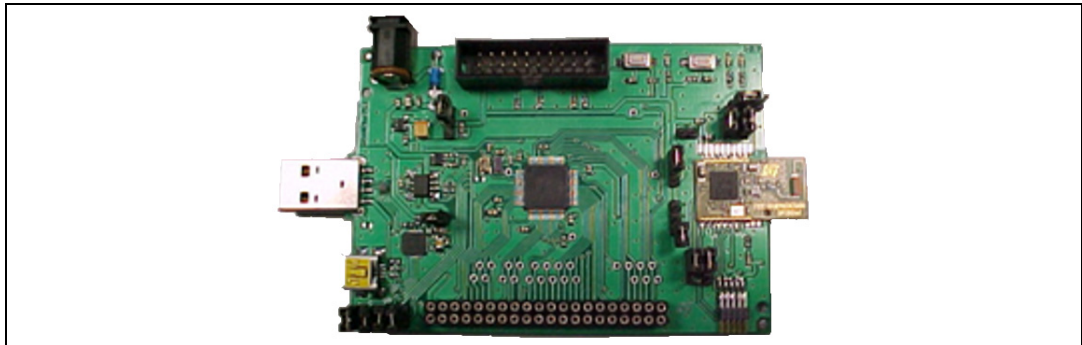


STEVAL-SPZB260Vx demonstration kit for the SPZB260-PRO series of ZigBee® radio communication modules

Description

Figure 1. STEVAL-SPZB260V1 HW



The STEVAL-SPZB260Vx is a demonstration kit of the SPZB260-PRO series of ZigBee modules that enables you to test ZigBee protocol feature capabilities and to prototype a coordinator, a router or an end device for your target ZigBee application. It includes a development board and a package of software libraries.

The main components integrated in the development board are a Zigbee radio communication module of the series SPZB260-PRO based on the EM260 network processor chipset and an STM32F103RET6 microprocessor. Both the micro and the Zigbee module are connected via their SPI interface and they communicate thanks to the Ember ZigBee serial protocol running on the micro. An extended number of external connectors allows the integration of peripherals as requested by the target application.

The software in the kit includes the hardware abstraction layer and microprocessor libraries, the Ember ZigBee Serial Protocol driver and a simple application implementing sensor and sink features for use in a typical remote monitoring scenario.

The STEVAL-SPZB260Vx can be used for the following purposes.

- **Demonstration:** by using the sensor/sink application example integrated in the kit and two development boards, you can easily set-up a demo showing a few of basic features of the ZigBee protocol stack. The demo shows the behavior of a typical wireless sensor network where a sink collects data sent by a sensor remotely connected.
- **Development:** by using external equipment consisting in a development environment for the STM32 and, optionally, the ember insight adapter and ember insight desktop for network analysis and debugging, the kit can be used to prototype and debug a target ZigBee application.

This document describes the hardware and software components of the STEVAL-SPZB260Vx and provides instructions for setting up the hardware and loading and running the application example.

The document is not meant to be a ZigBee tutorial and assumes that the reader is familiar with IAR development tools and the basic features of the STM32 microprocessor.

Contents

- 1 Introduction 5**
 - 1.1 Hardware 5
 - 1.2 Software 6
 - 1.3 CD 6
 - 1.4 External equipment 6
 - 1.4.1 IAR toolset 6
 - 1.4.2 Insight adapter and desktop 7
 - 1.5 Hardware and software compatibility 8

- 2 Hardware description 9**
 - 2.1 STEVAL board description 9
 - 2.2 Recommended operating conditions 10
 - 2.3 Board connections 11
 - 2.4 Board layout 15
 - 2.5 Hardware features 16
 - 2.5.1 I/O signal voltage configuration 16
 - 2.5.2 Reset 16
 - 2.5.3 Configurable button 16
 - 2.5.4 Voltage battery meter 16
 - 2.5.5 Temperature sensor 17
 - 2.5.6 Ground points 17
 - 2.6 Setting up STEVAL 17
 - 2.6.1 Powering setup 18
 - 2.6.2 Serial communication interface setup 19
 - 2.6.3 ZigBee module interface setup 20
 - 2.6.4 Boot mode setup 21

- 3 Getting started with the KIT 22**
 - 3.1 Installing the SPZB260kit library 22
 - 3.2 SPZB260kit content 22
 - 3.3 Installing the USB and CP1202 drivers 23
 - 3.3.1 USB driver 23
 - 3.3.2 CP2102 driver 23

3.4	Installing the Flash loader demonstrator tool	24
3.5	Checking that the STEVAL works with the "Version" application	24
4	Installing and running the sink-sensor application	26
4.1	Sink-sensor sample application	26
4.2	Loading the sink-sensor onto your STEVAL	27
4.3	Setting-up a network and running the sink-sensor application	28
5	Monitoring network activity	32
6	Developing your own application	32
7	Updating the ZigBee protocol stack on the ZigBee module	32
7.1	Updating the stack image using the Insight Adapter	32
7.2	Updating the stack image using the micro	33
8	RoHS compliance	34
Appendix A	35
A.1	Using the Insight Adapter	35
A.2	Using multiple USB-to-UART bridges	35
A.3	Using the STEVAL reset when the STEVAL is connected via USB	35
A.4	STEVAL electrical schematic	36
Revision history	37

List of figures

Figure 1.	STEVAL-SPZB260V1 HW	1
Figure 2.	Block diagram	9
Figure 3.	STEVAL board and main components	9
Figure 4.	STEVAL layout	15
Figure 5.	STEVAL mechanical dimensions	15
Figure 6.	Ground points for daughter board connection	17
Figure 7.	STEVAL jumper positions	17
Figure 8.	Power supply jumper configurations	18
Figure 9.	Serial connection jumper configurations	19
Figure 10.	Zigbee module connection jumper configurations	20
Figure 11.	Boot modes jumper configurations	21
Figure 12.	Virtual COM associated to the STM32	23
Figure 13.	COM associated to USB-to-UART bridge	24
Figure 14.	Version application data output	25
Figure 15.	Sink advertise and form network messages	29
Figure 16.	Sink: join and data messages	30
Figure 17.	Sensor: join and data messages	30
Figure 18.	Sink: "i" command output	31
Figure 19.	SPI_bootloader data output	33
Figure 20.	STEVAL electrical schematic	36

1 Introduction

As specified in [Table 1](#), several versions of the STEVAL-SPZB260Vx are defined based on the SPZB260-PRO module type that is integrated.

Table 1. STEVAL-SPZB260Vx versions

Order codes	Integrated module
STEVAL-SPZB260V1	SPZB260-PRO
STEVAL-SPZB260V2	SPZB260C-PRO
STEVAL-SPZB260V3	SPZB260PA-PRO
STEVAL-SPZB260V4	SPZB260PAC-PRO

In the rest of the document, the following abbreviations are used.

Table 2. Abbreviations

STEVAL-SPZB260V1 / STEVAL-SPZB260V2 / STEVAL-SPZB260V3 / STEVAL-SPZB260V4	KIT
STEVAL-SPZB260V1 hardware	STEVAL
STEVAL-SPZB260V1 software	SPZB260kit
SPZB260-PRO / SPZB260PA-PRO / SPZB260PAC-PRO	ZigBee module
Ember ZigBee serial protocol	EZSP
STM32F103RET6	STM32
Hardware abstraction layer	HAL
Ember insight adapter	ISA

The kit consists of the parts described in the following sections.

1.1 Hardware

Full featured development board that targets prototyping of a coordinator, router or end device for use in a ZigBee network. External connectors allows you to integrate the peripherals of your interest. The board can be supplied by means of an external +5 V supply or through one of its USB connectors. The STEVAL integrates the following.

- A ZigBee module that runs the version 3.3.1 of the EmberZNet PRO™ protocol stack.
- A host microcontroller (STM32F103RET6) with 512 kB Flash and 64 kB RAM.
- A 10-pin insight port and JTAG connectors for programming and debugging purposes.
- Configurable hardware support for application development:
 - temperature sensor
 - voltage battery measure circuitry
 - one push button
 - two LEDs
- Mini-USB and USB/RS-232 bridge connectors.

- A host microcontroller reset button.
- An STM32 selectable SPI/UART link to the ZigBee module (UART is only usable with SPZB260C-PRO, SPZB260PA-PRO and SPZB260PAC-PRO).
- A DC power source selection between the external power supply or external USB supply.
- Power indicator LEDs.
- Selectable STM32 boot modes: Flash, RAM and boot load through USART1 (USB/RS-232 bridge).
- Jumpers for USB/RS-232, SPI/UART, boot mode and supply selection.
- 40-pin, 0.1" pitch, double-row header for access to remaining host GPIO signals and interfaces (SPIs, USARTs, I2Cs, etc.)

1.2 Software

The kit is shipped with the EmberZNet 3.3.1 version pre-loaded on the ZigBee module. In addition, the kit contains a software package including the HAL libraries, the Ember ZigBee serial protocol driver and a simple application implementing sensor and sink features for use in a typical remote monitoring scenario.

1.3 CD

The kit also includes a CD that contains the software and related documentation (SPZB260kit zip file). A large number of documents for use with the STM32, insight adapter/desktop tools from Ember, and IAR tool suite can be found at the ST, Ember and IAR web sites respectively.

1.4 External equipment

The following minimum external equipment is required to use the kit functionalities.

- A PC with Windows XP®.
- The STM32 development toolset when the kit is used for application development purposes. The kit includes pre-built projects for use of the IAR Embedded Workbench IDE version 5.4 A. For network debugging and traffic analysis, the kit can be also used with the Insight adapter and Insight desktop from Ember Corporation.
- A mini-USB cable to connect the STEVAL with the PC via the mini-USB interface.
- An insight port cable to connect the STEVAL with the Insight adapter via the Insight port interface.

1.4.1 IAR toolset

The IAR Embedded Workbench IDE for ARM® is a very powerful integrated development environment used for developing and managing complete embedded application projects.

Note: For programming (and/or debugging) using the IAR toolset, an IAR J-Link JTAG emulator is required. The IAR J-LINK is a JTAG emulator designed for ARM cores. It connects via a USB port to a PC running Windows® 2000 or XP. It has a built-in 20-pin JTAG connector, which is compatible with the standard 20-pin connector defined by ARM. When using the IAR J-Link, an external power supply is required to power the STEVAL board.

The first time the IAR J-link is plugged into the PC's USB port, the user is requested to provide the relative J-Link driver. To do this, browse to the IAR installation directory and select the folder ARM > Driver > Jlink. The IAR toolset and the IAR J-Link are not provided with the kit. For detailed information and documentation about IAR products, refer to www.iar.com. As an alternative, ST-Link can be used in place of the IAR J-LINK emulator. ST-LINK is a very low-cost, in-circuit debugger/programmer for STM32. It connects to the application or demonstration board for programming and debugging via a standard JTAG connection. The complete ST-LINK documentation is available from www.st.com.

1.4.2 Insight adapter and desktop

The STEVAL board can be interfaced with an insight adapter and insight desktop (from Ember, available as part of the JumpStart Ember development kit). These tools are useful for updating the protocol stack on the module and for monitoring and debugging the network traffic over the network.

For detailed information about the Insight adapter and desktop, refer to the related document on the Ember website at www.ember.com. The following sections provide a short introduction to these modules.

Insight adapter

The Insight adapter (ISA) is a device that, via the Insight port, connects the STEVAL to the Ethernet. The adapter transmits network data collected by the Insight port and conveys it over its Ethernet connection to the Insight desktop tool. It also picks up any messages or new software that is addressed to this board, and processes emulation and debug commands. ISA enables the host PC to interface with the hardware node during debugging and programming.

The Insight is comprised of:

- a 10-pin Insight port for interfacing to the STEVAL (providing programming and debugging services).
- a TCP/IP 10/100 Ethernet interface with a power-over-Ethernet functionality.

Insight desktop

The Insight desktop is a graphical tool that displays network and node activities in real time. It provides a rich and flexible interface to the embedded networks, which helps you develop and debug new network applications. The Insight desktop includes the following features.

- Multiple editor panes that provide tiered views of network activity, letting you drill down from a high-level map of node interactions to the detail of each packet.
- Customizable filters that let you specify exactly which network activities to display.
- Log files that save captured data, enabling you to step through transactions and events for a detailed analysis.
- A file browser that lets you easily upload new applications to any connected node.
- A browser-based interface for automatic discovery of Ethernet-connected adapters and easy management of adapter applications.

1.5 Hardware and software compatibility

The STEVAL-SPZB260V1 has been successfully tested with the following libraries and ToolSuite versions.

- EmberZnet stack, version 3.3.1. Pre-loaded on the STEVAL when shipped (version 3.5 on the ZigBee module is an option that can be required at the time of ordering).
- Version 2.0.1 of the Flash loader demonstrator. Available at www.st.com.
- Version 2.0.3 of the STM32 firmware library. Included in the kit.
- EZSP driver. Included in the kit.
- Sink sensor example. Included in the kit.
- IAR 5.4, not included in the kit
- USB driver. Included in the kit.
- CP2102 driver. Included in the kit and available from www.silabs.com.

2 Hardware description

2.1 STEVAL board description

Figure 2. Block diagram

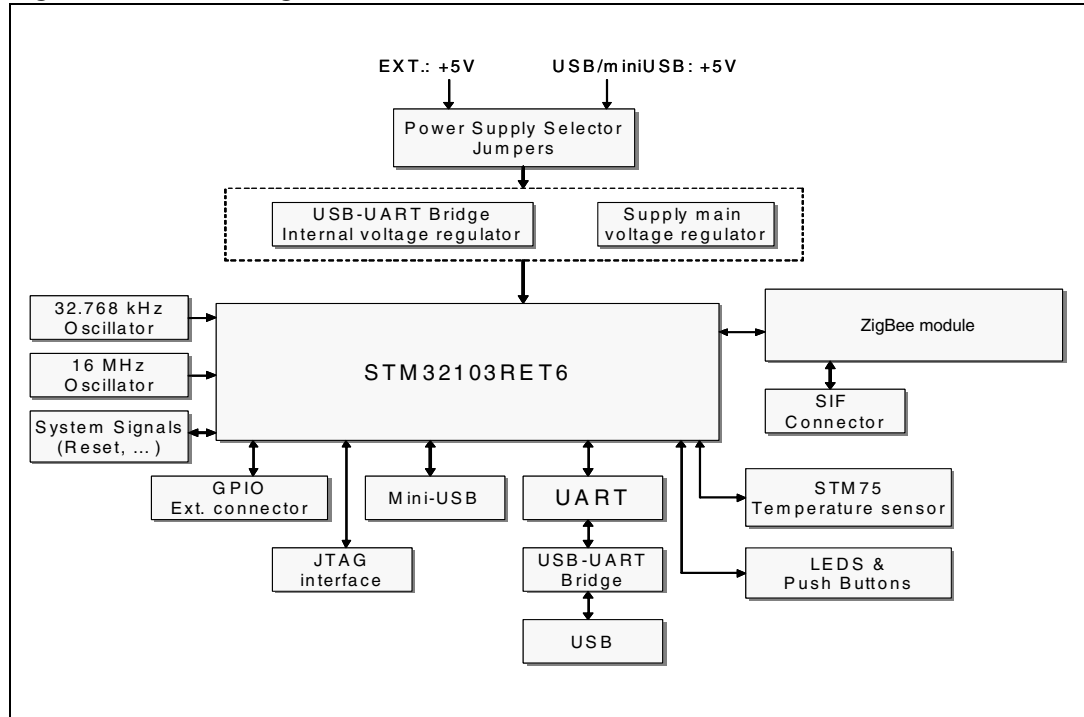
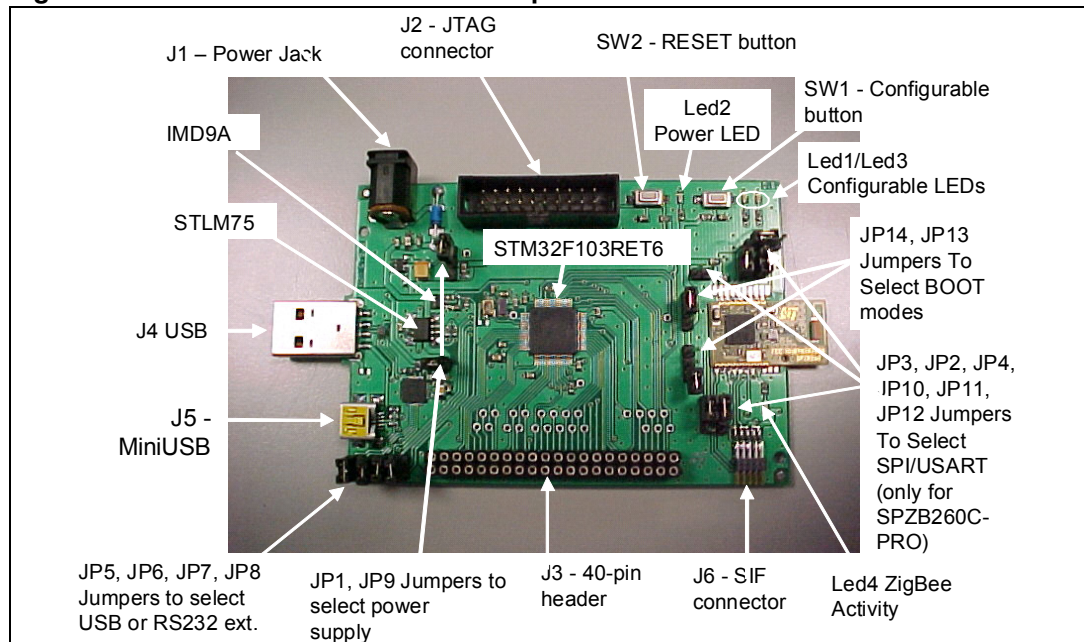


Figure 3. STEVAL board and main components



2.2 Recommended operating conditions

Table 3. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
J1- Ext.VIN	Main board supply voltage	$-20^{\circ}\text{C} < T < 70^{\circ}\text{C}$	4	5	6	V
J3- Ext.VIN	Alternate board (external battery) supply voltage	$-10^{\circ}\text{C} < T < 60^{\circ}\text{C}$	4	5	6	V
T_A	Operating ambient temperature		-20		+70	$^{\circ}\text{C}$

2.3 Board connections

Table 4. Board connections and configuration⁽¹⁾

Name	Pin n°	Description
J1	(2 poles)	Ext. VIN (typ. +5 V) external power supply plug.
J2	1	JTAG connector +3.3 V supply output (warning: current limited to 10 mA max.)
	2	JTAG connector +3.3 V supply output (warning: current limited to 10 mA max.)
	3	JTAG connector - JTRST
	4	JTAG connector - GND (system ground, 0 volt)
	5	JTAG connector - JTDI
	6	JTAG connector - GND (system ground, 0 volt)
	7	JTAG connector - JTMS
	8	JTAG connector - GND (system ground, 0 volt)
	9	JTAG connector - JTCK
	10	JTAG connector - GND (system ground, 0 volt)
	11	JTAG connector - (R6 - 10 kΩ pull-down connection)
	12	JTAG connector - GND (system ground, 0 volt)
	13	JTAG connector - JTDO
	14	JTAG connector - GND (system ground, 0 volt)
	15	JTAG connector - RESET
	16	JTAG connector - GND (system ground, 0 volt)
	17	JTAG connector - (R7 - 10 kΩ pull-down connection)
	18	JTAG connector - GND (system ground, 0 volt)
	19	JTAG connector - (R8 - 10 kΩ pull-down connection)
20	JTAG connector - GND (system ground, 0 volt)	

Table 4. Board connections and configuration⁽¹⁾ (continued)

Name	Pin n°	Description
J3	1	EXTENSION connector: +Vext. - positive pole for +5 V battery or external supply connection. See Figure 7 for use of JP1 jumper.
	2	EXTENSION connector: GND - negative pole for +5 V battery or external supply connection. See Figure 7 for use of JP1 jumper).
	3	EXTENSION connector: +3.3 V_O - (current limited 3.3 V output, max. 10 mA)
	4	EXTENSION connector: GND - (system ground, 0 volt)
	5	EXTENSION connector: PC0 - (STM32F103RET6 signal)
	6	EXTENSION connector: PC1 - (STM32F103RET6 signal)
	7	EXTENSION connector: PC2 - (STM32F103RET6 signal)
	8	EXTENSION connector: PC3 - (STM32F103RET6 signal)
	9	EXTENSION connector: PA0 - (STM32F103RET6 signal)
	10	EXTENSION connector: PA1 - (STM32F103RET6 signal)
	11	EXTENSION connector: PA2 - (STM32F103RET6 signal)
	12	EXTENSION connector: PA3 - (STM32F103RET6 signal)
	13	EXTENSION connector: PA4 - (STM32F103RET6 signal)
	14	EXTENSION connector: PA5 - (STM32F103RET6 signal)
	15	EXTENSION connector: PA6 - (STM32F103RET6 signal)
	16	EXTENSION connector: PA7 - (STM32F103RET6 signal)
	17	EXTENSION connector: PA8_16MHz_EN - (STM32F103RET6 signal)
	18	EXTENSION connector: PB0 - (STM32F103RET6 signal)
	19	EXTENSION connector: PB5 - (STM32F103RET6 signal)
	20	EXTENSION connector: PB6 (I2C bus SCL) - (STM32F103RET6 signal)
	21	EXTENSION connector: PB7 (I2C bus SDA) - (STM32F103RET6 signal)
	22	EXTENSION connector: PB8 - (STM32F103RET6 signal)
	23	EXTENSION connector: PB12 - (STM32F103RET6 signal)
	24	EXTENSION connector: PB13 - (STM32F103RET6 signal)
	25	EXTENSION connector: PB14 - (STM32F103RET6 signal)
	26	EXTENSION connector: PB15 - (STM32F103RET6 signal)
	27	EXTENSION connector: PC4 - (STM32F103RET6 signal)
	28	EXTENSION connector: PC5 - (STM32F103RET6 signal)
	29	EXTENSION connector: PC6 - (STM32F103RET6 signal)
	30	EXTENSION connector: PC7 - (STM32F103RET6 signal)
	31	EXTENSION connector: PC8 - (STM32F103RET6 signal)
	32	EXTENSION connector: PC9 - (STM32F103RET6 signal)
	33	EXTENSION connector: PC10 - (STM32F103RET6 signal)

Table 4. Board connections and configuration⁽¹⁾ (continued)

Name	Pin n°	Description
J3	34	EXTENSION connector: JTMS - (STM32F103RET6 signal)
	35	EXTENSION connector: JTCK - (STM32F103RET6 signal)
	36	EXTENSION connector: JTDI - (STM32F103RET6 signal)
	37	EXTENSION connector: JTDO - (STM32F103RET6 signal)
	38	EXTENSION connector: JTRST - (STM32F103RET6 signal)
	39	EXTENSION connector: TAMPER - (STM32F103RET6 signal)
	40	EXTENSION connector: RESET - (STM32F103RET6 signal)
J4	1	USB-RS232 BRIDGE connector: USB_VCC - (+5 V USB power supply)
	2	USB-RS232 BRIDGE connector: USB_D- - (USB DATA- signal)
	3	USB-RS232 BRIDGE connector: USB_D+ - (USB DATA+ signal)
	4	USB-RS232 BRIDGE connector: USB_GND - (USB GND)
J5	1	USB MINI connector: USB_VCC - (+5 V USB MINI power supply)
	2	USB MINI connector: USBDM - (USB MINI DATA- signal)
	3	USB MINI connector: USBDP - (USB MINI DATA+ signal)
	4	USB MINI connector: USB_GND - (USB MINI GND)
J6	1	Insight Port connector: 3.3V_ZB - power supply output (warning: current limited)
	2	Insight Port connector: SIF_MISO
	3	Insight Port connector: GND - (system ground, 0 volt)
	4	Insight Port connector: SIF_MOSI
	5	Insight Port connector: GND - (system ground, 0 volt)
	6	Insight Port connector: SIF_CLK
	7	Insight Port connector: SIF_LOADB
	8	Insight Port connector: 260_RSTB
	9	Insight Port connector: PTI_EN
	10	Insight Port connector: PTI_DATA
JP1	JUMPER	Configurable in combination with JP9. Refer to Section 2.6.1 on page 18 for jumper configuration cases. Connect this jumper to use the +5 V USB/miniUSB as power supply. (Warning: when this jumper is selected, remove the external power supply from J1 or from pin 1 of J3).
JP2	JUMPER	Configurable in combination with JP3, JP4, JP10, JP11, JP12. Refer to Section 2.6.3 on page 20 for configuration cases. The jumper enables the 260_SPI_MOSI signal (SPI connection between micro and ZigBee module).
JP3	JUMPER	Configurable in combination with JP2, JP4, JP10, JP11, JP12. Refer to Section 2.6.3 on page 20 for configuration cases. The jumper enables the 260_TXD signal (UART connection between micro and ZigBee module).

Table 4. Board connections and configuration⁽¹⁾ (continued)

Name	Pin n°	Description
JP4	JUMPER	Configurable in combination with JP2, JP3, JP10, JP11, JP12. Refer to Section 2.6.2 on page 19 for configuration cases. When connected, enables 260_RXD (for SPI connection between micro and ZigBee module) or HOSTINT (for UART connection between micro and ZigBee module), depending on the configuration of the other jumpers. When not connected, the jumper enables use of the micro's PB10 pin.
JP5	JUMPER	Configurable in combination with JP6, JP7, JP8. Refer to Section 2.6.2 on page 19 for configuration cases. When connected, this jumper enables the RTS_1 signal for use of the USB – RS-232 BRIDGE.
JP6	JUMPER	Configurable in combination with JP5, JP7, JP8. Refer to Section 2.6.2 on page 19 for configuration cases. When connected, this jumper enables the CTS_1 signal for use of the USB – RS-232 BRIDGE.
JP7	JUMPER	Configurable in combination with JP5, JP6, JP8. Refer to Section 2.6.2 on page 19 for configuration cases. When connected, this jumper enables the RXD_1 signal for use of the USB – RS-232 BRIDGE.
JP8	JUMPER	Configurable in combination with JP5, JP6, JP7. Refer to Section 2.6.2 on page 19 for configuration cases. When connected, this jumper enables the TXD_1 signal for use of the USB – RS-232 BRIDGE.
JP9	JUMPER (3 poles)	Configurable in combination with JP1. Refer to Section 2.6.1 on page 18 for configuration cases. By connecting pins 1-2 of the jumper, the user selects the main board voltage regulator (U1), while by connecting pins 2-3, the user selects the CP2102 internal voltage regulator.
JP10	JUMPER (3 poles)	Configurable in combination with JP2, JP3, JP11, JP12. Refer to Section 2.6.3 on page 20 for configuration cases. By connecting pins 1-2 the user selects the 260_SPI_CLK (SPI connection between micro and ZigBee module), while by connecting pins 2-3 the user selects the 260_RTS signal (UART connection between micro and ZigBee module).
JP11	JUMPER (3 poles)	Configurable in combination with JP2, JP3, JP10, JP12. Refer to Section 2.6.3 on page 20 for configuration cases. By connecting pins 1-2 the user selects the 260_SPI_MISO (SPI connection between micro and ZigBee module), while by connecting pins 2-3 the user selects the 260_CTS signal (UART connection between micro and ZigBee module).
JP12	JUMPER (3 poles)	Configurable in combination with JP2, JP3, JP10, JP11. Refer to Section 2.6.3 on page 20 for configuration cases. By connecting pins 1-2 the user selects the 260_SPI_SSEL (SPI connection between micro and ZigBee module), while by connecting pins 2-3 the user selects the 260_CTS signal.
JP13	JUMPER (3 poles)	Configurable in combination with JP14. Refer to Section 2.6.4 on page 21 for configuration cases. By connecting pins 2-3 the user selects the BOOT1 signal to enable the system memory boot load. By connecting pins 1-2 the user selects the embedded SRAM boot mode. By leaving the jumper disconnected, the user Flash boot mode is enabled.
JP14	JUMPER (3 poles)	Configurable in combination with JP13. Refer to Section 2.6.4 on page 21 for configuration cases. By connecting pins 2-3 the user selects the BOOT0 signal to enable the embedded system Ram or system memory boot modes. By connecting pins 1-2, the user enables the user Flash boot mode.
SW1	Push button	Software-configurable pushbutton connected to the STM32F103RCU6 PD2 pin.
SW2	Push button	Reset button – pushbutton acting on the STM32F103RCU6 reset pin. Note: use of this button can also be useful during programming of the microcontroller, by starting the programming phase without switching off/on the board's power supply).
Led1	GREEN	Software-configurable LED connected to PC12 (supplied by +3.3 V board voltage).
Led2	GREEN	LED showing the presence of the board's 3.3 V internal voltage.

Table 4. Board connections and configuration⁽¹⁾ (continued)

Name	Pin n°	Description
Led3	GREEN	Software-configurable LED showing status of PC11 internal signal (supplied by +3.3 V board voltage).
Led4	RED	LED showing status of the ZigBee module's ACTIVITY internal signal.

1. Refer to [Figure 3](#) for component layout.

2.4 Board layout

Figure 4. STEVAL layout

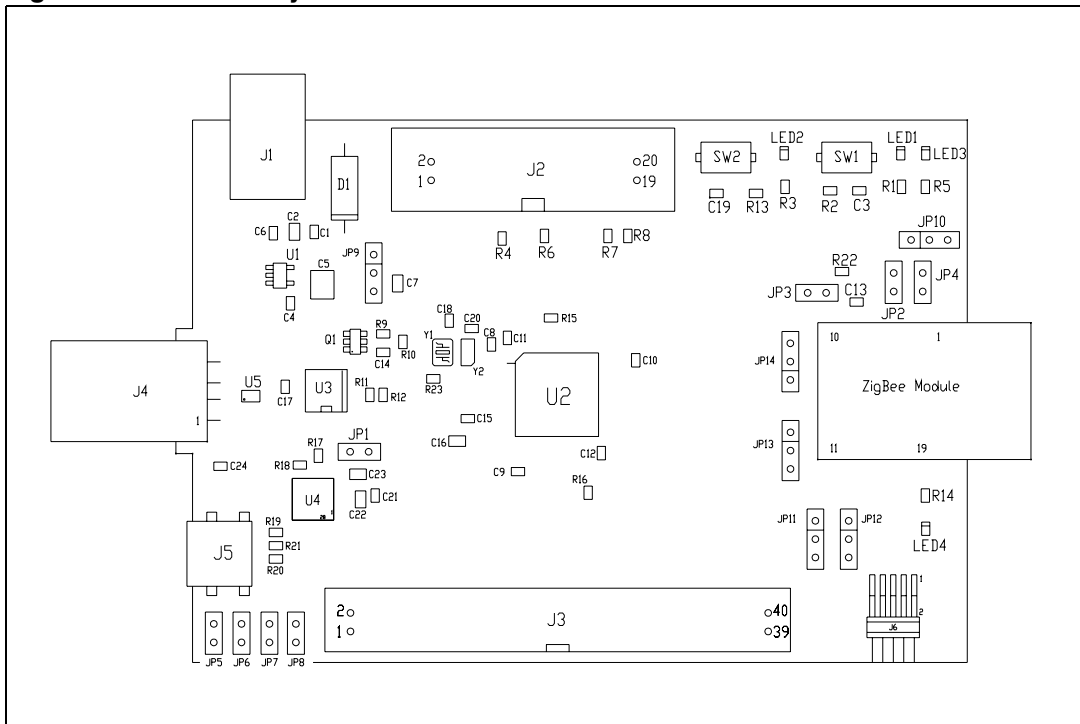
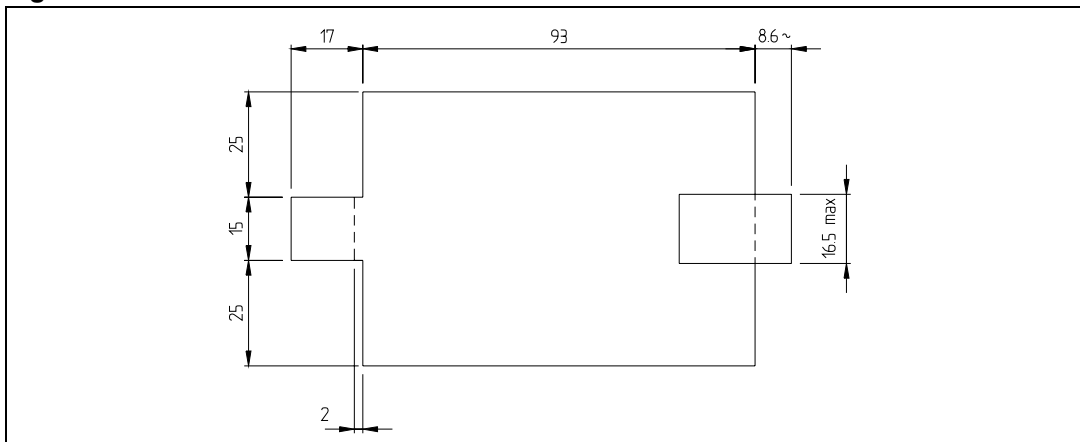


Figure 5. STEVAL mechanical dimensions



2.5 Hardware features

2.5.1 I/O signal voltage configuration

Table 5. Maximum voltage configuration of board interfaces

J3 extension connector	Pin 1	Maximum 6 V external power supply voltage (may be supply input if selected by user using the appropriate jumper positioning)	Pin is entirely user configurable (avoid conflicting power supplies)
	Pin 2	0 V interface	GND - system ground (0 V)
	Pin 3	3.3 V output board power supply (10 mA maximum current available)	Caution when used to supply external circuits
	Pin 4	0 V interface	GND - system ground (0 V)
	Pin 5 to 40	Maximum 3.3 V interface voltage	All system logic signals and I/O signals must be interfaced by a maximum 3.3 V level voltage
J2 emulator connector	Pin 1,2	Maximum 3.3 V interface voltage	Supply and ENABLE for external emulator (avoid conflicting power supplies)
	Pin 4,6,8,10,12,14,16,18,20	0 V interface	GND - system ground (0 V)
	Pin 3,5,7,9,13,15	Maximum 3.3 V interface voltage	All emulator interface logic signals must be interfaced by a maximum 3.3 V level voltage
	Pin 11,17,19	10 k Ω pull-down interface	10 k Ω resistor connected to GND internally on the board

2.5.2 Reset

The STEVAL integrates a reset push-button that generates a reset pulse for the microcontroller. The reset signal can also be externally generated via pin 40 of the J3 connector.

2.5.3 Configurable button

The STEVAL integrates a software-configurable push-button that is connected to the PD2 pin of the microprocessor.

2.5.4 Voltage battery meter

The STEVAL allows measuring the residual voltage available when an external battery is used. The functionality is enabled through the software and is derived by means of an IMD9A component whose output is connected to one of the analog ports of the STM32 micro.

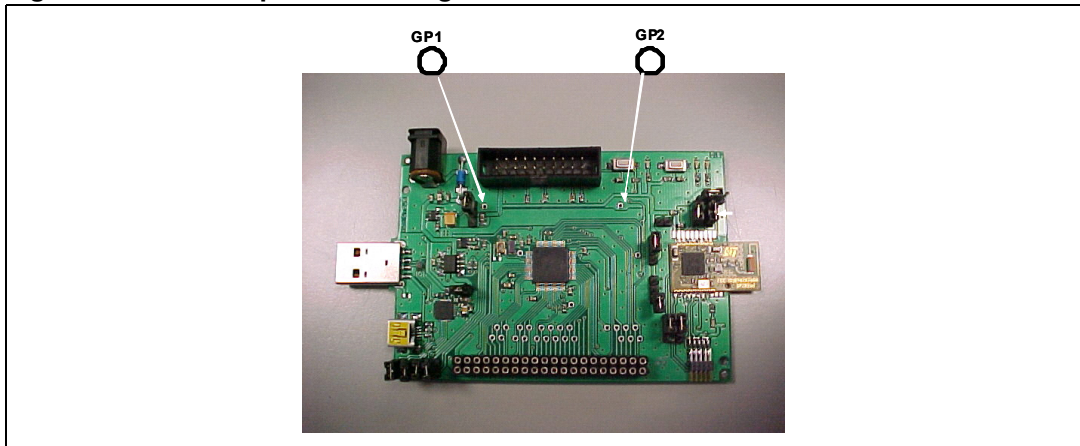
2.5.5 Temperature sensor

An STM-STTS75 CMOS digital temperature sensor is integrated in the STEVAL. The sensor presents an accuracy of +/-2 °C in the -25 °C to +100 °C range. Refer to the datasheet available at: <http://www.st.com> for a detailed specification of the device.

2.5.6 Ground points

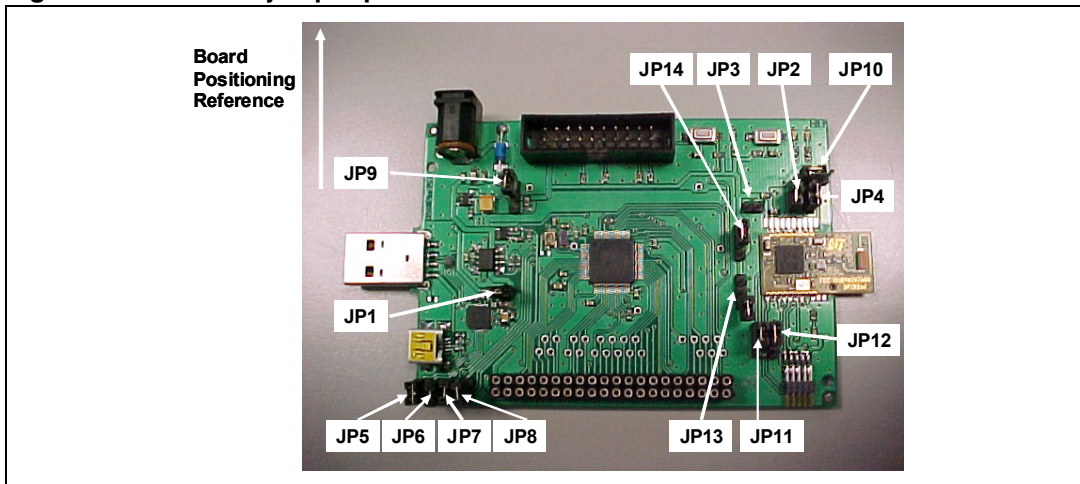
The G1 and G2 ground points shown in *Figure 6* facilitate the stacking of a daughter board.

Figure 6. Ground points for daughter board connection



2.6 Setting up STEVAL

Figure 7. STEVAL jumper positions



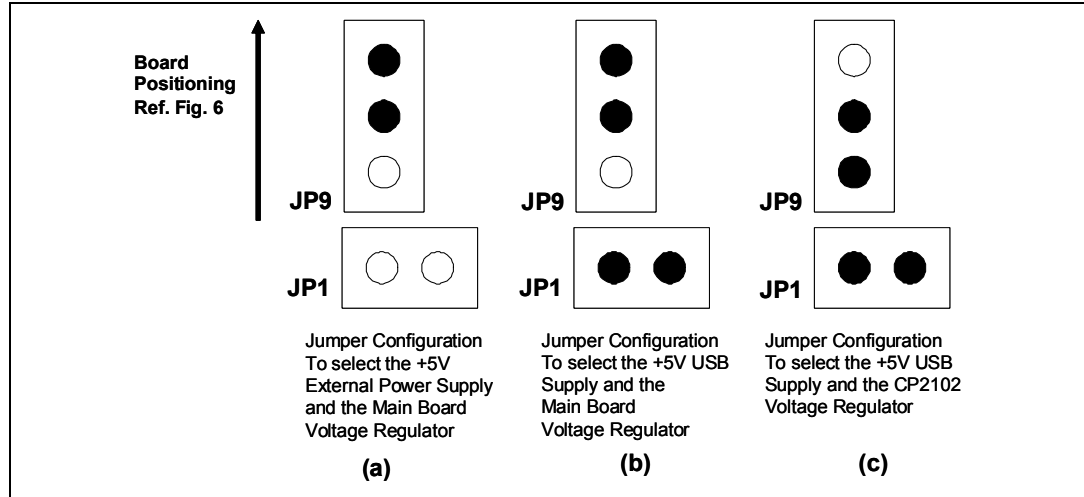
2.6.1 Powering setup

The STEVAL can be supplied with a standard DC 5 V external power supply or via one of the USB connectors, or by connecting an external supply to pin 1 of the J3 connector.

Two jumpers (JP1 and JP9) are used to select the power source supply and, in case of USB usage, the on-board voltage regulator between the main board regulator and the regulator that is integrated in the CP2102 chip.

Figure 8 shows how the jumpers must be configured in the different cases.

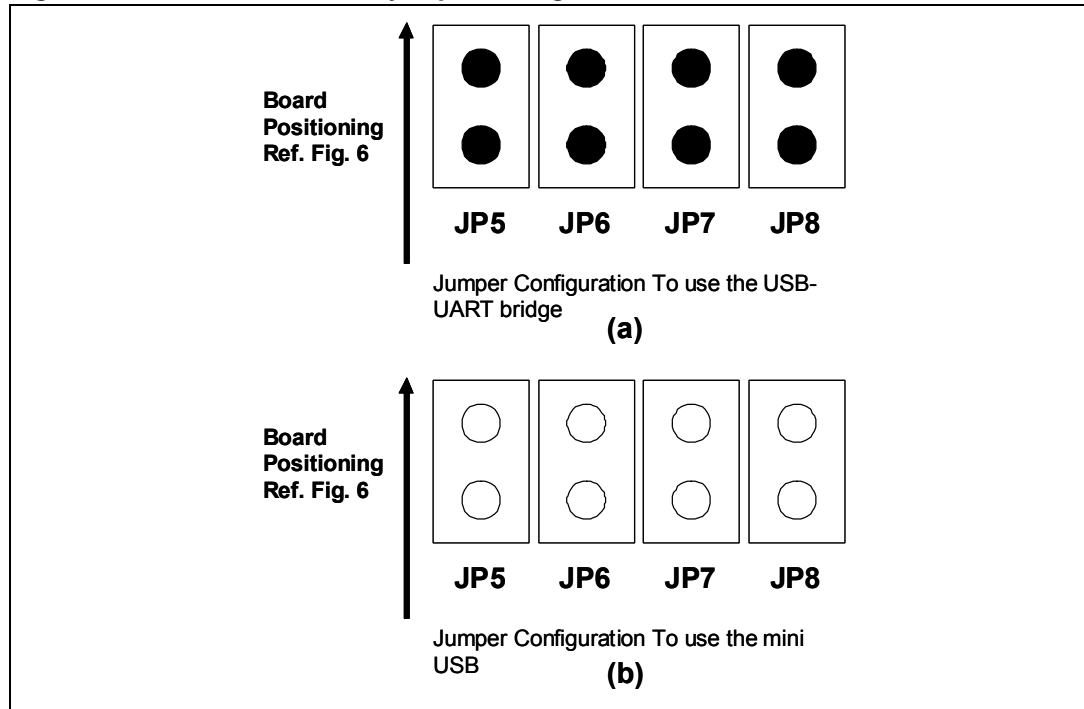
Figure 8. Power supply jumper configurations



2.6.2 Serial communication interface setup

The STEVAL can be connected via the USB-RS232 BRIDGE or via the (mini) USB connector. To obtain these functional features, the user must select the proper jumper configurations, as shown in [Figure 9](#).

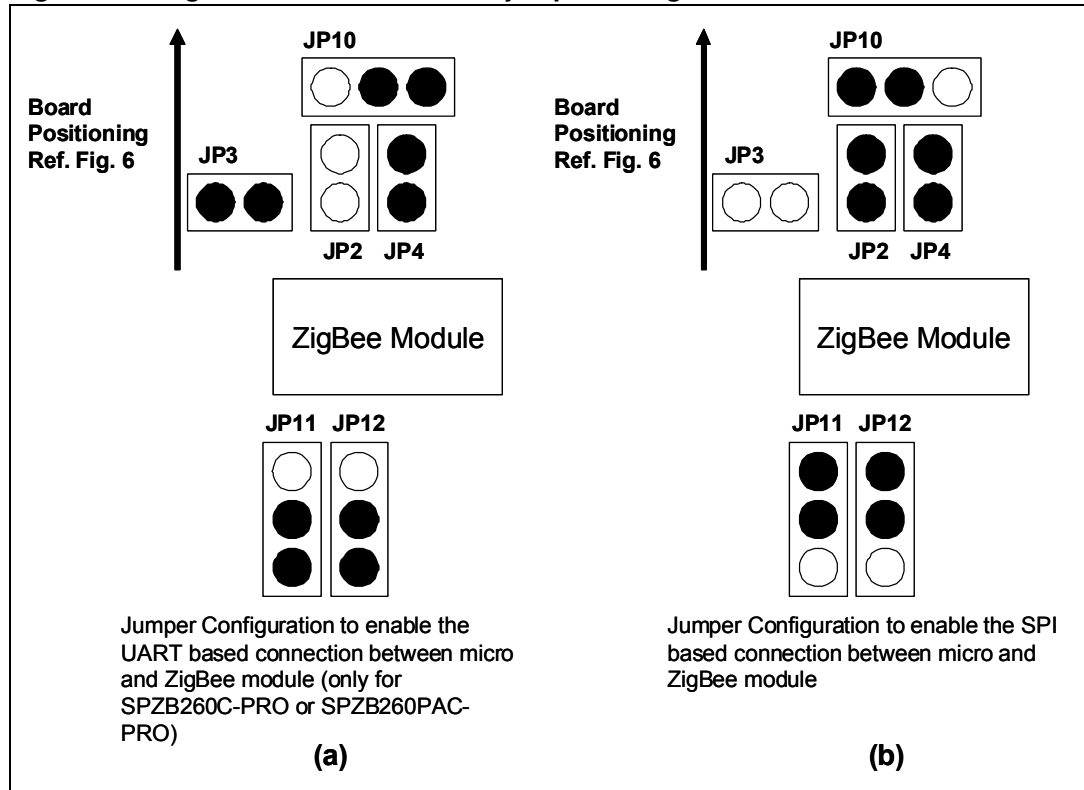
Figure 9. Serial connection jumper configurations



2.6.3 ZigBee module interface setup

If the STEVAL integrates the SPZB260-PRO (as it does by default), only the connection via the SPI is possible between the ZigBee module and the micro. If the STEVAL integrates the SPZB260C-PRO, SPZB260PA-PRO or SPZB260PAC-PRO, then the module can be connected to the micro via the SPI or UART. The configuration of jumpers for the different cases is shown in *Figure 10*. When the UART interface is used, the ZigBee module must be loaded with a dedicated firmware that is not provided with this kit.

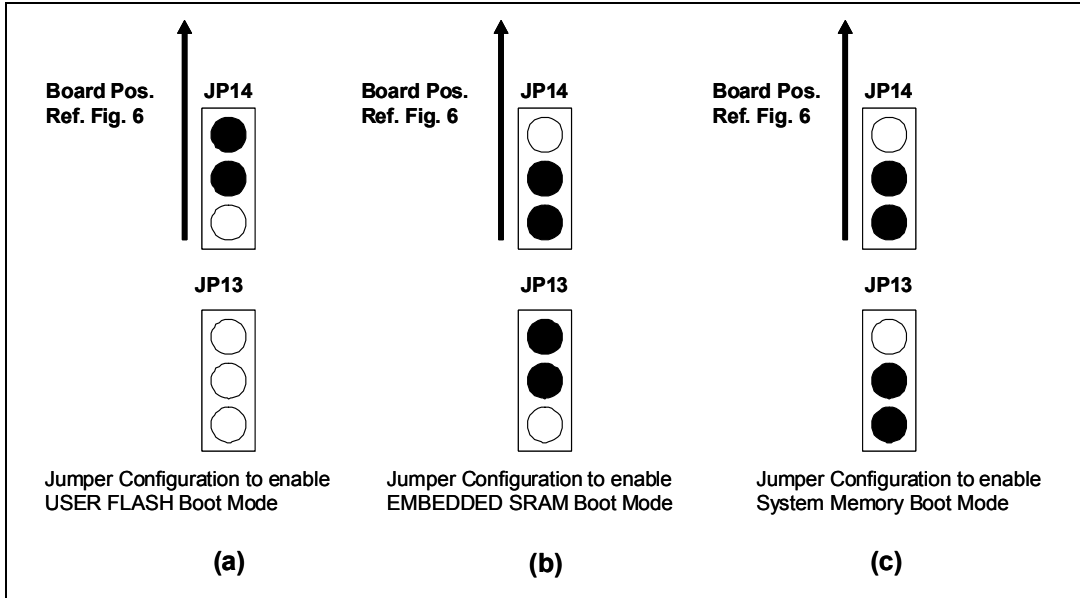
Figure 10. Zigbee module connection jumper configurations



2.6.4 Boot mode setup

To enable the different boot modes of the STM32, the JP13 and JP14 jumpers must be configured as in [Figure 11](#). Refer to the STM32 datasheet for details about selectable BOOT modes.

Figure 11. Boot modes jumper configurations



3 Getting started with the KIT

3.1 Installing the SPZB260kit library

- Copy the file SPZB260kit.zip contained on the CD to a folder on your PC.
- Unzip SPZB260kit.zip.

3.2 SPZB260kit content

The SPZB260kit library of the STEVAL-SPZB260V1 includes the STM32 library version 2.x, the EZSP protocol, application examples and related IAR project files.

The structure and content of the library package is described below.

- **App** contains version and sink-sensor application files and IAR projects.
- **Build** contains pre-built images of the pro-stack and of the sample applications provided with the kit.
- **Docs** contains some documents.
- **Ezsp** contains the Ember ZigBee serial protocol driver.
- **Hal** contains the board/ST microcontroller dependencies' header file and a library of drivers for addressing the STEVAL platform devices and capabilities (buttons, buzzer, LEDs, memory, micro, SPI protocol, system timer, UART).
- **Include** contains header files for use in the Zigbee application development.
- **SerialUSB** contains the STM32 library for use of the USB peripheral. The folder also includes a zip file, **vcdriver_v1.1_setup.zip**, to install the driver needed to use, via the USB, the STEVAL with your PC.
- **Stlib** contains include and binary files of the STM32 library, version 2.x.
- **Tools** contains:
 - **em2xx** utilities. For use of these utilities see the manual *120-4020-000_Uilities_Guide* included in **Docs**.
 - the **Flash_loader_demonstrator** tool that can be used to load hex files (as contained in the build directory) through the USB-to-UART bridge connector.
 - **CP2102**, which contains the driver and configuration tool for use of the CP2102 device (USB-to-UART bridge).
- **Util** contains the ZigBee libraries for security, fragmentation and additional Zigbee features.

3.3 Installing the USB and CP1202 drivers

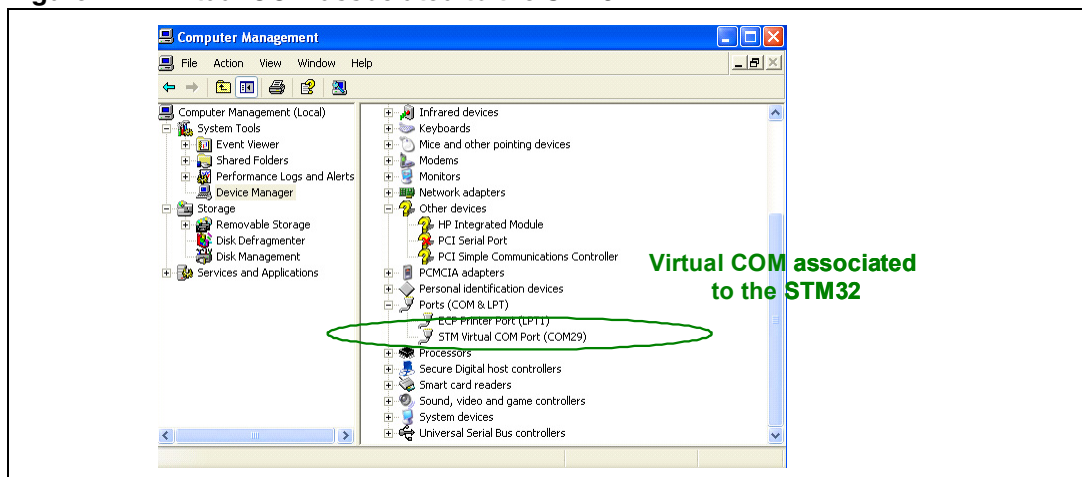
3.3.1 USB driver

The following steps are needed to install the driver for use of the mini-USB port on your PC.

- Unzip the file **vcpdriver_v1.1_setup.zip** contained in **SPZB260kit > SerialUSB**.
- Double click on **VCPDriver_V1.1_Setup.exe** to install the driver.
- Connect the STEVAL to your PC with a mini-USB cable.

Note: To use the mini-USB port, the jumpers JP1 and JP9 must be configured as shown in [Figure 8\(b\)](#) and JP5-JP6-JP7-JP8 must be configured as shown in [Figure 9\(b\)](#). When the driver is correctly installed, you will see the virtual COM associated to your STEVAL listed in the “Ports” field of the computer management utility of your PC ([Figure 12](#)).

Figure 12. Virtual COM associated to the STM32



3.3.2 CP2102 driver

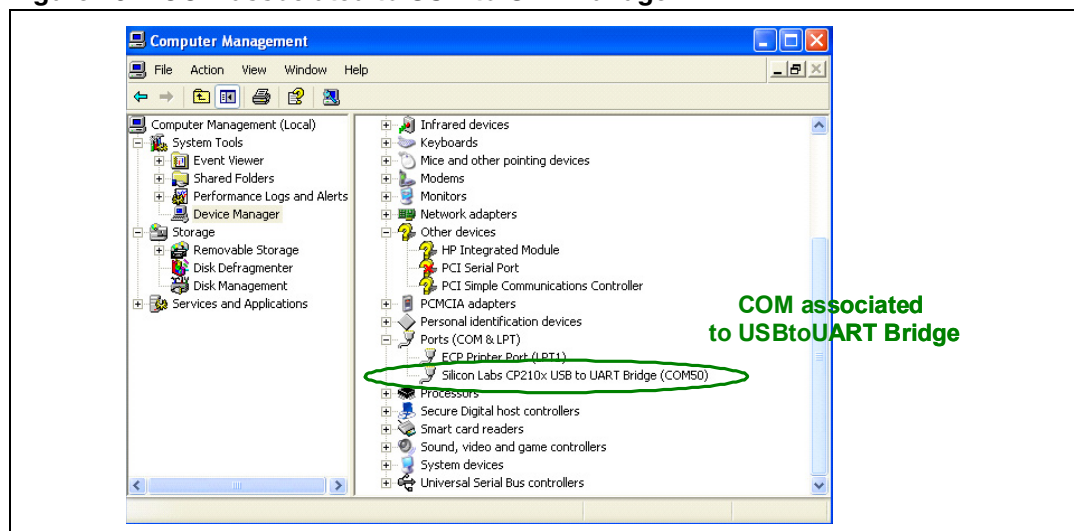
The following steps are needed to install the driver for use of the USB-UART bridge CP2102 on your PC.

Note: The driver can be found on the Silicon Labs web page at www.silabs.com, and a copy is also included in **SPZB260kit > Tools > CP2102**.

- Unzip the file **CP210x_VCP_Win2K_XP_S2K3.zip**.
- Double click on **CP210x_VCP_Win2K_XP_S2K3.exe** to install the driver.
- Connect the STEVAL by inserting the USB connector into one of the USB slots on your PC.

Note: To use the USB-to-UART bridge, JP1 and JP9 must be configured as shown in [Figure 8\(b\)](#) (or as in [Figure 8\(c\)](#)) and the jumpers JP6-JP7-JP8-JP9 must be configured as shown in [Figure 9\(a\)](#). When the driver is correctly installed, you will see the COM associated to your STEVAL listed in the “Ports” field of the computer management utility of your PC. See [Figure 13](#) as an example.

Figure 13. COM associated to USB-to-UART bridge



Note: Refer to [Section A.2 on page 35](#) to connect multiple STEVALs to your PC via the USB-to-UART bridges.

3.4 Installing the Flash loader demonstrator tool

The Flash loader demonstrator is useful in loading `.hex` files into the STEVAL micro via the USB-to-UART bridge connector.

Follow these steps to install the Flash demonstrator tool.

- Unzip the file `um0462.zip` contained in `SPZB260kit > tools > flash_loader_demonstrator`.
- Double click on `Flash_Loader_Demonstrator_V2.1.0_Setup.exe` to install the tool.

3.5 Checking that the STEVAL works with the "Version" application

The KIT is shipped with the "Version" application pre-loaded in the processor's Flash memory.

"Version" is a very simple application that allows the following basic operations to be performed.

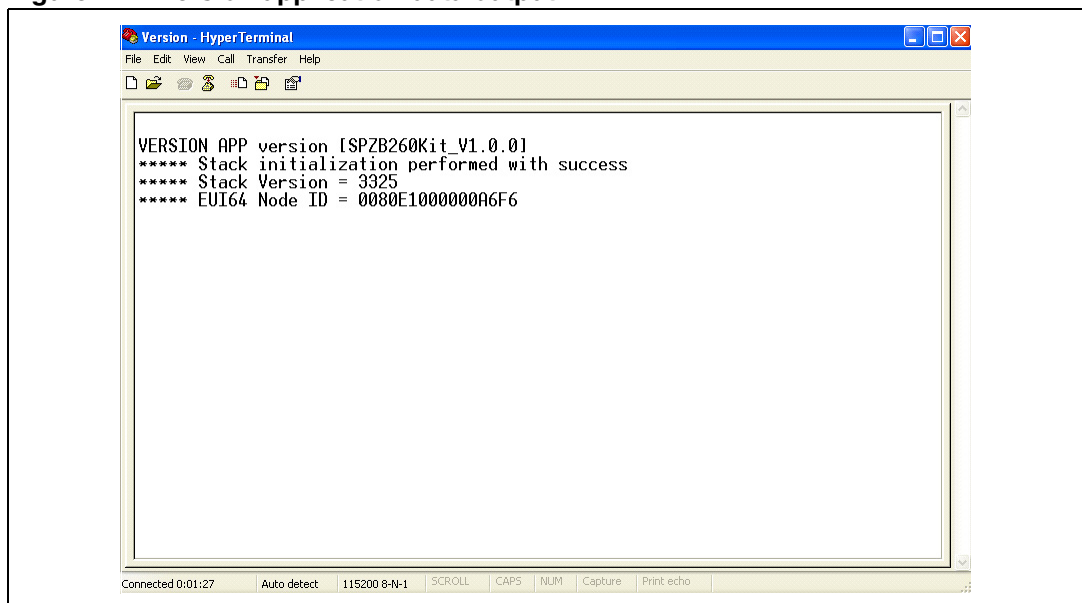
- Initialization of the EmberZNet stack.
- Running of the EmberZNet stack version on the SPZB260-PRO module.
- Retrieval of the `eui` address of the ZigBee module.
- Reading of the version of the SPZB260kit library.

The source files and ".exe" image of the Version application are available in `SPZB260kit > app` and `SPZB260kit > build > stm32-images` respectively.

"Version" has the only target that allows you to check that the STEVAL correctly communicates via the USB-to-UART bridge while not exploiting any ZigBee networking features. "Version" requires that the USB-to-bridge driver be installed and operating correctly on your PC.

- Check the jumpers are set as in [Figure 8\(a\)](#), [Figure 9\(a\)](#), [Figure 10\(b\)](#) and [Figure 11\(a\)](#).
- Insert the STEVAL into the USB plug of your PC. The power LED (LED2) goes on, indicating that the board is powered up.
- By using the computer management utility of your PC, find the virtual COM that has been associated with your STEVAL.
- Open a HyperTerminal by using the identified COM port and with the following configuration:
 - Bit Rate: 115000
 - Data Bits: 8
 - Parity: none
 - Stop bits: 1
 - Flow control: none
- Push the reset button on the STEVAL in order to restart the application execution on the board. Data is printed on the HyperTerminal as shown in [Figure 14](#).

Figure 14. Version application data output



```
Version - HyperTerminal
File Edit View Call Transfer Help
VERSION APP version ISPZB260Kit_V1.0.01
**** Stack initialization performed with success
**** Stack Version = 3325
**** EUI64 Node ID = 0080E100000A6F6
Connected 0:01:27 Auto detect 115200 8-N-1 SCROLL CAPS NUM Capture Print echo
```

4 Installing and running the sink-sensor application

The sink-sensor application included in the SPZB260kit is provided to allow the STEVAL user to easily set-up a ZigBee network by using only hardware and software components included in the kit. The sink-sensor is derived from the homonymous application also included in the Ember JumpStart kit and shows the basic features of a distributed sensor network for remote monitoring.

The sink-sensor application requires the use of at least two different STEVALs (or other compatible hardware), respectively running sink and sensor applications in the same network.

4.1 Sink-sensor sample application

The sensor-sink application is an example of a complete application that implements a distributed sensor network with one or more data collection points (called *sensors*) and one data storage point (called *sink*). This application uses a "push" style of communication, where the sensor periodically sends reports to the sink without needing to be asked for this data.

In our specific case, sensors capture temperature data measured by the sensor that is integrated in the board and send that data to a sink that is connected to a PC. Data collected by the sink is then available at the serial port associated to the STEVAL when it is connected to a PC, and can be used by every kind of application running on it.

The sink node is also set-up to be the ZigBee coordinator device, and it forms the network automatically on first startup, thus retaining the settings across reboots. The sink sends out advertisements (SINK_ADVERTISE) at regular intervals using a multicast (after making a many-to-one route request). If a joining procedure is activated by pushing a button on the boards, a not joined sensor hearing a SINK_ADVERTISE sends a message (SENSOR_SELECT_SINK) requesting to use that sink (after setting its address table entry to the sink). If the sink has a free address table entry it responds with a sink ready message (SINK_READY) and, at that point, the sensor is free to send data (DATA) to the sink at fixed intervals (as set by SEND_DATA_RATE).

The sink sensor communication is set with the following network parameters.

- CHANNEL – 26
- PANID 0x01ff
- APP_EXTENDED_PANID {'s','e','n','s','o','r',0,0}

The payload of the packet sent by the sensor is 12 bytes long and includes:

- 8 bytes corresponding to the 64-bit address of the sender.
- 2 bytes corresponding to the temperature values as captured by the sensor integrated in the STEVAL.
- 2 bytes corresponding to the voltage level as measured on the voltage meter integrated in the STEVAL.

The sensor-sink application allows a user to interact with the STEVAL by sending commands through a serial port (the COM associated to the STEVAL when connected to the PC).

The following is the list of commands supported by the sink and sensor.

- **?** = help;
- **i** = print node;
- **l** = send multicast [hello];
- **t** = play tune;
- **a** = print address table;
- **m** = print multicast table;
- **f** = send sink advertisement; (ONLY FOR SINK)
- **1** = simulate button BT1: turn allow join ON for 60 sec; (ONLY FOR SINK)
- **1** = simulate button BT1: join the network or if already joined, turn allow join ON for 60 sec; (ONLY FOR SENSOR)
- **c** = print child table;
- **k** = print the security keys;
- ***** = switch the network key: send the key followed by a switch key command 30 seconds later; (ONLY FOR SINK)
- **&** = send a switch key command. This is needed only if the device sent a new key and then reset before it was able to send the switch key command; (ONLY FOR SINK)
- **!** = leave ZigBee network;

In the SPZB260kit, the sensor and sink applications are provided as:

- **hex images.** *sensor.hex* and *sink.hex* available in **STEVAL260kit > build > stm32-images**. They can be loaded on the STEVAL by using the Flash tool as described in [Section 4.2 on page 27](#).
- **source files** (available in **STEVAL260kit > app > sink-sensor > src**) for sink, sensor and sleepy sensor (see Ember documentation for details on this application).
- **IAR projects** (available in **STEVAL260kit > app > sink-sensor > app > IAR**) to be used for customization of those applications by the user.

4.2 Loading the sink-sensor onto your STEVAL

The kit includes the ".hex" images of the sink and sensor application that can be loaded onto the STEVAL by using the Flash downloader tool. The following steps should be followed.

- Configure the jumpers JP1 and JP9 as in [Figure 8\(b\)](#).
- Configure the jumpers JP5, JP6, JP7 and JP8 as in [Figure 9\(a\)](#) for use of the USB-UART bridge.
- Configure the jumpers J13 and J14 as in [Figure 11\(c\)](#) to select the system memory BootMode.
- Plug the STEVAL into one of the USB slots on your PC and identify the serial port associated to the STEVAL (by using the computer management utility of your PC [see [Figure 13](#)]). LED2 goes on to indicate the STEVAL is powered via the USB.
- Run the Flash loader demonstrator as described in the related manual. Use the port identified in the previous step, 115200 baud rate and Parity None, and use *STM32_High-density_512K* as target. Download *sink.hex* or *sensor.hex* (from **<SPZB260kit> > build > stm32-images**) as per your needs.
- Unplug the STEVAL and configure the jumpers J13 and J14 as in [Figure 11\(a\)](#) in order to enable the Flash boot mode for use of the loaded application.

Note: The previous step can be followed to load any other ".hex" images on the STEVAL. Check that the jumpers are correctly configured if you get an error message from the Flash concerning the readability of the device.

4.3 Setting-up a network and running the sink-sensor application

This section describes how to use the STEVAL to run the sink-sensor application. Refer to the source code and Ember documentation for details on the application and use of EZSP APIs.

- You can run the sink-sensor application once you have successfully loaded the sensor and sink applications as described in [Section 4.2](#) onto two different STEVAL boards.
- Verify that the jumpers J13 and J14 are configured as represented in [Figure 11\(a\)](#) by allowing the Flash BootMode.
- The STEVAL allows multiple choices for communication with your PC, and therefore you need to configure the jumpers JP1, JP9, JP5-JP6-JP7-JP8 in accordance with your choice. In the procedure described below, we have chosen to connect both the sensor and sink to the same PC by using the miniUSB for the sensor and the USB-to-UART bridge for the sink. By also connecting the sensor to the PC, you can monitor the serial messages of both the sensor and the sink by using two different HyperTerminals on your PC.
- Connect "sink". Check that JP5, JP6, JP7, and JP8 are configured as in [Figure 8\(a\)](#) and connect the STEVAL-sink to one of the USB slots on your PC. LED1 and LED3 start toggling, indicating that the sink has appropriately formed the network as coordinator. Every 30 seconds LED4 blinks, indicating that a sink advertise message has been sent.
- Open a HyperTerminal by specifying the COM associated to the STEVAL-sink (see [Figure 12](#)) and by using the configuration **115200-8-NONE-1-NONE**. You will see the serial messages as shown in [Figure 14](#). Press the reset button on the STEVAL to make the sink application start from the beginning. The init and form network messages are also shown in [Figure 15](#).

Figure 15. Sink advertise and form network messages

```

SINK - HyperTerminal
File Edit View Call Transfer Help
TX [sink advertise], status 0x00
EVENT: sink send many-to-one route request, status 0x00
EVENT: sink automatically advertising to find sensors
TX [sink advertise], status 0x00
EVENT: sink send many-to-one route request, status 0x00
EVENT: sink automatically advertising to find sensors
TX [sink advertise], status 0x00
EVENT: sink send many-to-one route request, status 0x00
EVENT: sink automatically advertising to find sensors
TX [sink advertise], status 0x00
EVENT: sink send many-to-one route request, status 0x00
EVENT: sink automatically advertising to find sensors
TX [sink advertise], status 0x00
EVENT: ezsp011init passed
INIT: sink app 0080E100000A742
SINK APP: forming network - channel 0x1A, panid 0x01FF, ExtendedPanId: 73656E736
F720000
EVENT: stackStatus now EMBER_NETWORK_UP
EVENT: setting multicast table entry, status is 0x00
EVENT: sink send many-to-one route request, status 0x00
EVENT: sink automatically advertising to find sensors
TX [sink advertise], status 0x00

```

Set of messages printed out every time A sink advertise is sent.

Set of messages printed out the Initialization time and when the network is formed (press reset on STEVAL)

Connected 0:17:03 Auto detect 115200 8-N-1 SCROLL

- Connect “sensor”. Check that JP5-JP6-JP7-JP8 are configured as in [Figure 9\(b\)](#) and connect the STEVAL-sensor via the miniUSB to your PC. LED1 comes on, indicating that the init phase of the sensor application has run successfully.
- Open a HyperTerminal by specifying the COM associated to the STEVAL-Sink (see [Figure 12](#)) and by using the configuration **115200-8-NONE-1-NONE**.
- Caution. See [Section A.3: Using the STEVAL reset when the STEVAL is connected via USB](#) for instructions on how to use the reset function on the STEVAL when the miniUSB is used.
- To allow the sensor to join the network set-up by the STEVAL-sensor, press the SW1 button on the STEVAL-sink and the SW1 button on the STEVAL-sensor at an interval of less than 30 seconds. If this operation runs successfully, LED1 and LED3 start toggling and LED4 lights up every time there is an activity on the radio.
- [Figure 15](#) and [Figure 16](#) show the serial messages of the sink and sensor respectively during the join phase. After the network is set-up, the sensor sends a data packet every 5 seconds that contains the temperature value, the power supply voltage and the node ID, as highlighted in the figures.

Figure 16. Sink: join and data messages

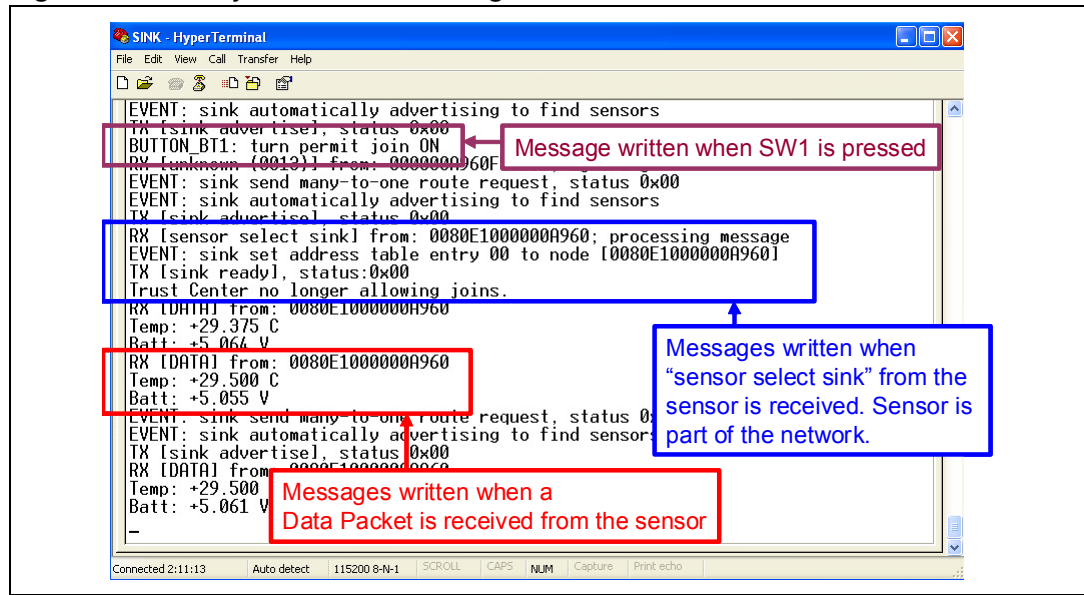
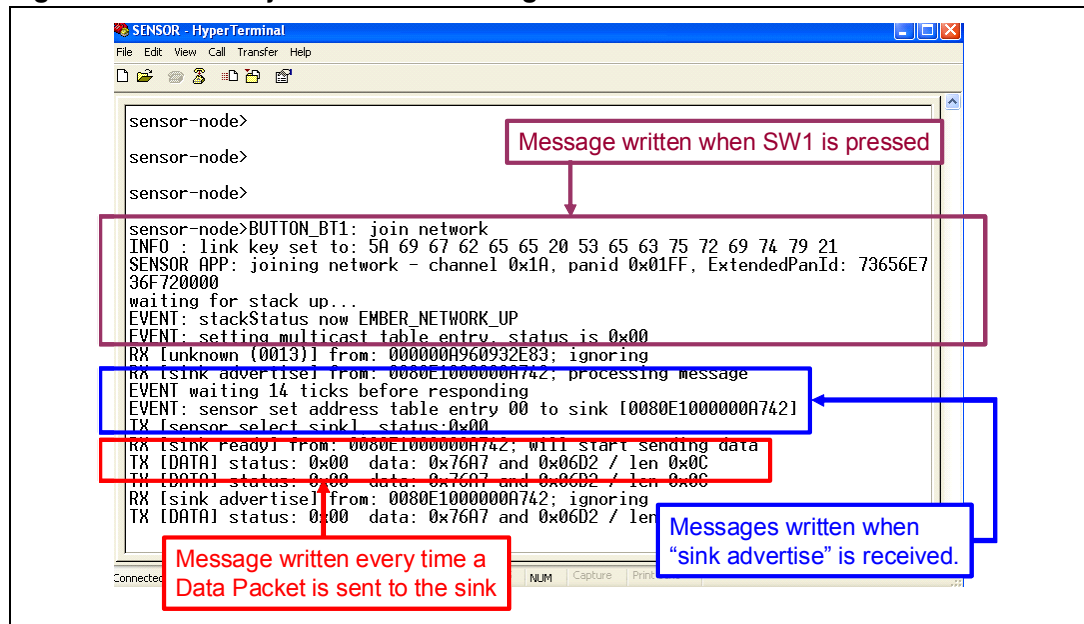


Figure 17. Sensor: join and data messages



- You can send commands through the HyperTerminal (as described in [Section 4.1 on page 26](#)) to both the STEVAL-sink and STEVAL-sensor. As an example, in [Figure 18](#) you can see the result of the command “i=print node info” sent to the STEVAL-sink.

Figure 18. Sink: "i" command output

```

sink-node>RX [DATA] from: 0080E1000000A960
Temp: +30.750 C
Batt: +5.085 V
1
sink eui [0080E1000000A742] short ID [0000]
channel [0x1A], power [0xFF], panId [0x01FF]
ExtendedPanId: 73656E736F720000, stack [3325], app [2.60]
security level [05]
SINK APP version [SPZB260Kit_V1.0.0]

```

Messages written on the SINK when "i" command is sent

- The application uses a constant called `MISS_PACKET_TOLERANCE` as a threshold for fault tolerance. On the sensor, this threshold controls how many message timeouts can be permitted between the sensor and sink before the sensor decides to attach itself to a different sink. For a sink, this controls how many data reports can be missed from a sensor before the sink “forgets” about the sensor (stops maintaining a record of its attachment). Although bindings are kept on the sink node to track the attached sensors, these could easily be made temporary (used only for the `SINK_READY` message) to allow the sink application to support more nodes without enlarging the binding table, assuming that the sink application does not care which sensors and how many sensors are attached to it.
- The sensor advertisement is a broadcast. The behavior of such a broadcast in the network depends on the network topology and density. ZigBee limits the number of broadcasts that can be active in a network to 10 so as to minimize the network disruption and loss of bandwidth. As this network increases in size or density, the rate of the sensor advertisement should be reduced in frequency.

5 Monitoring network activity

Once the Zigbee network has been formed, the InSight Desktop tool can be used to monitor and debug the network activity. The Insight Desktop displays the overall node and network activities in real time and in a non-intrusive way. It provides a rich and flexible interface to the network, which helps you to develop and debug new network applications. The Insight Desktop accesses the network nodes using the relative Insight Adapter hardware.

Caution: Refer to [Section A.1 on page 35](#) to connect your STEVAL with the Insight Adapter through the Insight cable.

6 Developing your own application

You can develop your own application by using one of the development environments available for the STM32 processor families. The library includes projects of the sensor and sink applications previously described for use of the IAR development kit version 5.4a.

The library provides an IAR project for sensor and sink, available at **STEVAL260kit > app > sink-sensor > app > IAR**.

A tutorial on how Zigbee and the sensor-sink application work is beyond the goal of this document. Ember manuals provide the basis for understanding how to develop an Ember application by using the EM260 chips ZigBee platform.

7 Updating the ZigBee protocol stack on the ZigBee module

When the STEVAL is shipped, the EmberZnet Pro stack version 3.3.1 is pre-loaded on the ZigBee Module. Contact your ST sales representative for availability of an updated version of the stack for development of your own application. If you have an Ember login, you can download the EmberZnet PRO libraries from the Ember Web Portal. See [Section 7.1](#) to update the protocol stack version by using the Insight Adapter Tool and [Section 7.2](#) to update the protocol stack version via the SPI serial port.

7.1 Updating the stack image using the Insight Adapter

The upload of the protocol stack via the Insight Adapter requires connecting the Insight Adapter to the STEVAL via the Insight Port integrated in the STEVAL. Refer to the appropriate Insight Adapter documentation for details.

Caution: When the Insight Adapter is connected via the Insight Port, the STEVAL is powered by pin1 of the Insight Port. Note that the driven current can be insufficient when many peripherals are connected to the STEVAL. By selecting the option Ext of the Insight Adapter Port Switch, you can disable Pin1 of the Insight Port, but will need to power-up the STEVAL externally.

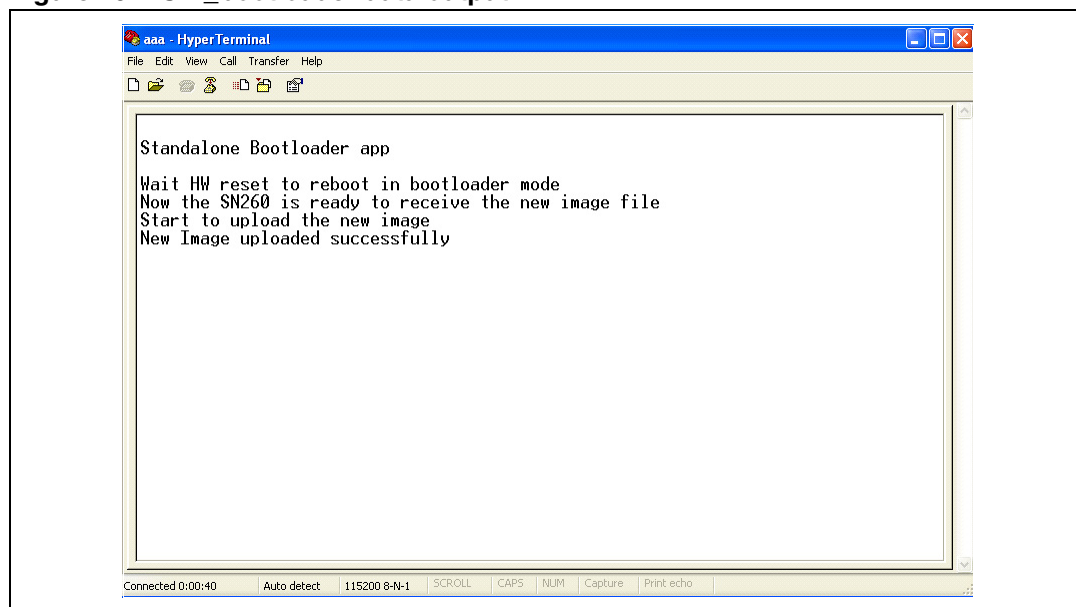
7.2 Updating the stack image using the micro

The EmberZNet 3.3.1 PRO stack supports the bootloader through the SPI interface feature. It is possible to update the ZigBee stack image on the module by running a simple application on the STM32F103 micro that switches the Zigbee chip to bootloader mode and then sending the new stack image packets through the SPI interface. This application requires the ZigBee chip previously loaded with a stack version (EmberZNet 3.01 or more recent) supporting the bootloader.

The upload process requires that the Flash loader demonstrator be installed, and consists of the following steps.

- Configure the jumpers JP5, JP6, JP7 and JP8 as in [Figure 8\(a\)](#) for use of the USB-to-UART bridge.
- Configure the jumpers J13 and J14 as in [Figure 11\(c\)](#) for selection of the system memory BootMode.
- Plug the STEVAL into one of the USB slots of your PC and identify the serial port associated to the STEVAL (see [Figure 13](#)).
- Run the Flash loader demonstrator as described in the related manual. Use the port identified in the previous step. Download *STM32_upload_stack_3.3.1_spi.hex* available in **SPZB260kit > build > stm32-images**.
- Unplug the STEVAL and configure the jumpers J13 and J14 as in [Figure 11 \(a\)](#) in order to enable the Flash boot mode for use of the application.
- Plug the STEVAL in the USB slot. The uploading of the stack starts and LED3 and LED4 start blinking. When the upload terminates, LED4 goes off and LED1 and LED3 start toggling. This step can be also monitored by opening a hyperterminal set with the configuration 115200-8-None-1-None. If the downloading runs successfully, the data represented in [Figure 19](#) is printed on the hyperterminal.

Figure 19. SPI_bootloader data output



8 RoHS compliance

The STEVAL is RoHS compliant.

Appendix A

A.1 Using the Insight Adapter

When using the Insight Adapter connected with the Insight Port in the STEVAL, select the option EXT of the RCM power select switch on the front panel of the insight adapter to allow the STEVAL to be powered with its own power supply. In fact, the current that can be sourced through the VBRD pin of the Insight Port (50 mA) can be too low for sourcing appropriately the peripherals integrated in the STEVAL.

A.2 Using multiple USB-to-UART bridges

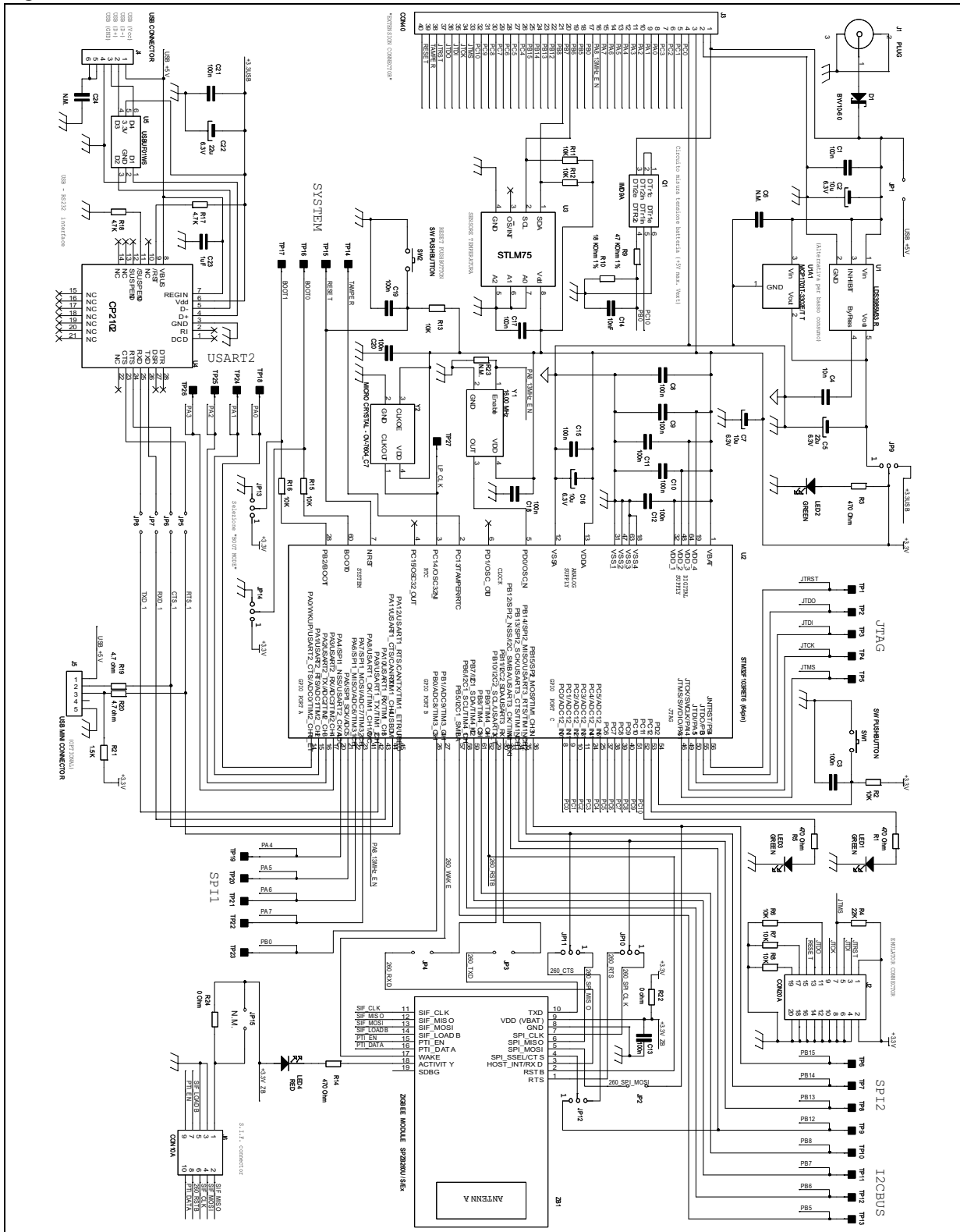
If you want to connect multiple STEVALs to your PC via the USB-to-UART bridge, you need to appropriately reprogram the ID associated to the CP2102 component. A tool from Silicon Labs can be used for this operation. That tool and related documentation is also available (an144sw.zip) in the folder **SPZB260kit > tools > CP2102**.

A.3 Using the STEVAL reset when the STEVAL is connected via USB

When the USB is used, the reset on the STEVAL implies its disconnection from the PC. Consequently, if you have a HyperTerminal or other application tied to the virtual COM, you will lose the connection with the STEVAL as well.

A.4 STEVAL electrical schematic

Figure 20. STEVAL electrical schematic



Revision history

Table 6. Document revision history

Date	Revision	Changes
17-Jan-2011	1	Initial release

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2011 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com