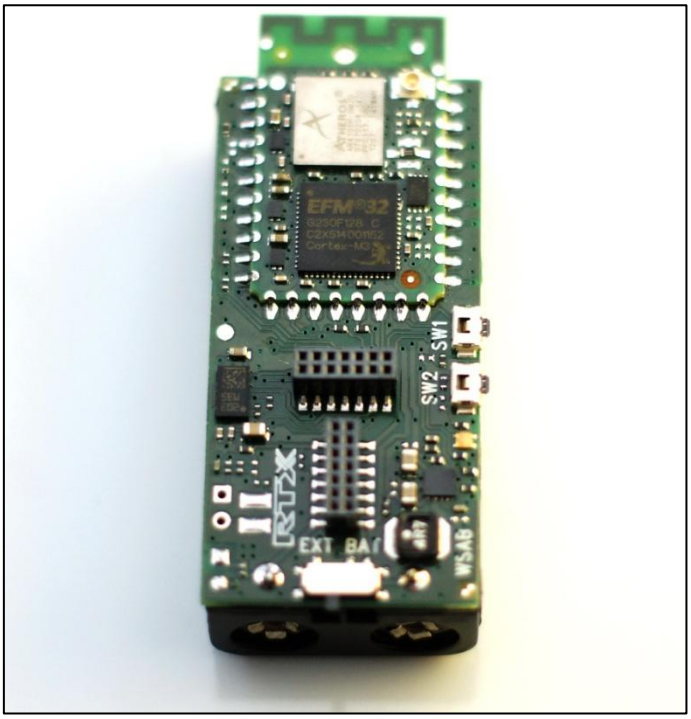
RTX41xx

Wireless Sensor Application Board (WSAB)

Variants covered by this document:
RTX4100-WSAB
RTX4140-WSAB



User Guide
WSAB
[UG6]

CONTENT

1 Introduction

1.1 General Description

The RTX41xx (RTX4100 or RTX4140) Wi-Fi Module is a small form-factor, single stream, 802.11b/g/n Wi-Fi module with on-board low power application processor. It is targeted at applications that send infrequent data packets over the network. Typically, 802.11 applications addressed by a RTX41xx module will place a priority on low power consumption, ease of development, and system integration.

This document serves as a manual for the Wi-Fi Sensor Application Board (WSAB). The WSAB is as a carrier board for the RTX41xx module to enable the user with a hardware platform for evaluation, application software development and rapid application hardware prototyping.

1.2 Module variants covered by this document

This document covers Wireless Sensor Application Boards (WSABs) based on both the RTX4100 and RTX4140 WiFi modules (RTX4100-WSAB and RTX4140-WSAB).

1.3 Document History

V1.3 Added RTX4140	TM	2013-06-06
V1.2 Updated references	TM	2013-02-19
V1.1 Updated schematics	TM	2012-10-29
V1.0 Official release	TM	2012-07-09

Disclaimer: This document can be subject to change without prior notice.

1.4 SW/HW Version

This document is applicable for the following versions.

- WSAB version V3RA

1.5 Document References

[DS1]. RTX4100_Datasheet_DS1.pdf.
[DS2]. RTX4140_Datasheet_DS2.pdf.
[UG1]. RTX4100_User_Guide_Module_Evaluation_UG1.pdf.
[UG3]. RTX4100_User_Guide_Application_Development_UG3.pdf.
[UG7]. RTX4100_User_Guide_WSAB_Dock_UG7.pdf.

2 Features

The Wi-Fi Sensor Application Board includes the following features.

- **RTX41xx module:** The RTX41xx Wi-Fi Module small form-factor, single stream, 802.11b/g/n Wi-Fi module with on-board low power application processor.

- **Two push buttons:** Two push buttons readable from RTX41xx pin. Can be used for application user interface and development.

- **Dual color LED (Red/Green):** LED controllable by RTX41xx pin. Can be used for application user interface and development

- **External sensor solder points:** Connection point for external resistive transducer, connected to RTX41xx ADC and analog comparator inputs. Can be used for connection of light sensor photo diode, NTC resistor etc.

- **MEMS (Micro Electro-Machanical System):** 3-axis accelerometer and 3-axis compass. Can be used to implement mechanical sensor and positioning applications.

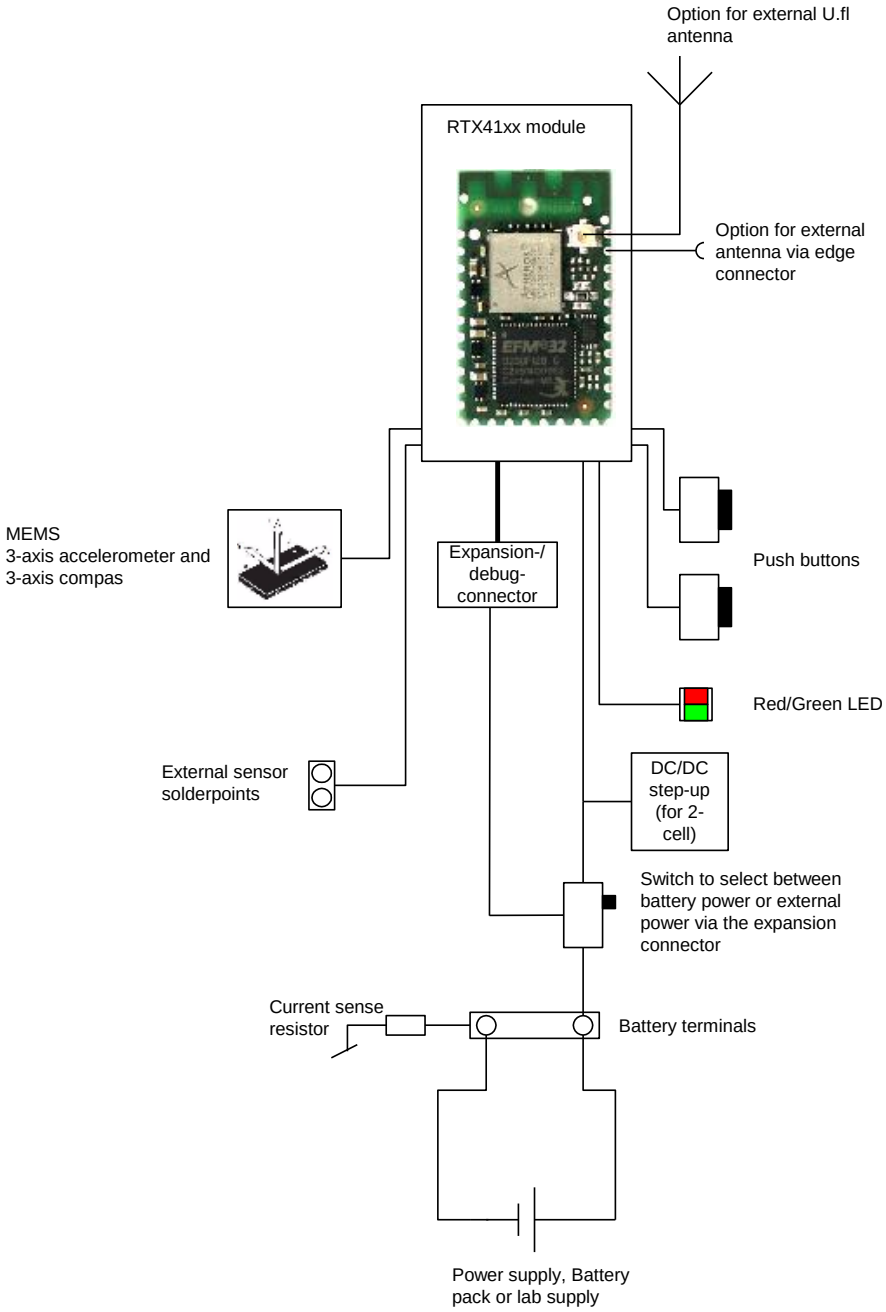
- **2x14 pin expansion-/debug-connector:** Expansion connector, with all RTX41xx IO's available (except pin 29), for adding customized application add-on boards. Can be used for adding new sensor devices, power supplies etc. The connector also serves as a connection to the USB controller cable used by the EVK, see reference ([UG1]) . The connector also enables the WSAB to be placed in the WSAB Docking Station, enabling a full development environment, see reference ([UG7]).

- **Power supply:** The power supply supports multible battery options as well as a lab supply for development.

- **Current sensing resistor:** A resistor in the ground path of the external power supply enables characterization of the current profile of the application simply using an oscilloscope.

- **Small form factor:** 25x53mm (25x59mm including RTX4100 module)

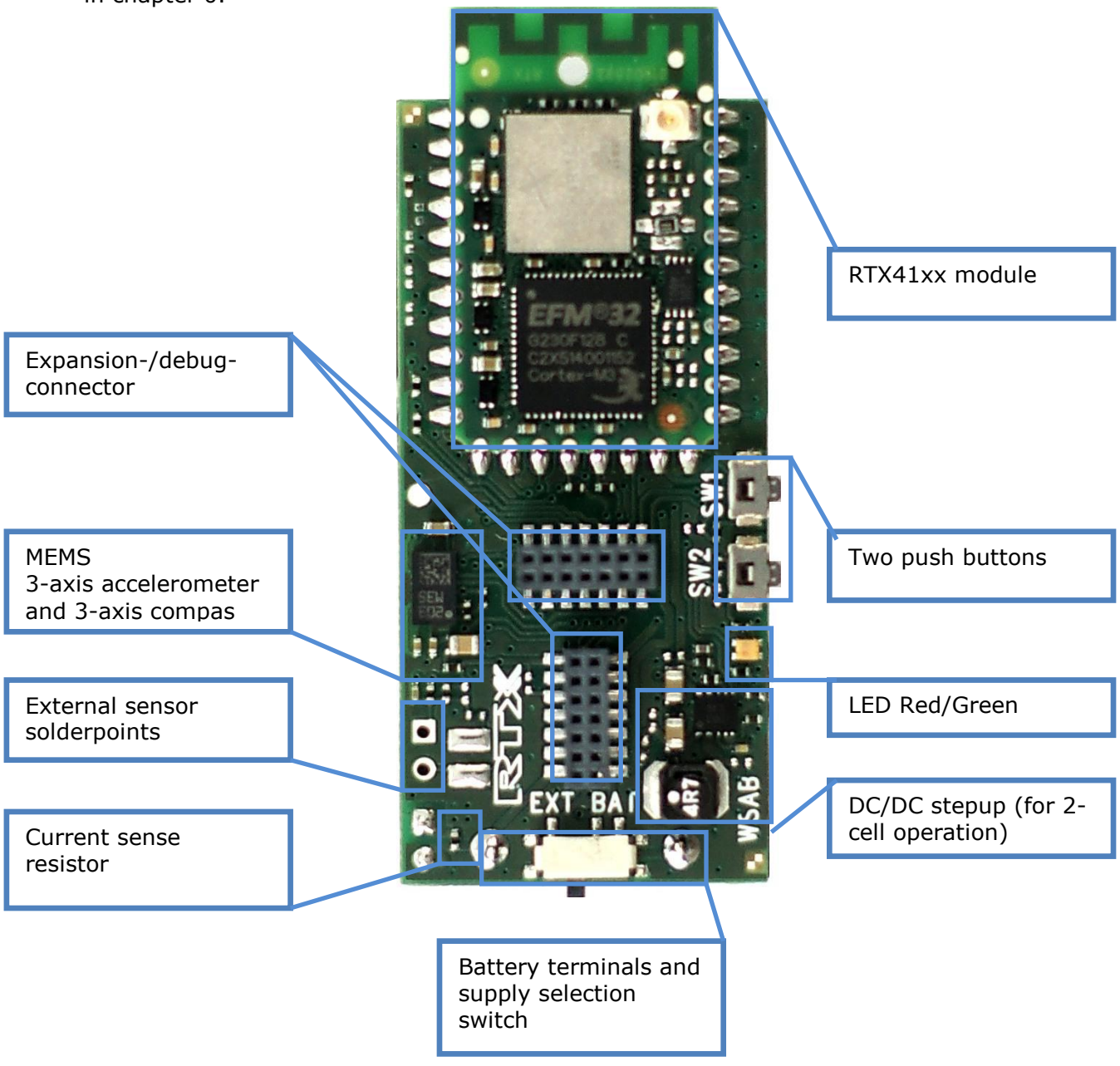
3 WSAB Block Diagram



Figur 1 WSAB blockdiagram, see section 6 for alternative antenna options

4 Hardware Layout

The layout of the WSAB is shown below. See detailed component placing and schematics in chapter 0.



5 Power Supply

The board supports battery power or external power. The two sources are selected by a switch SW3, see component drawing in section 10.

In all power supply configurations the operating voltage requirements stated in the RTX4100 module datasheet must be respected, see ([DS1]).

5.1 Battery Powered

With SW3 set to BAT the battery terminals BAT+ and BAT- supplies the board from the batteries inserted in the battery compartment. BAT+ is the positive supply connection, and BAT- is the negative supply connection.

The board can be configured in two power supply configurations which are described in the following two sections. The WSAB is delivered in low voltage power supply configuration (also refered to as 2-cell).

5.1.1 Low Voltage Power Supply Configuration (Default configuration: 2-cell)

The low voltage power supply configuration supplies parts of the internal module directly (VCC1) from the battery and other parts from the DC/DC step-up converter (VCC2) implemented on the WSAB. The minimum input voltage in this configuration is 2.1V.

Recommended battery configurations include but are not limited to:

- 2x AAA alkaline (V_{nom}=2x1.5V)
- 2x AA alkaline (V_{nom}=2x1.5V)

5.1.2 Direct Power Supply Configuration (3-cell)

In the direct power supply configuration the battery terminals are supplying the module directly on both module supplies VCC1 and VCC2.

Recommended battery configurations include but are not limited to:

- 3x AAA alkaline (V_{nom}=3x1.5V)
- 3x AA alkaline (V_{nom}=3x1.5V)
- 1x Li-ion rechargeable batteries (V_{nom}=3.7V)

To use the direct power supply configuration the following modifications are needed :

- Un-mount R8
- Move zero ohm size 0402 resistor from position R18 to R17

see component drawing in in section 10.

5.2 External Power

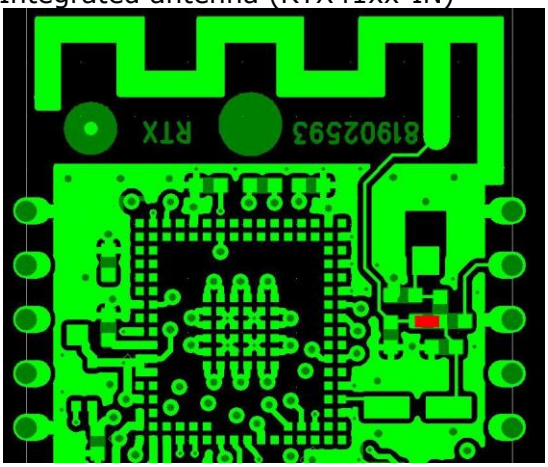
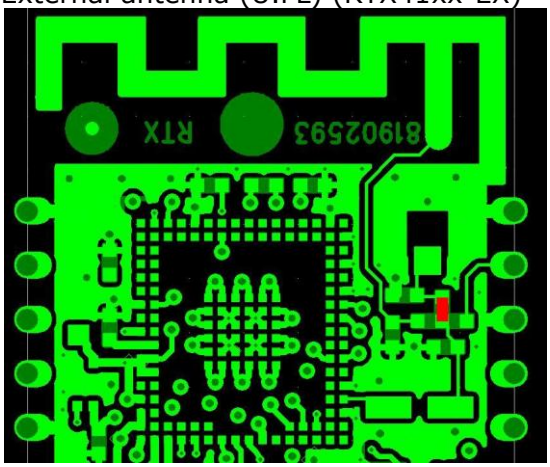
With SW3 set to EXT the board is supplied from the Expansion connector, this setting should be used when the board should be powered from the WSAB Docking Station, see reference ([UG7]).

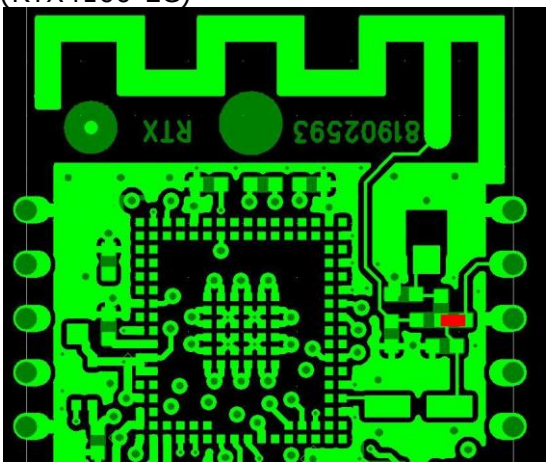
6 Antenna Configuration

The RTX4100 module has an integrated antenna and an option for external antennas on either a U.fl coaxial connector or an edge connector. The module is in its default configuration set to use the integrated antenna.

How to change the antenna configuration between internal and external antenna is described in the figure below.

A number of 2.4GHz WiFi antennas using the U.FL connector are available from different vendors.

<table>
<tr>
<td>Integrated antenna (RTX41xx-IN)
 
Mount 3.3 nH chip inductor 0402 (Murata LQG15HS3N3S02x) in above marked position to enable the internal antenna. This is the default configuration of the module hardware.</td>
<td>External antenna (U.FL) (RTX41xx-EX)
 
Mount 0 ohm resistor size 0402 in above marked position to enable U.FL antenna connector.

U.FL connector type:
Manufacturer: Amphenol
Order number: A-1JB</td>
</tr>
<tr>
<td>External antenna (Edge connector) (RTX4100-EC)
 
Mount 0 ohm resistor size 0402 in above marked position to enable the external edge connector.</td>
<td>(empty)</td>
</tr>
</table>

7 RTX41xx Module Connections

The table below shows the RTX4100 module pin connections on the WSAB and their intended function. All module pins (except pin29) are available on the expansion connector, see section 8. For additional information please see the RTX4100 and RTX4140 datasheets, reference ([DS1]) and ([DS2]).

Module Pin no.	Type	Module pin name	WSAB function
1	GND	GND	GND
2	I/O	PA0	I2C_SDA, for MEMS (IC3)
3	I/O	PA1	I2C_SCL, for MEMS (IC3)
4	VCC2	VCC2	Supplied by +3V5 output from DC/DC stepup (2-cell) Can be supplied from VBAT+ (3-cell) See section 5.1
5	GND	GND	GND
6	VCC1	VCC1	Battery supply input VBAT+
7	O	VIO	Used as. -Reference for resistive sensor -Supply for MEMS -Pull up for DBG_SWDIO
8	I/O	PA3/PC1	US1_RX UART_RX signal used for eg. CoLA application download and debugging via USB virtual COM port.
9	I/O	PA4/PC0	US1_TX UART_TX signal used for eg. CoLA application download and debugging via USB virtual COM port.
10	I/O	PB7	Unused
11	I/O	PB8	Unused
12	GND	GND	GND
13	I	RESETn	Unused
14	I/O	PB12	INT1 for MEMS (IC3)
15	I/O	PB13	Enable signal for DC/DC stepup (used in 2-cell configuration, see section 5.1)
16	I/O	PB14	INT2 for MEMS (IC3)
17	GND	GND	GND
18	I/O	PD5	Input from push button SW1
19	I/O	PC6	LEU1_TX Low energy UART_TX signal used for terminal demo application via USB virtual COM port
20	I/O	PC7	LEU1_RX Low energy UART_RX signal used for terminal demo application via USB virtual COM port
21	I/O	PC5/PB11	DRDY for MEMS (IC3)
22	I/O	PC4/PD4	ADC0_CH4, ADC input for external sensor
23	I/O	PC2	Output for Red LED (D3)
24	I/O	PC3	Input from push button SW2
25	I/O	PF0	DBG_SWCLK, advanced debug interface clock (requires purchase of RTX2040 Unity-II debugger)
26	I/O	PF1	DBG_SWDIO, advanced debug interface data IO (requires purchase of RTX2040 Unity-II debugger)

27	I/O	PF2	Output for Green LED (D3)
28	GND	GND	GND
29	I/O	ANT	Unused
30	GND	GND	GND

8 Expansion-/Debug-connector

The expansion connector, with all RTX41xx IO's available, can be used for adding customized application add-on boards. eg. adding new sensor devices, power supplies etc. The connector also serves as the connection to the WSAB Docking Station and the terminal cable supplied with the EVK, see application development guide ([UG3]). The below table shows the pinout of the expansion-/debug-connector.

J6 Pin no.	Type	Module pin name	WSAB function
1	O	RESETn	See section 7
2	I/O	PA0	See section 7
3	I/O	PB12	See section 7
4	I/O	PA1	See section 7
5	I/O	PB8	See section 7
6	I/O	PA3/PC1	See section 7
7	GND	GND	See section 7
8	I/O	PA4/PC0	See section 7
9	I/O	PB13	See section 7
10	I/O	PB7	See section 7
11	I/O	PB14	See section 7
12	GND	GND	AGND Analog ground may be used as reference for RTX4100 analog I/O's
13	I/O	PC5/PB11	See section 7
14	I/O	PC4/PD4	See section 7

J5 Pin no.	Type	Module pin name	WSAB function
1	Power	VIO	VDD_EFM VIO reference voltage.
2	Power	VCC2(*)	+3V5 Step up voltage
3	I/O	PD5	See section 7
4	I/O	PF2	See section 7
5	I/O	PF1	See section 7
6	I/O	PF0	See section 7
7	I/O	PC3	See section 7
8	I/O	PC2	See section 7
9	I/O	PC7	See section 7
10	I/O	PC6	See section 7
11	Power		VEXT Supply input from WSAB Docking Station. Set SW 3 in position EXT to use this supply for the WSAB.
12	GND	GND	
13	Power		VBAT- negative battery terminal

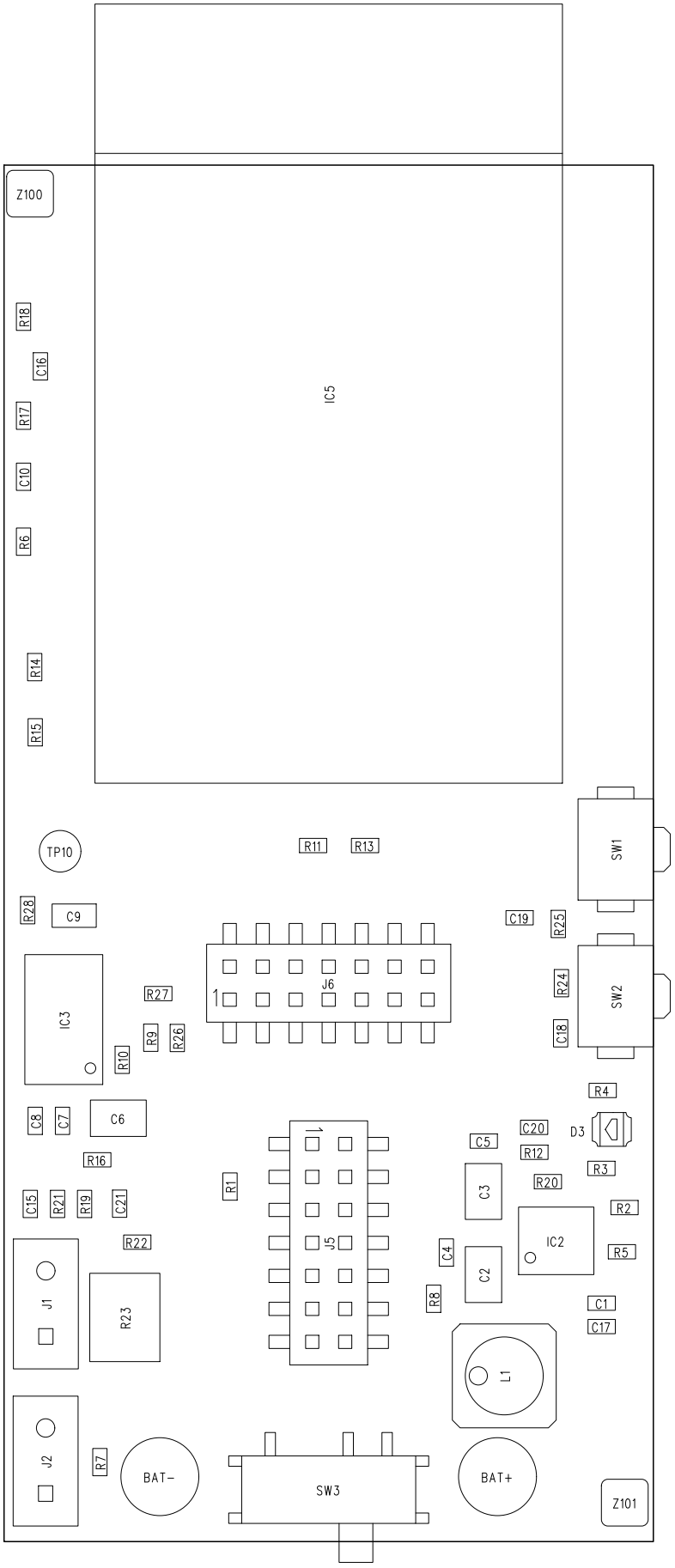
14	Power		VBAT+ positive battery terminal

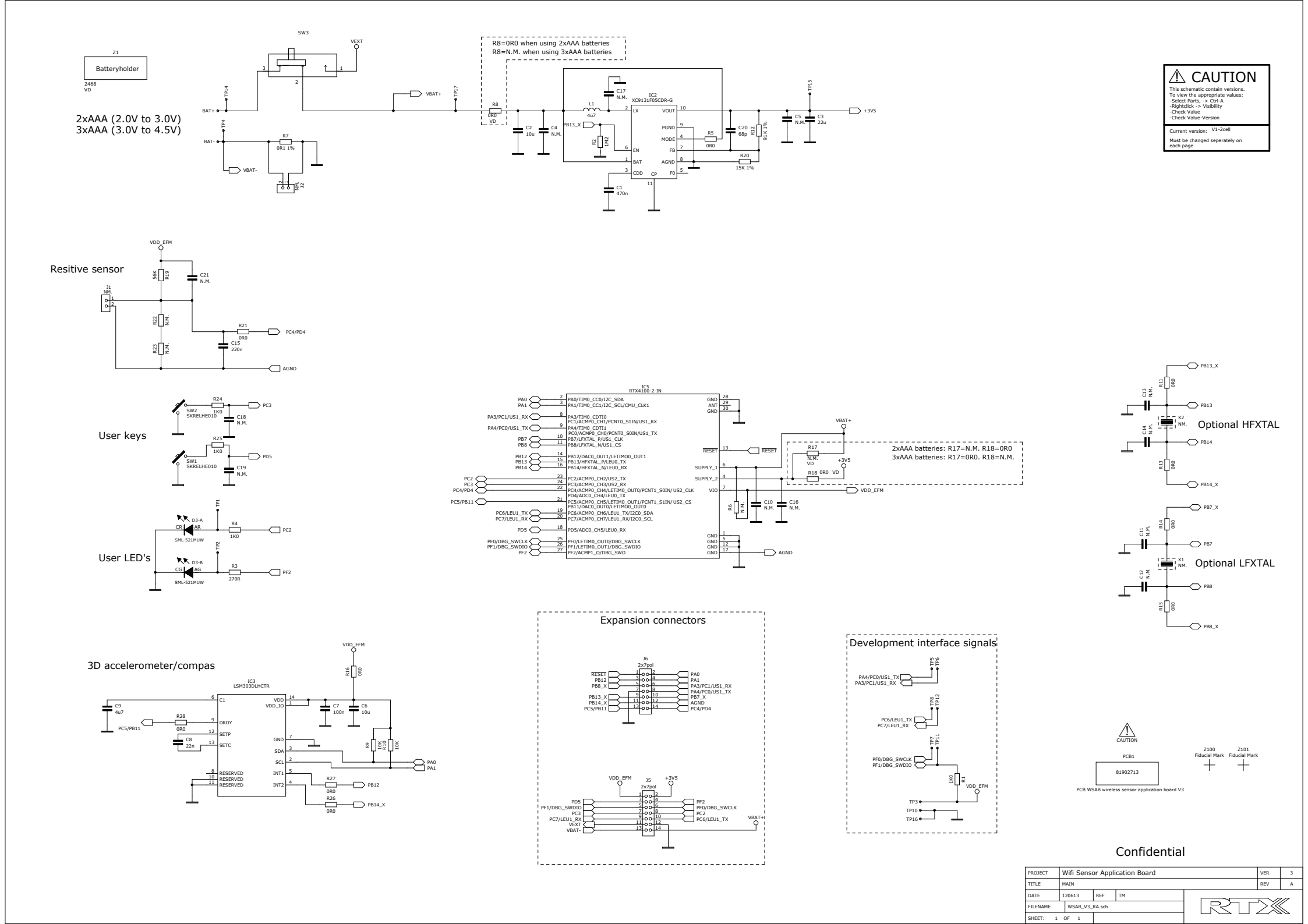
(*) Only valid when WSAB is configured for 2-cell operation. 2-cell operation is the default configuration.

9 Current Profile Measurements

The current sensing resistor (R7=0,1 Ohm) is placed in the ground path of the battery terminals. This provides the option of characterizing the current profile of the application simply by using an oscilloscope. Measurements can be done between J2 solder points using a 1x probe. Connect the probe ground to the square pad of J2 and the probe tip to the round pad of J2. A momentary current of 100mA will translate to -10mV on the oscilloscope. Therefore the signal should be inverted in the oscilloscope channel setup. The measurements can be used to profile or watch the active current consumption when developing and testing applications. Due to the low value of the resistor the measurements are only valid in active states with Wi-Fi activity. Sleep currents are too low to measure using the current sensing resistor, and should be done by other means.

10 Board Documentation


Z100
IC5
R18
C16
R17
C10
R6
R14
R15
TP10
R11
R13
SW1
R28
C9
C19
R25
J6
1
IC3
R27
R24
SW2
R9
R26
C18
R10
R4
C8
C7
C6
D3
C20
C5
R16
R12
R3
R1
J5
C3
R20
C15
R21
R19
C21
R2
IC2
R22
C4
R5
J1
R23
C2
R8
C1
C17
L1
J2
R7
BAT-
SW3
BAT+
Z101


Z1
Batteryholder
2468
VD
2xAAA (2.0V to 3.0V)
3xAAA (3.0V to 4.5V)
SW3
VEXT
TP14
BAT+
TP4
BAT-
VBAT+
TP17
VBAT-
R7
0R1 1%
J2
J1
NM.
R8
0R0
VD
R8=0R0 when using 2xAAA batteries
R8=N.M. when using 3xAAA batteries
C2
10u
C4
N.M.
L1
4u7
C17
N.M.
IC2
XC9131F05CDR-G
LX
VOUT
PGND
MODE
FB
EN
BAT
AGND
CDD
CP
FO
PB13_X
R2
1M2
R5
0R0
C20
68p
R12
91.K 1%
R20
15K 1%
C5
N.M.
C3
22u
TP15
+3V5
C1
470n
CAUTION
This schematic contain versions.
To view the appropriate values:
-Select Parts, -> Ctrl-A
-Rightclick -> Visibility
-Check Value
-Check Value-Version
Current version: V1-2cell
Must be changed seperately on each page
Resitive sensor
VDD_EFM
R19
56K
C21
N.M.
J1
NM.
R22
N.M.
R23
N.M.
R21
0R0
C15
220n
PC4/PD4
AGND
User keys
SW2
SKRELHE010
SW1
SKRELHE010
R24
1K0
R25
1K0
C18
N.M.
C19
N.M.
PC3
PD5
User LED's
D3-A
D3-B
SML-521MUW
R4
1K0
R3
270R
TP1
TP2
PC2
PF2
IC5
RTX4100-2-IN
PA0/TIM0_CC0/I2C_SDA
PA1/TIM0_CC1/I2C_SCL/CMU_CLK1
PA3/PC1/US1_RX
PA3/TIM0_CDTI0
PC1/ACMP0_CH1/PCNT0_S1IN/US1_RX
PA4/PC0/US1_TX
PA4/TIM0_CDTI1
PC0/ACMP0_CH0/PCNT0_S0IN/US1_TX
PB7
PB7/LFXTAL_P/US1_CLK
PB8
PB8/LFXTAL_N/US1_CS
PB12
PB12/DAC0_OUT1/LETIM00_OUT1
PB13
PB13/HFXTAL_P/LEU0_TX
PB14
PB14/HFXTAL_N/LEU0_RX
PC2
PC2/ACMP0_CH2/US2_TX
PC3
PC3/ACMP0_CH3/US2_RX
PC4/PD4
PC4/ACMP0_CH4/LETIM0_OUT0/PCNT1_S0IN/US2_CLK
PD4/ADC0_CH4/LEU0_TX
PC5/PB11
PC5/ACMP0_CH5/LETIM0_OUT1/PCNT1_S1IN/US2_CS
PB11/DAC0_OUT0/LETIM00_OUT0
PC6/LEU1_TX
PC6/ACMP0_CH6/LEU1_TX/I2C0_SDA
PC7/LEU1_RX
PC7/ACMP0_CH7/LEU1_RX/I2C0_SCL
PD5
PD5/ADC0_CH5/LEU0_RX
PF0/DBG_SWCLK
PF0/LETIM0_OUT0/DBG_SWCLK
PF1/DBG_SWDIO
PF1/LETIM0_OUT1/DBG_SWDIO
PF2
PF2/ACMP1_O/DBG_SWO
GND
ANT
RESET
SUPPLY_1
SUPPLY_2
VIO
VBAT+
R17
N.M.
VD
+3V5
R18 0R0 VD
VDD_EFM
R6
N.M.
C10
N.M.
C16
N.M.
AGND
2xAAA batteries: R17=N.M. R18=0R0
3xAAA batteries: R17=0R0. R18=N.M.
PB13_X
R11
0R0
C13
N.M.
PB13
X2
NM.
C14
N.M.
PB14
R13
0R0
PB14_X
Optional HFXTAL
PB7_X
R14
0R0
C11
N.M.
PB7
X1
NM.
C12
N.M.
PB8
R15
0R0
PB8_X
Optional LFXTAL
3D accelerometer/compas
IC3
LSM303DLHCTR
C1
VDD
VDD_IO
GND
SDA
SCL
INT1
INT2
DRDY
SETP
SETC
RESERVED
C9
4u7
C8
22n
C7
100n
C6
10u
R16
0R0
R28
0R0
PC5/PB11
R9
10K
R10
10K
R27
0R0
R26
0R0
PB12
PB14_X
PA0
PA1
Expansion connectors
J6
2x7pol
RESET
PB12
PB8_X
PB13_X
PB14_X
PC5/PB11
PA0
PA1
PA3/PC1/US1_RX
PA4/PC0/US1_TX
PB7_X
AGND
PC4/PD4
J5
2x7pol
VDD_EFM
+3V5
PD5
PF1/DBG_SWDIO
PC3
PC7/LEU1_RX
VEXT
VBAT-
PF2
PF0/DBG_SWCLK
PC2
PC6/LEU1_TX
VBAT+
Development interface signals
PA4/PC0/US1_TX
PA3/PC1/US1_RX
TP5
TP6
PC6/LEU1_TX
PC7/LEU1_RX
TP8
TP12
PF0/DBG_SWCLK
PF1/DBG_SWDIO
TP7
TP11
R1
1K0
VDD_EFM
TP3
TP10
TP16
CAUTION
PCB1
81902713
PCB WSAB wireless sensor application board V3
Z100
Fiducial Mark
Z101
Fiducial Mark
Confidential
PROJECT
Wifi Sensor Application Board
VER
3
TITLE
MAIN
REV
A
DATE
120613
REF
TM
FILENAME
WSAB_V3_RA.sch
SHEET:
1
OF
1

11 Abbreviations

The following abbreviations are used in this document:

API	**Application Programming Interface**
BSP	**Board Support Package**
CoLA	**Co-Located Application**
GPIO	**General Purpose Input/Output**
MCU	**Micro Controller Unit**
RTOS	**Real-Time Operating System**
UART	**Universal Asynchronous Receiver/Transmitter**
WEP	**Wired Equivalent Privacy**
Wi-Fi	**Wireless Fidelity**
WPA	**Wi-Fi Protected Access**
WPS	**Wi-Fi Protected Setup**

12 Liability Disclaimer

General

This document and the information contained, is property of RTX A/S, Denmark. Unauthorized copying is not allowed. The information in this document is believed to be correct at the time of writing. RTX A/S reserves the right at any time to change said content, circuitry and specifications.

Information contained in this document is subject to change without notice. RTX makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. RTX shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishings, performance, or use of this material.

Warranty

This product is warranted against defects in material and Workman ship for a period of one year from date of shipment. During the warranty period, RTX will at its option, either repair or replace products, which prove to be defective. For warranty service or repair, this product must be returned to a service facility designated by RTX. Buyer shall prepay shipping charges to RTX and RTX shall pay shipping charges, duties, and taxes for products returned to RTX from another country. RTX warrants that its software and firmware designated by RTX for use with a module will execute its programming instructions when properly installed on that instrument. RTX does not warrant that the operation of the product or firmware will be uninterrupted or error free.

Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.
NO OTHER WARRANTY IS EXPRESSED OR IMPLIED.
RTX SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.