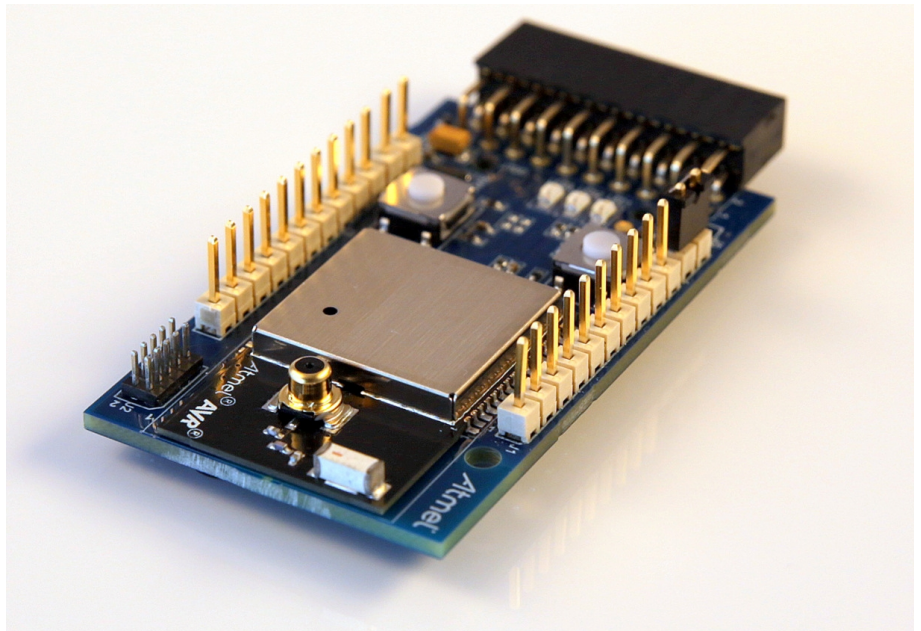


### ZigBit Extension User Guide

#### Introduction

This user guide describes how to get started with the Atmel® ZigBit® extension boards.

The ZigBit extension boards is targeted for evaluating the features of the Atmel ZigBits, currently supporting ATmega256RFR2 wireless SoC, the AT86RF212B and AT86RF233 radio transceivers.



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# 1. Getting Started

## 1.1 Features

The ZigBit extensions is a range of Extension boards providing a development/prototyping platform for the ZigBits.

## 1.2 Design Documentation and Related Links

The following list contains links to the most relevant documents and software for the extension boards.

<http://www.atmel.com/tools/ATZB-256RFR2-XPRO.aspx>

<http://www.atmel.com/tools/ATZB-X-212B-XPRO.aspx>

<http://www.atmel.com/tools/ATZB-X-233-XPRO.aspx>

<http://www.atmel.com/tools/ATZB-212B-XPRO.aspx>

<http://www.atmel.com/tools/ATZB-A-233-XPRO.aspx>

## 1.3 Board Assembly

The extension board can be used in number of combinations. To provide wireless communication to a Xplained Pro board, to act as a standalone wireless node, to provide wireless communication to your own prototype for SW development and HW verification.

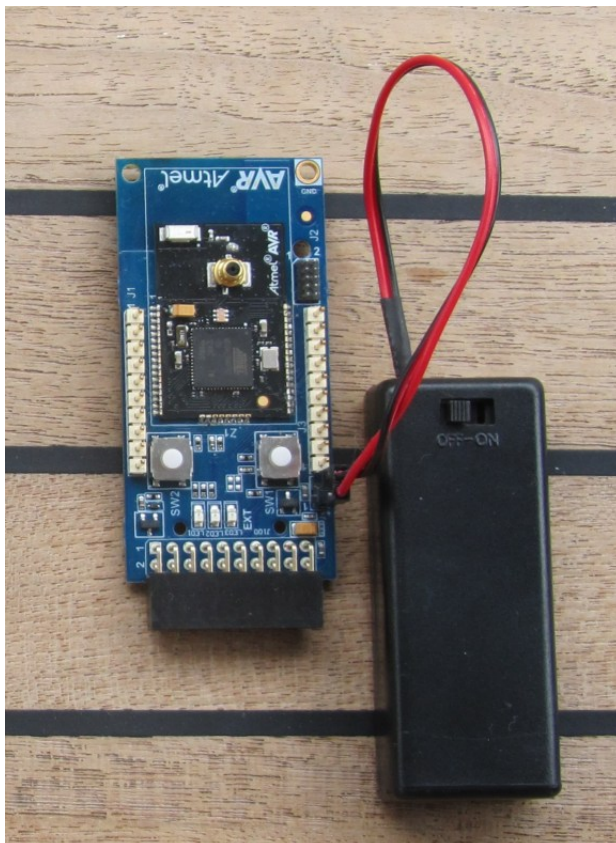
### 1.3.1 Connect to a Xplained Pro Board

The Extension board can be connected to any Xplained Pro main board using the extension header.

### 1.3.2 Standalone Node

The Extension board can be used as a standalone node - use the 2xAAA battery pack available in Atmel store to provide power as shown in [Figure 1-1, "Board Powered by External Battery Pack" on page 3](#).

**Figure 1-1. Board Powered by External Battery Pack**



### 1.3.3 In Customer Development Assembly

The Extension board can be wired into the customer prototype assembly by using the on-board connectors, all ZigBit signal are available.

## 1.4 Connecting the Kit

How to connect the extension board.

### 1.4.1 Atmel Studio

How to connect the Extension board and the Xplained Pro board assembly to Atmel Studio.

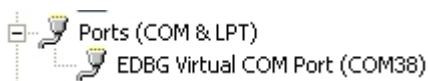
1. Download and install [Atmel Studio](#)<sup>1</sup>.
2. Launch Atmel Studio.
3. Connect an USB cable to the DEBUG USB port and the kit will be visible in Atmel Studio.

### 1.4.2 Connect the Extension UART to the EDBG COM port

This section describes how to connect to the extension board UART by using the EDBG COM port.

All Xplained Pro boards have an embedded debugger (EDBG) with a number of features, among them a CDC/COM port which enables the user to connect to on-board SW and using the boot-loader on the extension boards.

1. Select a Xplained Pro board supported with a "Serial bridge application", currently supported by the SAM4L- XPRO and the ATmega256RFR2-XPRO boards.
2. Download the "Wireless Library hex" extension using Atmel Studio Extension Manager.  
Atmel Studio: Tools → Extension Manager → Wireless, download and unzip in a directory of your choice.
3. Connect the EDBG USB to the PC and Program the "Serial bridge application" hex file on the XPRO board.  
Atmel Studio: Tools → Device Programming, select the XPRO-EDBG as Tool and click Apply.  
Select "Memories" and locate the "Serial bridge application" hex file and click Program.
4. The UART on EXT1 should now be connected to the EDBG COM port at 9600baud.



## 1.5 Programming

How to program the extension.

### 1.5.1 JTAGICE

How to program using the AVR® JTAGICE mkII and JTAGICE3.

1. Connect the JTAGICE USB to the PC.
2. Connect the JTAGICE to the Extension board connector (J2) as shown in [Figure 1-2, "Connecting the JTAGICE3" on page 5](#).
3. Go to Atmel Studio: Tools → Device Programming, and select the JTAGICE connected as Tool and click Apply.
4. Select Device = ATxmega256A3U or ATmega256RFR2.
5. Select "Memories" and locate the source hex or elf file and click Program.

<sup>1</sup> <http://www.atmel.com/tools/atmelstudio.aspx>

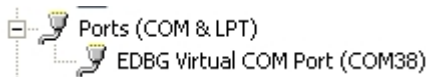
Figure 1-2. Connecting the JTAGICE3



## 1.5.2 Bootloader

This section describes how to use the bootloader to program the ZigBit on the Extension board.

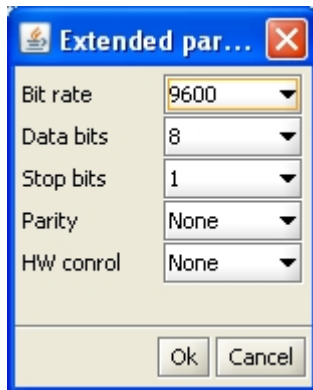
1. Use a Xplained Pro board with a "Serial bridge application" ("[Connect the Extension UART to the EDBG COM port](#)" on page 4) to connect the Extension board UART to the Embedded debugger COM port or connect the "Extension board UART" using any other level shifter solution you might have.



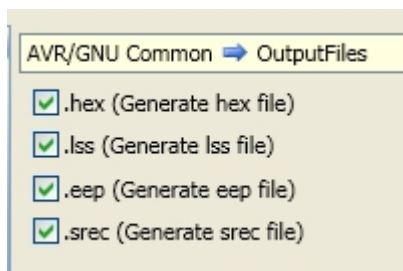
2. Start the "Bootloader PC tool" "[How to Install the "Bootloader PC tool"](#)" on page 6



3. Set "Connection" to Serial and "Port" to the COM port number.
4. Configure the serial port settings as (click symbol at the right of Port setting).



5. "Select srec file", the file have to be of SREC format.  
Atmel Studio output files can be of SREC format.



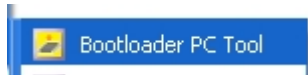
6. Deselect EEPROM erase if not required.
7. Click "Upload".

8. Press the HW reset button (SW1) on the device if requested. The Bootloader PC tool will be waiting for approximately 30 seconds for the button to be released. If this does not happen, programming will be aborted.
9. Exit the GUI and reset the board - your new application should be up and running.

#### 1.5.2.1 How to Install the "Bootloader PC tool"

How to install the Bootloader PC GUI tool.

1. Run the "Bootloader\_PC\_Tool\_Setup\_...exe" provided in the "Atmel AVR2054 Serial Bootloader" extension from the Extension Gallery and complete the installation.
2. The Bootloader PC Tool is now available in the Atmel program folder.



## 1.6 Available Example Code

SW examples provided in Atmel Studio ASF.

## 2. Performance Analyzer

### 2.1 Introduction

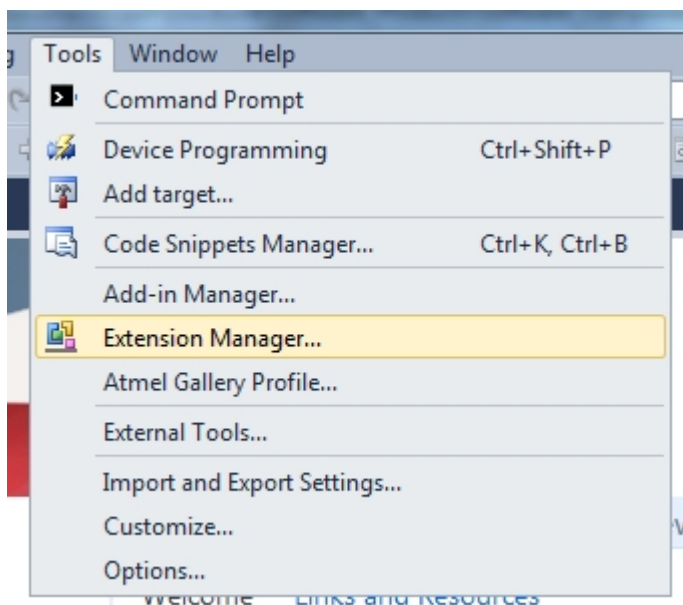
The Performance Analyzer FW together with the GUI in Atmel Studio Wireless Composer Extension provides a number of basic functional RF tests.

A quick start guide and general help is provided in Wireless Composer once started.

### 2.2 Program Installation

How to install necessary SW.

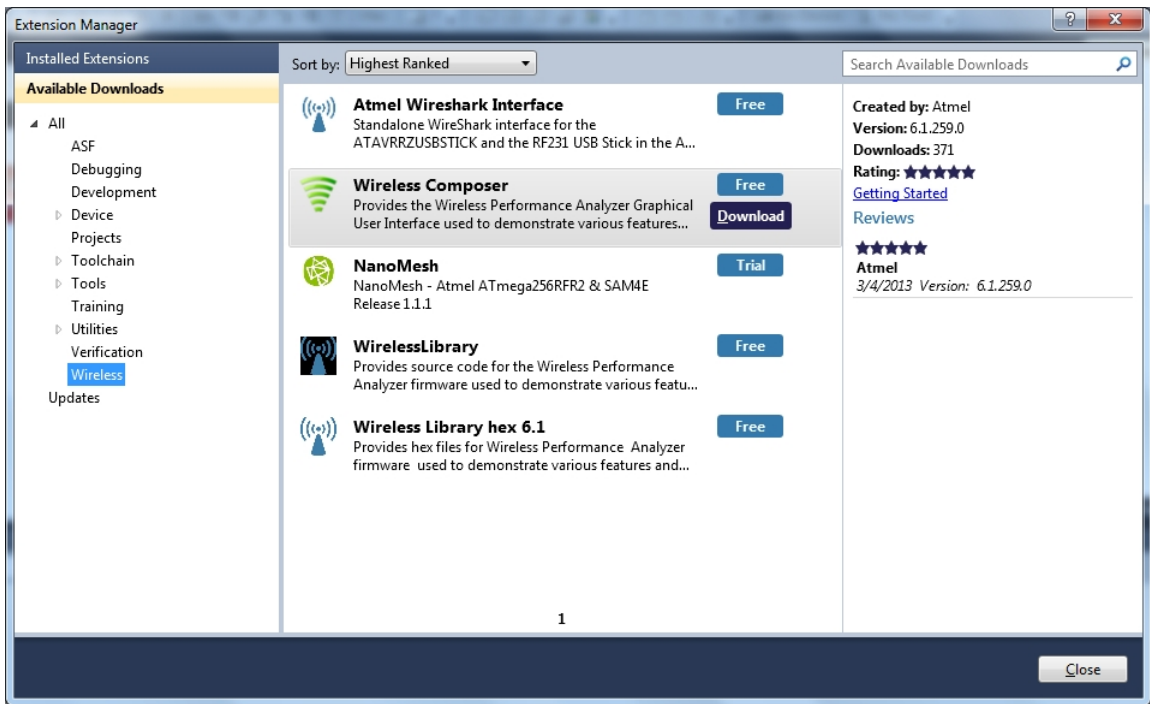
1. Install [Atmel Studio](http://www.atmel.com/tools/atmelstudio.aspx)<sup>1</sup>.
2. Once Studio is installed and started use the Tools - Extension Manager to install the Wireless Composer.



Select Wireless and Wireless Composer.

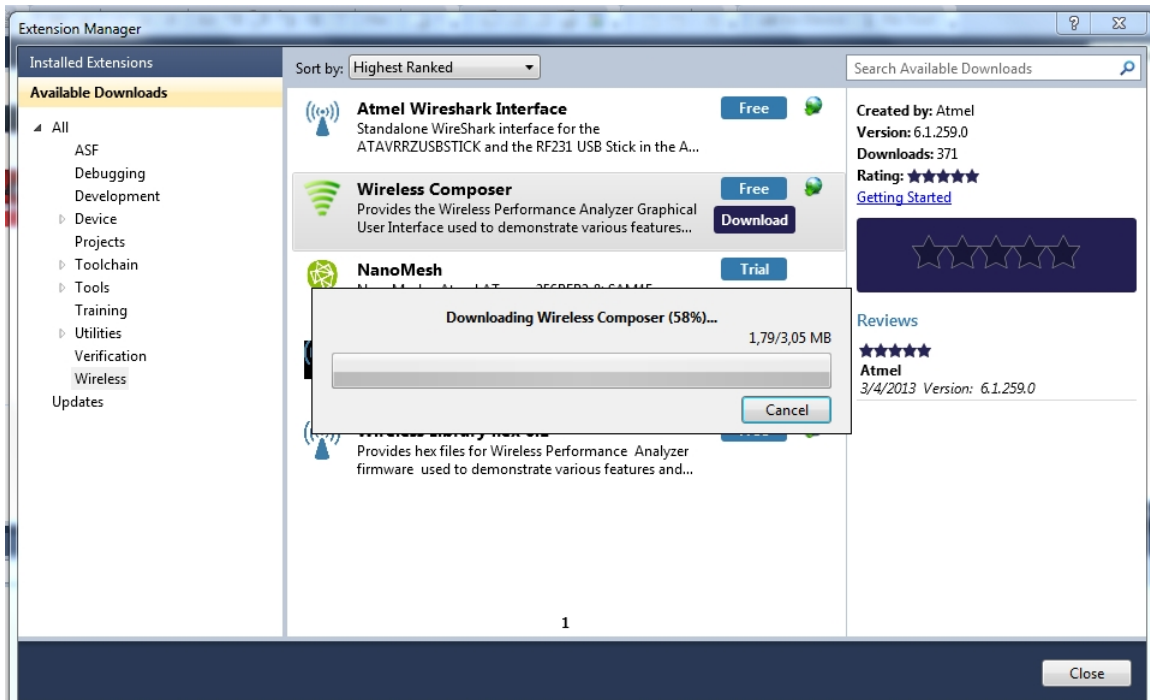
<sup>1</sup> <http://www.atmel.com/tools/atmelstudio.aspx>



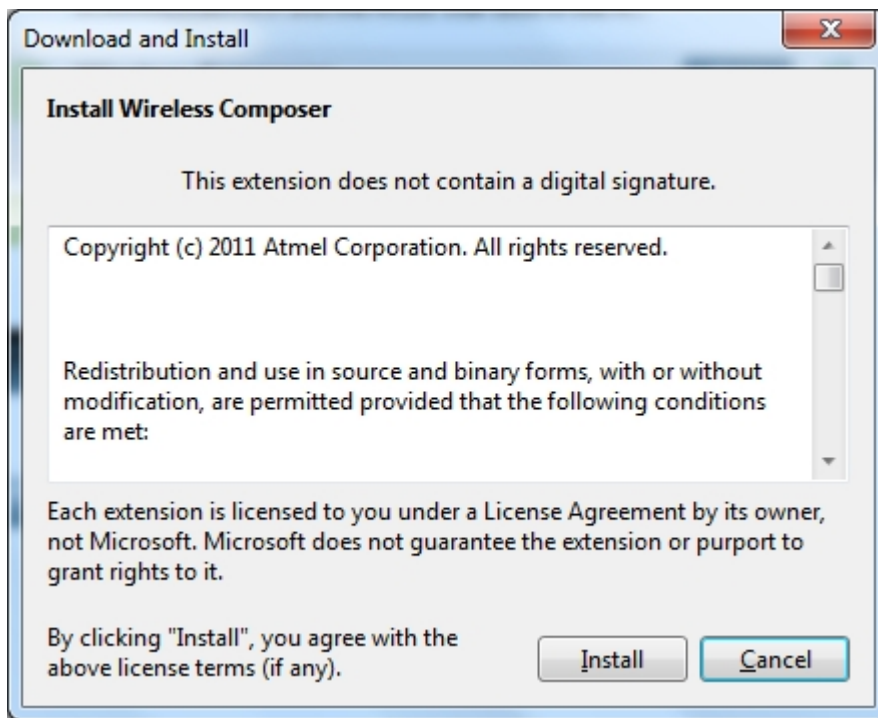


Log in to Atmel Gallery.

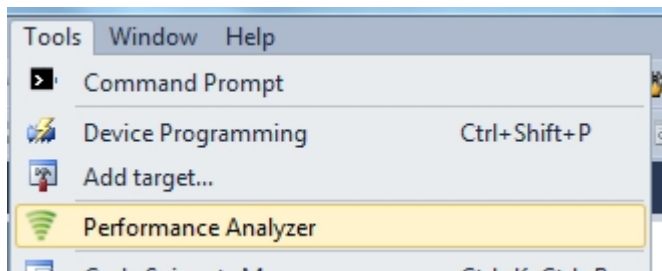
Click download again and download starts.







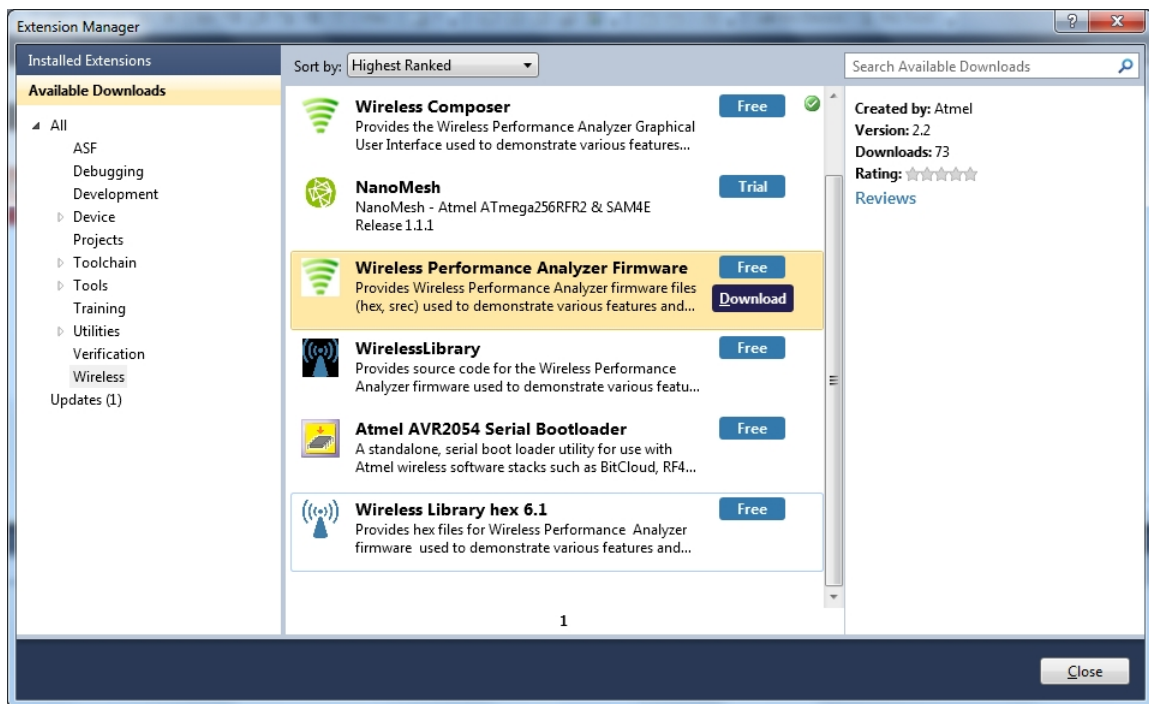
Restart Atmel Studio, allow help to make changes and the Performance Analyzer GUI is available in the Tools menu.



3. If not already preprogrammed - program the node with the Performance Analyzer FW available in the "Wireless Performance Analyzer Firmware extension" or from source code provided in ASF.

If using an Wireless board with a  $\mu$ C embedded, the Performance Analyzer FW has to be programmed using the Bootloader or JTAGICE.

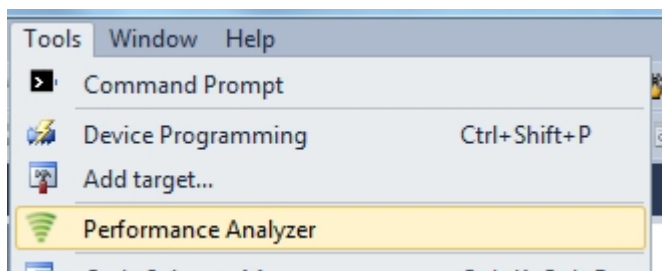
If using a extension board which do not have a  $\mu$ C embedded, the Performance Analyzer FW has to be programmed on the Xplained Pro board using the EBDG from Atmel Studio.



## 2.3 Program Use

How to get started.

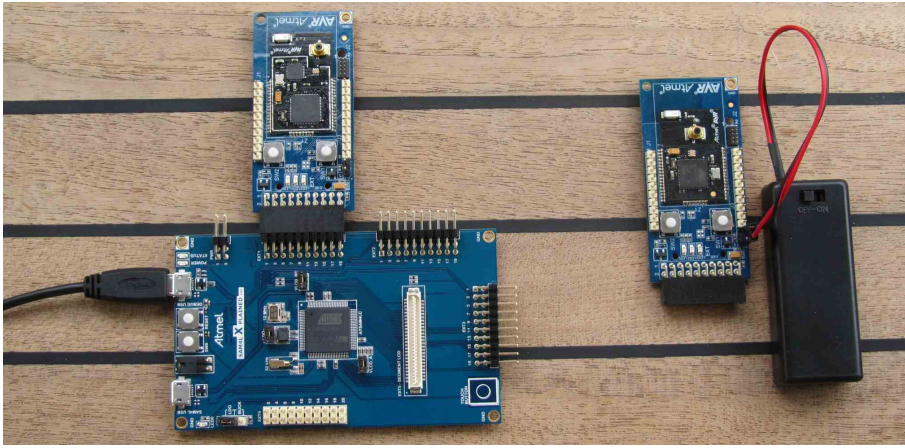
1. Connect the Wireless board assembly, with the Performance Analyzer FW programmed, to the PC USB connector and power on, a COM port should now be available for the kit.
2. Power on any other wireless node assemblies of similar frequency, running the Performance Analyzer FW, and use it as a reference.
3. Start Performance Analyzer GUI, connect to the kit via the COM port and follow the quick start guide.



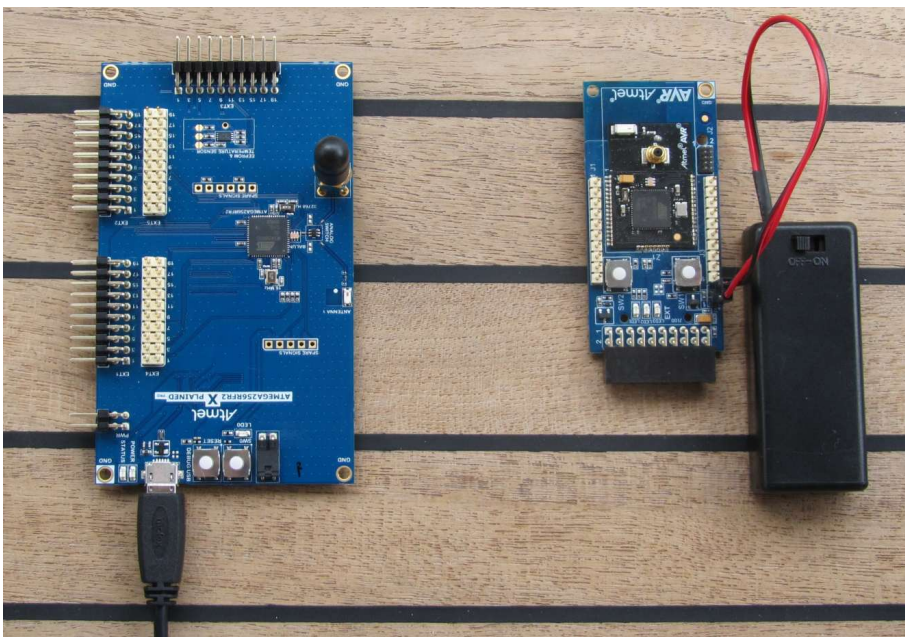
## 2.4 Typical Wireless Nodes

Typical board assembly.

The Atmel SAM4L Xplained Pro Evaluation Kit with Wireless Extension and remote node consisting of a Wireless extension board and a battery pack.



The Atmel ATmega256RFR2 Xplained Pro Evaluation Kit and remote node consisting of a Wireless extension board and a battery pack.



## 3. Xplained Pro

Xplained Pro is an evaluation platform that provides the full Atmel microcontroller experience. The platform consists of a series of Microcontroller (MCU) boards and extension boards that are integrated with Atmel Studio, have Atmel Software Framework (ASF) drivers and demo code, support data streaming and more. Xplained Pro MCU boards support a wide range of Xplained Pro extension boards that are connected through a set of standardized headers and connectors. Each extension board has an identification (ID) chip to uniquely identify which boards are mounted on a Xplained Pro MCU board. This information is used to present relevant user guides, application notes, datasheets and example code through Atmel Studio. Available Xplained Pro MCU and extension boards can be purchased in the [Atmel Web Store](#)<sup>1</sup>.

### 3.1 Hardware Identification System

All Xplained Pro compatible extension boards have an Atmel ATSHA204 CryptoAuthentication™ chip mounted. This chip contains information that identifies the extension with its name and some extra data. When an Xplained Pro extension board is connected to an Xplained Pro MCU board the information is read and sent to Atmel Studio. The Atmel Kits extension, installed with Atmel Studio, will give relevant information, code examples and links to relevant documents. [Table 3-1, “Xplained Pro ID Chip Content” on page 12](#) shows the data fields stored in the ID chip with example content.

**Table 3-1. Xplained Pro ID Chip Content**

| Data Field            | Data Type    | Example Content               |
|-----------------------|--------------|-------------------------------|
| Manufacturer          | ASCII string | Atmel'\0'                     |
| Product Name          | ASCII string | Segment LCD1 Xplained Pro'\0' |
| Product Revision      | ASCII string | 02'\0'                        |
| Product Serial Number | ASCII string | 1774020200000010'\0'          |
| Minimum Voltage [mV]  | uint16_t     | 3000                          |
| Maximum Voltage [mV]  | uint16_t     | 3600                          |
| Maximum Current [mA]  | uint16_t     | 30                            |

### 3.2 Standard Headers and Connectors

#### 3.2.1 Xplained Pro Standard Extension Header

All Xplained Pro kits have one or more dual row, 20-pin, 100mil extension headers. Xplained Pro MCU boards have male headers while Xplained Pro extensions have their female counterparts. Note that all pins are not always connected. However, all the connected pins follow the defined pin-out described in [Table 3-2, “Xplained Pro Extension Header” on page 12](#). The extension headers can be used to connect a wide variety of Xplained Pro extensions to Xplained Pro MCU boards and to access the pins of the target MCU on Xplained Pro MCU board directly.

**Table 3-2. Xplained Pro Extension Header**

| Pin number | Name   | Description  |
|------------|--------|--|
| 1          | ID     | Communication line to the ID chip on extension board.                          |
| 2          | GND    | Ground.  |
| 3          | ADC(+) | Analog to digital converter , alternatively positive part of differential ADC. |
| 4          | ADC(-) | Analog to digital converter , alternatively negative part of differential ADC. |
| 5          | GPIO1  | General purpose I/O.   |
| 6          | GPIO2  | General purpose I/O.   |
| 7          | PWM(+) | Pulse width modulation , alternatively positive part of differential PWM.      |
| 8          | PWM(-) | Pulse width modulation , alternatively positive part of differential PWM.      |

<sup>1</sup> <http://store.atmel.com/CBC.aspx?q=c:100113>

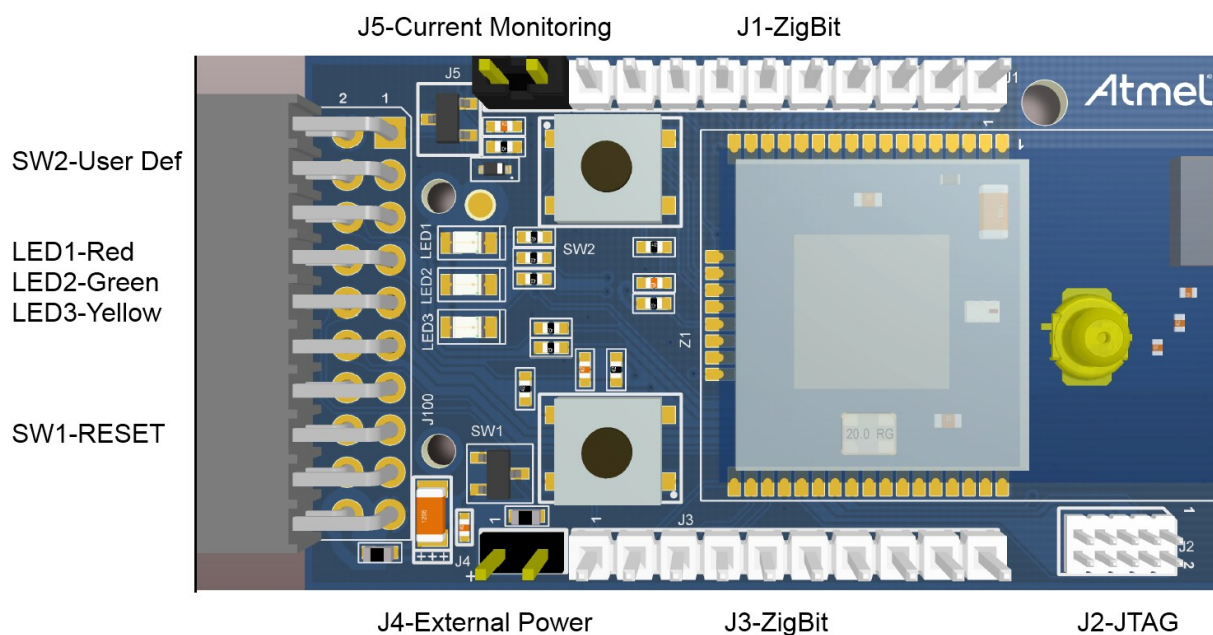
| Pin number | Name          | Description   |
|------------|---------------|---|
| 9          | IRQ/GPIO      | Interrupt request line and/or general purpose I/O.  |
| 10         | SPI_SS_B/GPIO | Slave select for SPI and/or general purpose I/O.  |
| 11         | TWI_SDA       | Data line for two-wire interface. Always implemented, bus type.                             |
| 12         | TWI_SCL       | Clock line for two-wire interface. Always implemented, bus type.                            |
| 13         | USART_RX      | Receiver line of Universal Synchronous and Asynchronous serial Receiver and Transmitter.    |
| 14         | USART_TX      | Transmitter line of Universal Synchronous and Asynchronous serial Receiver and Transmitter. |
| 15         | SPI_SS_A      | Slave select for SPI. Should be unique if possible.   |
| 16         | SPI_MOSI      | Master out slave in line of Serial peripheral interface. Always implemented, bus type.      |
| 17         | SPI_MISO      | Master in slave out line of Serial peripheral interface. Always implemented, bus type.      |
| 18         | SPI_SCK       | Clock for Serial peripheral interface. Always implemented, bus type.                        |
| 19         | GND           | Ground.   |
| 20         | VCC           | Power for extension board.  |



## 4. Hardware User Guide

### 4.1 Board Overview

Figure 4-1. Board Overview



### 4.2 Headers and Connectors

The extension board connectors.

#### 4.2.1 J100 Xplained Pro Extension Connector

The Xplained Pro extension connectors, used to connect the extension board to the Xplained Pro board.

Table 4-1. J100 Xplained Pro Extension Header

| Pin | Name           | ZigBit pin | 256RFR2 pin   | XMEGA® pin  | RF233/RF212B pin | Description   |
|-----|----------------|------------|---------------|-------------|------------------|---|
| 1   | ID             |            |               |             |                  | Communication line to the ID chip on extension board.           |
| 2   | GND            |            |               |             |                  | Ground.   |
| 3   | ADC(+)         | NC         | NC            | NC          | NC               |   |
| 4   | ADC(-)         | 34         | NC (R7 NM)    | NC (R7 NM)  | 10-DIG2          | DIG2.   |
| 5   | GPIO1          | 11         | 49-PE3        | 2-PA4       | NC               | General purpose IO.   |
| 6   | GPIO2          | 39         | NC (R6 NM)    | NC (R6 NM)  | 17-CLKM          | CLK_OUT - can be disconnected by not mounting R6.               |
| 7   | PWM(+)         | 5          | 12-RSTN       | 57-RESET    | 8-RSTN           | RESET to Extension board.                                       |
| 8   | PWM(-)         | 38         | 33-CLKI       | 41-PE5      | CPS U2           | FEM_SEL, disable AMP to save power.                             |
| 9   | IRQ/GPIO       | 40         | 32-PD7        | 46-PF0      | 24-IRQ           | Interrupt request line to uC on Xplained Pro board.             |
| 10  | SPI_SS_B/ GPIO | 35         | 50-PE4 (INT4) | 38-PE2      | 11-SLP_TR        | Wake up interrupt to RF.  |
| 11  | TWI_SDA        | 37         | 26-PD1        | 36-PE0/ SDA | EEPROM           | Data line for two wire interface. Always implemented, bus type. |

| Pin | Name     | ZigBit pin | 256RFR2 pin | XMEGA® pin  | RF233/RF212B pin | Description   |
|-----|----------|------------|-------------|-------------|------------------|---|
| 12  | TWI_SCL  | 36         | 25-PD0      | 37-PE1/SCL  | EEPROM           | Clock line for two wire interface. Always implemented, bus type.                            |
| 13  | USART_RX | 14         | 28-PD3-TXD1 | 29-PD3/TXD0 | NC               | Receiver line of Universal Synchronous and Asynchronous serial Receiver and Transmitter.    |
| 14  | USART_TX | 13         | 27-PD2-RXD1 | 28-PD2_RXD0 | NC               | Transmitter line of Universal Synchronous and Asynchronous serial Receiver and Transmitter. |
| 15  | SPI_SS_A | 6          | 36-PB0      | 30-PD4/SS   | 23-SEL           | Slave select for SPI. Should be unique if possible.   |
| 16  | SPI_MOSI | 7          | 38-PB2      | 31-PD5/MOSI | 22-MOSI          | Master out slave in line of Serial peripheral interface. Always implemented, bus type.      |
| 17  | SPI_MISO | 8          | 39-PB3      | 32-PD6/MISO | 20-MISO          | Master in slave out line of Serial peripheral interface. Always implemented, bus type.      |
| 18  | SPI_SCK  | 9          | 37-PB1      | 33-PD7/SCK  | 19-SCLK          | Clock for Serial peripheral interface. Always implemented, bus type.                        |
| 19  | GND      |            |             |             |                  | Ground.   |
| 20  | VCC      |            |             |             |                  | Power for extension board.  |

#### 4.2.2 J1 and J3

J1 and J3 provide access to all ZigBit pin's not routed to the J100 Xplained Pro interface.

**Table 4-2. J1**

| Pin   | ZigBit pin | 256RFR2 pin     | XMEGA pin | RF233 pin | RF212B pin |
|-------|------------|-----------------|-----------|-----------|------------|
| J1-1  | 10         | PE2/XCK0/AIN0   | PA5       | DIG1      | DIG1       |
| J1-2  | 11         | PE3/OC3A/AIN1   | PA4       | FEM_CSD   | NC         |
| J1-3  | 13         | PD2/RXD1/INT2   | PD2/RXD0  | NC        | NC         |
| J1-4  | 14         | PD3/TXD1/INT3   | PD3/TXD0  | NC        | NC         |
| J1-5  | 15         | PD5/XCK1        | PD1/XCK0  | NC        | NC         |
| J1-6  | 16         | PD4/ICP1        | PDI_DATA  | NC        | NC         |
| J1-7  | 17         | PD6/T1          | PA6       | NC        | NC         |
| J1-8  | 18         | PG2/AMR         | PA7       | NC        | NC         |
| J1-9  | 19         | PB4/OC2A/PCINT4 | PB3       | NC        | NC         |
| J1-10 | 20         | PB6/OC1B/PCINT6 | PB2       | NC        | NC         |

**Table 4-3. J3**

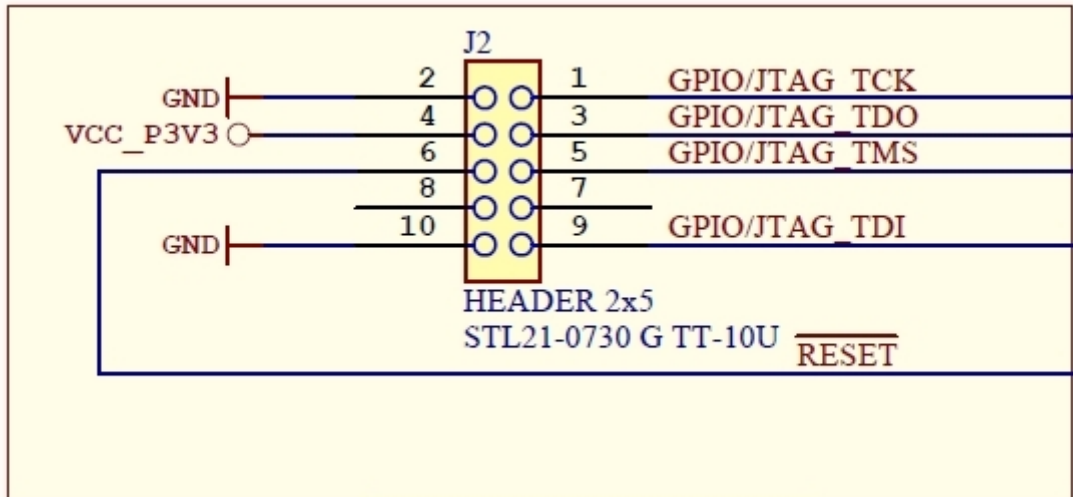
| Pin  | ZigBit pin | 256RFR2 pin     | XMEGA pin         | RF233 pin | RF212B pin |
|------|------------|-----------------|-------------------|-----------|------------|
| J3-1 | 25         | PF0/ADC0        | PA0/ADC0/INT      | NC        | NC         |
| J3-2 | 26         | PF1/ADC1        | PA1/ADC1/INT      | NC        | NC         |
| J3-3 | 27         | PF2/ADC2/DIG2   | PA2/ADC2/INT      | NC        | NC         |
| J3-4 | 28         | PF3/ADC3/DIG4   | PA3/ADC3/INT      | NC        | NC         |
| J3-5 | 24         | AREF            | PB0/IAREF/INT     | NC        | NC         |
| J3-6 | 23         | PE1/TXD0        | PF3/OC0D/INT/TXD0 | NC        | NC         |
| J3-7 | 22         | PE0/RXD0/PCINT8 | PF2/OC0C/INT/RXD0 | NC        | NC         |



| Pin   | ZigBit pin | 256RFR2 pin              | XMEGA pin         | RF233 pin | RF212B pin |
|-------|------------|--------------------------|-------------------|-----------|------------|
| J3-8  | 21         | PB7/OC0A/OC1C/<br>PCINT7 | PF1/OC0B/INT/XCK0 | NC        | NC         |
| J3-9  | 34         | PG5/OC0B                 | PE3               | DIG2      | DIG2       |
| J3-10 | 39         | PE7/ICP3/INT7/CLKO       | PE4/SYNC/OC1A     | FEM_SEL   | CLKM       |

#### 4.2.3 JTAG (J2)

J2 is the JTAG programming header typically used by the JTAGICE.



#### 4.2.4 External Power (J4)

J4 enable connection of external power supply when not inserted into an Xplained Pro mother board.

The connector has reverse voltage protection.

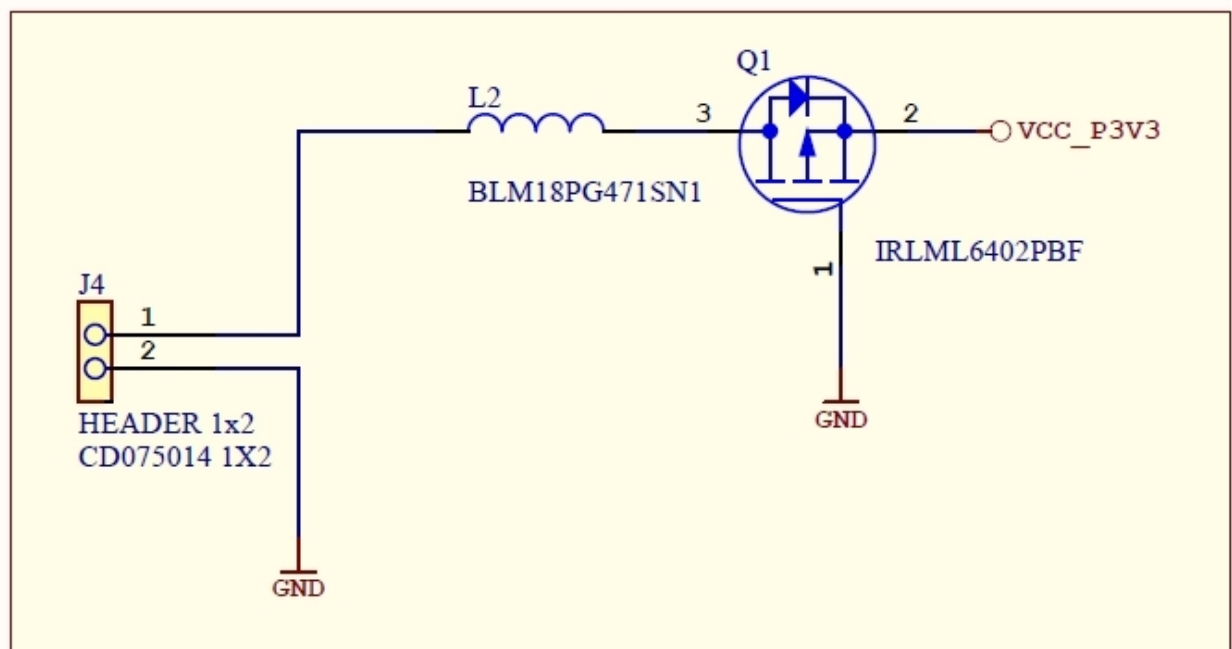


Table 4-4. J4 Power

| J4 pin             | Function  |
|--------------------|---|
| 1 - External power | External 3.3V source - typical 2xAAA battery pack |
| 2 - GND            | Extension board GND                               |

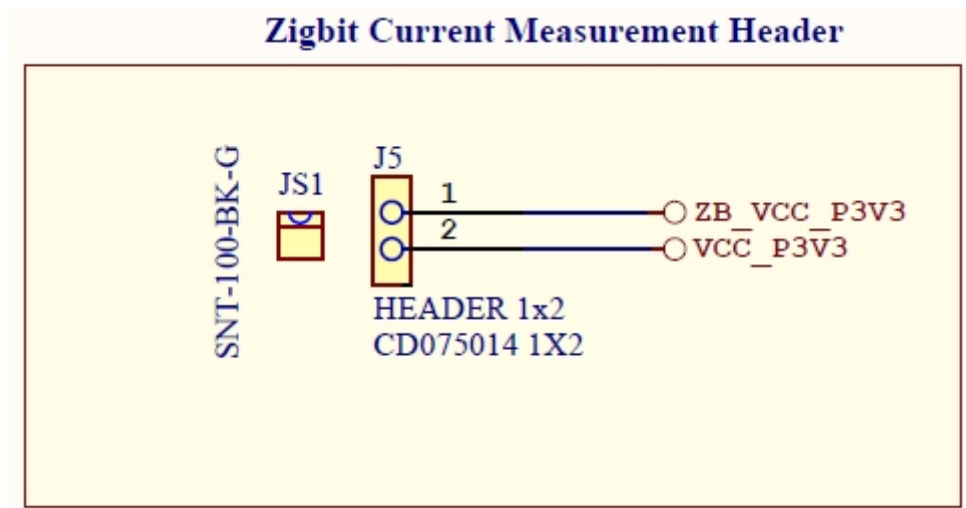
## 4.2.5 Current Monitoring (J5)

J5 enables current monitoring using an external multimeter.

Connect multimeter between J5-1 and J5-2 and measure current used by the ZigBit.

**Warning** When **not** monitoring current the strap need to be inserted in order to provide power to the ZigBit.

**Important** If the JTAG programmer is attached the current measurement will include any power used by the programmer.



**Table 4-5. J5 Current Measurement**

| J5 pin          | Function                |
|-----------------|-------------------------|
| 1 - ZB_VCC_P3V3 | 3.3V pin on the ZigBit  |
| 2 - VCC_P3V3    | 3.3V on extension board |

## 4.3 Board GUI

### 4.3.1 LED's

There are three LED's available for use by application SW.

**Table 4-6. LED's**

| LED           | ZigBit pin | 256RFR2 pin | XMEGA pin | AT86RF233/RF212B |
|---------------|------------|-------------|-----------|------------------|
| LED1 - Red    | 17         | 31 - PD6    | 4 - PA6   | NC               |
| LED2 - Green  | 18         | 16 - PG2    | 5 - PA7   | NC               |
| LED3 - Yellow | 10         | 48 - PE2    | 3 - PA5   | NC               |

### 4.3.2 Button

There are two buttons - one RESET and one for general use by application SW.

**Table 4-7. Buttons**

| Button | Function                                  | ZigBit pin | 256RFR2 pin | XMEGA pin  | RF233 pin | RF212B pin |
|--------|---|------------|-------------|------------|-----------|------------|
| SW1    | ZigBit Reset, press to reset              | 5          | 12 - RSTN   | 56 - RESET | 8 - RSTN  | 8 - RST    |
| SW2    | User defined high signal, press to negate | 22         | 46 - PE0    | 48 - PF2   | NC        | NC         |

## 4.4 Factory Programmed Data

The ZigBit has a preprogrammed unique MAC address - details available in the ZigBit data sheet and in [“Persistent Memory” on page 19](#).

The extension board comes with a Bootloader and the Performance Analyzer preprogrammed.

## 5. Persistent Memory

A persistent memory space is allocated to store product specific information. The organization of the persistent memory is as follows:

**Table 5-1. Persistent Memory**

| Data                                       | Data Type                 | Size     |
|--|---------------------------|----------|
| Structure Revision                         | uint 16                   | 2 bytes  |
| MAC address                                | uint 64                   | 8 bytes  |
| Board information – PCBA Name              | ASCII string <sup>1</sup> | 30 bytes |
| Board information – PCBA Serial number     | ASCII string <sup>1</sup> | 10 bytes |
| Board information – PCBA Atmel Part Number | ASCII string <sup>1</sup> | 8 bytes  |
| Board information – PCBA Revision          | uint 8                    | 1 byte   |
| Reserved                                   |                           | 3 bytes  |
| XTAL Calibration Value                     | uint 8                    | 1 byte   |
| Reserved                                   |                           | 7 bytes  |
| Reserved                                   |                           | 4 bytes  |
| CRC  | uint 16                   | 2 bytes  |

Notes: <sup>1</sup>'\0' terminated ASCII string.

The MAC address stored inside the MCU is a uniquely assigned ID for each kit and is owned by Atmel. User applications can use this unique MAC ID to address the kit.

## 6. Document Revision History

| Document revision | Date    | Comment  |
|-------------------|---------|--|
| 42186C            | 07/2014 | Fixed dead links to resources in the "Getting Started" chapter |
| 42186B            | 06/2014 | "J100 Xplained Pro Extension Header" updated                   |
| 42186A            | 10/2013 | Initial document release                                       |



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