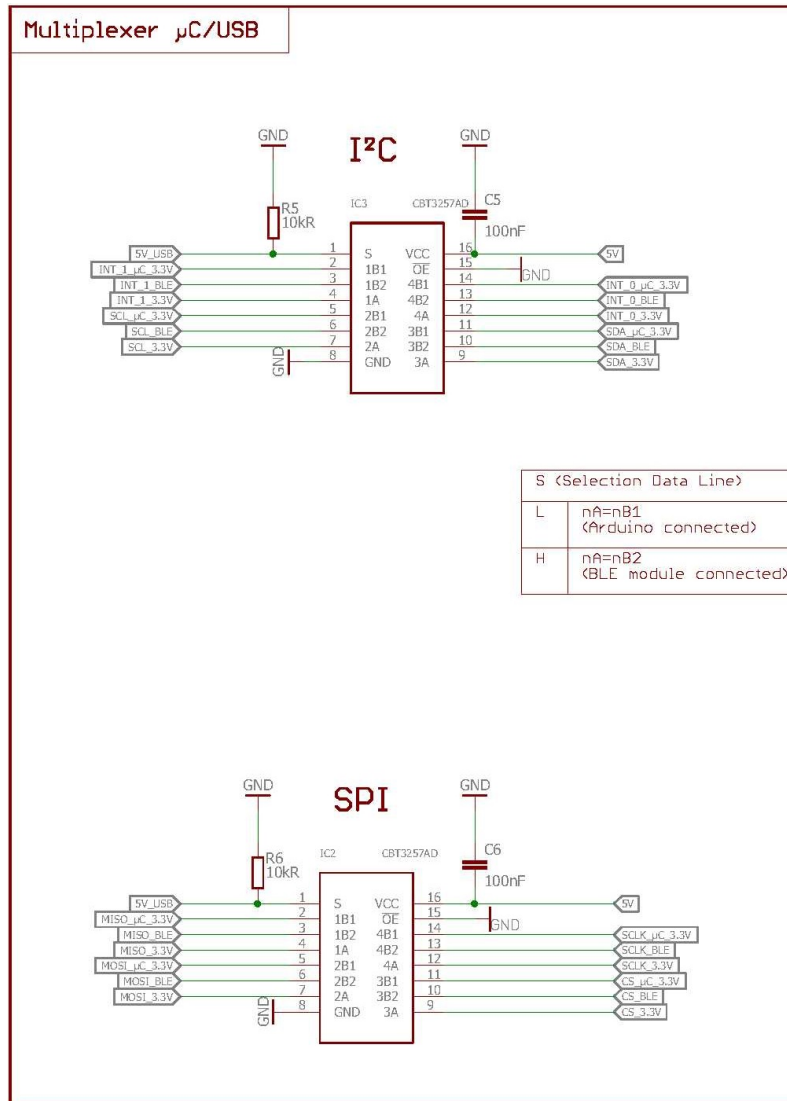


Figure 18: Radio module connection

3.4.4.2 Programming interface

The EV-Board provides a 2 x 10 pin connector to connect directly a JTAG or SWD flash adapter used for development. Please take care of the correct mounting of the flash adapter (Pin 1 is marked as such). Depending on your flash tool an additional adapter may be required. The recommended flash adapter is one from the "Segger J-Link" family.

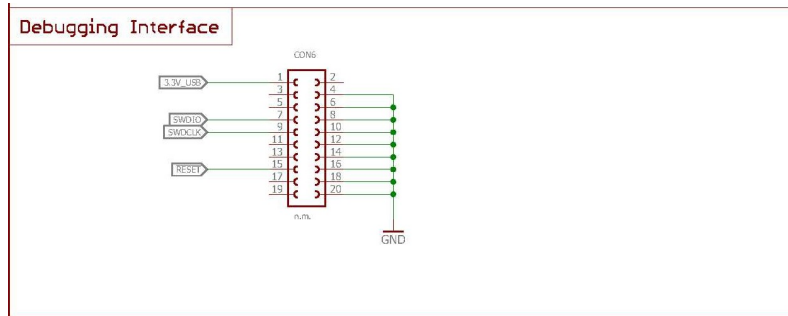
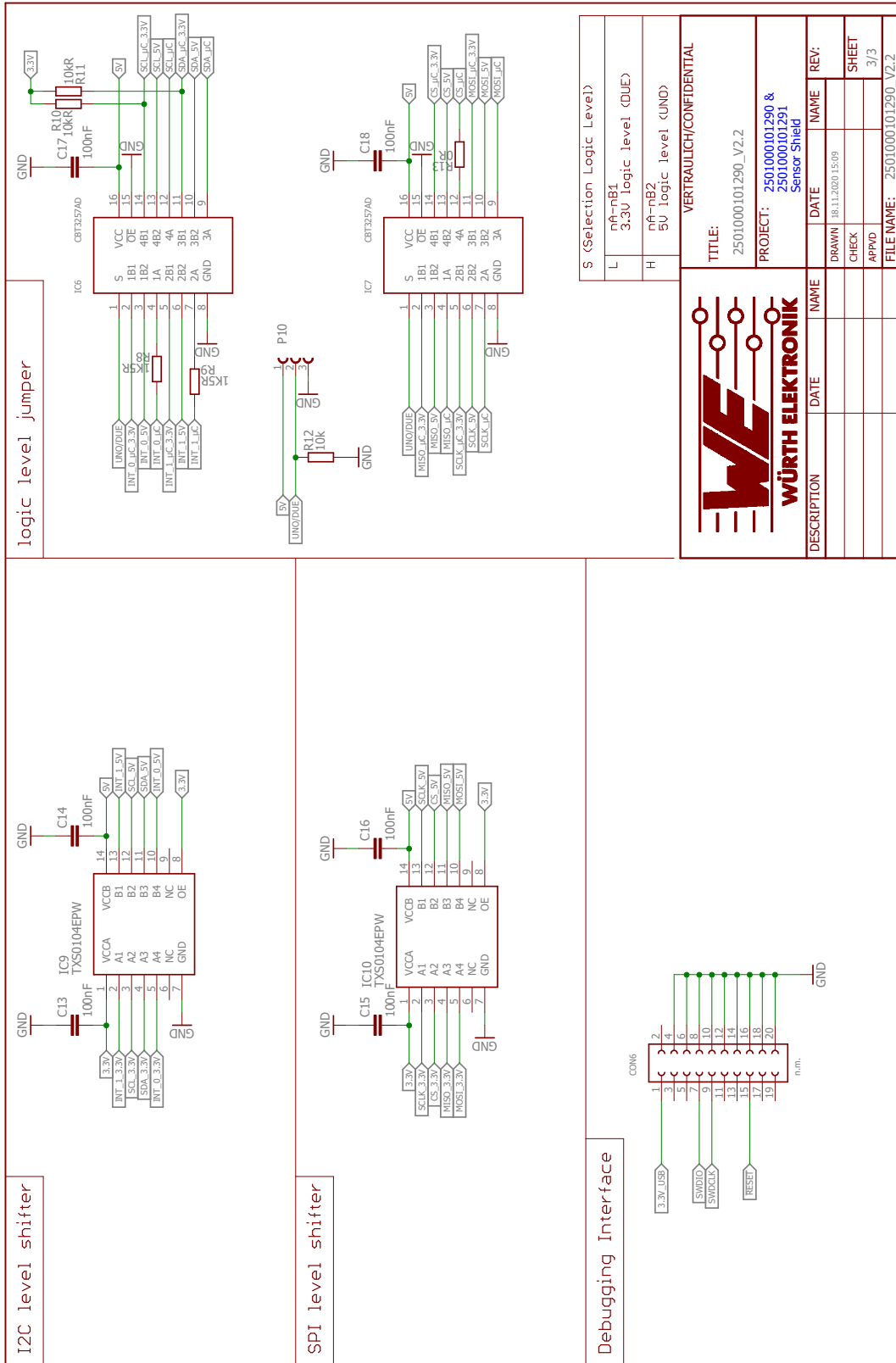


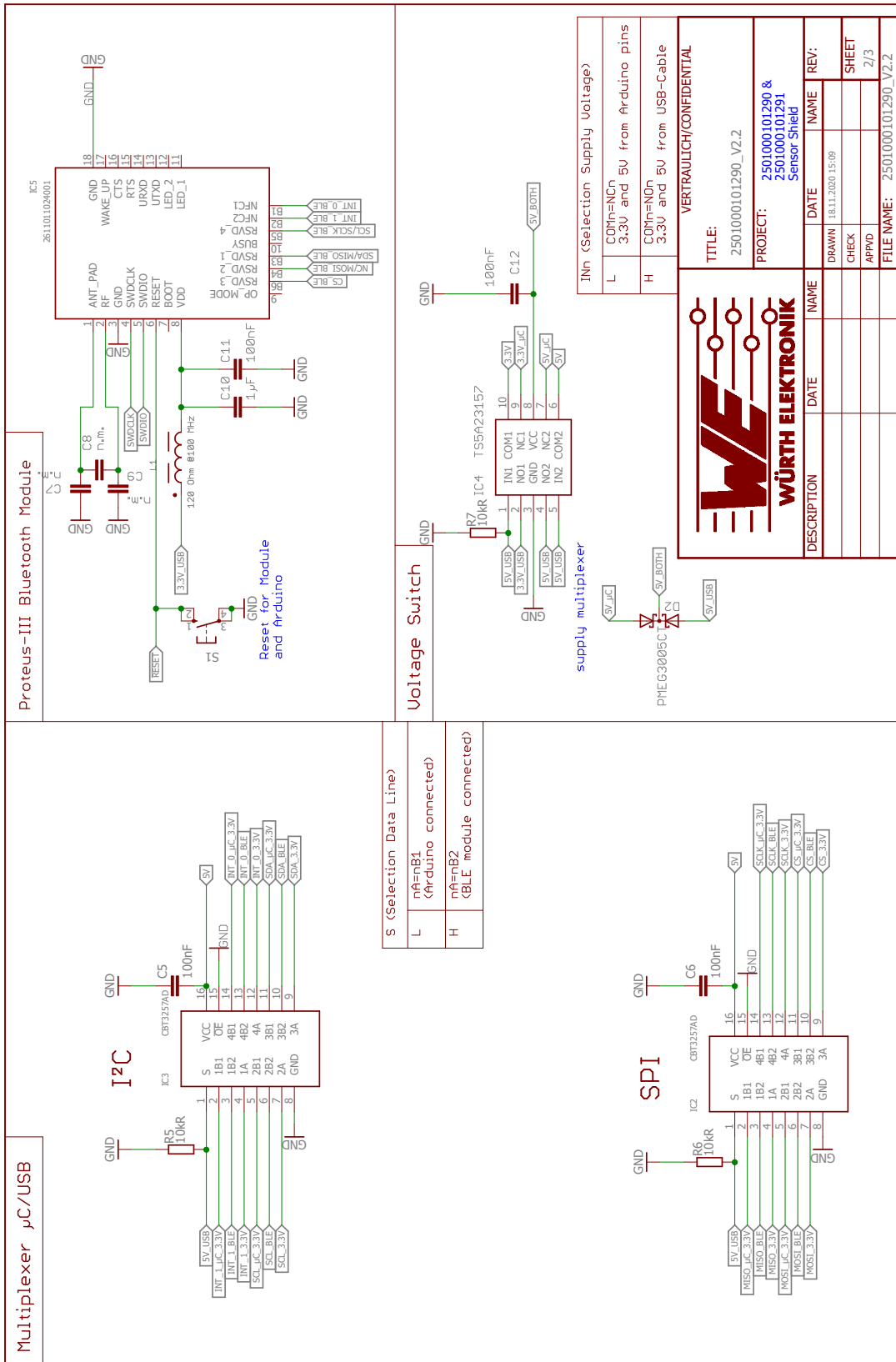
Figure 19: Debugging interface of the optional radio module

3.5 Schematic



S (Selection Logic Level)	
L	nA-nB1 3.3V logic level (DUE)
H	nA-nB2 5V logic level (UNO)

TITLE: VERTRAULICH/CONFIDENTIAL 2501000101290_V2.2 PROJECT: 2501000101290 & 2501000101291 Sensor Shield			
DESCRIPTION	DATE	NAME	REV:
DRAWN	18.11.2020	15109	
CHECK			SHEET
APPROV			3/3
FILE NAME:		2501000101290_V2.2	



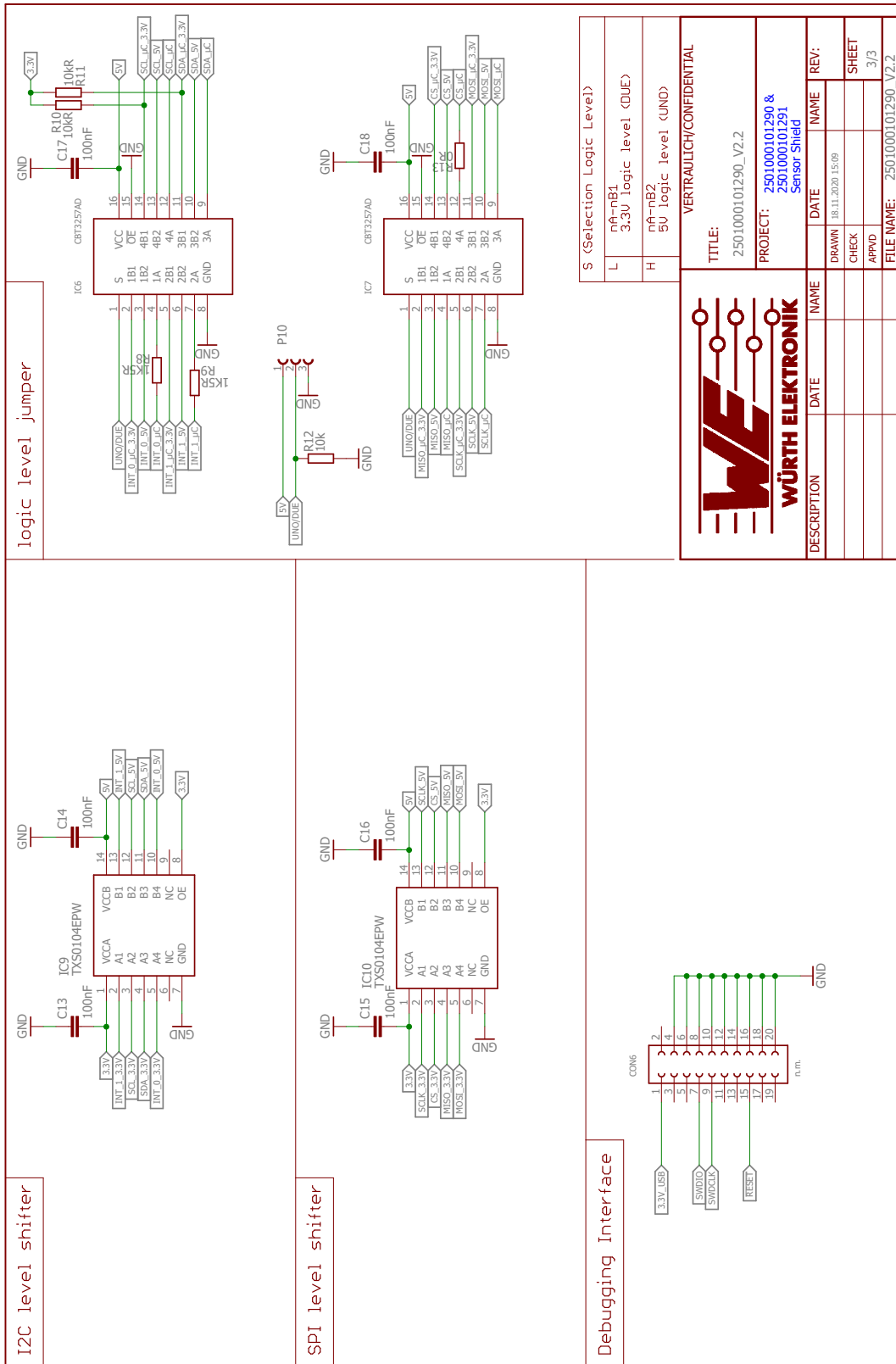


Figure 20: Circuit diagram

3.6 Full layout

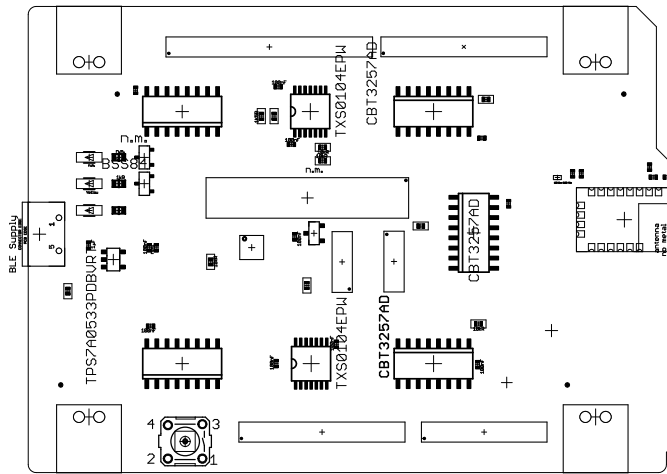


Figure 21: Assembly diagram

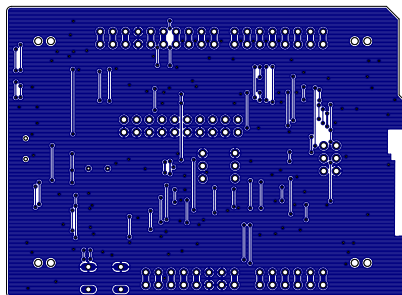
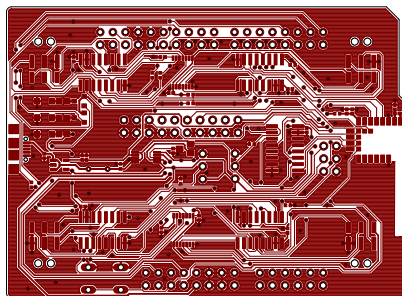


Figure 22: Layer

4 Software history

Arduino library software history

Version 1.0.0 "Release"

- First released version of the Arduino library.
- I²C drivers and examples for: WSEN-PADS, WSEN-PDUS, WSEN-HIDS, WSEN-TIDS and WSEN-ITDS

5 Regulatory compliance information

Pursuant to Article 1 (2.) of the EU directive 2014/53/EU, Article 1 (2.) the directive does not apply to equipment listed in Annex I (4.): custom-built EV-Kits destined for professionals to be used solely at research and development facilities for such purposes.

5.1 Exemption clause

Relevant regulation requirements are subject to change. Würth Elektronik eiSos does not guarantee the accuracy of the before mentioned information. Directives, technical standards, procedural descriptions and the like may be interpreted differently by the national authorities. Equally, the national laws and restrictions may vary with the country. In case of doubt or uncertainty, we recommend that you consult with the authorities or official certification organizations of the relevant countries. Würth Elektronik eiSos is exempt from any responsibilities or liabilities related to regulatory compliance.

Notwithstanding the above, Würth Elektronik eiSos makes no representations and warranties of any kind related to their accuracy, correctness, completeness and/or usability for customer applications. No responsibility is assumed for inaccuracies or incompleteness.

6 Important notes

The following conditions apply to all goods within the wireless connectivity and sensors product range of Würth Elektronik eiSos GmbH & Co. KG:

General customer responsibility

Some goods within the product range of Würth Elektronik eiSos GmbH & Co. KG contain statements regarding general suitability for certain application areas. These statements about suitability are based on our knowledge and experience of typical requirements concerning the areas, serve as general guidance and cannot be estimated as binding statements about the suitability for a customer application. The responsibility for the applicability and use in a particular customer design is always solely within the authority of the customer. Due to this fact, it is up to the customer to evaluate, where appropriate to investigate and to decide whether the device with the specific product characteristics described in the product specification is valid and suitable for the respective customer application or not. Accordingly, the customer is cautioned to verify that the documentation is current before placing orders.

Customer responsibility related to specific, in particular safety-relevant applications

It has to be clearly pointed out that the possibility of a malfunction of electronic components or failure before the end of the usual lifetime cannot be completely eliminated in the current state of the art, even if the products are operated within the range of the specifications. The same statement is valid for all software source code and firmware parts contained in or used with or for products in the wireless connectivity and sensor product range of Würth Elektronik eiSos GmbH & Co. KG. In certain customer applications requiring a high level of safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health, it must be ensured by most advanced technological aid of suitable design of the customer application that no injury or damage is caused to third parties in the event of malfunction or failure of an electronic component.

Best care and attention

Any product-specific data sheets, manuals, application notes, PCNs, warnings and cautions must be strictly observed in the most recent versions and matching to the products revisions. These documents can be downloaded from the product specific sections on the wireless connectivity and sensors homepage.

Customer support for product specifications

Some products within the product range may contain substances, which are subject to restrictions in certain jurisdictions in order to serve specific technical requirements. Necessary information is available on request. In this case, the Business Development Engineer (BDM) or the internal sales person in charge should be contacted who will be happy to support in this matter.

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Due to constant product improvement, product specifications may change from time to time. As a standard reporting procedure of the Product Change Notification (PCN) according to the JEDEC-Standard, we inform about major changes. In case of further queries regarding the PCN, the Business Development Engineer (BDM), the internal sales person or the technical support team in charge should be contacted. The basic responsibility of the customer as per section 6 and 6 remains unaffected.

All software like "wireless connectivity SDK", "Sensor SDK" or other source codes as well as all PC software tools are not subject to the Product Change Notification information process.

Product life cycle

Due to technical progress and economical evaluation, we also reserve the right to discontinue production and delivery of products. As a standard reporting procedure of the Product Termination Notification (PTN) according to the JEDEC-Standard we will inform at an early stage about inevitable product discontinuance. According to this, we cannot ensure that all products within our product range will always be available. Therefore, it needs to be verified with the Business Development Engineer (BDM) or the internal sales person in charge about the current product availability expectancy before or when the product for application design-in disposal is considered. The approach named above does not apply in the case of individual agreements deviating from the foregoing for customer-specific products. The approach named above does not apply in the case of EV-Boards. EV-Boards may be changed without any notification.

Property rights

All the rights for contractual products produced by Würth Elektronik eiSos GmbH & Co. KG on the basis of ideas, development contracts as well as models or templates that are subject to copyright, patent or commercial protection supplied to the customer will remain with Würth Elektronik eiSos GmbH & Co. KG. Würth Elektronik eiSos GmbH & Co. KG does not warrant or represent that any license, either expressed or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, application, or process in which Würth Elektronik eiSos GmbH & Co. KG components or services are used.

General terms and conditions

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Würth Elektronik eiSos GmbH & Co. KG provide you as a user with technical data (including data sheets), design resources (including reference designs), recommendations for use or other design recommendations, web tools, safety information and other information in the form of evaluation-boards, -kits or -modules (hereinafter jointly referred to as "EVB") in accordance with the terms and conditions contained here. The EVB is provided in the "as is" state. WE disclaims all express and implied warranties, in particular those concerning the suitability for a certain purpose, the absence of defects or non-violation of third-party rights. The EVB is intended for experienced developers to develop

User manual Sensor Arduino shield

their application with WE components. As a user, you are solely responsible for: (1) selection of the appropriate WE components for the application, (2) design, validation and testing the application, and (3) assurance that the application meets the applicable standards and all other safety requirements and other applicable requirements. WE may change the EVB without prior notice. WE grants you permission to use the EVB only for developing an application suitable for using WE components. Any other duplication, representation or transfer of the EVB is expressly prohibited. WE does not grant any licenses for the use of the intellectual property rights from WE or third parties. WE is fully indemnified from all claims, damages, costs, losses and liabilities arising from the misuse of this EVB. The WE components are provided in accordance with WE's conditions of sale or other applicable conditions available either at <https://katalog.we-online.com> or in conjunction with such WE components. WE's provision of the EVB does not constitute an extended warranty in relation to the WE components.

General warnings

Do not touch the EVB when it is live, and allow charged components, such as capacitors, to discharge completely before handling the EVB. Depending on the individual application, high voltages can occur on the EVB and some components can reach temperatures above 50 °C. Even after disconnecting the EVB from the power source, these conditions remain for a significant time. Please ensure that the appropriate safety precautions are taken when installing and operating this EVB, as one of the following may occur if you handle or use this EVB without observing the relevant safety precautions: - Death - Serious injury - Electric shock - Electric burns - Severe heat burns -

When using the EVB, you undertake to read the instructions for use in full together with the relevant information supplied and/or available on the homepage www.we-online.de/wcs-manuals before putting this EVB into operation. The following points have to be observed in particular:

- Do not touch the EVB while it is live.
- The EVB must be fully assembled and all devices to be tested must be connected before voltage is applied to the EVB.
- The EVB should never be left unattended during operation.
- Capacitors must be completely discharged. The capacitors must be actively discharged using a suitable resistor.

Protection against static electricity

Use the unpackaged product only in ESD protected areas. Wear the ESD personal protective equipment prescribed for these areas. Ground all conductive components, including personnel, as prescribed in ESD protected areas. Ensure that the product is only used by trained personnel.

Purpose and use

The EVB is not a finished product and is not intended for general use by the consumer. The EVB is intended exclusively for use in the evaluation of WE components in the lab or in development environments by highly qualified technicians or engineers, familiar with the risks involved in handling electrical or mechanical components, systems and subsystems. The use of the EVB is your full and independent responsibility. The EVB is expressly not intended to be installed in a terminal device or to be part of a terminal device in whole or in part. WE reserves the right, at its own discretion, to make corrections, improvements, adjustments or other changes to the EVB or to discontinue the EVB. The EVB is not intended for use in devices and applications for which a higher safety and reliability standard is prescribed. It is also not approved for use in safety-relevant applications or where personal injury or fatal consequences must be expected in the event of failure.

Operation of the EVB

The EVB may only be operated within the specifications and environmental parameters recommended by WE, as described in the instructions for use. Exceeding the specified parameters (including, but not limited to, input and output voltage, current, power, and ambient conditions) may result in damage to property. If you have questions about these electrical parameters, please contact WE at (regulatory-compliance@we-online.com) prior to connecting peripheral electronics (including the input voltage and intended loads). Any load outside a certain power range may lead to negative consequences, including, but not limited to, unintended or inaccurate evaluations or possibly permanent damage to the EVB or the electronics connected to it. Please ensure that the appropriate safety precautions are taken when working with the EVB, as serious injuries, including severe or even fatal injuries from electric shock or electric burns, may occur if you do not follow the appropriate safety precautions. Under no circumstances should the EVB be touched while live. When the EVB is connected to a power source, some of its components are electrically charged and/or have temperatures above 50 °C. This condition also applies for a short time after disconnecting from the supply voltage until the capacitors are completely discharged and hot components have cooled down. These components include connectors, linear regulators, switching transistors, heat sinks, resistors, diodes, inductors and other components, which can be identified from the documentation in the instructions for use. As with all electronic lab work, only qualified persons with knowledge of electronic performance evaluation, measurement and diagnostic tools, should use the EVB.

Hazards and warnings

Before putting the EVB into operation, please read the instructions for use and especially the various hazards and warnings described therein. The instructions for use contain important safety information on voltages and temperatures. You take full responsibility and liability for the proper and safe handling of the EVB. You agree to comply with all safety requirements, rules and regulations related to the use of the EVB. You also take full responsibility for: (1) establishing safeguards to ensure that the use of the EVB does not cause damage to property, personal injury or death, even if the EVB does not function as described, intended or expected, (2) the test setup in which the EVB is integrated, all safety requirements, rules and regulations and also that no damage to property, personal injury or other hazardous situation occurs even if the EVB fails, and (3) ensuring the safety of all activities performed by you or your employees when using the EVB. In particular, this means that the technical rules VDE [German Electrical Engineering, Electronic and Information Technology Association] 0105-100 and BGI [German trade association information] 891 (or corresponding applicable safety regulations outside Germany) for the operation of electrical test setups must be observed, the test area is protected against unauthorized access or accidental touching, current limitations, and emergency stop mechanisms are functional and test setups are never operated unattended. If you have any questions about the safe use of the EVB, please contact WE at regulatory-compliance@we-online.com for more information.

Your responsibility with regard to the applicable laws

- You are responsible for being sufficiently informed about and complying with all international, national, state and local applicable laws, rules and regulations that apply to the handling or use of the EVB by you or your employees.
- The EVB generates, uses and radiates radio frequency energy, but has not been tested for conformity with the limits applicable to the product category, which are applicable according to the European Union regulations for protection against radio frequency interference. Operation of the EVB may cause interference with radio communication. In this case, the costs incurred for necessary measures to remedy the interference are to be borne by the user.

As the EVB is not a finished product, it may not comply with applicable regulatory, safety or certification standards that are normally as-

User manual Sensor Arduino shield

sociated with other products, such as Directive 2011/65/EC of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of hazardous substances and Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). You take full responsibility for compliance with such standards that apply to the EVB. You also take responsibility for the proper disposal of the components and materials of the EVB.

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