AVR-IoT WA User Guide

AVR-IoT WA Development Board User Guide

Preface

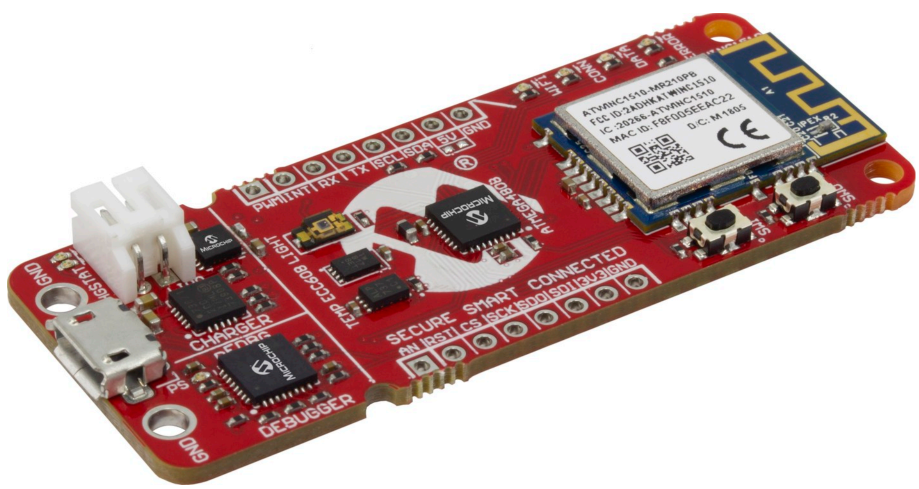
Introduction

The AVR-IoT WA Development Board is a small and easily expandable demonstration and development platform for IoT solutions. Based on the AVR® microcontroller architecture and using Wi-Fi® technology, it is designed to demonstrate that the design of a typical IoT application can be simplified by partitioning the problem into three blocks:

- Smart – represented by the ATmega4808 microcontroller
- Secure – represented by the ATECC608A secure element
- Connected – represented by the WINC1510 Wi-Fi controller module

The AVR-IoT WA Development Board features the following elements:

- The PICkit™ On-Board (PKOB nano) supplies full programming and debugging support through Atmel Studio/ MPLAB® X IDE Communication Library. It also provides access to a serial port interface (serial to USB bridge) and two logic analyzer channels (debug GPIO)
- On the PC, the on-board debugger acts as a mass storage interface device for easy drag-and-drop programming, Wi-Fi configuration, and full access to the microcontroller application Command Line Interface (CLI)
- A mikroBUS™ socket allows for expansion of the board capabilities with the selection from 450+ sensors and actuators options offered by MikroElektronika (www.mikroe.com) via a growing portfolio of Click boards™
- A light sensor used to demonstrate published data
- Microchip MCP9808 high-accuracy temperature sensor used to demonstrate published data
- Microchip MCP73871 Li-Ion/LiPo battery charger with power path management



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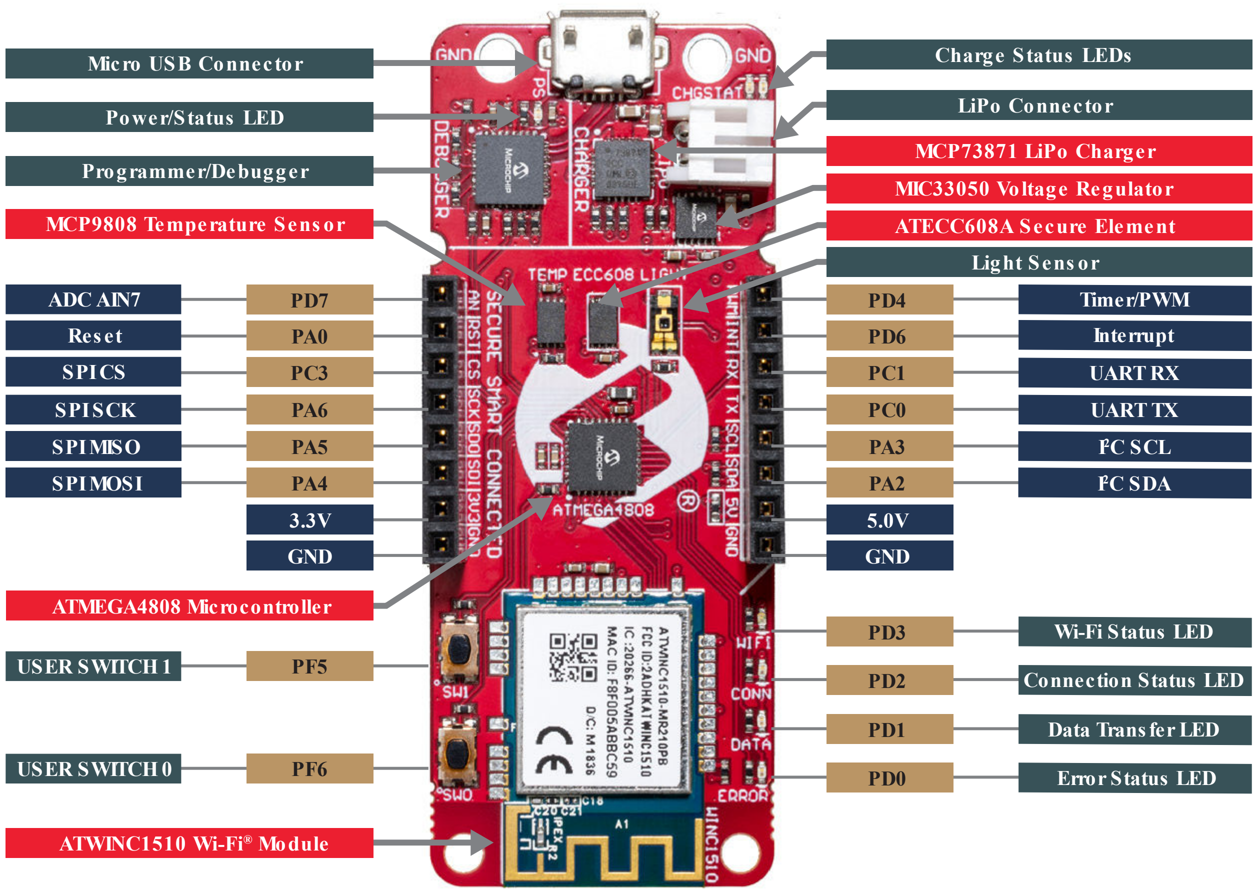
1. Overview

1.1 The AVR-IoT WA Board

The AVR-IoT WA Development Board is shown in AVR-IoT Development Board.

Figure 1-1. AVR-IoT Development Board



1.2 LED Indicators

The development board features four LEDs that can be used to provide diagnostic information for the demo code that comes with the board. At power-up, the LED array should flash twice in the following order: Blue, Green, Yellow, and Red. This will indicate that the board is pre-programmed. Each LED is assigned to indicate the status of a certain aspect of the IoT system, which can be found in the table below.

Table 1-1. LED Indicators

LED Color	Type		Indication	Details
	Label	Pattern		
Blue	WIFI	Solid Blue	Wi-Fi Network Connection	Indicates a successful connection to the local Wi-Fi network.
		Blinking Blue (slow blink)	Soft AP Mode	Indicates that the board can be detected and used as a Wi-Fi access point. For details, refer to Section 2.3.3 Via Soft AP.
		Blinking Blue (fast blink)	Wi-Fi Network Connection	Indicates that the board is trying to establish a successful connection to a Wi-Fi network. In combination with a blinking green LED, it means that the board is trying to connect to the network using default Wi-Fi credentials.
Green	CONN	Solid Green	AWS Cloud Connection	Indicates a successful MQTT connection to AWS Cloud.
		Blinking Green	AWS Cloud Connection	Indicates that the board is trying to establish a MQTT connection to AWS Cloud
Yellow	DATA	Blinking Yellow	Data Publication to the Cloud	Indicates that sensor data in the form of MQTT packet has been successfully published to AWS Cloud.
		Solid Yellow for ON state, LED Off for OFF state for extended time	State of Toggle sent within MQTT publish packet	Indicates the state of the Toggle switch (ON = 1 / OFF = 0), received as part of the packet published by AWS Cloud on the subscribed topic.
Red	ERROR	Solid Red	Error Status	Indicates an error in the application.

1.3 Switch Button Use Cases

The AVR-IoT WA board also has two switches that can be used to enter modes at power-up:

- Hold SW0 for two LED cycles to enter Soft AP mode (refer to Section 2.3.3 Via Soft AP)
- Hold both SW0 and SW1 to use default Wi-Fi credentials. The default credentials are configurable through MCC, and the application uses the following default values:

Table 1-2. Wi-Fi Credentials

SSID	Password
MCHP.IOT	microchip

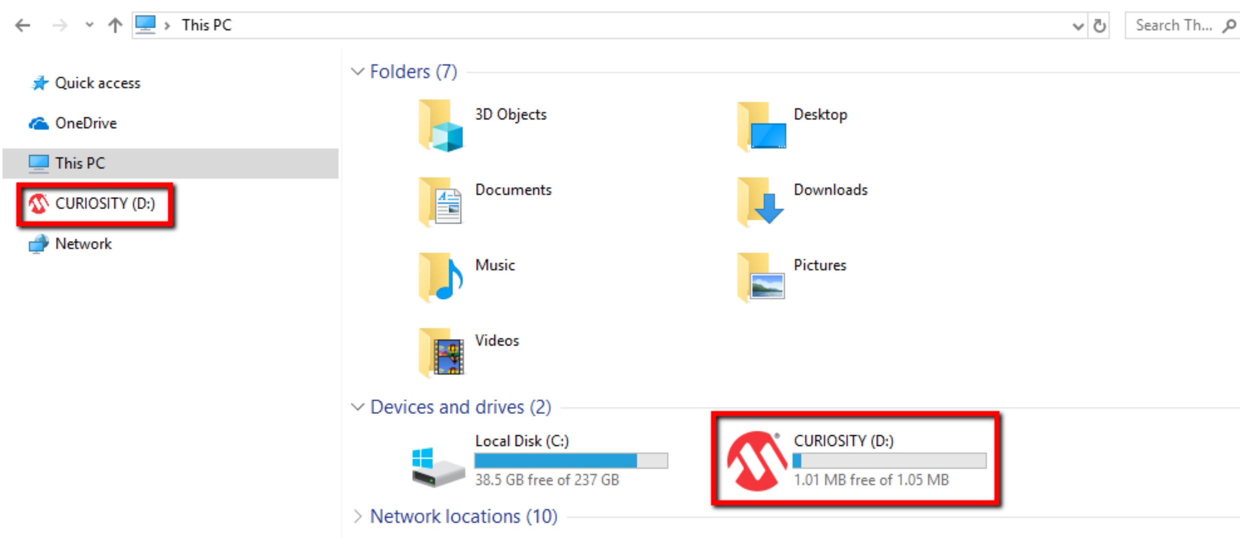
2. Getting Started

2.1 Connecting the Board to the Host PC

The AVR-IoT WA development board can be connected to a computer using a standard Micro-USB cable. Once plugged in, the LED array at the top right-hand corner of the board should flash twice in the following order: Blue, Green, Yellow, and Red. When the board is not connected to Wi-Fi , the blue LED will blink continuously. The board will appear as a Removable Storage Device on the host PC, as shown in Curiosity Board as Removable Storage. Double click the **CURIOSITY** drive to open it and get started.

Note: All procedures are identical for Windows®, Mac OS®, and Linux® environments.

Figure 2-1. Curiosity Board as Removable Storage



The CURIOSITY drive should contain the following five files:

- CLICK-ME.HTM – redirects the user to the AVR-IoT web demo application
- KIT-INFO.HTM – redirects the user to a site containing information and resources about the board
- KIT-INFO.TXT – a text file with details about the PKOB nano firmware and the board's serial number
- PUBKEY.TXT – a text file with the public key used for data encryption
- STATUS.TXT – a text file with the status of the board

Double click on the **CLICK-ME.HTM** file to enter the dedicated web page to access the web application.

2.2 The AVR-IoT Web Page

AVR-IoT Web Page shows an image of the AVR-IoT WA web page. This page displays the sensor data and allows the user to regenerate the Wi-Fi credentials as a file labeled WIFI.CFG. This can be loaded onto the board, acting as a storage device to reconfigure access point parameters.

The status markers in the middle of the page, as shown in Web Page Status Indicators, indicate the progress of the system setup. These markers will light up once each stage has completed successfully.

Figure 2-2. AVR-IoT Web Page

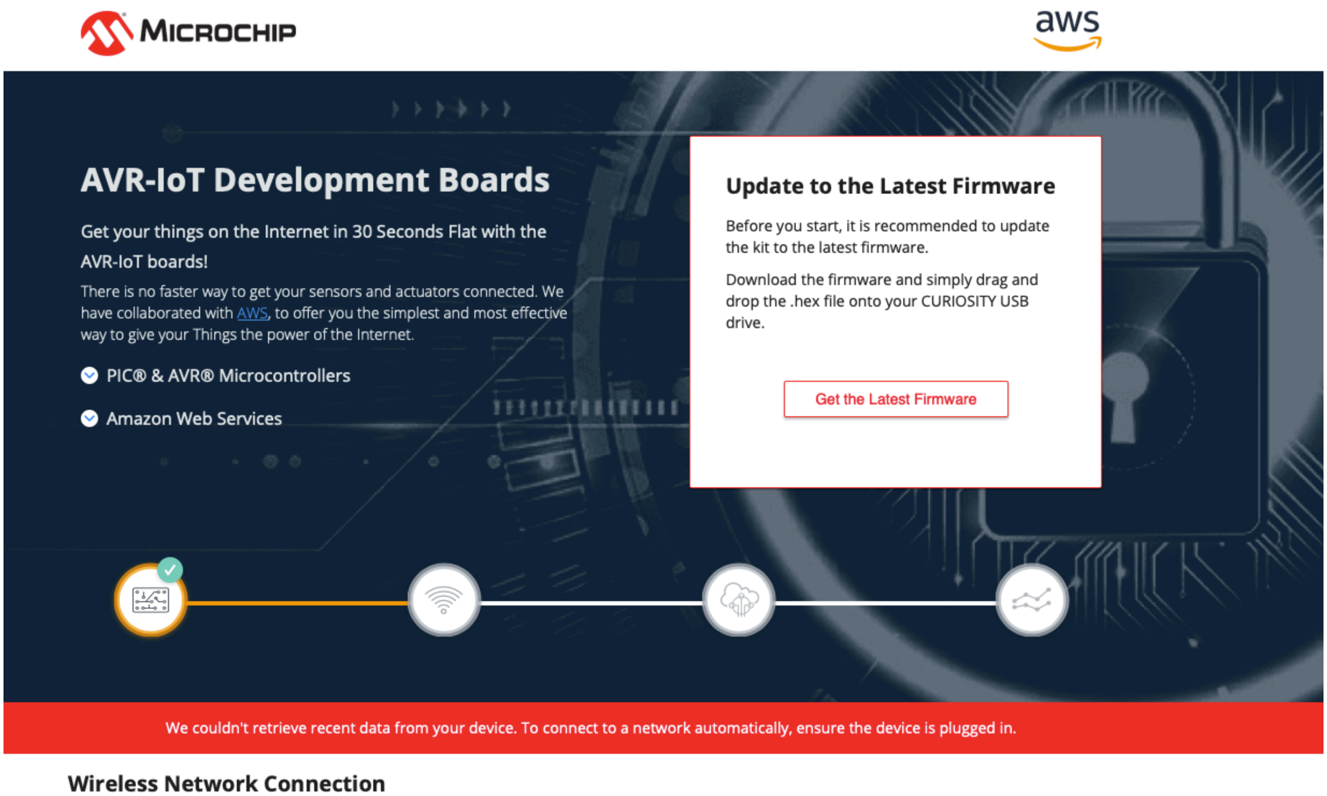


Figure 2-3. Web Page Status Indicators

The leftmost marker indicates if the board is connected to the host PC. Next to this, the Wi-Fi marker lights up once the board is connected to a Wi-Fi network and the blue LED will stop blinking and stay on to indicate the board connection state. To the right of the Wi-Fi marker, the AWS Cloud Message Queuing Telemetry Transport (MQTT) marker is found, indicating the status of the TCP socket connection and MQTT connection to AWS Cloud. The corresponding green LED will stop blinking and stay on to indicate the board connection state. Finally, the rightmost marker lights up, signifying that data is streaming from the board to the cloud. For each successful MQTT publication of data, yellow LED on the board blinks.

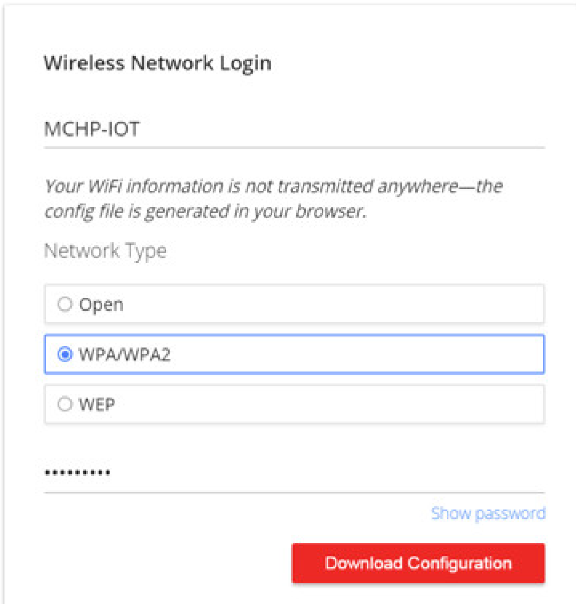
2.3 Connecting the Board to Wi-Fi® Networks

2.3.1 Via AVR-IoT Web Page

There are several ways to connect the AVR-IoT WA Development Board to the Internet. The easiest way is through the AVR-IoT web page (www.avr-iot.com/aws). The lower left-hand corner of the site will show a wireless network connection window where the user can choose to connect to an open (no password required) network or enter the credentials for a password protected (WPA/WPA2/WEP) Wi-Fi network. Entering Wi-Fi Credentials in AVR-IoT Web Page shows how to enter the Wi-Fi credentials on the website.

Important:
- The Wi-Fi network SSID and password are limited to 31 characters. Avoid using quotation marks, names, or phrases that begin or end with spaces.
- The AVR-IoT WA Development Board supports only 2.4 GHz networks inline, thus it is recommended to use mobile hotspots to connect the board to the Internet.

Figure 2-4. Entering Wi-Fi Credentials in AVR-IoT Web Page



Once the required details are entered, click the **Download Configuration** button. This will download the WIFI.CFG (text) file to the host PC. From the WIFI.CFG's download location, drag and drop the file to the CURIOSITY drive to update the Wi-Fi credentials of the board. The blue LED will stop blinking and will stay continuously ON to show a successful connection to the Wi-Fi Access Point.

Important: Any information entered in the SSID and password fields is not transmitted over the web or to the Microchip or any of the Cloud servers. Instead, the information is used locally (within the browser) to generate the WIFI.CFG file.

2.3.2 Via Command Line Interface (CLI)

Another way of connecting to the Wi-Fi is through the Serial Command Line Interface (CLI). This interface can be accessed through any serial terminal application. Using the UART settings defined in Section 2.5.2 Serial USB Interface , the user can reconfigure the board to a Wi-Fi network by entering the Wi-Fi command. Wi-Fi Configuration via Serial Command Line (Open Network) and Wi-Fi Configuration via Serial Command Line (Secured Network) show examples of trying to connect to open, or secured networks, respectively. For more details on the Wi-Fi command and its parameters, refer to Section 2.5.2 Serial USB Interface .

Figure 2-5. Wi-Fi Configuration via Serial Command Line (Open Network)

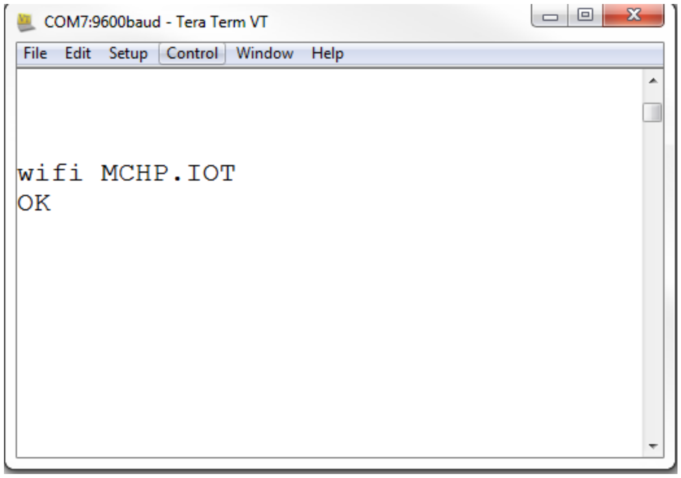
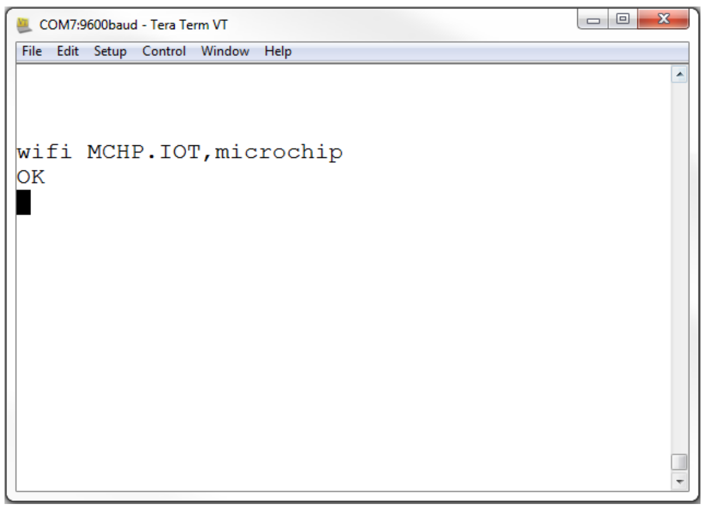


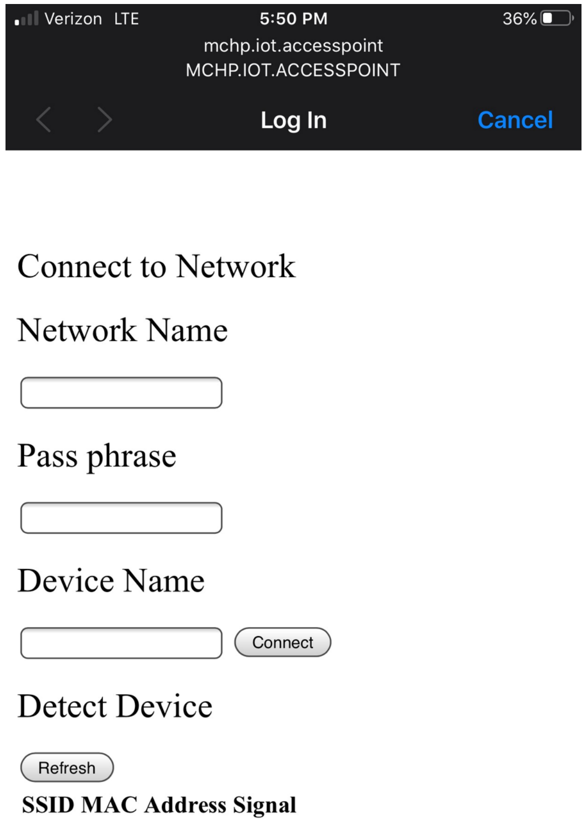
Figure 2-6. Wi-Fi Configuration via Serial Command Line (Secured Network)



2.3.3 Via Soft AP

The last method to connect to the Wi-Fi is through the advanced Software Access Point (Soft AP) mode, a feature of the WINC module on board. This method is ideal if the user is only using a mobile device, such as a mobile phone or tablet, instead of a laptop or PC. The Soft AP mode can be entered by pressing and holding the SW0 push button for most of the start-up time between initial power-up LED cycling. When the Soft AP mode has been successfully entered, the board can be detected as a Wi-Fi access point named MCHP.IOT.ACCESSPOINT. The blue LED will start blinking when Soft AP is available. Using a mobile device such as a mobile phone or tablet, connect to the MCHP.IOT.ACCESSPOINT hotspot. It will redirect to a sign-in page where the user can enter the SSID and password of the network to which the board will connect. The Device Name will not be considered, and the authorization type will always be WPA/WPA2 (2). Once these details are entered, click the **Connect** button to connect the board to the network. Refer to Figure 2-7 to see how the sign-in page will look like.

Figure 2-7. Connecting via Soft AP



2.4 Visualizing Cloud Data in Real Time

Out of the box, all AVR-IoT WA Development Boards are pre-registered to Microchip's AWS Cloud sandbox account. This account is set up for demonstration purposes only. All data gathered by the sensors of the AVR-IoT WA Development Boards are published on the Microchip sandbox account and can be identified by the following details:

Table 2-1. Project Details

Region:	iot.us-east-2
Port:	8883

There is no permanent storage or collection of data published by the boards connected to the Microchip sandbox account. The full storage catalog of the AWS Cloud features, such as data storage/retention, can be available to the user with the use of the board once removed from the sandbox and the associated Thing NamePublic Key has been migrated to a private account.

2.4.1 Publishing data to AWS Cloud

A MQTT publish packet is always sent to the MQTT broker using a specific topic. The AVR-IoT WA Development Board publishes messages using the topic '`thingName/sensors`' in communication to the AWS cloud. The messages published on this topic contains the real-time data obtained from the on-board light and temperature sensors. The frequency of sending a PUBLISH packet can be decided by the user application. The application is written such that the sensor data is published to the Cloud every second.

2.4.1.1 Updating the Device Shadow

In order to control the device from the Cloud, the AWS Shadow Service feature is used. The AWS Shadow service maintains a shadow of the device in the form of a JSON document. The device's state can be stored and retrieved, leveraging upon the AWS Shadow Topics. To set and get the state of the device, either HTTP or MQTT can be used. For the demo application, MQTT protocol is chosen. Each device is represented by its unique thing name.

To update the device's shadow, publish on the topic '`$aws/things/thingName/shadow/update`'.

1. Device updating its reported state:
   – The device would publish on this topic to update the state of its reported attributes. Below is an example of a payload where 'toggle' is the attribute:

```
{
    "state" :
    {
        "reported" :
        {
            "toggle" : 1
        }
    }
}
```

   – The payload consists of key-value pairs. In the above example, attribute 'toggle' is set to '1'. The user can expand the application to add more attributes, which requires updates in the firmware.
2. Client requesting to update a device shadow:
   – To request a change in attribute value, the client will publish on the same topic and the payload will be:

```
{
    "state" :
    {
        "desired" :
        {
            "toggle" : 1
        }
    }
}
```

   – The payload consists of key-value pairs. In the above example, attribute 'toggle' is set to '1'. The user can expand the application to add more attributes, which requires updates in the firmware.

```
{
    "state" :
    {
        "reported" :
        {
            "toggle" : 1
        }
    }
}
```

Further information can be found here: /update

Note: Remember to replace thingName with the device's actual thing name.

2.4.2 Subscribing to AWS Shadow Topic

To get information about the device's shadow from the shadow service, the device has to subscribe to specific shadow topics. More information on shadow topics can be found here at Shadow MQTT topics.

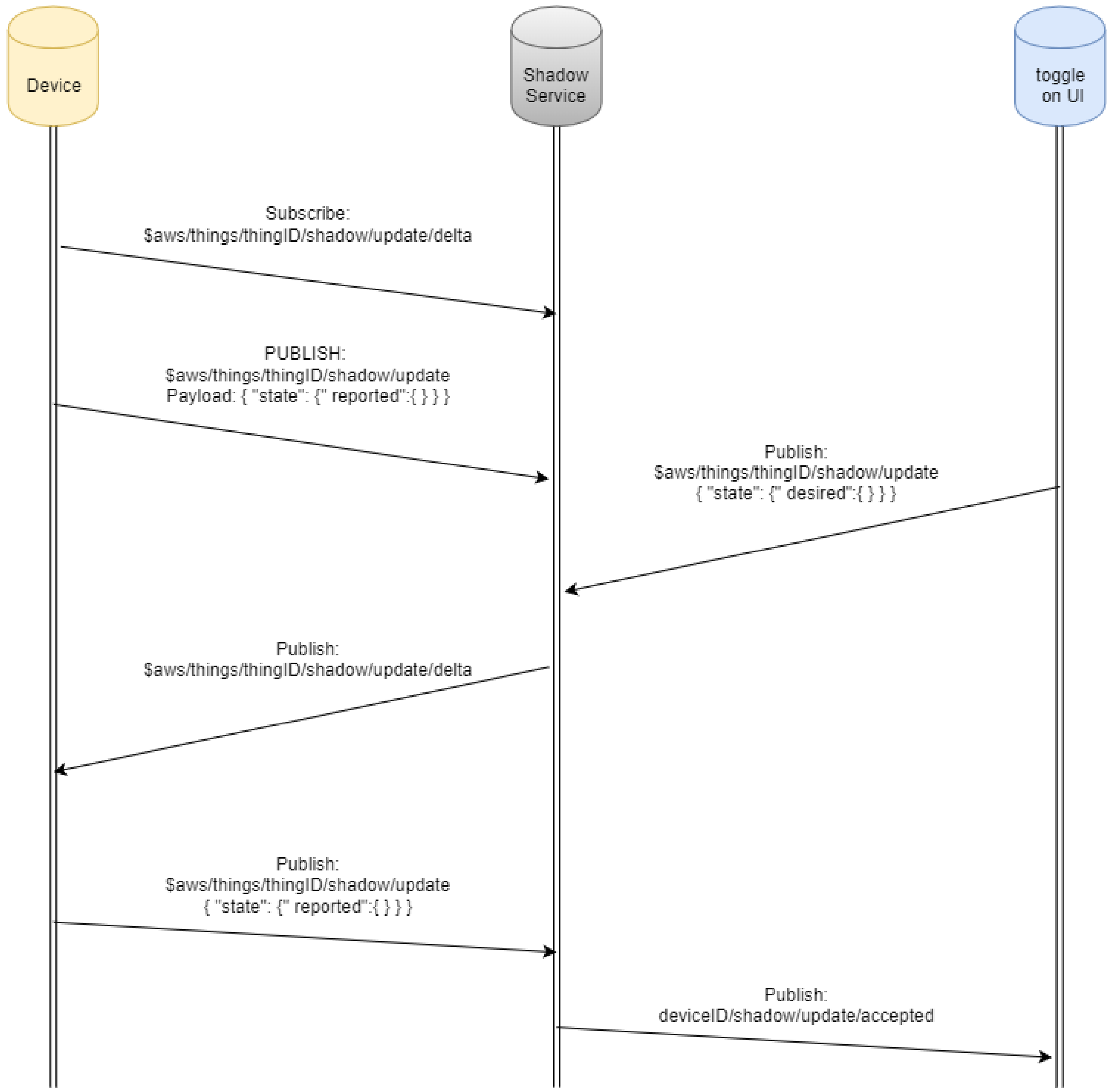
The device subscribes to '`$aws/things/thingName/shadow/update/delta`'.The shadow service will send updates on this topic when there is a difference in attribute values. For example, the reported toggle state is 1 but a client sent a desired state for toggle as 0. The device would receive update like below:


```
{
          "version": 1349,
          "timestamp": 1583450271,
          "state": {
            "toggle": 0
             },
          "metadata": {
            "toggle": {
              "timestamp": 1583450271
                }
            }
        }
```


Further information can be found here: /update/delta

Note: Remember to replace thingName with the device's actual thing name.

Figure 2-8. Illustration of AWS Shadow Service Publish-Subscribe Model



2.4.3 Sending the Messages

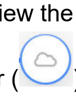
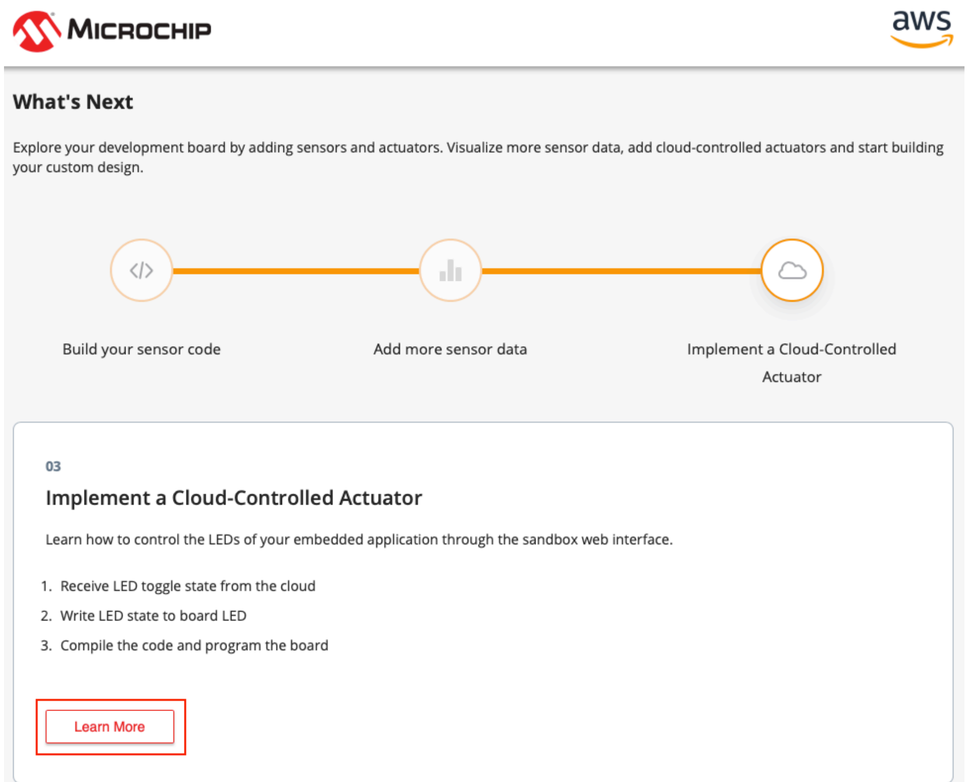
The AVR-IoT web page displays a section called **What's Next**, two sections below the Light and Temperature graphs. In this section, the user can go through the steps of building their own custom application. To quickly preview the capability to send messages from the Cloud to the board, click the Implement a Cloud-Controlled Actuator () icon, and then click the **Learn More** button to expand the section.

Figure 2-9. What's Next

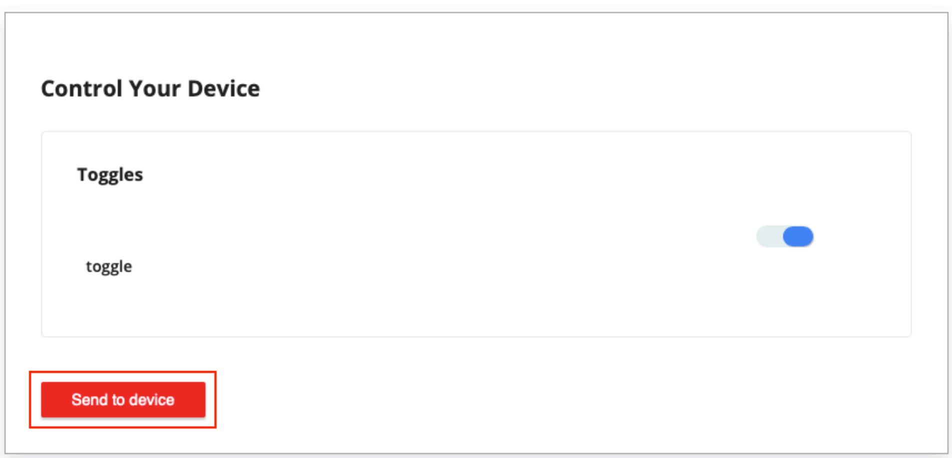


Scroll down to the **Control Your Device** section. Here, control mechanisms can be seen:

- The **Toggle** button is used to send the switch value to the AVR-IoT WA board.

The values are only published over the '`$aws/things/thingName/shadow/update`' topic upon pressing the **Send to device** button. Since the board subscribes to '`$aws/things/thingName/shadow/update/delta`' by default, the shadow service will send updates on this topic when there is a difference in attribute values. The payload received here is limited by the MQTT Receive Buffer (bytes) configurable in MQTT library MCC window (see Figure 3-12 for more details).

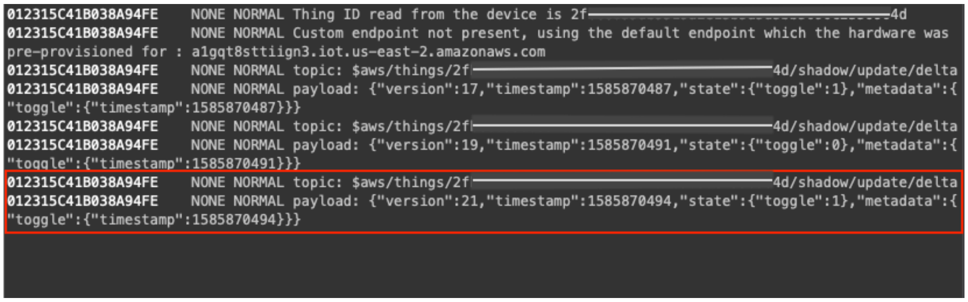
Figure 2-10. Sending Messages on the Subscribed Topic



2.4.4 Viewing Messages Received on Subscribed Topic

The toggle switch value corresponds to a short forced ON/OFF state to the yellow LED on the AVR-IoT WA Development Board. The LED will stay on/off for a short time depending on the position of the toggle switch before it resumes normal behavior of blinking to indicate the transmission sensor data through PUBLISH packets. As with sending messages, the payload is limited by the MQTT Receive Buffer (bytes) configurable in the MQTT library MCC window.

Figure 2-11. Viewing Messages on a Serial Terminal



There is no permanent storage or collection of the data published by the boards connected through the Microchip sandbox account. The full storage features available to AWS Cloud are available to the user after the board has been removed from the Microchip sandbox and migrated to a private account.

2.5 Configuring Other Settings

While the AVR-IoT WA Development Board comes fully programmed and provisioned right out of the box, the user can still control aspects of the application firmware behavior through the USB interface. There are three methods to do this:

1. Hex file (reprogram) or WIFI.CFG (reconfigure credentials) drag and drop using the mass storage feature.
2. Commands through the Serial Command Line Interface (CLI), or using MPLAB X IDE.
3. The on-board programmer/debugger PKOB nano.

2.5.1 Mass Storage Drag and Drop

There are two ways to utilize the Mass Storage Drag-and-Drop Option:

- Program the embedded device is to drag and drop a `.hex` file into the CURIOSITY drive. The C compiler toolchain generates a `.hex` file for each project it builds. This `.hex` file contains the code of the project. The Nano Embedded Debugger (PKoB nano) also provides access to a serial port interface (serial to USB bridge). This facilitates the user to drag and drop a modified `.hex` file, which contains the firmware updates. This feature does not require any USB driver to be installed and works in all major OS environments.
- If the WiFi credentials need to be reconfigured and/or the board needs to connect to the new access point, the user can enter the new credentials in the AVR-IoT webpage, download the WIFI.cfg file, and then drag and drop this file into the CURIOSITY drive. The board securely remembers the last successful connection to the access point.

2.5.2 Serial USB Interface

The Wi-Fi Access Point credentials can be reconfigured through a Serial Command Line Interface (CLI) on the AVR-IoT WA Development Boards. This interface may also be used to provide application diagnostic information. To access this interface, use any preferred serial terminal application (Tera Term, CoolTerm, and PuTTy) and open the serial port labeled Curiosity Virtual COM port, with the following settings:

Table 2-2. Serial USB Interface Settings

Baud rate	Data	Parity bit	Stop bit	Flow control	Local echo	Transmit protocol
9600	8 bits	None	1 bit	None	ON	CR+LF (Carriage Return + Line Feed)

Note: For Windows® users, the USB serial interface requires the installation of a USB serial port driver, included in the installation of the MPLAB® X IDE.

The user can control the board by typing the command keywords, listed in Serial Command Line Commands:

Table 2-3. Serial Command Line Commands

Command	Arguments	Description
`reset`	—	Reset the settings on the device
`device`	—	Print the unique device ID of the on-board ECC device
`thing`	—	Print the unique thing name of the board
`reconnect`	—	Re-establish connection to the Cloud
`version`	—	Print the version of the AVR-IoT firmware library
`cli_version`	—	Print the command line interface firmware version of the AVR-IoT library
`wifi`	<Network SSID>, <Password>, <Security Option*>	Enter the Wi-Fi network authentication details
`debug`	<Debug Options**>	Print debug messages to see status of board operation

*- Authorization Type options are available by typing one of the following three numbers to determine the network security option used:

1. Open – Password and Security option parameters are not required.
2. WPA/WPA2 – Security Option Parameter not required.
3. WEP – Network Name, Password, and Security Option (3) Parameter are required when connecting to a WEP network. For example, ‘`wifi MCHP.IOT,microchip,3`’.

- The debug option won't work unless the user selects **Enable debug messages option in the AVR-IoT Sensor Node Library. Configured Debug Severity level is used to determine messages displayed using `debug_printer()`:

0. **Normal** – At this level, only standard operating behavior or data are displayed.

1. **Warning** – At this level, information related to nuance in operation or configuration is displayed.

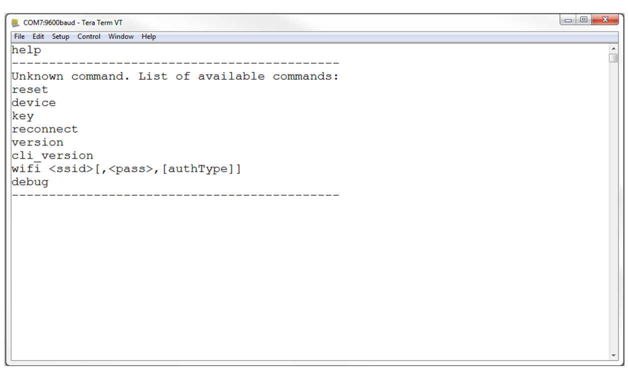
2. **Notice** – At this level, alerts or context-specific information is displayed.

3. **Info** – At this level, operation or variable information relevant to the end application is displayed.

4. **Debug** – At this level, error messages, state, or run-time variations during problem solving or development process are displayed.

Note: Setting the Debug Severity level also enables the printing of all other information or messages associated with all levels beneath the set Debug Severity level (e.g., Severity level of NOTICE will also result in WARNING and NORMAL level debug messages to also be displayed). Extensive use of Debug logger at ANY severity level requires memory and execution resources which could affect application behavior.

Figure 2-12. Serial Command Line Interface



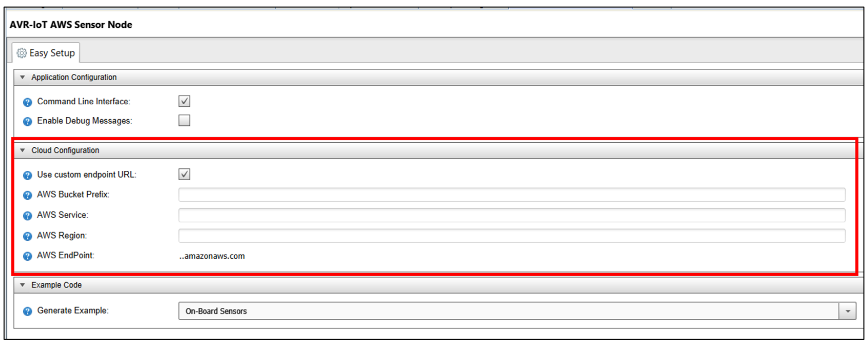
2.5.3 Onboard Programmer/Debugger Interface

For users familiar with the MPLAB X IDE, the AVR-IoT boards can be programmed, and/or debugged directly through the IDE. The AVR-IoT Development Boards are automatically detected by the MPLAB X, enabling full programming and debugging through the on-board PKOB nano interface. For code generation, see Section 3. Code Source Platforms on how to generate a sample application code in MCC.

2.6 Migrating to a Private AWS Cloud Account

Once the features and capabilities of the AVR-IoT WA board have been explored, the user can begin the process to move development out of the MCHP sandbox environment and into a private AWS Cloud. In MCC, under the settings for the AVR-IoT AWS Sensor Node Library, tick the **Use custom endpoint URL** check box and fill in the AWS cloud details. Hit the **Generate** button, and make and program the board.

Figure 2-13. Migrating to a Private AWS Cloud Account



3. Code Source Platforms

3.1 Code Generation from MCC

The source code of the AVR-IoT WA development board demo program is available for generation via the MPLAB® Code Configurator (MCC) plugin in MPLAB X IDE. To generate the code, the following software and the appropriate versions should be installed.

Table 3-1. Software Versions

Software	Version
MPLAB® X IDE	5.30 or later
Compilers • AVR GCC • XC8	Versions: • 5.4.0 or later • 2.10 or later
MPLAB® Code Configurator (MCC)	3.95.0 or later
AVR-IoT AWS Sensor Node Library	1.0.0

3.1.1 Generating the Demo

Once the board is connected to the host machine and MPLAB X is launched, see the description in the sections from 3.1.1.1 Creating the MPLAB X Project to 3.1.1.4 Generating MCC Files and Programming the Board for how to generate a microcontroller code for it.

3.1.1.1 Creating the MPLAB X Project

1. Create a new stand-alone project (see Create New Project) in MPLAB X using the ATmega4808 as the device (see Selecting a Device); the PKOB nano as a programming tool (see Selecting a Programmer); and the XC8 or AVR GCC as a compiler (see Selecting a Compiler). Finally, name the MPLAB project and its location (see Naming a New Project). The Start page of MPLAB X will then appear.
2. On the MPLAB X toolbar, look for and click the MPLAB®\ Code Configurator (MCC) Icon ( ) or click *Tools > Embedded > MPLAB X Code Configurator v3 Open/Close*. For assistance with installation, refer to MPLAB ® Code Configurator Page (www.microchip.com/mplab/mplab-code-configurator)
3. Under Device Resources, scroll down to the **Internet of Things** header. Under Examples, double click on **AVR-IoT AWS Sensor Node** (see MCC Start Page).

Figure 3-1. Create New Project

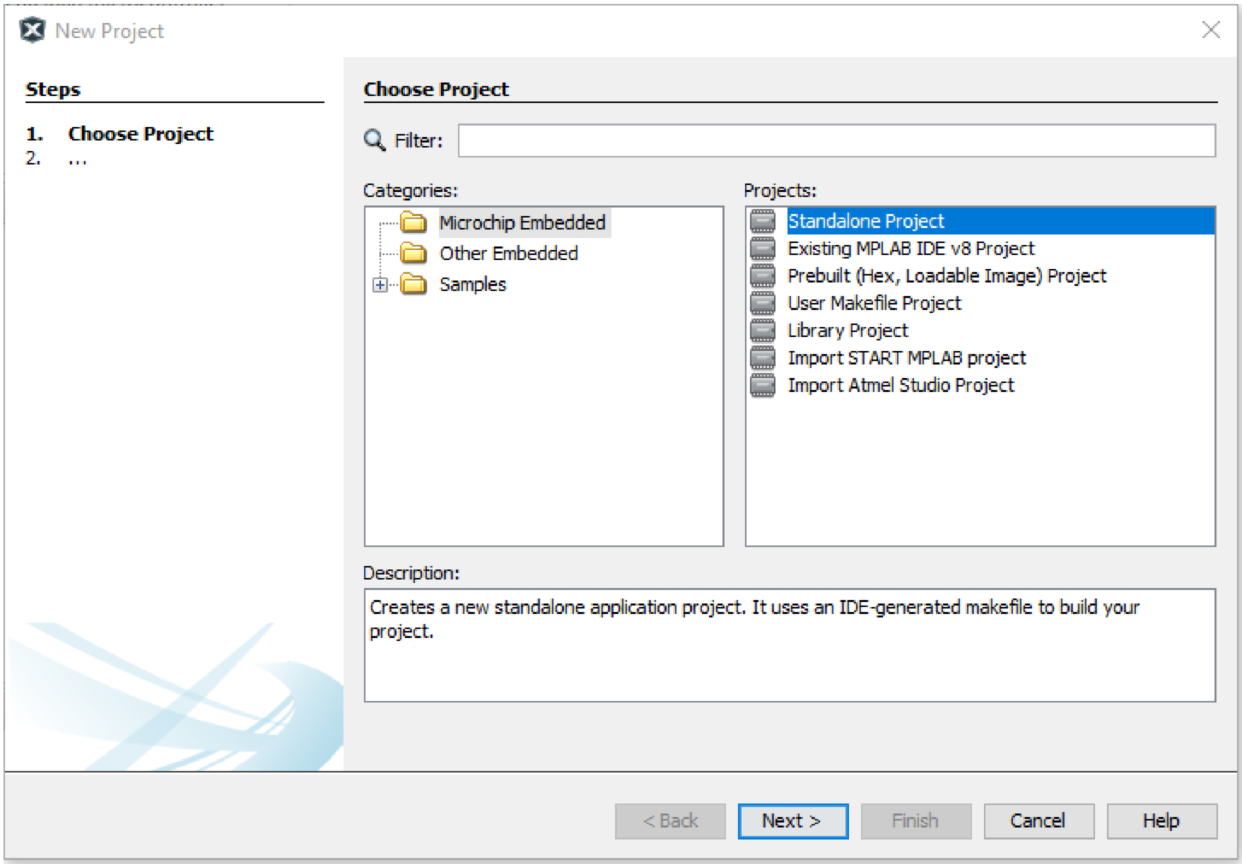


Figure 3-2. Selecting a Device

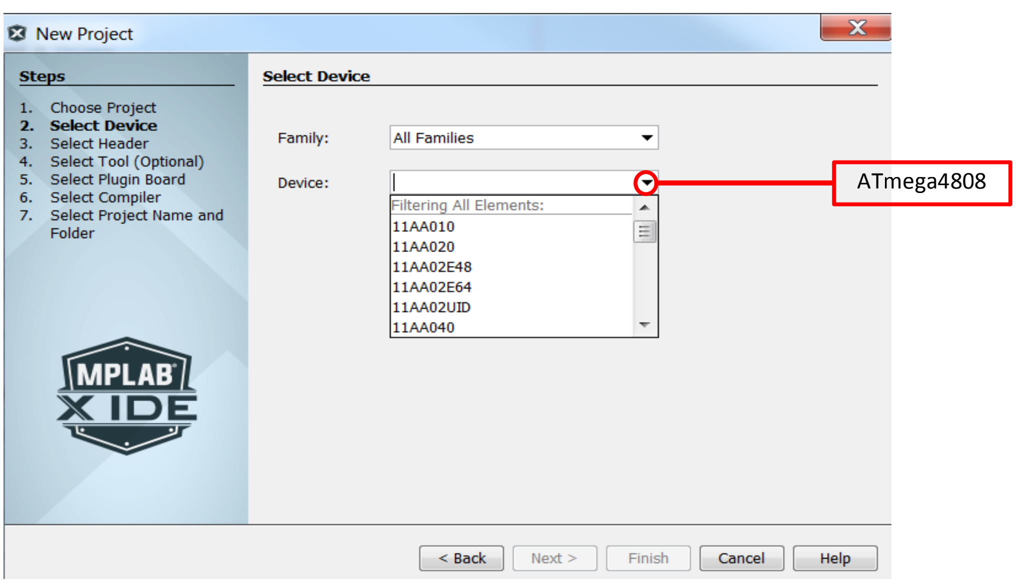


Figure 3-3. Selecting a Programmer

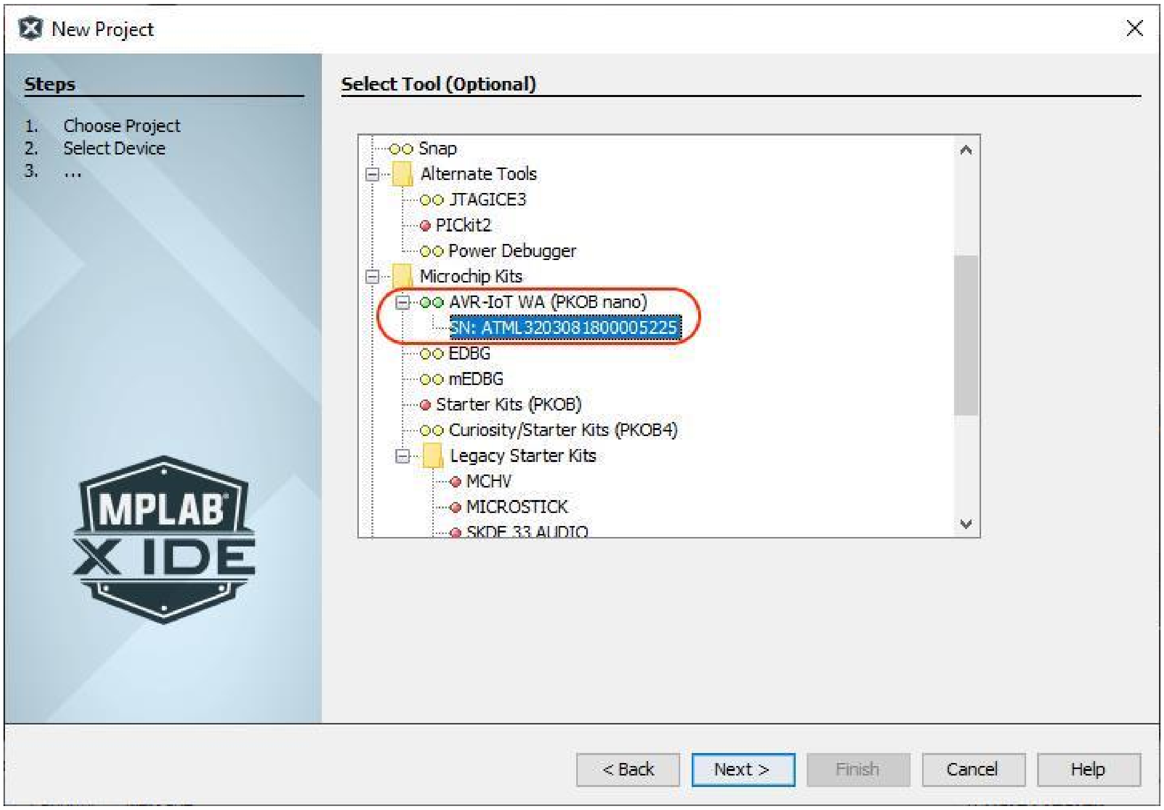


Figure 3-4. Selecting a Compiler

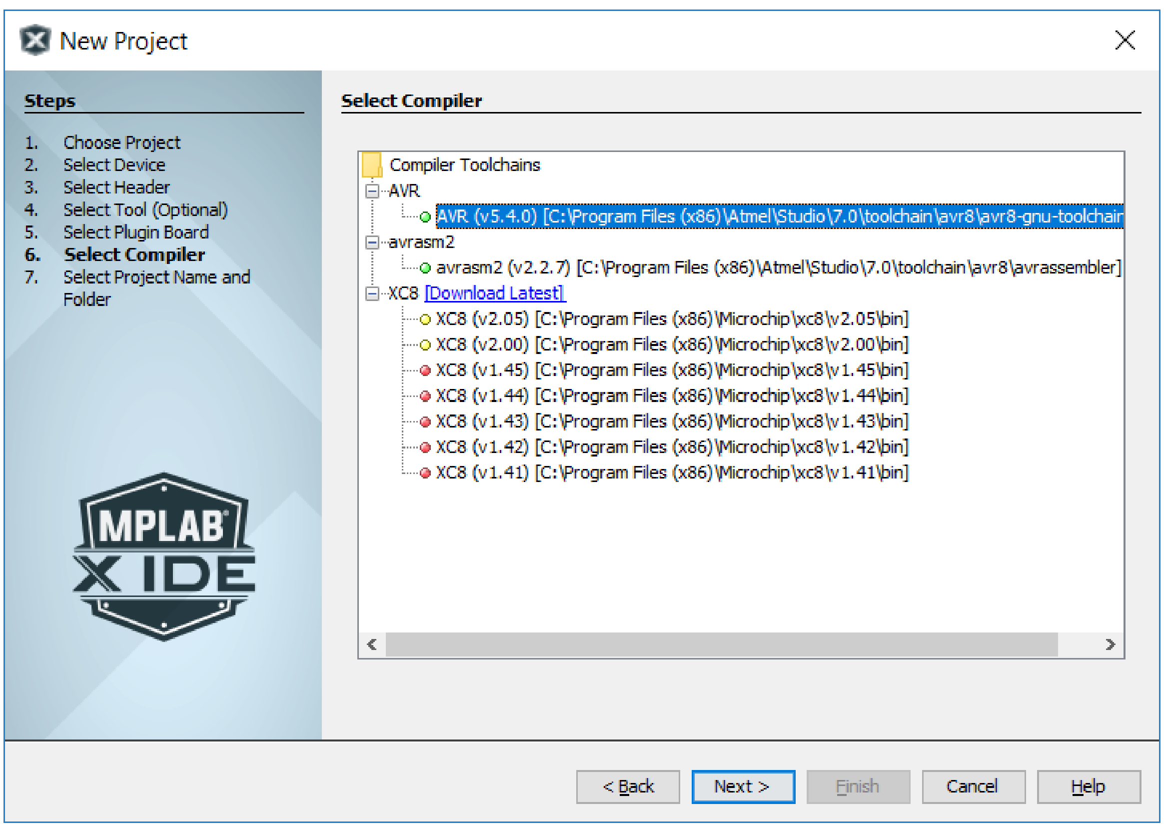


Figure 3-5. Naming a New Project

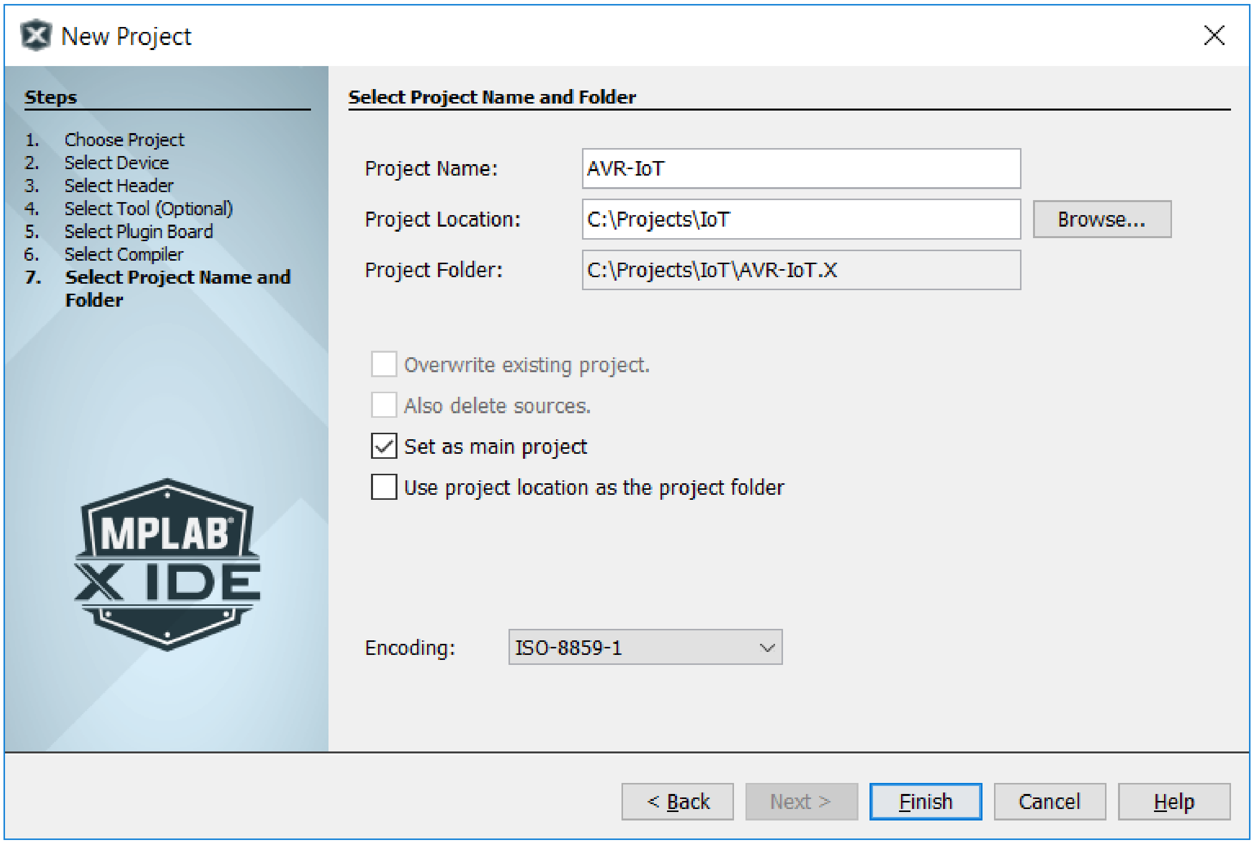
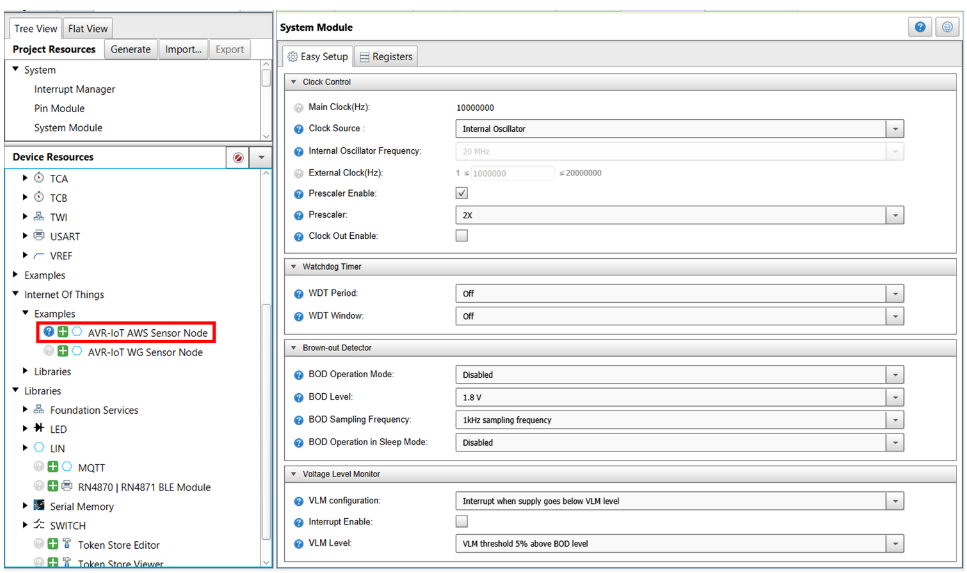


Figure 3-6. MCC Start Page



3.1.1.2 Configuring the Settings of the Project

The example module makes use of multiple libraries and peripherals. To configure the libraries, double click on each library in the Device Resources window to view their setup windows.

Figure 3-7. AVR-IoT Peripheral Libraries

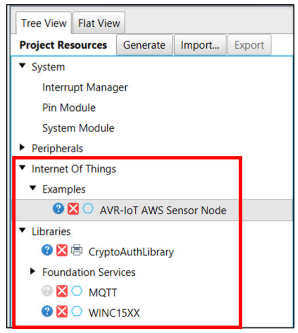
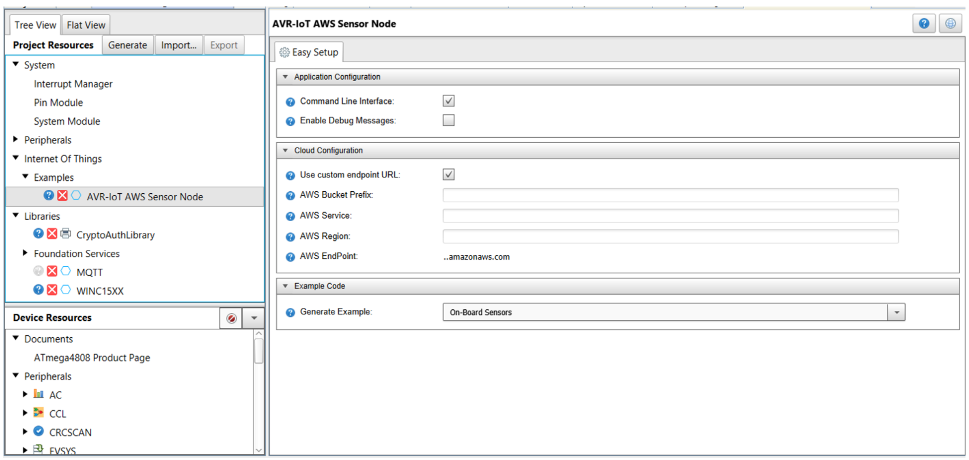
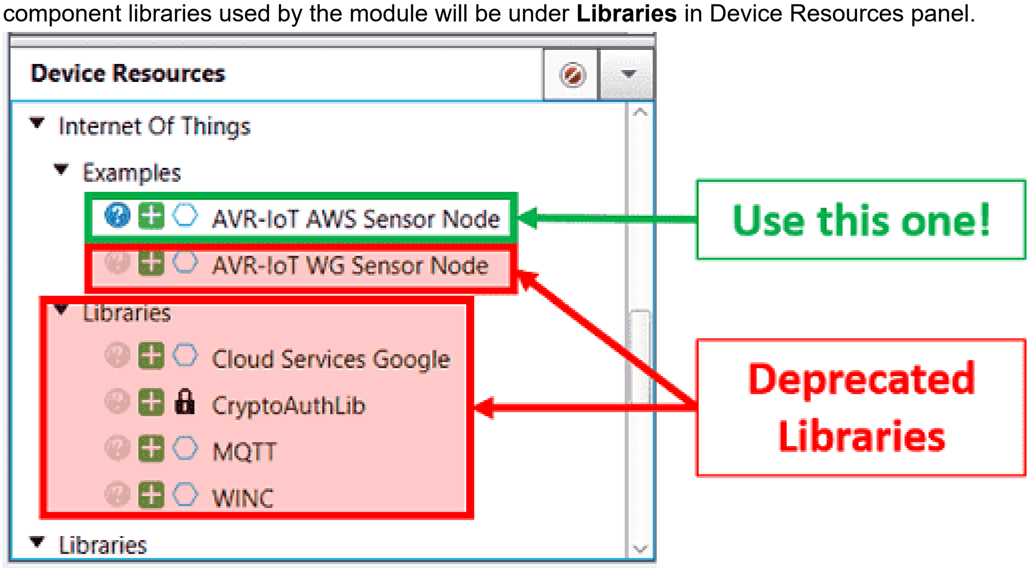


Figure 3-8. AVR-IoT AWS Sensor Node Library Configuration



3.1.1.3 Component Libraries and Peripherals

Important: Launching MCC v3.95 or earlier will automatically install an obsolete deprecated version of the AVR-IoT WG library. To avoid using this outdated library and its components, always check that you are loading the **AVR-IoT AWS Sensor Node** Library and not the "AVR-IoT WG Sensor Node" Library. The correct library will also have a blue question mark beside its name as shown below. The correct component libraries used by the module will be under **Libraries** in Device Resources panel.



- CrypthoAuthLib – The Crypto Authentication Library (CryptoAuthLib) shows the settings needed to configure the on-board ECC608 chip that provides the security features of the AVR-IoT WA board to work. It also indicates the communication settings between the ECC608 chip and the embedded microcontroller on board, as shown in CryptoAuthLib MCC.
- WINC – Under the WINC library, the user can configure the default SSID, password, authentication type, and inclusion of IPSocket for the network to which the board will be connected, as seen in WINC MCC.
- Message Queuing Telemetry Transport (MQTT) – MQTT is used as a messaging protocol which operates on top of a TCP/UDP connection to transporting data between client and broker over the Cloud. In MCC, the user can change their MQTT host and connection time-out duration, as shown in MQTT MCC for desired application configuration).

Figure 3-9. CryptoAuthLib MCC

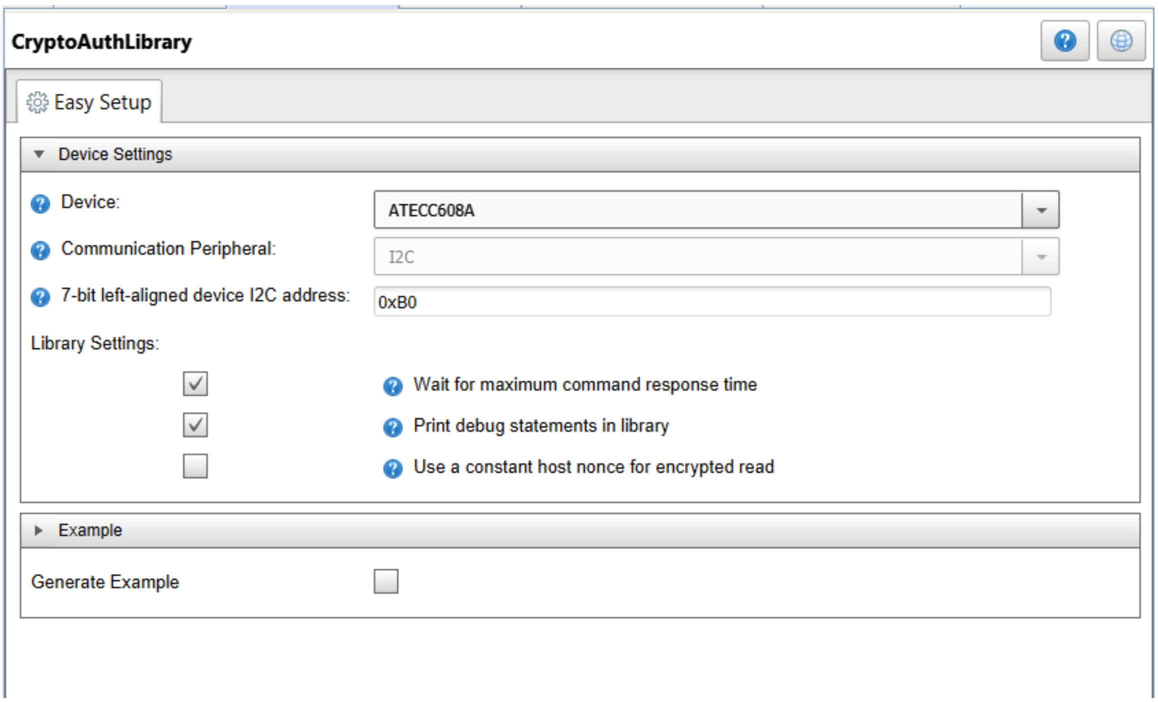


Figure 3-10. WINC MCC

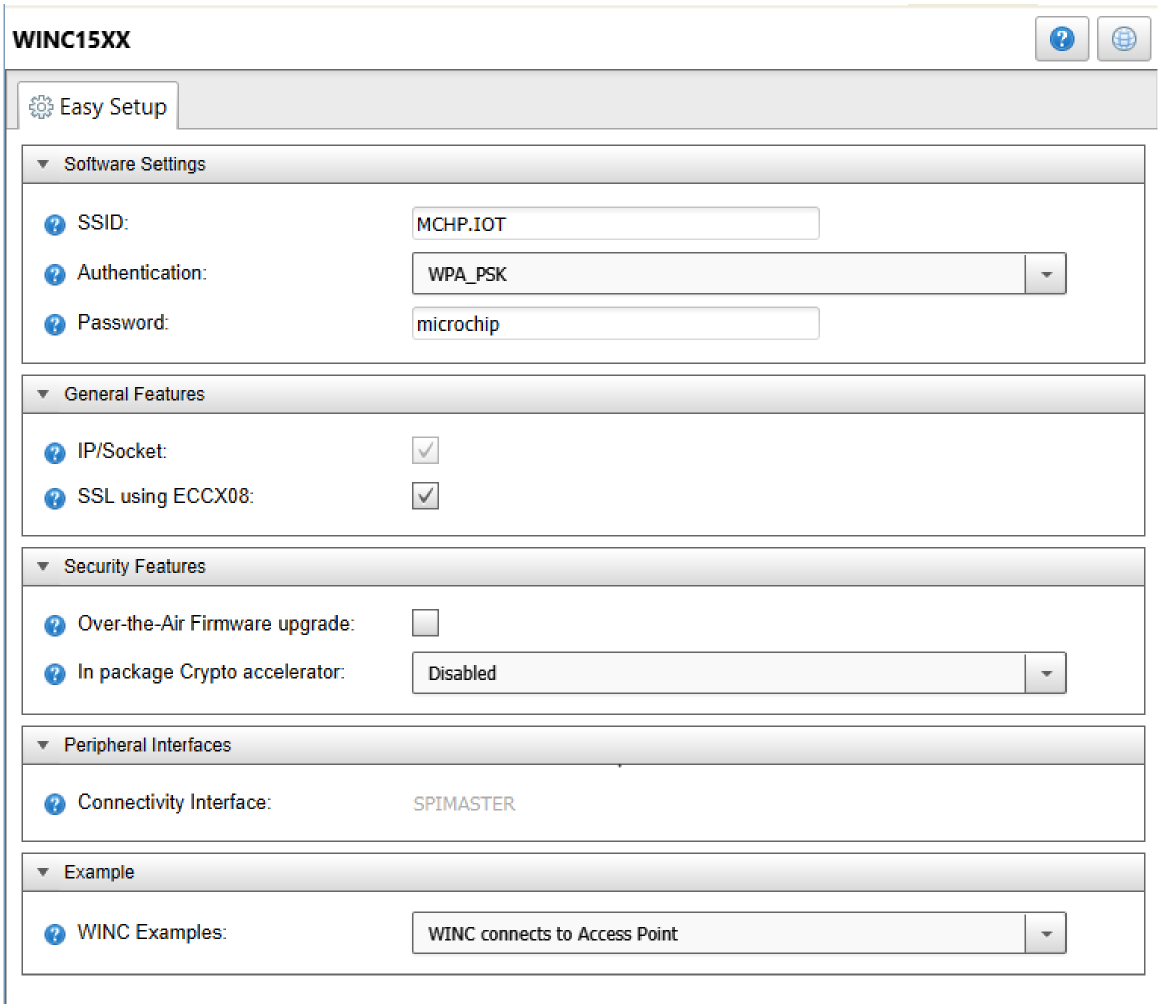
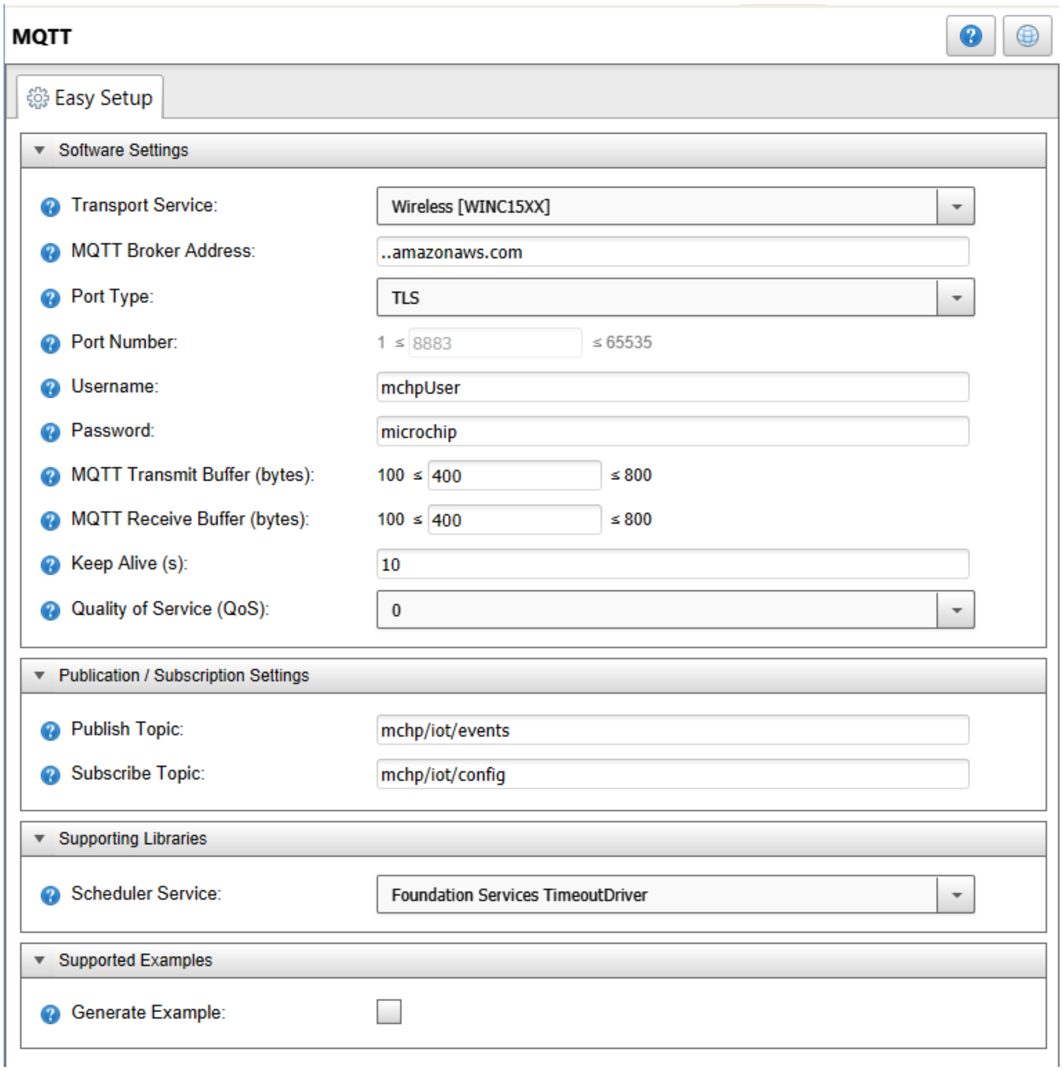


Figure 3-11. MQTT MCC



3.1.1.4 Generating MCC Files and Programming the Board

- After the addition and/or configuration of component libraries and peripherals, click the **Generate** button on the left-hand corner of the window, as shown in the Generating MCC Code, and wait for the generation to complete.
- Click the **Make and Program Device** button near the middle of the toolbar. Make sure the board is connected to the system during programming.

Figure 3-12. Generating MCC Code

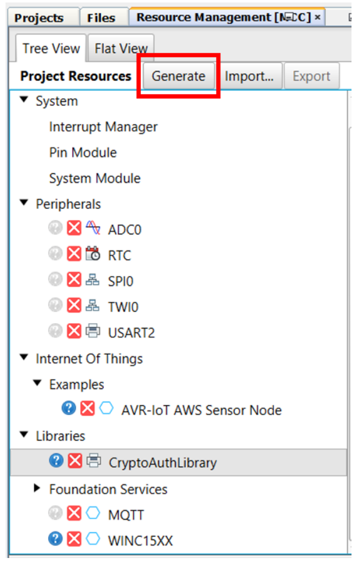
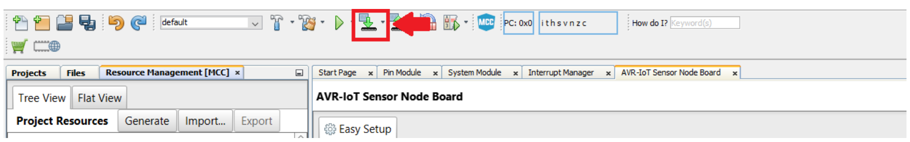


Figure 3-13. Make and Program Device in MPLAB X



3.2 Getting the Source Code from GitHub

The source code for the AVR-IoT WA development board can also be downloaded from GitHub. There are different versions of the source code for MPLAB X and Atmel Studio. The hex file is also available for download from the releases tab for drag-and-drop programming. Refer to the table below for the links to the GitHub deployments. For full URLs to the links below, refer to the Relevant Links section of this document.

Table 3-2. GitHub Deployment Links

MPLAB X	Atmel Studio
Source Code	Source Code
.hex file	.hex file

4. Hardware Guide

The AVR-IoT WG and AVR-IoT WA boards, collectively referred to as the AVR-IoT Wx boards, share the same hardware components, configuration, and schematics. For in-depth information on the hardware features of the AVR-IoT Wx boards, see the full AVR-IoT Wx Hardware User Guide. For the full URL of the document, refer to the Relevant Links section of this document.

5. FAQs, Tips, and Troubleshooting

5.1 FAQs and Tips

1. How can the user change the Wi-Fi configuration?

There are four ways to do it:

1. Connect to the USB and click the '`click-me`' file to reach the dedicated page for the device and enter the new credentials in the web form. Download the resulting file to the CURIOSITY drive. Read more in Section 2.3.1 Via AVR-IoT Web Page.
2. Connect to the USB and open a serial port terminal (Windows users will need to install serial port drivers). From the command line, use the `Wi-fi` command. Read more in Section 2.3.1 Via AVR-IoT Web Page.
3. Press the **SW0** button while powering up the board and the WINC will turn to Access Point mode. Connect the laptop or phone to it and fill in the online form. See Section 2.3 Connecting the Board to Wi-Fi Networks for details.
4. Use MCC to re-build the project after changing the default Wi-Fi configuration in the WINC module. Reprogram the board using MPLAB X or drag and drop the new image to the CURIOSITY drive. Further details can be found in Section 3.1 Code Generation from MCC .

2. How can the user change the Wi-Fi credentials using the online form without exposing the details to security threats?

Although it appears in the browser, the Wi-Fi credential setup form does not transfer any information to third parties. A small text file (WIFI.CFG) is created (this can also be done manually using any text editor) and it is recommended that saves it directly to the CURIOSITY drive. Since the browser settings vary according to the platform and personal preferences, the user might have to change them or perform a drag and drop from the default download folder. Even though it looks like the WIFI.CFG file is now stored on the CURIOSITY drive, this is just an artifact of the operating system (caching). No file is permanently recorded and the information contained is immediately used to update the Wi-Fi module settings. These settings will be maintained after subsequent power cycles of the AVR-IoT Development Board, but the file will disappear.

3. Can a phone/tablet alone be used to perform the demo?

Assuming the user has a way to provide power to the board (a USB back-up battery, a USB charger, a Li-Ion battery, or other 3.3V-5V power supply), the QR code can be scanned (on a sticker under the board, next to the Microchip and Amazon color logos) using any smartphone camera (old operating system versions might still require a separate app) and open the resulting link in the smartphone browser.

4. The user scanned the bar code with the phone/tablet, but nothing happened?

Ensure the scanning of the QR code present on the sticker under the AVR-IoT WA board. It can be recognized by the distinguishing squares on the three of its corners and its proximity (same sticker) to the MCHP and Amazon logos (in color). Although there are also other bar codes present on the Wi-Fi module, and/or the anti-static bag the board came with, those are not QR codes.

5. Which battery is recommended to be used with the AVR-IoT WA Sensor Node board?

Microchip recommends Li-Ion or Li-Poly batteries with at least 400 mAh capacity and 3.7V nominal. For more information about powering the board, refer to the AVR-IoT Wx Hardware User Guide.

Other Helpful Tips:

The following steps are not required for operating the AVR-IoT WA Sensor Node board, but will significantly increase the possibility of positive results.

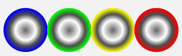
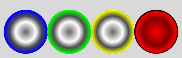
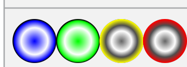
1. **Get a USB cable with all the four wires connected**. There are a lot of non-compliant USB cables available that provide only 5V power (two wires). How can the user verify it? Plug the board into the laptop and check in the File Manager (Finder) for the presence of a new hard drive (named CURIOSITY). If it fails to pop up after a second or two, the cable is not the appropriate one.
2. **Prepare the Wi-Fi router for the demo**. The easiest way to go is to set up the phone as a hotspot. The following credentials should be used, name (SSID): **MCHP.IOT** and password: **microchip** (**WPA 2** is assumed,

do no use WEP nor OPEN.) This Wi-Fi configuration is the factory default for all boards, so it will minimize the effort for first-time users. If preparing for a (medium/large) classroom demo, the user should set up a proper Wi-Fi router (2.4 GHz) instead. This will give a better range and capacity while using the same Wi-Fi credentials, if possible.

3. Make Google Chrome or Firefox the default web browser. Safari works well on MACs. Internet Explorer is not recommended.
4. Ensure no pop-up blockers or other anti-virus browser extensions are active. These can and will interfere with the script that is at the heart of the microsite. Often, these can be selectively disabled for that specific web page.
5. Take into account the amount of Wi-Fi pollution in the place where the board is operated.
6. If using a router, verify that the network does not have a firewall that can block access to the AWS Cloud server. If using a mobile 4G (or phone LTE hotspot) for Internet connectivity, ensure it is fully charged and does not have any firewall settings that might block access.

5.2 LED Status Troubleshooting

Table 5-1. Application LED Troubleshooting

LED Sequence	Description	Diagnosis	Action
	All LEDs are OFF	Board is not programmed	Download the image `.hex` file from GitHub or the AVR-IoT website
	Only Red LED is ON	Indicates a hardware fault issue with the development board	With debug option enabled in MCC, connect to serial terminal and pass the command ‘`debug 4`’. This will print out the log indicating the cause of the error.
	Blue LED BLINKS slowly (at 0.5s rate) with all other LEDs OFF	Board is in Soft AP mode	• Connect to the board using a phone or a network capable device • Send updated credentials via Soft AP
	Blue LED BLINKS quickly (at 0.25s rate) with all other LEDs OFF	Board is not connected to an access point and trying to connect.	• Verify the access point credentials • Verify if the access point is online
	Green LED is BLINKING; Blue LED is also BLINKING quickly (at 0.25s rate)	Board is using WiFi DEFAULT CREDENTIALS	• Allow board to connect to Access Point • Update CREDENTIALS through CLI if DEFAULTS selection was invalid

...........continued

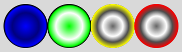
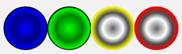
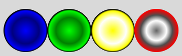
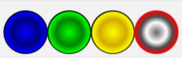
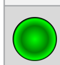
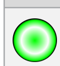
LED Sequence	Description	Diagnosis	Action
	Blue LED is ON, Green LED is BLINKING	Board is not connected to the AWS Cloud Servers	• Verify MQTT required ports • Verify project credentials • Check local network firewall settings • Use tethered cell phone or laptop connection for internet
	Blue and Green LEDs are ON but Yellow LED is OFF	Sensor data is not being published to Cloud	• Verify device registration to the project • Check AWS account settings
	Blue and Green LEDs are ON. Yellow LED is BLINKING.	Everything is working	• No action required
 OR 	Blue and Green LEDs are ON. Yellow LED held high/ low.	Subscribe topic toggle value received	• Nothing to do • LED will reflect ‘Toggle’ value LED behavior returns to normal after HOLD PERIOD

Table 5-2. PKOB nano LED Troubleshooting

LED Sequence	Description	Diagnosis	Action
	PKOB nano LED is OFF	Board is not powered	• Check the USB connection • Replace the board
	PKOB nano LED is ON but CURIOSITY driver is not found	Faulty USB connection	• Check the PC device manager • Replace the USB cable
	PKoB nano LED is blinking	Debugger is working	No action required. Refer to the AVR-IoT Wx Hardware User Guide for more details.

6. Relevant Links

The following tables contain links to the most relevant documents and software for the AVR-IoT Wx Development Boards. For those accessing the electronic version of this document, the active links below will redirect to the appropriate website.

Table 6-1. AVR-IoT Relevant Links and Documentation

	URL	Description
AVR-IoT WG website	www.microchip.com/DevelopmentTools/ProductDetails.aspx?PartNO=AC164160	Find schematics, design files, and purchase the board. Set up for Google Cloud IoT Core
AVR-IoT WG on MCHPDirect	www.microchipdirect.com/ProductSearch.aspx?Keywords=AC164160	Purchase the AVR-IoT WG board on Microchip Direct
AVR-IoT WA website	www.microchip.com/DevelopmentTools/ProductDetails.aspx?PartNO=EV15R70A	Find schematics, design files, and purchase the board. Set up for Amazon Web Services
AVR-IoT WA on MCHPDirect	www.microchipdirect.com/ProductSearch.aspx?Keywords=EV15R70A	Purchase the AVR-IoT WA board on Microchip Direct
AVR-IoT Wx Hardware User Guide	microchip.com/DS50002805	Find more information on the hardware of the AVR-IoT Wx boards.
AVR-IoT WG for MPLAB X on GitHub	Source code • github.com/microchip-pic-avr-solutions/avr-iot-google-sensor-node-mplab .hex file • github.com/microchip-pic-avr-solutions/avr-iot-google-sensor-node-mplab/releases/latest	Download the AVR-IoT WG source code and .hex files for MPLAB X from GitHub
AVR-IoT WG for Atmel Studio on GitHub	Source code • github.com/microchip-pic-avr-solutions/avr-iot-google-sensor-node-studio .hex file • github.com/microchip-pic-avr-solutions/avr-iot-google-sensor-node-studio/releases/latest	Download the AVR-IoT WG source code and .hex files for Atmel Studio from GitHub
AVR-IoT WA for MPLAB X on GitHub	Source code • github.com/microchip-pic-avr-solutions/avr-iot-aws-sensor-node-mplab .hex file • github.com/microchip-pic-avr-solutions/avr-iot-aws-sensor-node-mplab/releases/latest	Download the AVR-IoT WA source code and .hex files for MPLAB X from GitHub
AVR-IoT WA for Atmel Studio on GitHub	Source code • github.com/microchip-pic-avr-solutions/avr-iot-aws-sensor-node-studio .hex file • github.com/microchip-pic-avr-solutions/avr-iot-aws-sensor-node-studio/releases/latest	Download the AVR-IoT WA source code and .hex files for Atmel Studio from Gitb

Table 6-2. Related Tools and Resources

	URL	Description
MPLAB X IDE	www.microchip.com/mplab/mplab-x-ide	Free IDE to develop applications for Microchip microcontrollers and digital signal controllers.
Atmel Studio	www.microchip.com/development-tools/atmel-studio-7	Free IDE for the development of C/C++ and assembler code for microcontrollers.
MPLAB Code Configurator (MCC)	www.microchip.com/mplab/mplab-code-configurator	Free, graphical programming environment that generates seamless, easy-to-understand C code to be inserted into the project. Using an intuitive interface, it enables and configures a rich set of peripherals and functions specific to the application.
Atmel START	www.microchip.com/start	Online tool that helps the user to select and configure software components and tailor the embedded application in a usable and optimized manner.
Microchip Sample Store	www.microchip.com/samples/default.aspx	Microchip sample store where the user can order samples of devices.
Data Visualizer	www.microchip.com/mplab/avr-support/data-visualizer	A program used for processing and visualizing data. The Data Visualizer can receive data from various sources such as the Embedded Debugger Data Gateway Interface found on Xplained Pro boards and COM ports.

7. Revision History

Doc Rev.	Date	Comments
A	06/2020	Initial document release.

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