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**ATSAMR30M Sensor Board User's Guide**

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## Introduction

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The ATSAMR30M Sensor Board (DT100130) is a hardware platform used to evaluate the performance of the ATSAMR30M18A (Sub-1 GHz IEEE® 802.15.4™ compliant) RF module. The sensor board provides easy access to various ready-to-use applications supported by the ATSAMR30M18A module in the Atmel Studio Integrated Development Platform (IDP). This document describes how to get started with the sensor board and how to integrate the module in a custom design. The sensor board provides 802.15.4 wireless functionality to the mikroBUS™ compatible Clicker Board evaluation platform in the 800/900 MHz ISM band.

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## Features

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- ATSAMR30M18A Module is an IEEE 802.15.4 Compliant Wireless Module for 700/800/900 MHz<sup>(1)</sup> Applications
  - ATSAMR30E18A (ARM® Cortex® -M0+) System-in-a-Package (SiP)
  - Single-ended RF output through the PCB castellated pad
  - Radio module with a link budget
    - RX sensitivity up to -105<sup>(2)</sup> dBm
    - TX output power up to 8.7<sup>(2)</sup> dBm
  - High precision 16 MHz crystal oscillator
- On-board PCB Antenna
- On-board AT30TSE758A Digital Temperature Sensor
  - Integrated temperature sensor, non-volatile registers and serial EEPROM
  - 2-wire I<sup>2</sup>C and SMBus compatible serial interface
- Footprint Provision for Evaluating CryptoAuthentication™ Device (ATECC608A/ATECC508A)
- Power Supply Options
  - Battery holder for a standard 3V CR2450 coin/button cell battery
  - Header (J5) for external supply
  - Clicker receptacle (J1) for supply from a Click board
- Serial Wire Debug (SWD) Header
- Digital I/O
  - Clicker receptacles comprising SPI, I<sup>2</sup>C and UART interfaces of ATSAMR30M18A
  - One RESET button and one user button
  - One user LED
- Supports Performance Analyzer Example Application in Atmel Studio
- Operating Temperature Range: -40°C to +85°C

**Notes:**

1. The PCB antenna supports only the 868-928 MHz band.
2. When  $f_{RF} = 868.3$  MHz, BPSK-20.

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## 1. Quick References

### 1.1 Reference Documentation

For further study, refer to the following:

- [ATSAMR30M Sensor Board Product Page](#)
- [ATSAMR30M Sensor Board Design Documentation Package containing Schematics, BOM, Assembly drawings, 3D plots, PCB Layer plots and so on](#)
- [SAMR30 Module Xplained Pro User's Guide](#)
- [SAMR30 IEEE® 802.15.4™ Sub-1GHz Module Datasheet](#)
- [IEEE 802.15.4 Sub-GHz System-in-Package Datasheet](#)
- [AT86RF212B Low Power, 700/800/900MHz Transceiver for ZigBee, IEEE 802.15.4, 6LoWPAN, and ISM Applications Data Sheet](#)
- [9- to 12-bit Selectable, ±0.5°C Accurate Digital Temperature Sensor with Nonvolatile Registers and Serial EEPROM Datasheet](#)
- [CryptoAuthentication™ Device Summary Datasheet](#)

### 1.2 Software Prerequisites

- Atmel Studio 7.0
- Wireless Composer 7.0

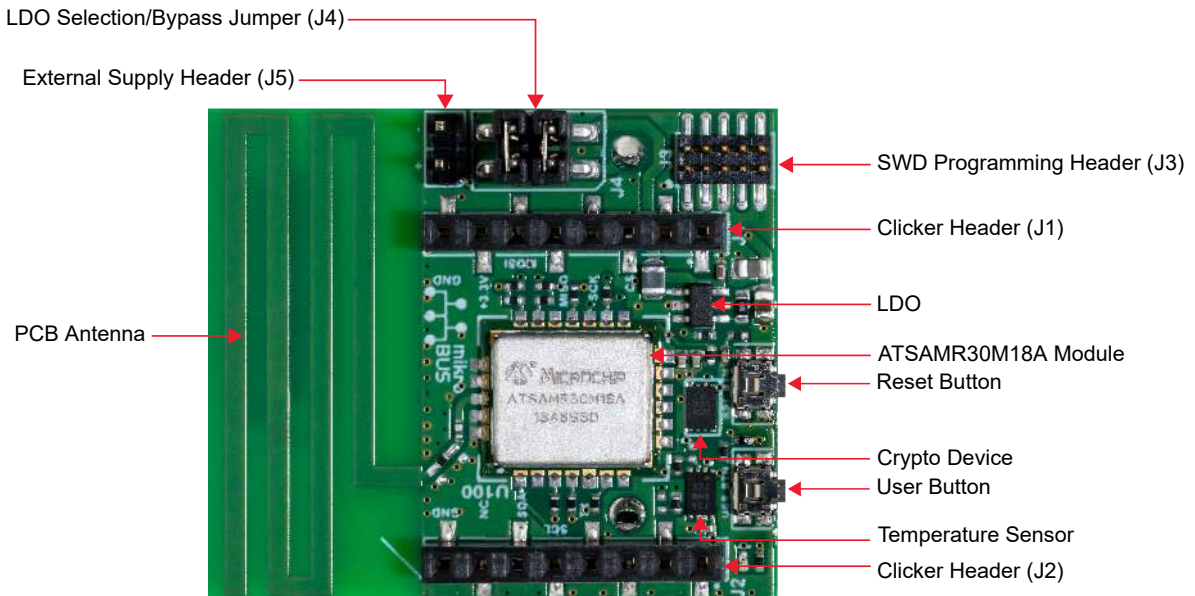
### 1.3 Hardware Prerequisites

- ATSAMR30M Sensor Board Evaluation Kit
- Atmel-ICE basic kit (ATATMEL-ICE-BASIC)
- USB to UART converter or mikroBUS FTDI Click Board

## 2. Kit Overview

The ATSAMR30M Sensor Board is a hardware platform used to evaluate the ATSAMR30M18A module in the mikroBUS compatible Clicker evaluation platform. This evaluation kit supports the Standalone mode, using a CR2450 battery or an external supply.

**Figure 2-1. ATSAMR30M Sensor Board**



### 3. Hardware Specifications

This chapter describes the hardware features and a range of peripheral components of the ATSAMR30M Sensor Board.

#### 3.1 Battery Holder

A 3V coin cell battery can be used to power-up the board using the battery holder (BT1) in the Standalone mode (for example, battery powered wireless sensor node). The positive terminal of the holder is marked with a '+' symbol on top of it.

#### 3.2 LED

The red color user LED (D1) is available on the board. The ATSAMR30M18A module can control this LED by driving the connected I/O line to GND to activate the LED. There is no power indication LED available on the board.

**Table 3-1. LED Functions**

Pin on ATSAMR30M	Pin Function
PA27	Red LED (D1) control

#### 3.3 Mechanical Buttons

The ATSAMR30M Sensor Board contains two mechanical buttons:

- Reset button (RS\_BTN) connected to the ATSAMR30M Reset line
  - When the RS\_BTN button is pressed, the Reset line is driven to ground, which resets the module
- Generic user-configurable button (USR\_BTN)
  - When the USR\_BTN button is pressed, the I/O line is driven to ground

**Note:** The PA28 pin connected with USR\_BTN can be used as a wake-up source from the Backup mode of the ATSAMR30M Sensor Board.

**Table 3-2. Mechanical Button Functions**

Pin on ATSAMR30M	Signal Name	Pin Function
RESET	RST_BTN	Reset switch
PA28	USR_BTN	User switch

#### 3.4 Temperature Sensor

The ATSAMR30M Sensor Board has an on-board digital temperature sensor (AT30TSE758A). This sensor is interfaced with the ATSAMR30M through I<sup>2</sup>C bus and is available on I<sup>2</sup>C slave address 0x48 (7-bit MSb address). The AT30TSE758A also has a serial EEPROM, which is accessible through the same I<sup>2</sup>C bus with the slave address as 0x50 (7-bit MSb address).

**Table 3-3. Temperature Sensor Functions**

Pin on ATSAMR30M	Pin Function	Shared Functionality
PA08	I2C Serial Data (I2C SDA)	ATECC608A and J2 pin 6
PA09	I2C Serial Clock (I2C SCL)	ATECC608A and J2 pin 5

.....continued

Pin on ATSAMR30M	Pin Function	Shared Functionality
PA07	Alert	J2 pin 2

### 3.5 CryptoAuthentication Device

The ATSAMR30M Sensor Board has a footprint provision for evaluating the Microchip ATECC608A CryptoAuthentication IC. The following table lists the interfaces between the CryptoAuthentication IC and the ATSAMR30M.

**Table 3-4. CryptoAuthentication Device Functions**

Pin on ATSAMR30M	Pin Function	Shared Functionality
PA08	I2C Serial Data (I2C SDA)	Temperature sensor and J2 pin 6
PA09	I2C Serial Clock (I2C SCL)	Temperature sensor and J2 pin 5

### 3.6 Headers and Receptacles

The following headers and receptacles are supported by the ATSAMR30M Sensor Board.

#### 3.6.1 mikroBUS Compatible Clicker Receptacles

The mikroBUS Clicker Board is an evaluation platform that provides an easy extension to many applications. This platform consists of a series of Click Boards that are easily pluggable with the ATSAMR30M Sensor Clicker Board. The mikroBUS Click Boards support a wide range of different applications. These Click Boards are connected through a set of standardized headers and receptacles. All mikroBUS Clicker Boards contain two single row, 8-pin, 100-mil receptacles. The Clicker Boards have female connectors, while Click Boards have their male counterparts.

**Note:** All pins are not always connected. The Clicker receptacles can be used to connect a variety of Click Boards or to access the pins of the target MCU on the Clicker Board directly.

The mikroBUS Clicker Board receptacles (J1 and J2) provide the interface to use the ATSAMR30M Sensor Board. The following tables provide the pin details of these receptacles, respectively.

**Table 3-5. Receptacle (J1) Pin Details**

Pin on J1	Pin Function	Pin on ATSAMR30M	Description
1	MB_AN	PA06	AIN[6]; ADC pin
2	MB_RST	PA15	GPIO; can be used to reset the connected Click Board
3	MB_CS	PA17	SERCOM1/PAD[1]; slave select for SPI
4	MB_SCK	PA19	SERCOM1/PAD[3]; clock for SPI
5	MB_MISO	PA16	SERCOM1/PAD[0]; MISO line of SPI
6	MB_MOSI	PA18	SERCOM1/PAD[2]; MOSI line of SPI

.....continued

Pin on J1	Pin Function	Pin on ATSAMR30M	Description
7	VCC_3V3	VCC	3.3V power supply <ul style="list-style-type: none"> <li>To power the connected Click Boards when the ATSAMR30M Sensor Board is supplied by battery or external supply in the LDO Selection mode.</li> <li>To power the ATSAMR30M Sensor Board from a connected Click Board like the FTDI Click Board, which has its own power source.</li> </ul>
8	GND	GND	Ground

**Table 3-6. Receptacle (J2) Pin Details**

Pin on J2	Pin Function	Pin on ATSAMR30M	Description	Shared Functionality
1	MB_PWM	PA14	PWM output	—
2	MB_INT	PA07	Hardware input interrupt	—
3	MB_RX	PA25	SERCOM3 PAD[3]; UART RX of the ATSAMR30M	—
4	MB_TX	PA24	SERCOM3 PAD[2]; UART TX of the ATSAMR30M	—
5	MB_SCL	PA09	SERCOM0/PAD[1]; I <sup>2</sup> C Serial Clock Line (SCL) for the bus clock	Temperature sensor and ATECC608A
6	MB_SDA	PA08	SERCOM0/PAD[0]; I <sup>2</sup> C Serial Data Line (SDA) for data transfer	Temperature sensor and ATECC608A
7	NC	—	Not connected	—
8	GND	GND	Ground	—

### 3.6.2 Serial Wire Debug Header

The SWD header (J3) is on-board for programming and debugging the ATSAMR30M18A module. The pinout of this header is compatible to interface with the SAM port of Atmel-ICE or SAM-ICE using the ATATMEL-ICE-ADPT accessory kit. The following table lists the pin details of the SWD header.

**Table 3-7. SWD Header**

Pin Number	Pin Name
1	VCC
2	SWDIO
3	GND
4	SWDCLK
5	GND
6	NC



.....continued	
Pin Number	Pin Name
7	NC
8	NC
9	GND
10	RESET

### 3.6.3 LDO Selection/Bypass Header

The ATSAMR30M Sensor Board operates with supply voltage ranging from 1.8V<sup>(1)</sup> to 3.63V. Low Dropout Regulator (LDO) selection/bypass header (J4) is used to select/bypass the LDO based on the need for 3.3V supply.

Jumper positions for the following modes of power supply:

- LDO Bypass mode<sup>(2)</sup> – Place the jumper cap between pins (1 and 2) of J4
- LDO Selection mode<sup>(3)</sup> – Place the jumper caps between pins (1 and 3) and pins (2 and 4) of J4 as shown in [Figure 2-1](#).

**Notes:**

1. If the CryptoAuthentication™ device (ATECC608A) is mounted on the board, the minimum supply voltage required to operate it is 2V.
2. LDO Bypass mode can be used to avoid LDO current consumption for extending the battery life. This is the preferred mode if the ATSAMR30M Sensor Board is supplied with a 3V battery or 3.3V from a Click Board (FTDI Click Board).
3. LDO Selection mode can be used if the ATSAMR30M Sensor Board supplies power to the connected Click Board, which needs 3.3V to operate.

### 3.6.4 External Supply Header

The standard bench power supply provides power to the external supply header (J5), to evaluate the operating voltage range (1.8V – 3.6V). LDO Bypass mode must be used to test the supply voltage range.

**Note:** With no power multiplexer on-board, connect either a battery or an external supply or an FTDI Click Board to power up the ATSAMR30M Sensor Board.

## 4. Getting Started

This chapter provides the prerequisites to start the evaluation with the ATSAMR30M Sensor Board. The sensor board is factory programmed with the Performance Analyzer application firmware. Users with a new board from the factory must follow instructions given in Section 4.1 [Setup for Standalone Operation](#) and Section 4.2.2 [Programming Wireless Assembly Using Atmel Studio 7.0](#) (skip Step 7 and 8) for setup. Refer to Section 4.2.1 [Installing Wireless Composer 7.0 Extension in Atmel Studio 7.0](#) to install the wireless composer and to get started with Performance Analyzer GUI.

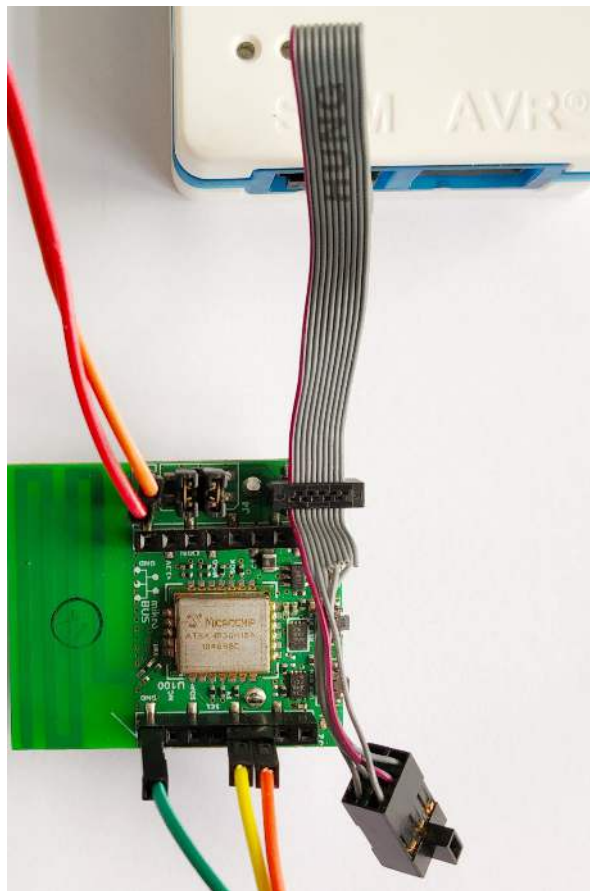
### 4.1 Setup for Standalone Operation

The ATSAMR30M Sensor Board supports the Standalone mode with an external programmer/debugger (Atmel-ICE or SAM-ICE™) and a UART-USB converter (like FTDI Cable) interfaced to UART pins of J2 for evaluation. To supply power, connect the board with either a 3V coin cell battery or a 3.3V through J5 header (external supply).

The setup shown in the following figure consists of a jumper configuration for the LDO Selection mode. To power the module across the operating voltage range of 1.8V to 3.63V, the jumpers must be in LDO Bypass mode.

**Note:** Refer to Section 3.6.3 [LDO Selection/Bypass Header](#) for more details.

**Figure 4-1. Sensor Board Setup with External Programmer/Debugger, UART-USB Converter and External Supply**



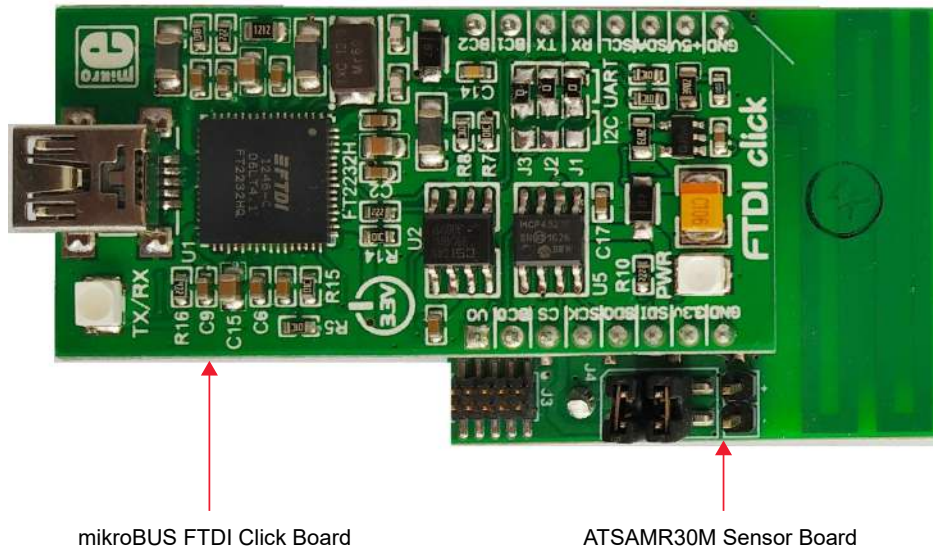
#### 4.1.1 ATSAMR30M Sensor Board and mikroBUS Click Board Interface

The receptacles (J1 and J2) provide the interface to use the ATSAMR30M Sensor Board with a Click Board. The connection of the sensor board with an FTDI Click Board is shown in the following figure. Similarly, the sensor board

can also be connected with a Click Board that has different functionality to demonstrate applications based on customer requirements.

The ATSAMR30M sensor board interfaced with the FTDI Click Board could be used as an alternate to the setup shown in [Figure 4-1](#). The FTDI Click Board could power the ATSAMR30M sensor board and act as the UART-USB Converter. This setup can only be operated at 3.3V as the FTDI Click Board is the power source.

**Figure 4-2. ATSAMR30M Sensor Board and mikroBus FTDI Click Board Connection**



## 4.2 Performance Analyzer

The Performance Analyzer firmware with a GUI (Wireless Composer Extension) in Atmel Studio provides a way to perform a number of basic RF functional tests. A quick-start guide and general help are available in the starting page of the Performance Analyzer window of the Atmel Studio. The latest version of Atmel Studio is 7.0.

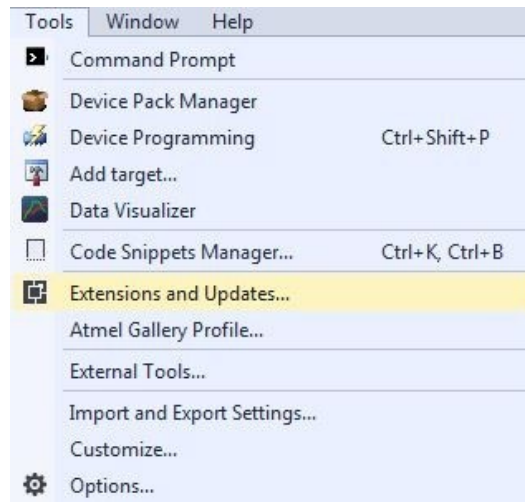
This section guides the user to install the necessary wireless extension and to program the wireless assembly using Atmel Studio 7.0.

### 4.2.1 Installing Wireless Composer 7.0 Extension in Atmel Studio 7.0

The following steps explain how to install the necessary wireless extension tool in Atmel Studio 7.0.

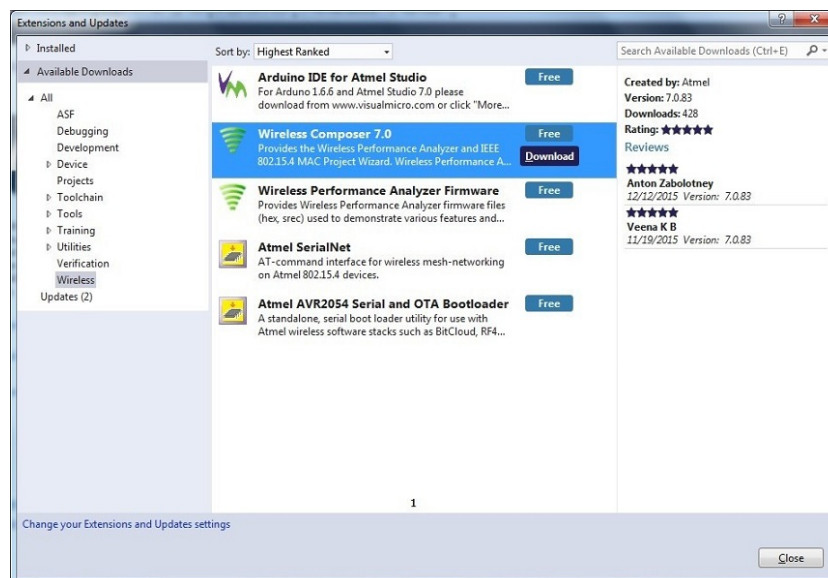
1. Install and open [Atmel Studio](#).
2. Go to the Tools menu and click **Extensions and Updates....**

**Figure 4-3. Extensions and Updates Menu Option**



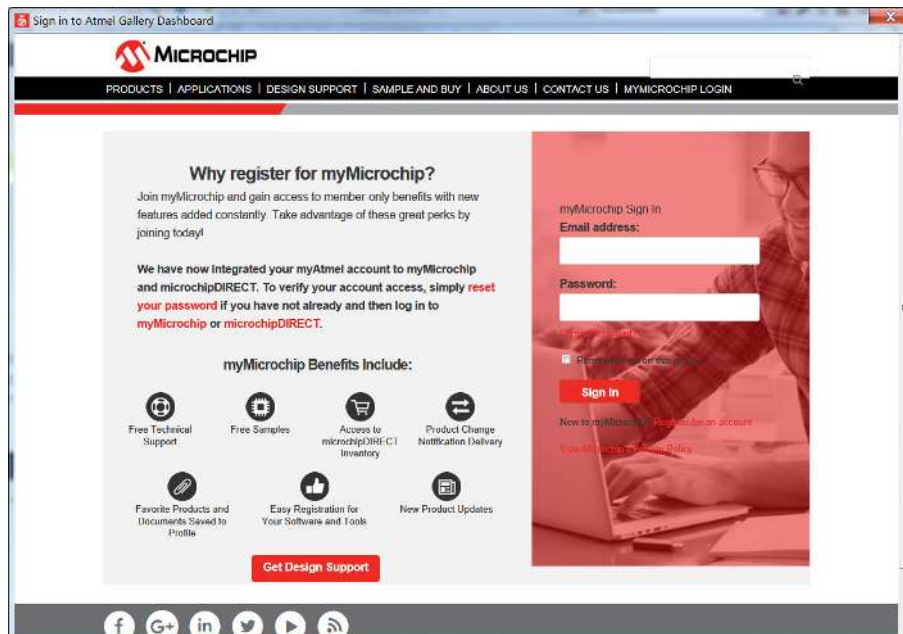
3. In the **Extensions and Updates** window, click **Available Downloads**.
4. Expand **All** options on the left navigation pane and click **Wireless**.
5. Select *Wireless Composer 7.0* and click **Download**, which directs to Microchip Gallery.

**Figure 4-4. Extensions and Updates Window**



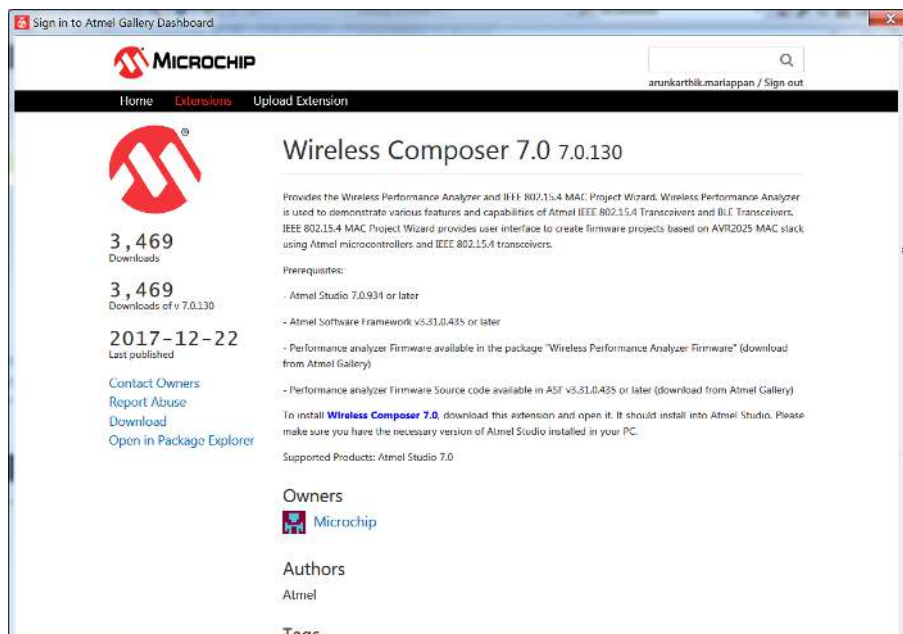
6. Log in to the Microchip Gallery with a myMicrochip account.

Figure 4-5. Microchip Gallery Dashboard



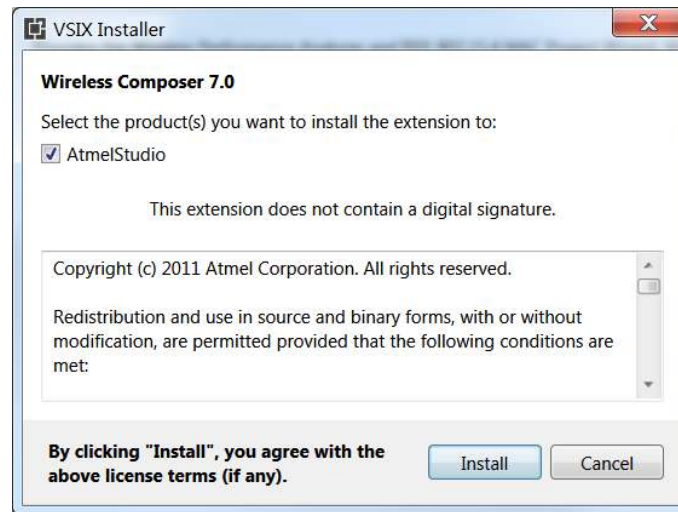
7. Search for **Wireless Composer** in the search bar and click the latest version.

Figure 4-6. Wireless Composer Page



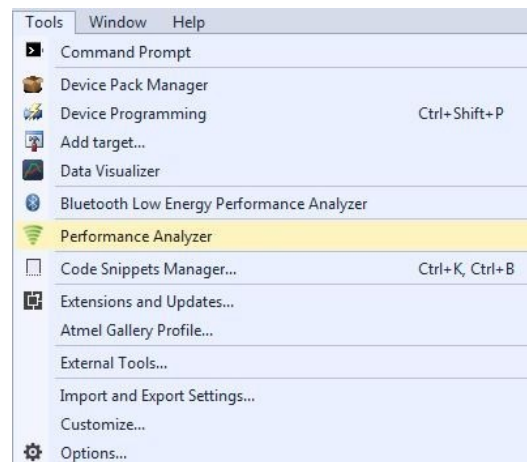
8. On the webpage of the extension, click **Download** and, when prompted for file download, click **Open**. The extension automatically installs after completion of the download.
9. Install Wireless Composer.

Figure 4-7. VSIX Installer



- Restart Atmel Studio after the installation. The Performance Analyzer GUI will be available in the Tools menu.

Figure 4-8. Performance Analyzer Menu Option



### 4.2.2 Programming Wireless Assembly Using Atmel Studio 7.0

The following steps explain how to program the ATSAMR30M Sensor Board and get started with the Performance Analyzer application.

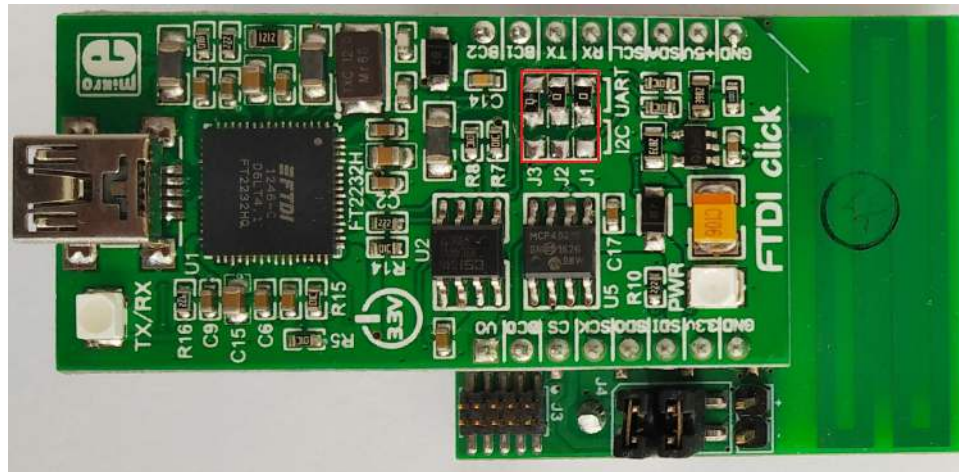
- Power up the board with a battery or external supply and connect a generic USB-UART converter to the UART pins of the sensor board. Otherwise, use an FTDI Click Board<sup>(1)</sup> for powering up<sup>(2)</sup> and enabling UART communication with the Sensor Board.

**Notes:**

- The resistors (J1, J2, J3) mounted in the position indicated by I2C need to be removed and assembled in the UART position as shown in the following figure.
- Do not use the FTDI Click Board for the UART connection if the sensor board is powered from an external supply voltage other than 3.3V. When required to evaluate at voltage levels other than 3.3V, use the setup described in [Figure 4-1](#).

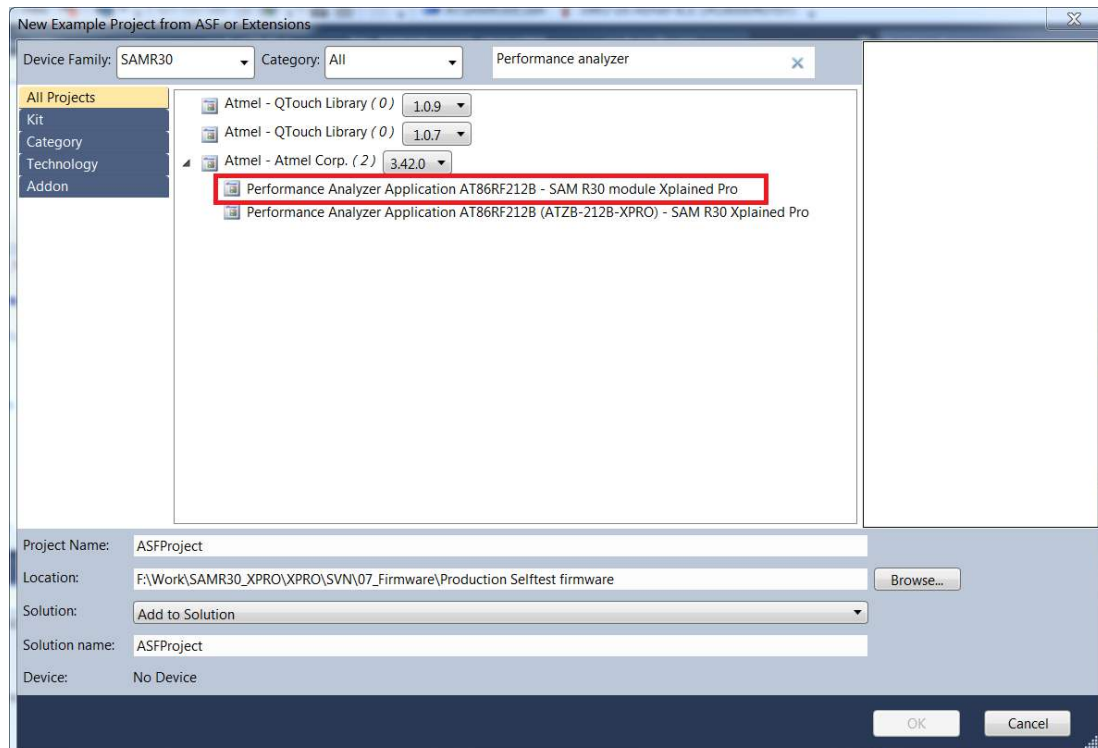


**Figure 4-9. Resistor Jumpers' Placement for FTDI Click Board in UART Mode**



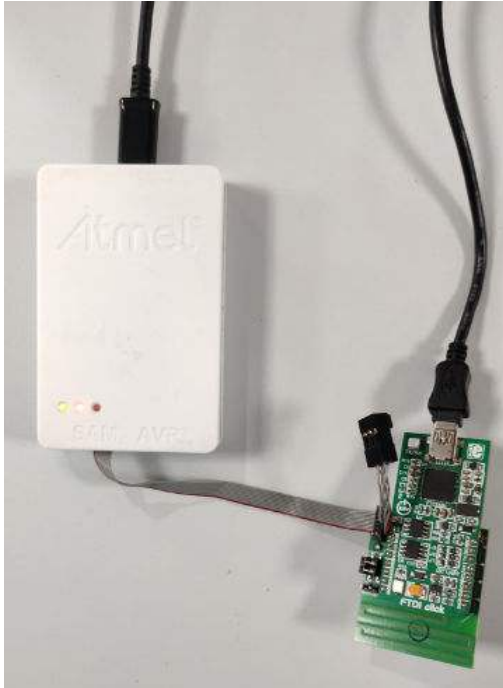
2. Open Atmel Studio.
3. Navigate to the menu *File > New > Example Project*.
4. Select **SAMR30** from the Device Family drop-down list.
5. Enter **Performance analyzer** in the "Search for Example Projects" field. Select "Performance Analyzer Application AT86RF212B - SAM R30 Module Xplained Pro" to create an example project under the selected directory.

**Figure 4-10. Selecting Performance Analyzer Application**



6. After the project solution is successfully opened, initiate the build by clicking '**Build solution**' from the **Build** menu.
7. Connect an external debugger, like Atmel-ICE, to the ATSAMR30M Sensor Board. Ensure that the pin 1 of the cable (indicated by red wire) is interfaced to the SWD header, as shown in the following figure.

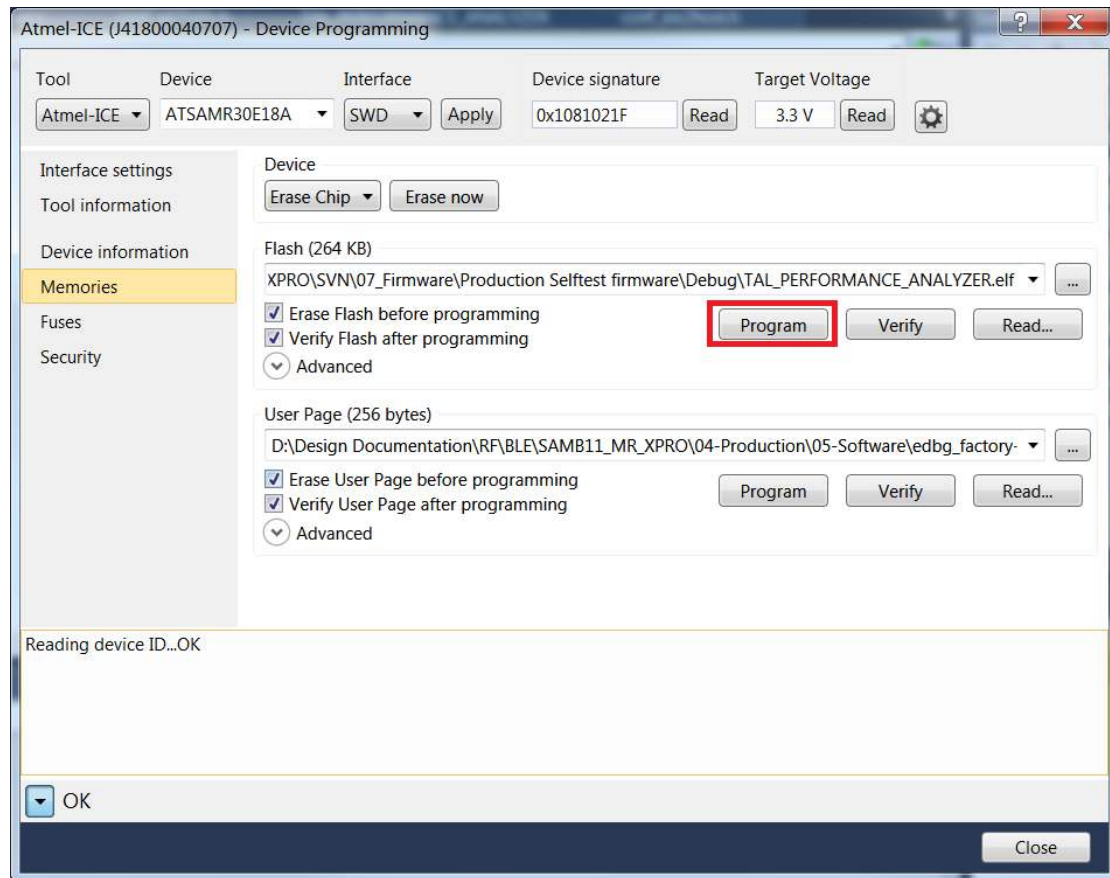
Figure 4-11. Connecting Programmer/Debugger with ATSAMR30M Sensor Board



8. After successful build completion, open the Device Programming window from the **Tools** menu.
9. In the Device Programming window, set the following:
  - Tool – *Atmel-ICE*
  - Device – *ATSAMR30E18A*
  - Interface – *SWD*
10. Click **Read** to read the device signature and target voltage. If there are issues in reading the signature or target voltage, ensure that the programming cable is firmly connected to the SWD header.
11. Navigate to the **Memories** tab and click **Program**.



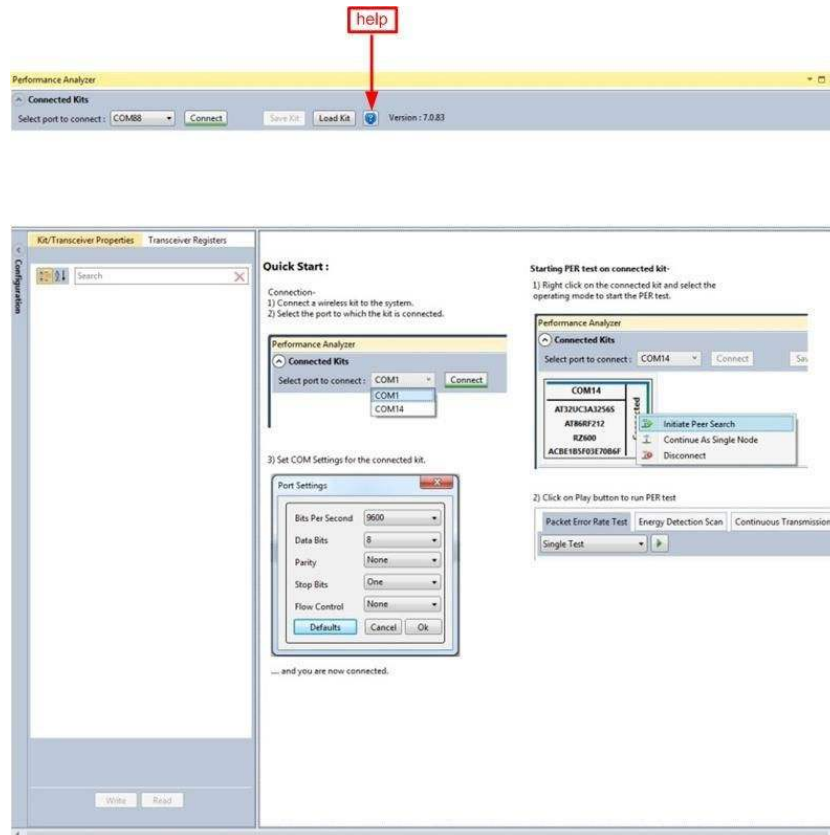
Figure 4-12. Device Programming



12. Open the Performance Analyzer from the **Tools** menu in Atmel Studio.
13. Follow the Quick Start guidelines available in the starting page of the Performance Analyzer window.
14. Select COM port of the UART-USB converter and click **Connect**. The Performance Analyzer connects with the ATSAMR30M Sensor Board. When using the FTDI Click Board as a UART-USB converter, the FTDI Click Board enumerates as Two COM ports. Use the port with lower COM number for interfacing with the Performance analyzer GUI.

**Note:** The Performance Analyzer allows setting or changing of the parameters like Channel Page, Channel, TX Power Register Value and so on, to perform various RF tests. For more details about the use of the Performance Analyzer, click the help icon as shown in the following figure.

**Figure 4-13. Performance Analyzer - Help**



## 5. Regulatory Approval

This equipment (ATSAMR30M Sensor Board/DT100130) is an evaluation kit and not a finished product. It is intended for laboratory evaluation purposes only. It is not directly marketed or sold to the general public through retail; it is only sold through authorized distributors or through Microchip. Using this requires engineering expertise towards understanding of the tools and relevant technology, which can be expected only from a person who is professionally trained in the technology.

When this module is used in USA/Canada, the user must restrict the operating frequency band within 902-928 MHz. For Europe, the user must ensure that the module is operated only within the 868-868.6 MHz frequency band. Regulatory compliance settings have to follow the ATSAMR30M18A module certifications.

The following regulatory notices are to cover the requirements under the regulatory approval.

### 5.1 United States

The ATSAMR30M Sensor Board (DT100130) contains the ATSAMR30M18A module, which has received Federal Communications Commission (FCC) CFR47 Telecommunications, Part 15 Subpart C "Intentional Radiators" single-modular approval in accordance with Part 15.212 Modular Transmitter approval.

Contains Transmitter Module FCC ID: 2ADHKR30M

**This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.**



#### **Important:** FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for uncontrolled environment. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. This transmitter is restricted for use with the specific antenna(s) tested in this application for certification.



Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

#### **FCC Notice**

This kit is designed to allow:

- Product developers to evaluate electronic components, circuitry or software associated with the kit to determine whether to incorporate such items in a finished product.
- Software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.
- The kit is for evaluation only; not FCC approved for resale; and any radio frequency transmitter employed as part of an evaluation kit shall be designed to comply with all applicable FCC technical rules, including frequency use, spurious and out-of-band emission limits and maximum power or field strength ratings applicable to final products that would employ the components or circuitry to be evaluated.

- Under 47 CFR 2.805(d)(2), in order to operate the evaluation kit, the user must ultimately render the device inoperable or return it to Microchip.
- Evaluation kit is defined by FCC as “[a]n assembly of components, subassemblies, or circuitry, including software, created by or for a component maker, system integrator, or product developer for the sole purpose of facilitating: End product developer evaluation of all or some of such components, subassemblies, or circuitry, or (ii) the development of software to be used in an end product.” (see 47 CFR 2.1)

## 5.2 Canada

The ATSAMR30M Sensor Board (DT100130) contains the ATSAMR30M18A module, which has been certified for use in Canada under Innovation, Science and Economic Development Canada (ISED, formerly Industry Canada) Radio Standards Procedure (RSP) RSP-100, Radio Standards Specification (RSS) RSS-Gen and RSS-247.

Contains IC: 20266-R30M

This device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada’s license-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference;
2. This device must accept any interference, including interference that may cause undesired operation of the device.

L’émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d’Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L’exploitation est autorisée aux deux conditions suivantes:

1. L’appareil ne doit pas produire de brouillage;
2. L’appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d’en compromettre le fonctionnement.



This equipment complies with radio frequency exposure limits set forth by Innovation, Science and Economic Development Canada for an uncontrolled environment. This equipment must be installed and operated with a minimum distance of 20 cm between the device and the user or bystanders.

Cet équipement est conforme aux limites d'exposition aux radiofréquences définies par d’Innovation, Sciences et Développement économique Canada pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20cm de distance entre le dispositif et l'utilisateur ou des tiers.

The following table provides the specification of the integrated PCB antenna on the ATSAMR30M Sensor Board.

**Table 5-1. PCB Antenna Specifications**

Parameter	Value
Peak gain	0.44 dBi
Operating frequency	868- 928 MHz

## 5.3 Europe

This equipment (DT100130) has been assessed under the Radio Equipment Directive (RED) for use in European Union countries. The product does not exceed the specified power ratings, antenna specifications and/or installation requirements as specified in the user manual. A Declaration of Conformity is issued for each of these standards and kept on file as described in RED.

### Simplified EU Declaration of Conformity

Hereby, Microchip Technology Inc. declares that the radio equipment type [DT100130] is in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at (refer product specific pages): [www.microchip.com/design-centers/wireless-connectivity/](http://www.microchip.com/design-centers/wireless-connectivity/).

**6. Document Revision History**

Revision	Date	Section	Description
A	08/2020	Document	Initial revision

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