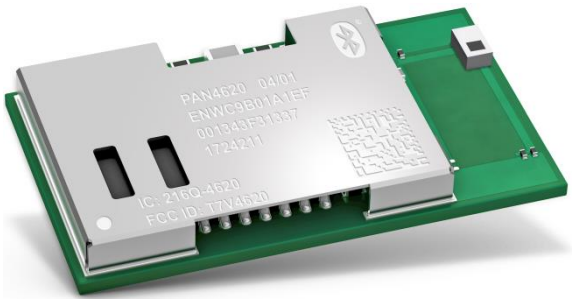
Panasonic

PAN4620

IEEE® 802.15.4 and Bluetooth® Low Energy Module

Module Integration Guide

Rev.0.1



Wireless Modules

Overview

The PAN4620 is Panasonic's Internet of Things dual mode module comprising NXP®'s Kinetis MKW41Z512CAT4 SoC - a 2.4 GHz 802.15.4 and Bluetooth® Low Energy wireless radio microcontroller based on an ARM® Cortex-M0+ core.

Features

- UART, SPI, I²C, TSI, ADC & DAC
- Same form factor and compatible pinout for VCC, GND, Reset, UART, I²C, and SWD as PAN1026, PAN1760, PAN1760A, and PAN1761
- Single and concurrent operation of IEEE® 802.15.4 and BLE
- Open to various known application layers or proprietary solutions
- Surface Mount Type dimensions: 15.6 mm x 8.7 mm x 1.9 mm
- On module 32 MHz and 32 kHz crystal
- SoC: NXP® Kinetis® KW41Z – 2.4 GHz 802.15.4 and BLE 4.2 Wireless Radio Microcontroller
- Core: Up to 48 MHz 32 bit ARM® Cortex-M0+
- Memory: 512 kB of flash and 128 kB of SRAM
- Voltage range: 1.8 V to 4.2 V
- Temperature range: -40 °C to 85 °C

Characteristics

- Transceiver frequency range 2360 MHz to 2483.5 MHz
- Programmable transmitter output power: -30 dBm to 3.5 dBm
- Receiver sensitivity (BLE): -95 dBm
- Receiver sensitivity typical for IEEE® Standard 802.15.4: -100 dBm
- Typical receiver current consumption (3.6 V supply): 8.5 mA
- Transmitter current consumption (3.6 V supply, 0 dBm): 7.6 mA

Bluetooth®

- Bluetooth® LE 4.2 compliant implementation certified by BT SIG
- Supporting software consisting of BLE host stack and profiles and IPv6 6LoBLE
- Bluetooth® Developer Studio Plug-In

IEEE® 802.15.4

- IEEE® standard 802.15.4 compliant
- Supporting software consisting of 802.15.4 MAC/PHY implementation, Simple Media Access Controller (SMAC), and NXP®'s certified Thread® and ZigBee® stacks are available.

Block Diagram

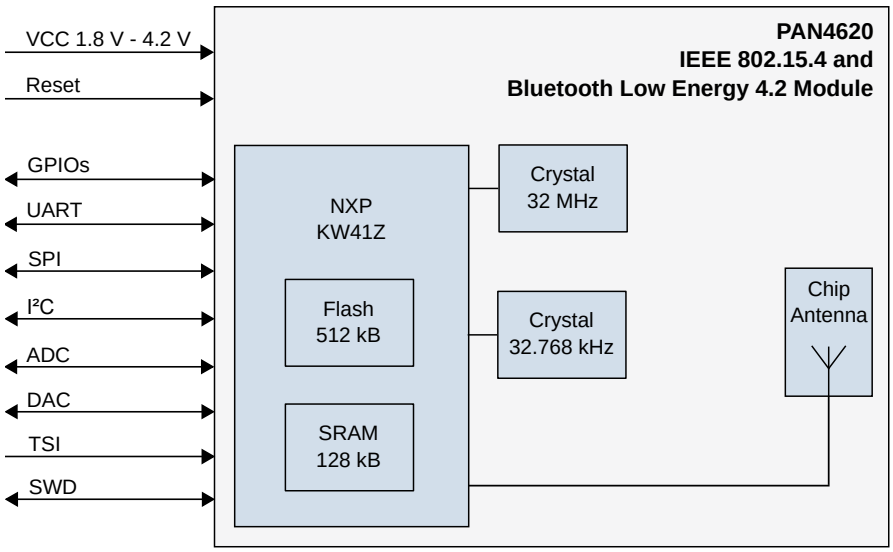


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Table of Contents

1 About This Document

1.1 Purpose and Audience

This Integration Guide applies to the IEEE® 802.15.4 and Bluetooth® Low Energy development platform PAN4620 USB. The intention is to enable our customers to easily integrate our module PAN4620 in their product and to ensure compliance with regulatory requirements.

This guide describes the hardware by giving a reference design, which is an evaluation board for the PAN4620. It furthermore describes how to use the PAN4620 on the evaluation board with software provided by NXP. It will describe how to start up the evaluation board, get all needed software sources, execute example code and build own implementations.

Please read this guide carefully to assure the compliance of your product to regulatory requirements.

1.2 Revision History

Revision	Date	Modifications/Remarks
0.1	28.06.2019	Initial version.

1.3 Use of Symbols

Symbol	Description
	**Note** Indicates important information for the proper use of the product. Non-observance can lead to errors.
	**Attention** Indicates important notes that, if not observed, can put the product's functionality at risk.
	**Tip** Indicates useful information designed to facilitate working with the PAN4620.
⇨ [chapter number] [chapter title]	**Cross reference** Indicates cross references within the document. **Example:** Description of the symbols used in this document ⇨ 1.3 Use of Symbols.
✓	**Requirement** Indicates a requirement that must be met before the corresponding tasks can be completed.
➔	**Result** Indicates the result of a task or the result of a series of tasks.

Symbol	Description
This font	**GUI text** Indicates fixed terms and text of the graphical user interface. **Example:** Click **Save**.
Menu > **Menu item**	**Path** Indicates a path, e.g. to access a dialog. **Example:** In the menu, select **File** > **Setup page**.
`This font`	**File names, messages, user input** Indicates file names or messages and information displayed on the screen or to be selected or entered by the user. **Examples:** `pan1760.c` contains the actual module initialization. The message `Failed to save your data` is displayed. Enter the value `Product 123`.
Key	**Key** Indicates a key on the keyboard, e.g. **F10**.

1.4 Related Documents

Please refer to the Panasonic website for more information as well as related documents
⇨ 8.1.2 Product Information.

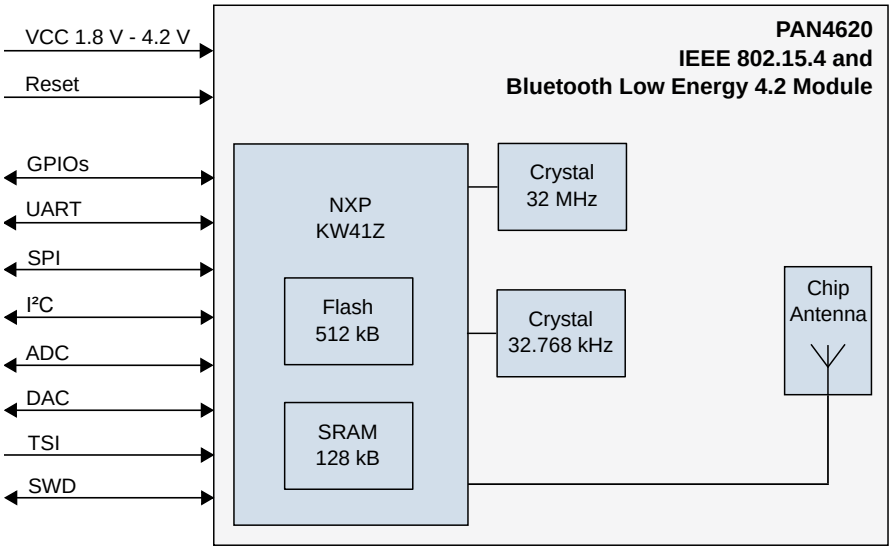
2 Overview

The PAN4620 USB is a development platform for the PAN4620 IEEE® 802.15.4 and Bluetooth® Low Energy module to implement Bluetooth and IEEE® 802.15.4 functionality into various electronic devices.

Please refer to the Panasonic website for related documents ⇨ 8.1.2 Product Information.

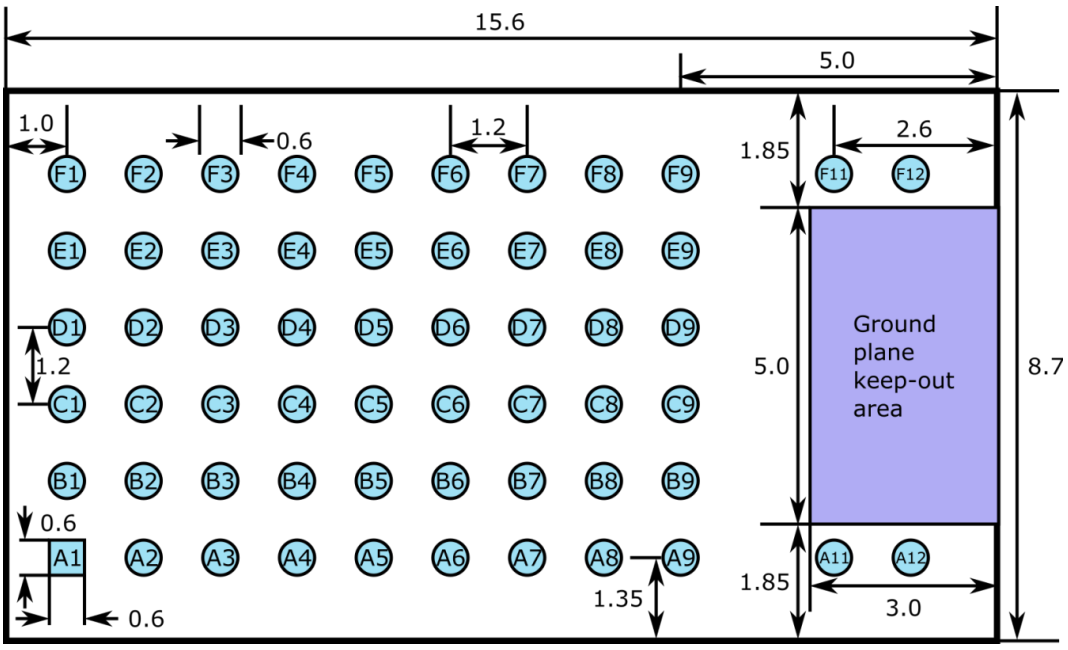
3 PAN4620 Module

3.1 Block diagram



3.2 Footprint

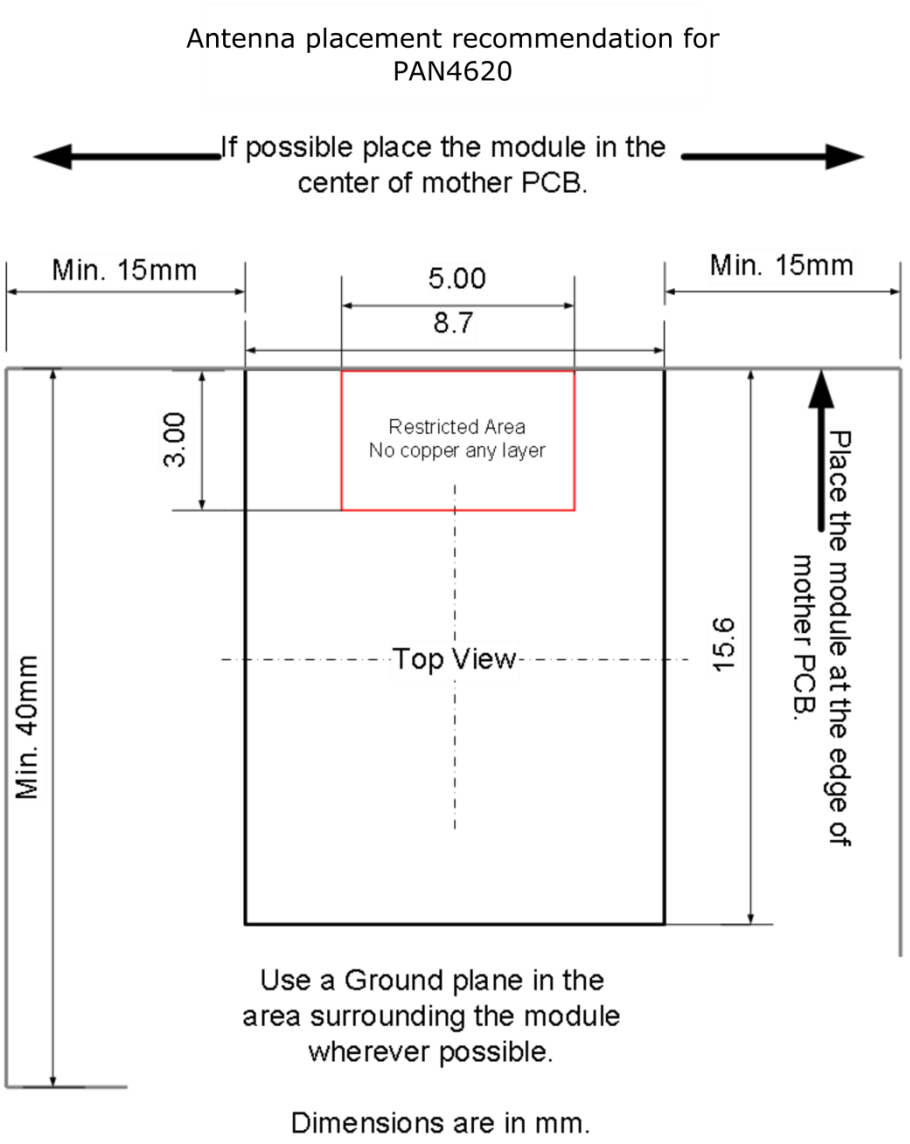
Top view (dimensions are in mm)



3.3 Placement

Antenna Keep-out Area

Do not place any ground plane under the marked restricted antenna area in any layer! This would be affecting the performance of the chip antenna in a critical manner.



Note: The above recommendation for the ground plane is based on a FR4 4-Layer PCB.

Antenna Keep-out Area

The antenna requires a cutout area of 5 mm x 3 mm under the PAN4620 module. This keep-out area shall be located in every layer under the module antenna. Note for example the keep-out area in all four layers of the PAN4620 evaluation board.

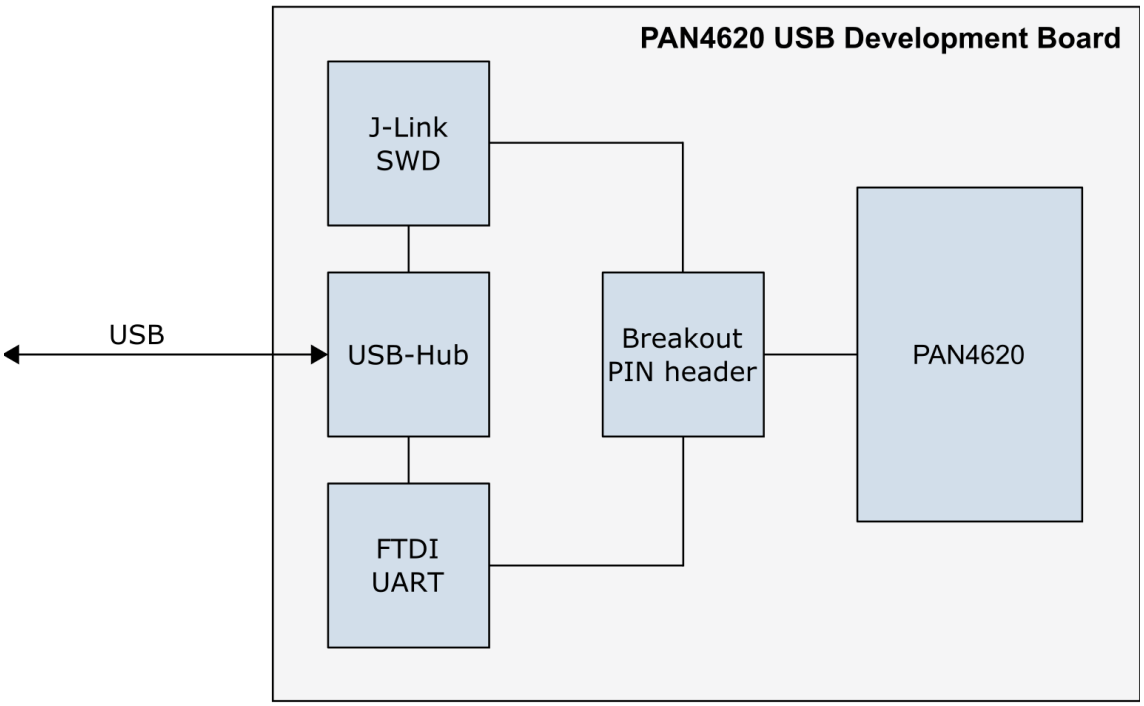
Impact of Placement on the Antenna Radiation Pattern

The placement of the module, surrounding material, and customer components have an impact on the radiation pattern of the antenna.

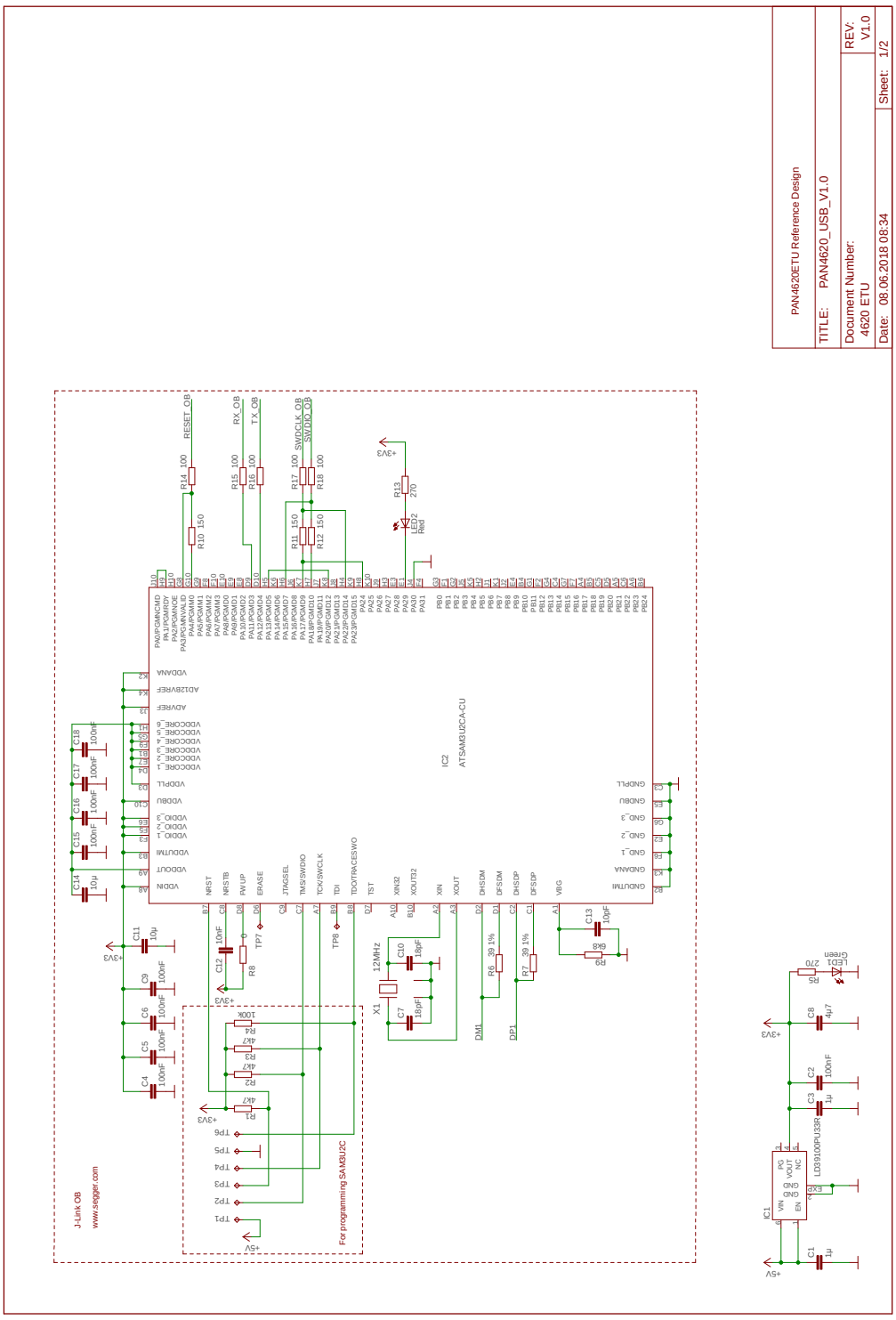
It is recommended to verify the perfect position of the module in the target application before fixing the design.

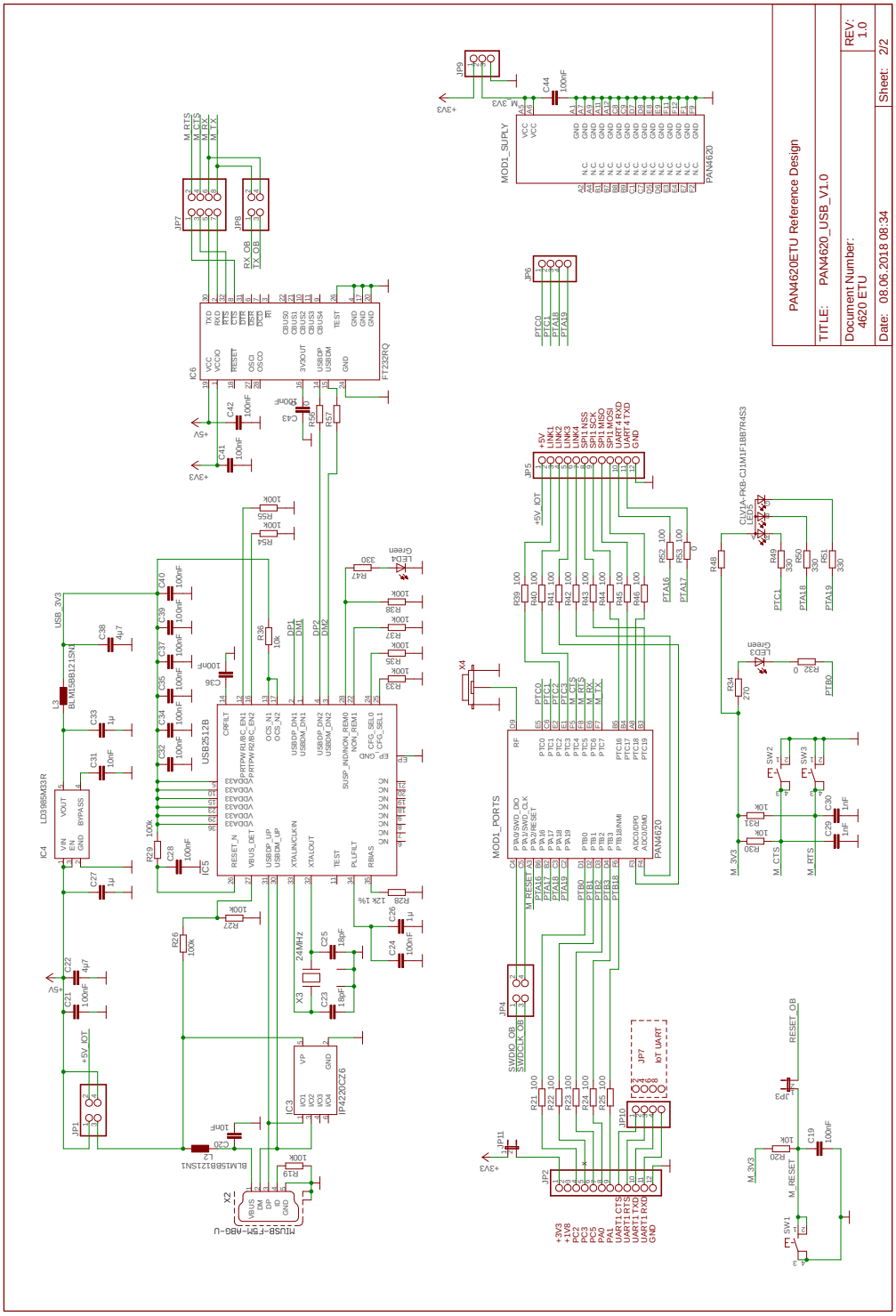
4 Reference Design

4.1 Block diagram

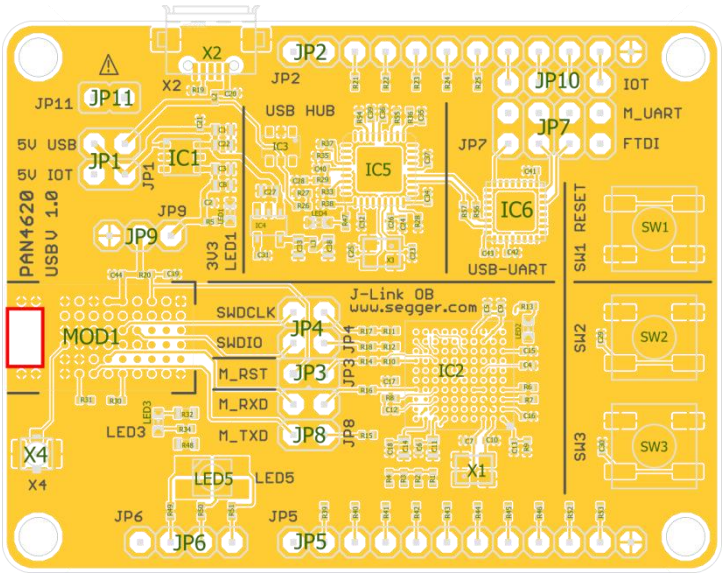


4.2 Schematic




PAN4620ETU Reference Design
TITLE: PAN4620_USB_V1.0
Document Number: 4620 ETU
REV: 1.0
Date: 08.06.2018 08:34
Sheet: 2/2
MOD1_SUPLY
MOD1_PORTS
USB2512B
PAN4620
FT232RQ
IP4220CZ6
LD3985M33R
BLM15BB121SN1
BLM15BB121SN1
MUSB-FSH-A80-U
C1V1A-FKB-C11M1F1BB7R4S3
JP1
JP2
JP3
JP4
JP5
JP6
JP7
JP8
JP9
JP10
JP11
JP12
SW1
SW2
SW3
X2
X3
X4
IoT UART
M_RESET_OB
SWDIO_OB
SWDCLK_OB
TX_OB
RX_OB

4.3 Placement Recommendations



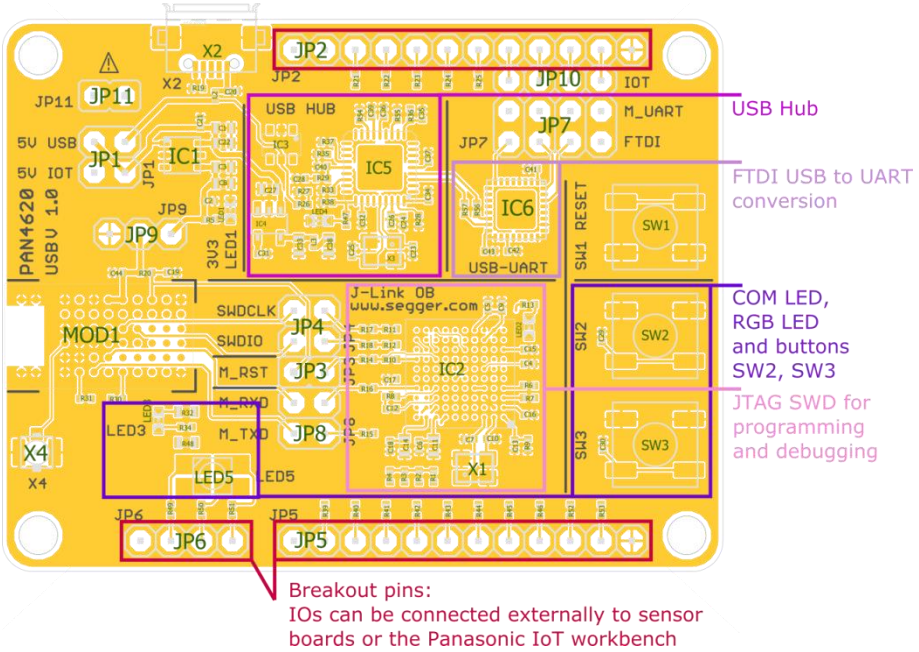
The module shall be placed as close as possible to the edge of the application.

It is important to have the keep out area below the antenna. Keep out area

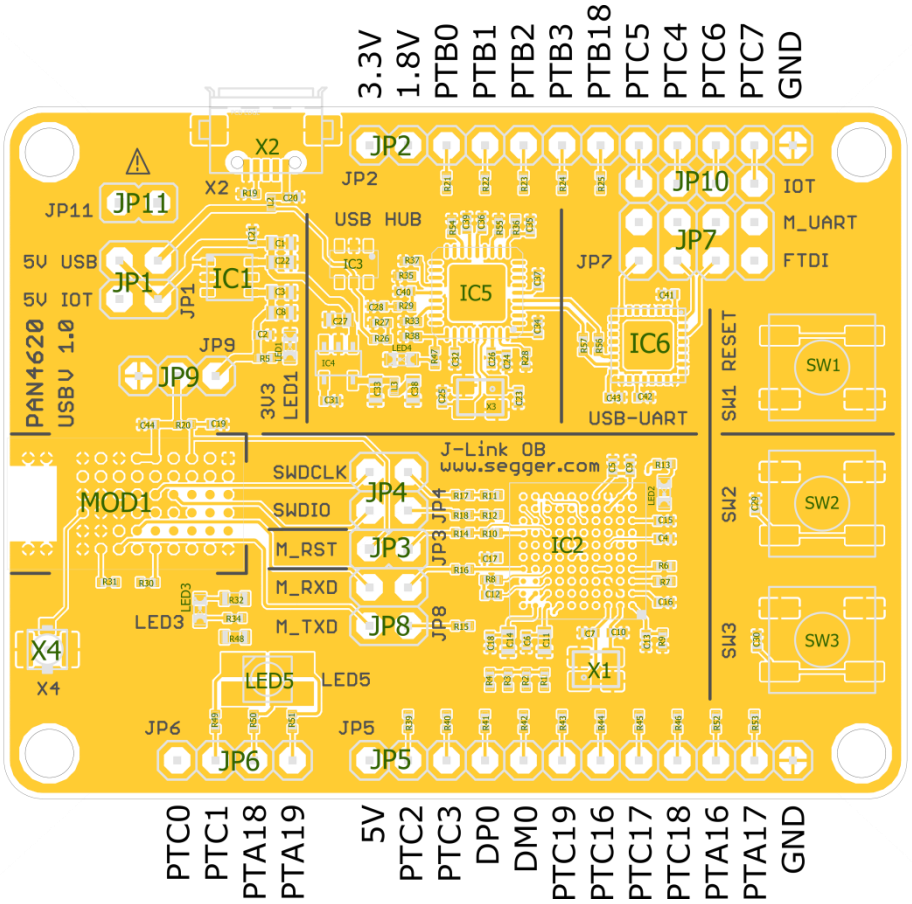
To download the design files go to the download area on the product website.

⇨ 8.1.2 Product Information.

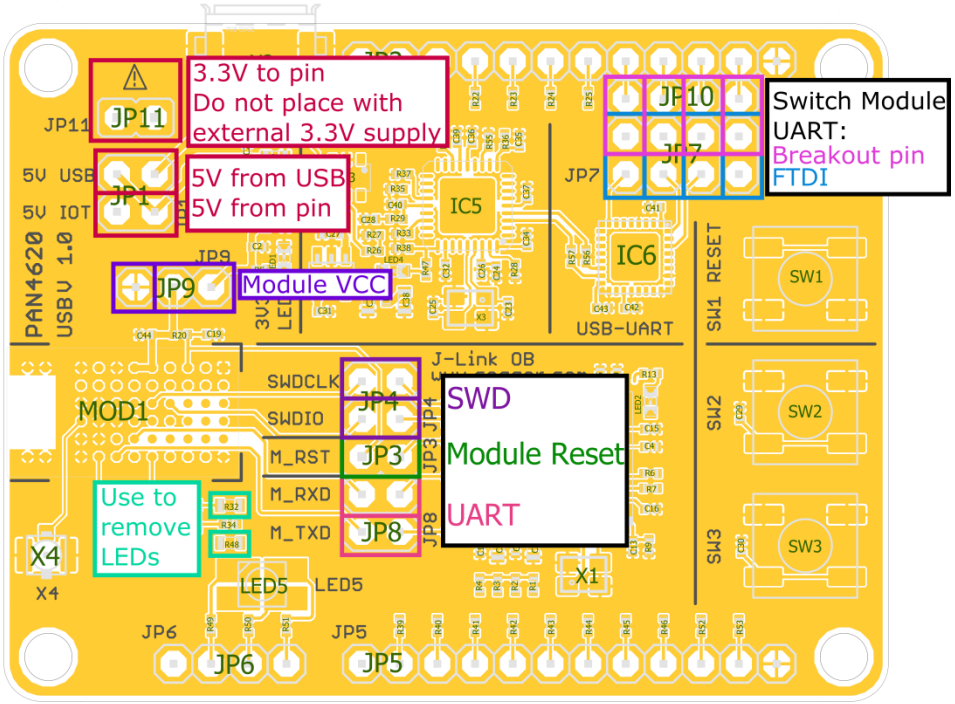
4.4 Building Blocks



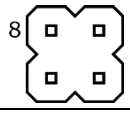
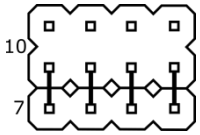
4.5 Breakout pins



4.6 Configuration Settings



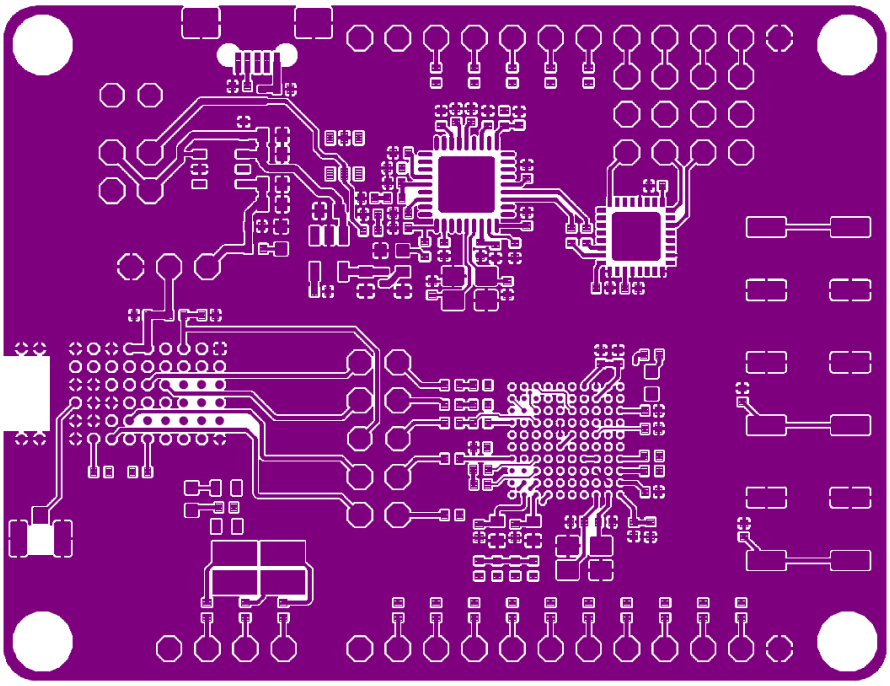
Jumper	Description		
J1	1	5 V from USB connected	5 V power option, to power the board from USB or the 5 V pin. The 5 V from USB can also be used to power the sensor board.
	1	5 V from or to breakout pin connected	
J3	3	Module reset connected	If there is no firmware on the module, the reset will be pulled low. This has to be considered when the module is sharing a common reset with other components.
	3	Module reset disconnected	
J4	4	SWD connected	Access to module and programmer SWD
	4	SWD disconnected	
J8	8	Module UART connected	Access to module UART RX and TX.

		Module UART disconnected	
J9		Module VCC connected.	Module VCC connection and GND pin. The module VCC jumper can be removed for current measurements.
J7, J10		FTDI connected to module UART.	Option for module UART to breakout pin or FTDI. Place jumpers either on J7 or J10.
		Breakout pin connected to module UART.	
J11 ⚠		3.3 V are supplied to the breakout pin.	Option to power an external sensor board sensors with 3.3 V. Do not place this jumper, if an external 3.3 V source is present.
		3.3 V are not supplied to the breakout pin.	
R32, R48	These 0 Ω resistors can be removed, to disconnect the LEDs in case the IOs PTB0, PTC1, PTA18, and PTA19 shall be used for other purposes.		
SW2, SW3	If you want to use PTC4 and PTC5 for other purposes, do not push the buttons.		

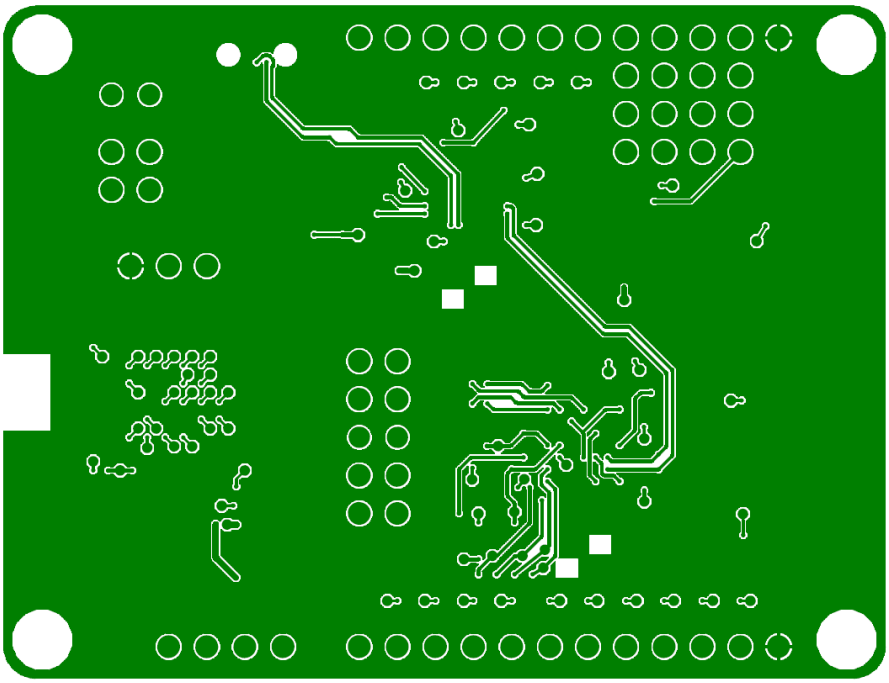
After each different configuration the reset button needs to be pressed.

4.7 PCB Layout

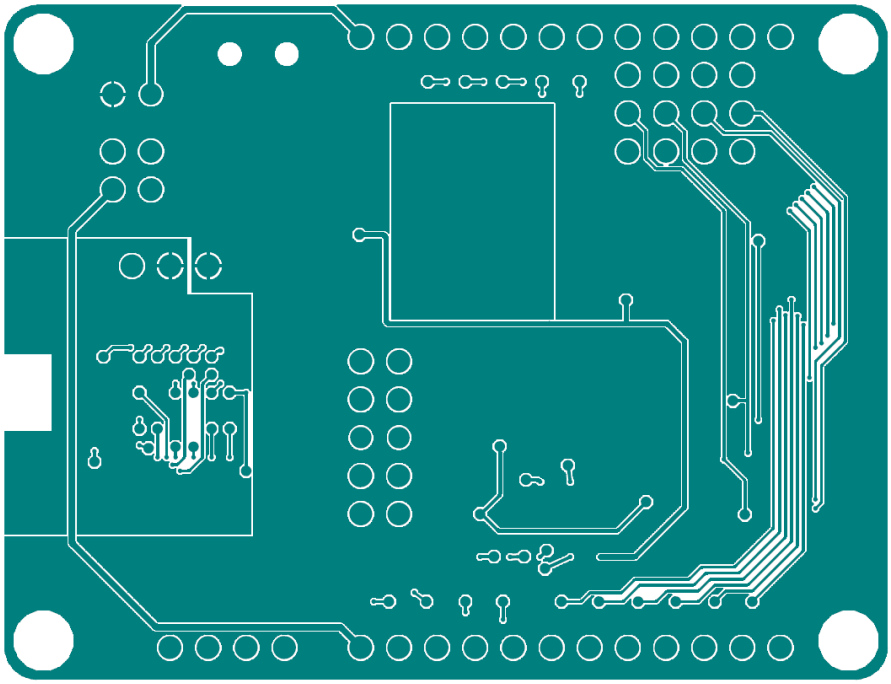
4.7.1 Top Layer



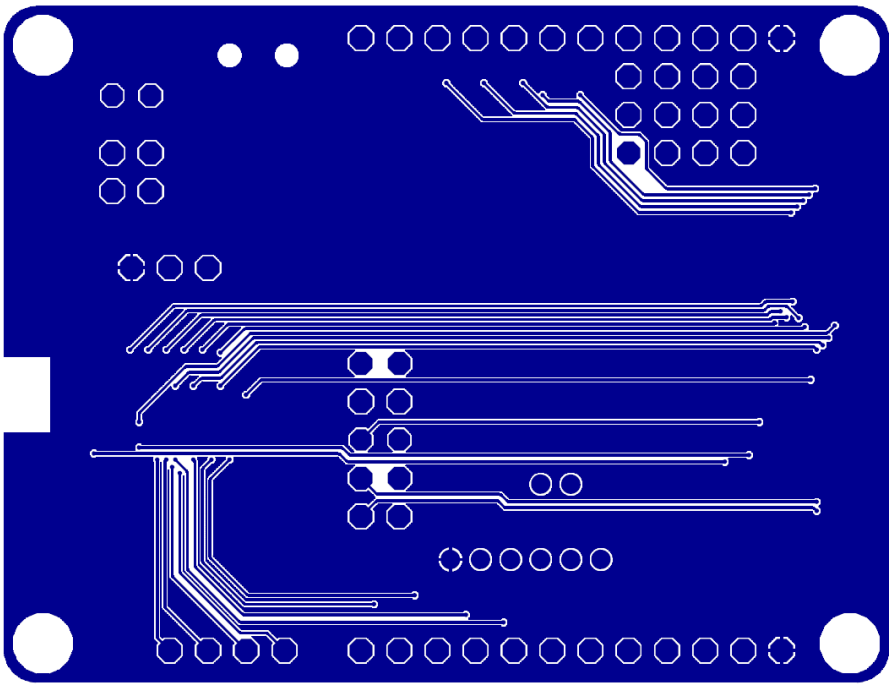
4.7.2 Second Layer



4.7.3 Third Layer



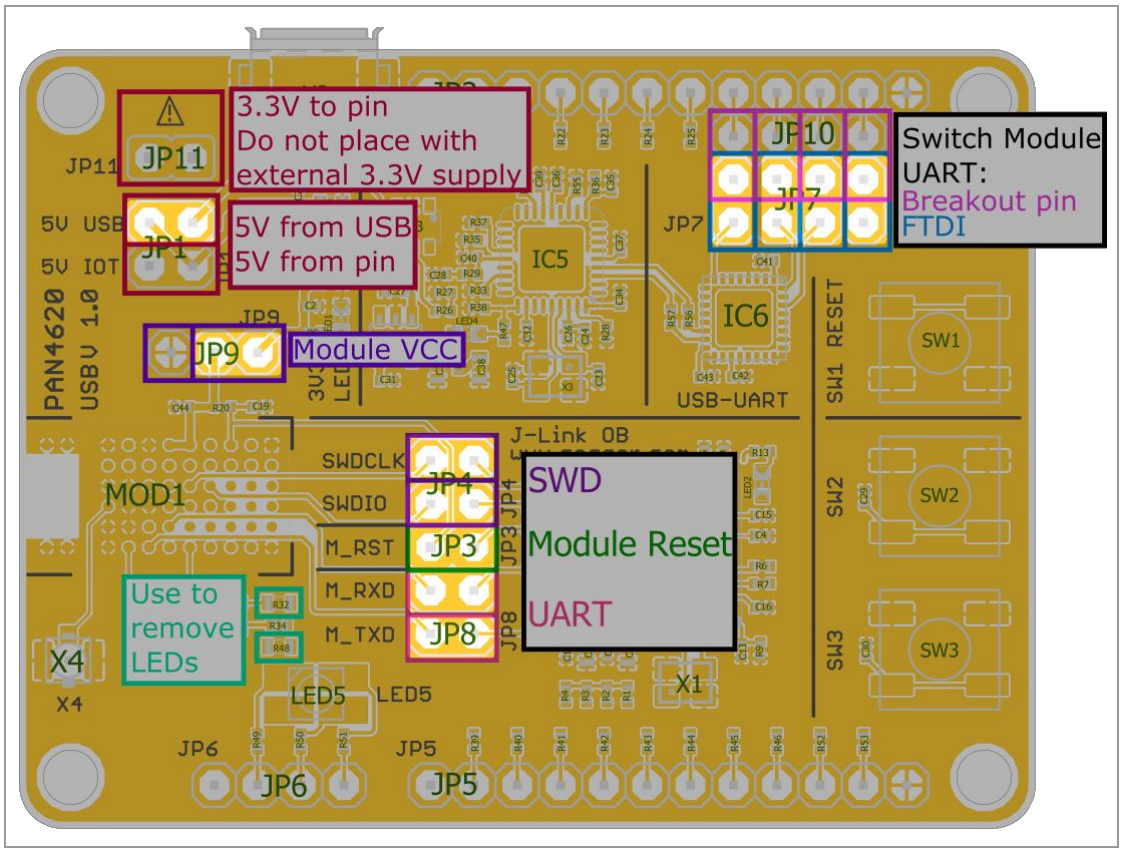
4.7.4 Bottom Layer



5 Getting Started

5.1 Jumper Start up Configuration

Place all highlighted jumpers on PAN4620 evaluation board. Connect the device via USB cable to a PC, to power it and run demo examples.

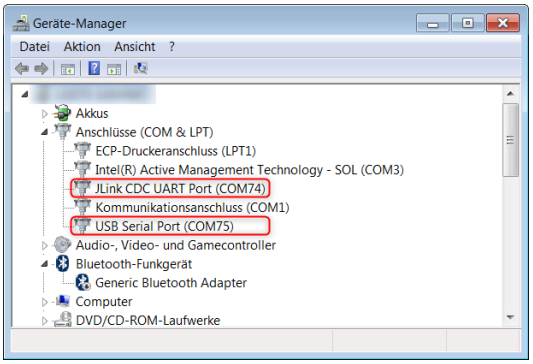


5.2 Device Drivers

5.2.1 General

It might be necessary to install drivers for some components.

Please note that the “FTDI USB UART” and the “Segger J-Link” SWD debugger will provide COM ports to the system.



On the PAN4620 USB evaluation board both COM ports can be used to open a UART connection to the PAN4620 module.

5.2.2 FTDI USB UART

Having the drivers installed correctly is mandatory for all the examples mentioned in this Quick Start Guide.

Depending on the operating system that is used, drivers for the “FTDI USB UART” might not be installed automatically. If in doubt, please check the FTDI website and install the drivers manually.

For further information please visit https://www.ftdichip.com/Drivers/VCP.htm.

5.2.3 Segger J-Link SWD Debugger

Depending on the operating system that is used, drivers for “Segger J-Link” SWD debugger might not be installed automatically. Having the drivers installed correctly is not strictly mandatory for the basic example mentioned in this Quick Start Guide, but necessary for using other software examples from NXP SDK.

If in doubt, please check the “Segger” website and install the drivers manually.

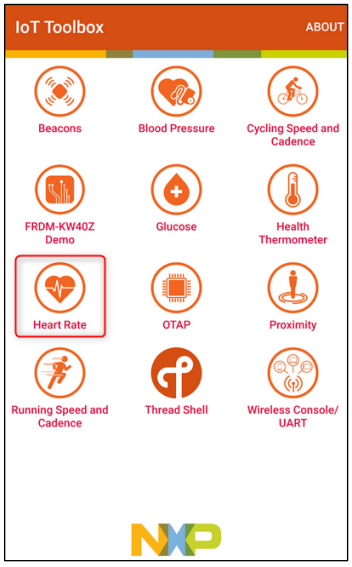
For further information please visit https://www.segger.com/downloads/jlink/.

5.3 Using Initial Bluetooth Heart Rate Example on PAN4620 USB

The PAN4620 evaluation board is coming with preinstalled Bluetooth Low Energy demo example.

Run the first demo

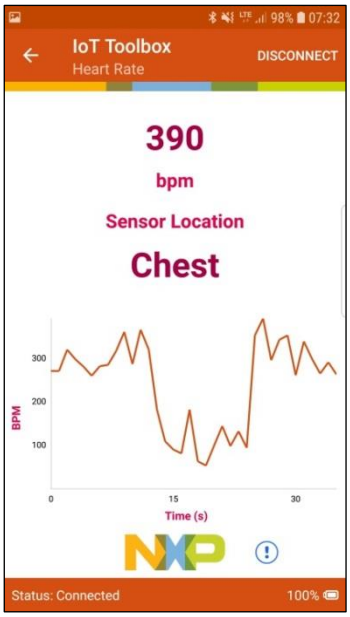
1. Download the app **IoT-Toolbox** from Google Play or Apple iTunes Store.
2. Start the app **IoT-Toolbox**.
3. Select the icon **Heart Rate**.



4. Switch on Bluetooth on Smartphone/Tablet.
5. Press the button **SW3** on PAN4620-ETU to start advertising.
6. Scan for devices on Smartphone/Tablet.
7. Select and connect to the found device (e.g. **FSL_HRS**).

8. Press the button **SW2** on the PAN4620-ETU to send changed heart rate data.

   ➔ See heart rate changes on Smartphone/Tablet.



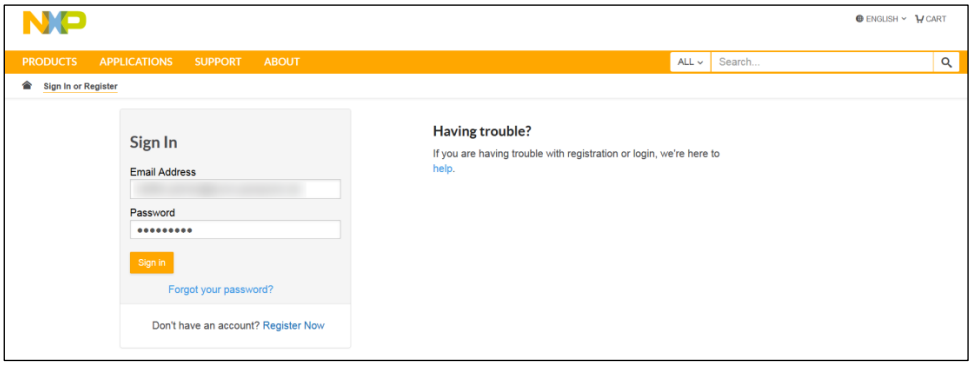
5.4 Getting NXP MCUXpresso IDE for PAN4620 Module

The following requirements must be met:

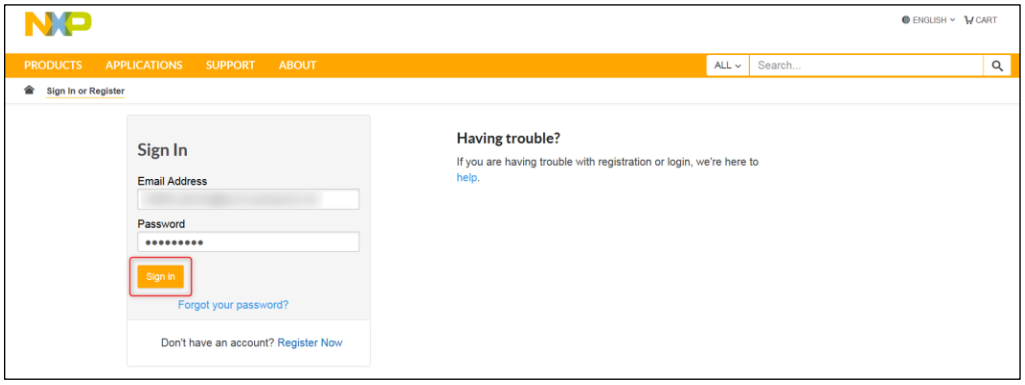
✓ Created user account on NXP website

1. Visit the website www.nxp.com.
2. Search for `MCUXpresso Integrated Development Environment (IDE)` and download it.

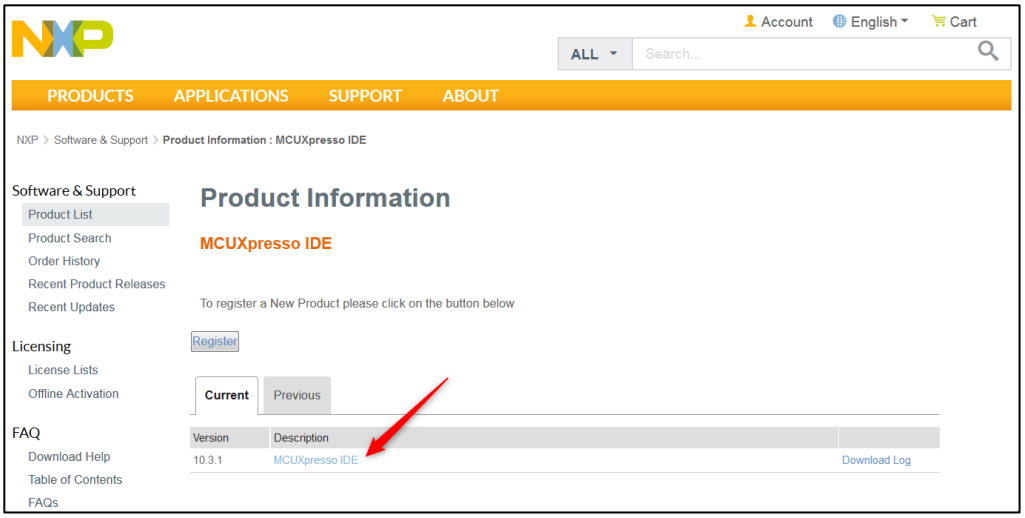
   ➔ NXP will lead to the following page.



3. Click **Sign in**.



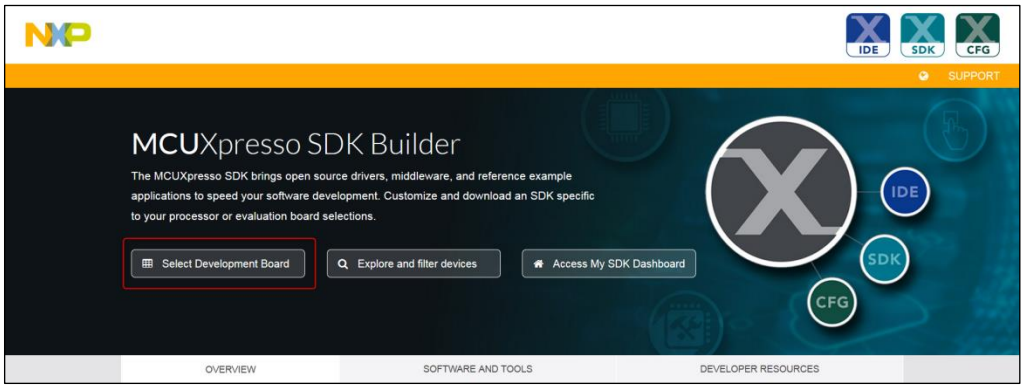
4. Download the preferred **MCUXpresso IDE** version and install the IDE.



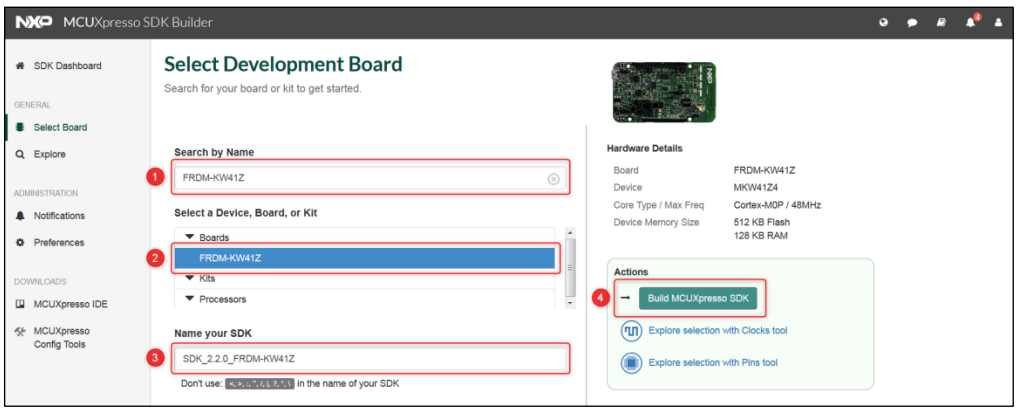
5.5 Getting NXP SDK for PAN4620 Module

Getting necessary sources for software development

1. Visit the website www.nxp.com.
2. Search for `MCUXpresso SDK Builder`.
3. Click **Select Development Board** to search for the correct board or kit to get started. The PAN4620-ETU is based on the FRDM-KW41Z platform from NXP.



4. Enter `FRDM-KW41Z` to the field **Search by Name** (1).



5. Select the found board (2).
6. Enter a preferred name for the SDK (3).
7. Click on **Build MCUXpresso SDK** (4).

The regulatory testing of PAN4620 was done using SDK version 2.2.0 with release date 2019-04-24, to not risk voiding the precertification of the module and to avoid problems during regulatory testing we strongly recommend to use exactly this version of the SDK.

SDK version: 2.2.0

Release date: 2019-04-24

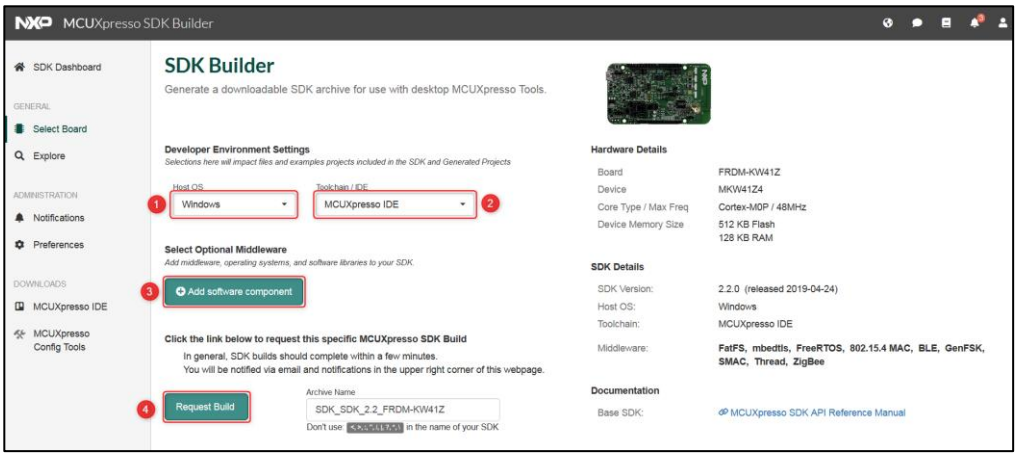
Bluetooth LE software version: v1.2.8

IEEE 802.15.4 MAC/PHY software: v5.3.8

SMAC software: v3.3.7

Generate a downloadable SDK archive for use with desktop MCUXpresso tools

1. Select the **Host OS** (Host Operating System) (1).



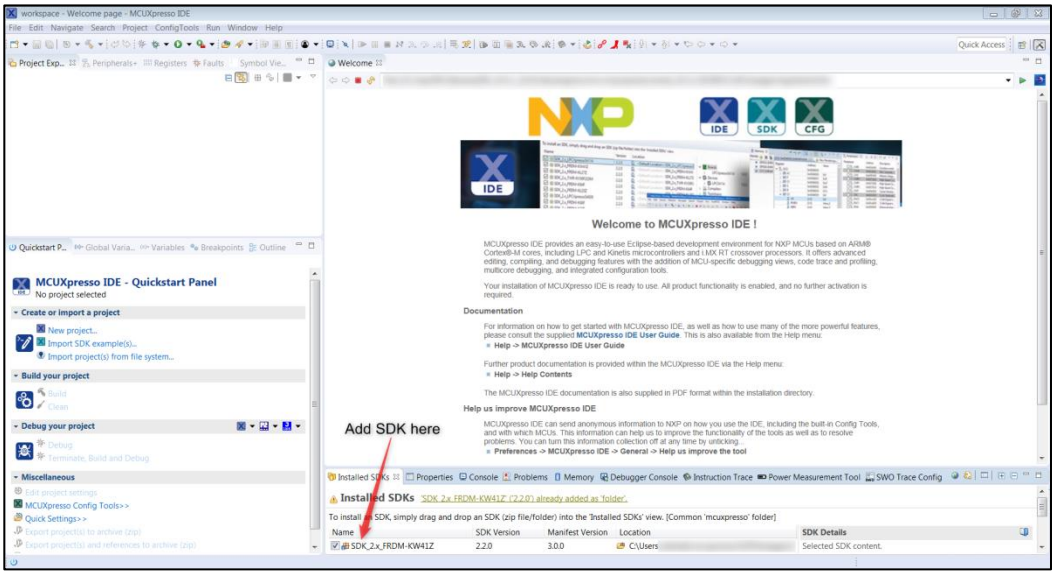
2. Select the preferred **Toolchain / IDE** (2).

3. Click **Add software component** (3) and select optional Middleware.
   Available are middleware like CMSIS DSP Lib, FatFS, mbedtls, NTAG I2C, wolfssl, FreeRTOS operating system and wireless stacks like 802.15.4 MAC, Bluetooth LE, GenFSK, SMAC, Thread and Zigbee.
4. Click **Download SDK** (4). The SDK Details will show that **SDK version 2.2.0** is available.

5.6 Using SDK in MCUXpresso IDE

To get access to the sources in the SDK, it is necessary, to link the SDK to the IDE.

1. Open **MCUXpresso IDE** (**v10.3.1_2233**).
2. Pull the folder (zipped or unzipped) into the tab **Installed SDKs** in **MCUXpresso IDE**.



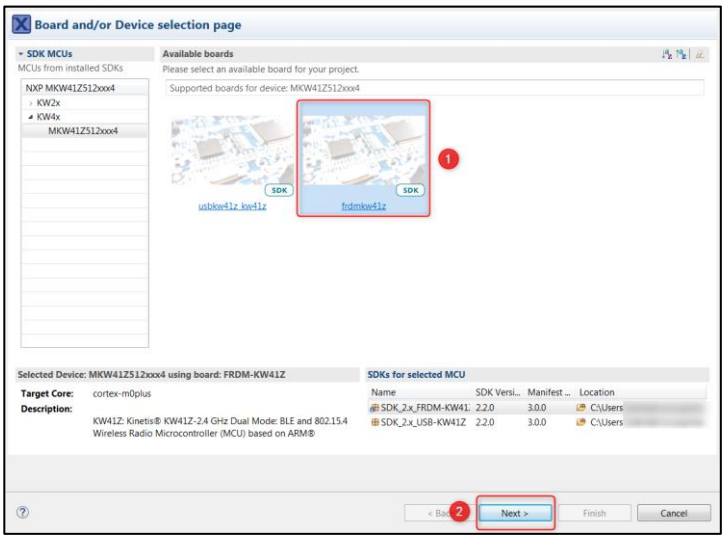
For further information about getting started with the API, the middleware and examples for wireless stacks, see the documentation folder in the SDK (**SDK_2.2.0_FRDM-KW41Z** > **docs**).

Open and Run Software Example from SDK

Import software examples

1. Click the field **Import SDK example(s)** in the **Quickstart Panel** of the **MCUXpresso IDE**.

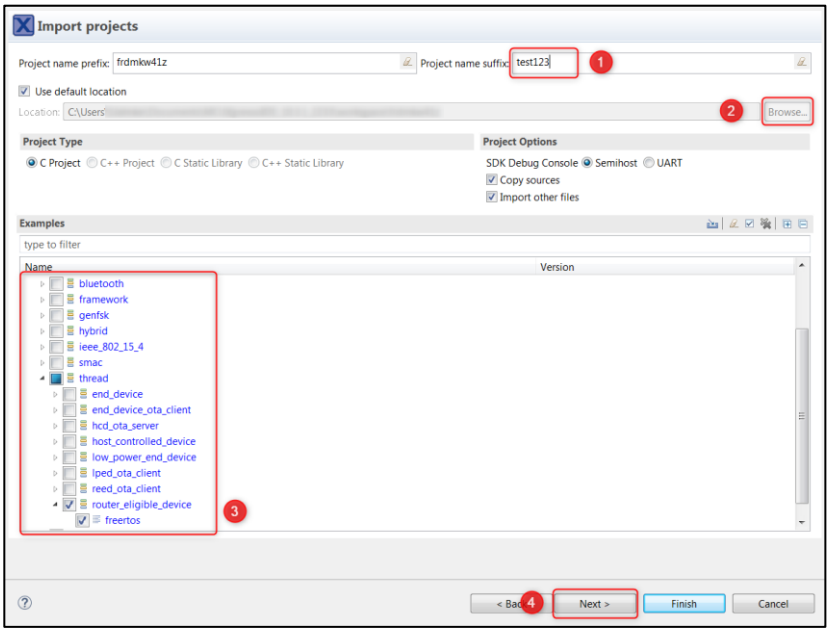
2. Select the previously loaded SDK **frdmkw41z** (1).



3. Click **Next >** (2).

Run the software

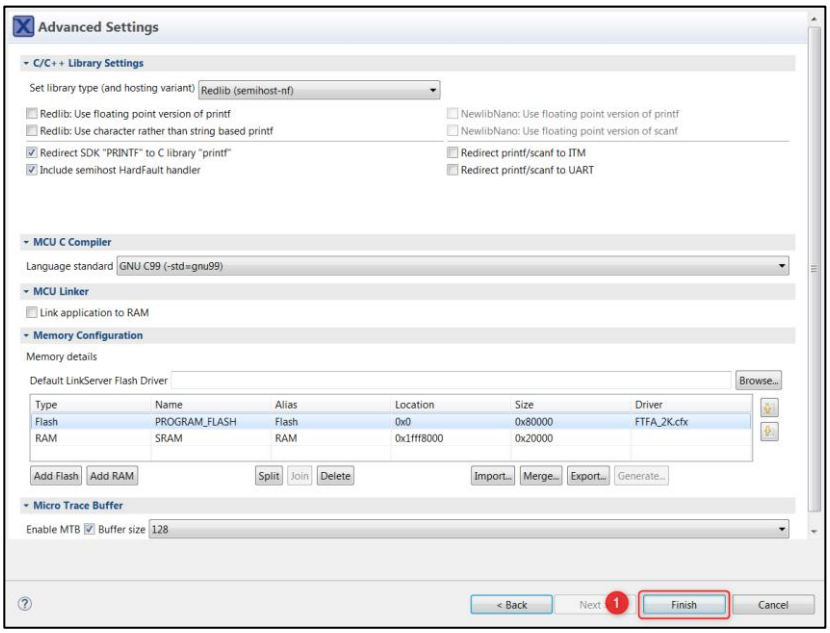
1. Select the preferred example for running a demo.
2. Enter a **Project name suffix** (1) to distinguish between different programs in the workspace.



3. Click **Browse** (2) to select the location for the project (usually, the predefined workspace).
   We will select the **wireless_examples** > **thread** > **router_eligable_device >** **freertos** (3) example to show a Thread network demonstration.
4. Click **Next >** (4).

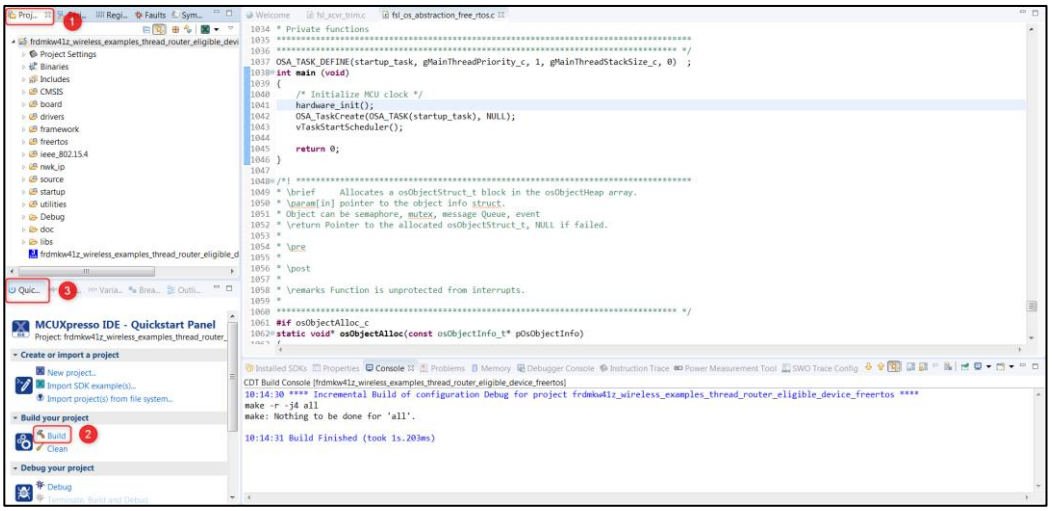
Advanced Settings

5. Click **Finish** (1).



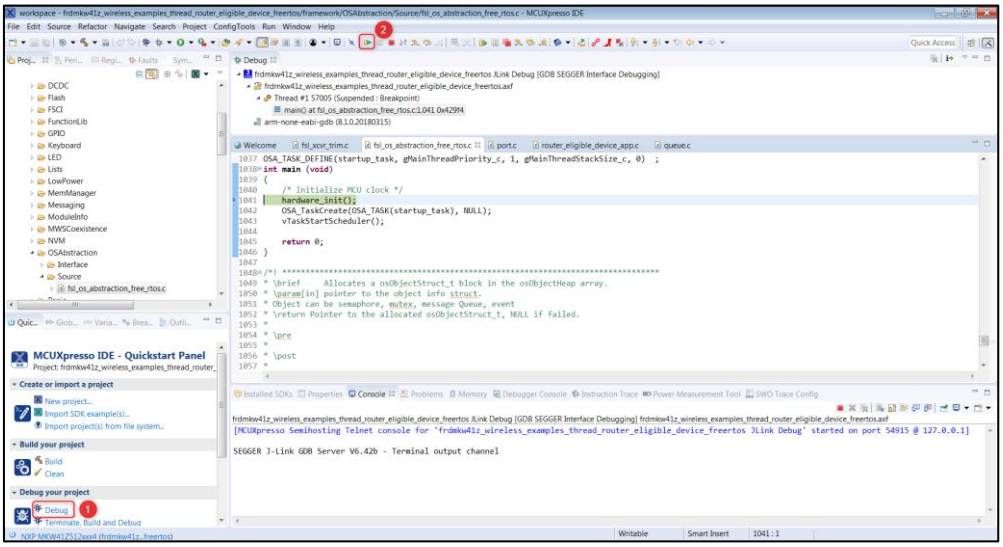
Compile the example project

1. Click onto the project inside the **Project Explorer** (1) within **MCUXpresso IDE**.



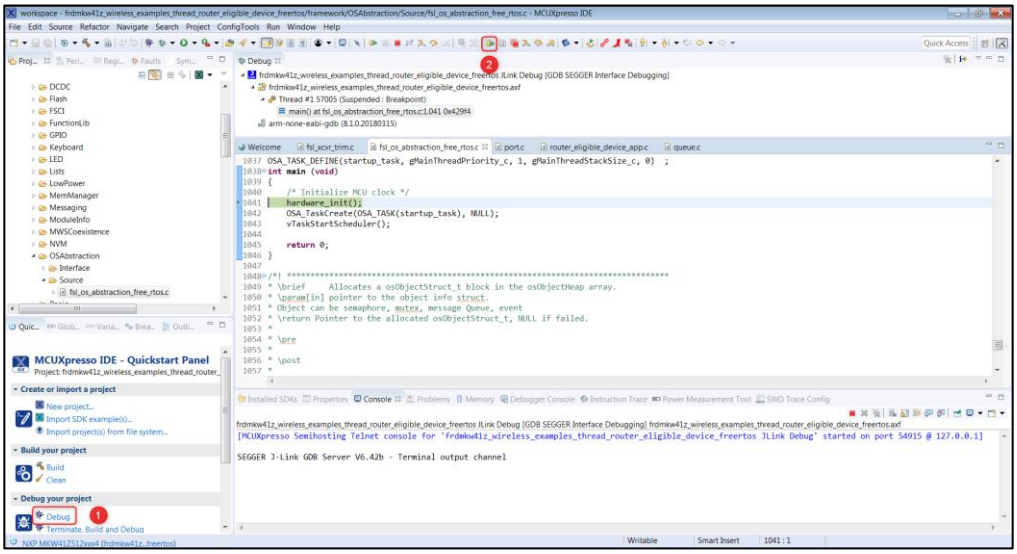
2. Click the Build icon (2) in **Quickstart Panel** (3) or Toolbar, to compile the example project.

➔ **MCUXpresso IDE** after starting the debug process.



Flash the software

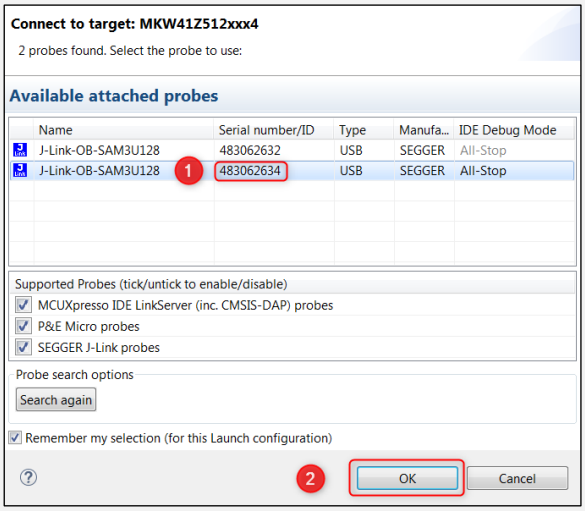
1. Connect the PAN4620 evaluation board to the PC.
2. Click the Debug icon (1).



➔ The software will be flashed with the onboard **J-Link-OB-SAM3U128** to the PAN4620 module. Wait till this process is finished.

3. Click the Start icon (2) in the toolbar, to run the application on the PAN4620 evaluation board.

In case of more than one connected PAN4620 board, the IDE will give the possibility, to choose which one should be flashed. Compare the **Segger Serial number/ID** (1) with the label on the bottom of the PAN4620 board. Click **OK** (2).



5.7 Using Test Tool 12

Another way to flash a previously written program to the PAN4620 device is the **Test Tool 12** provided by NXP.

The following requirements must be met:

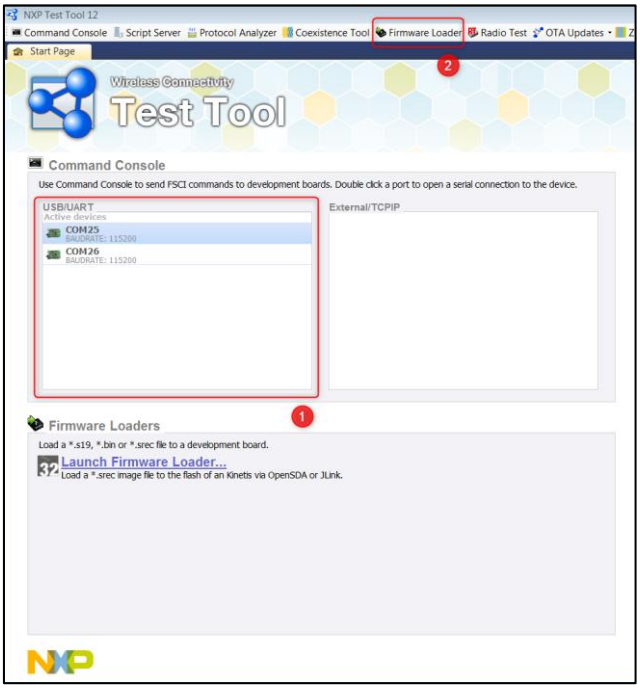
✓ NXP account

1. Go to NXP website (www.nxp.com).
2. Search for `Test Tool for Connectivity Products`.
3. Accept the Agreement for the Test Tool.
4. Sign in on NXP website.
5. Download and install the Test Tool on the PC.

Starting the Test Tool 12

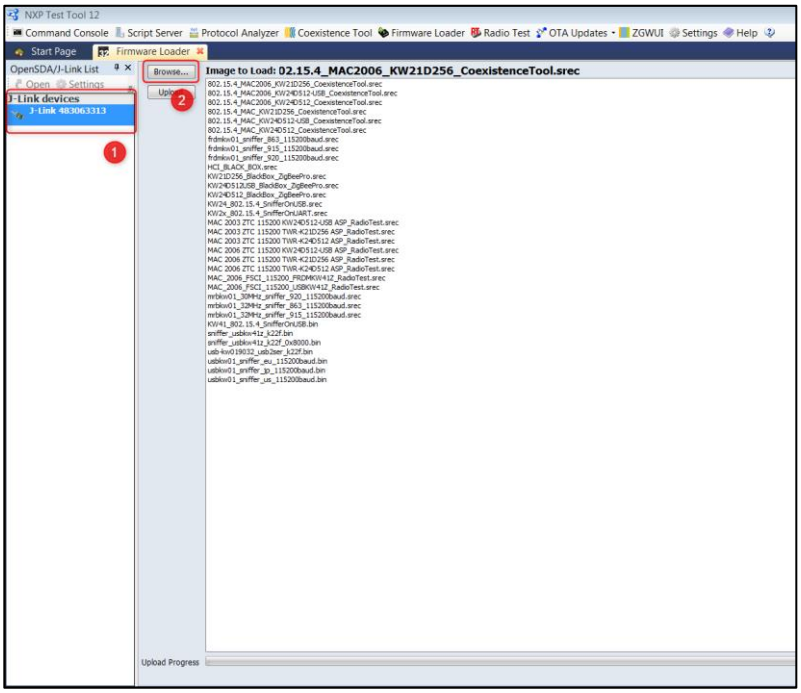
1. Connect the PAN4620 ETU device to the PC.

➔ After windows driver installation the device with COM port will show up in window **Command Console** (1).

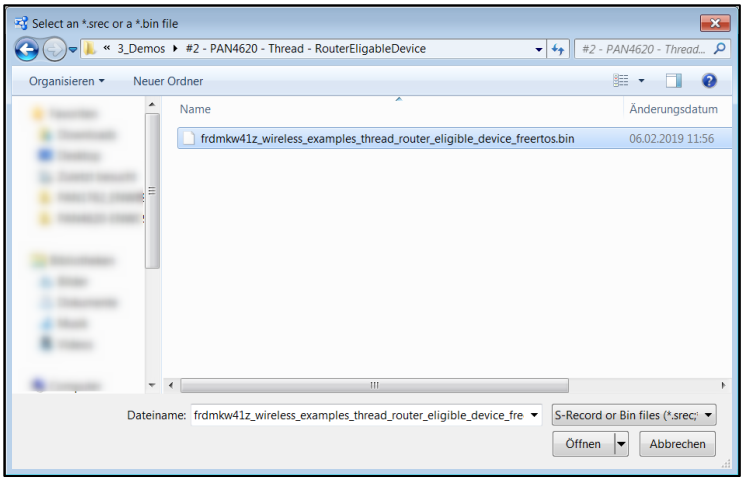


2. Click on the tab **Firmware Loader** (2).
3. Select the preferred J-Link device in the list (1).

> The label on the bottom of the PAN4620 ETU device will give the Segger J-Link ID of the board, which can be found in the mentioned list.



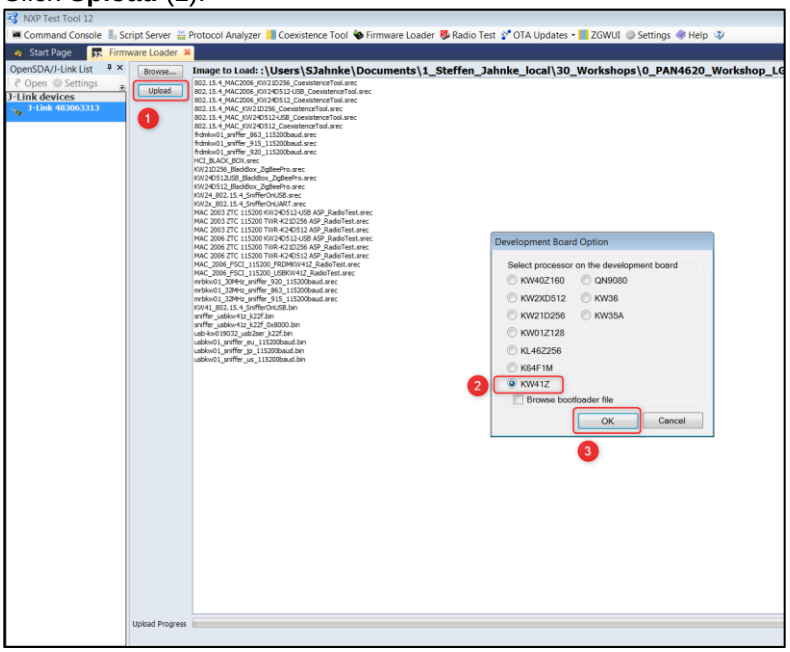
4. Click **browse** (2).
5. Navigate to the file, which should be flashed on the PAN4620 ETU device. The file must be in `*.srec` or in `*.bin` format.



There are two options: The first option is to generate the mentioned files in an Integrated Development Environment (IDE) like IAR Embedded Workbench or MCUXpresso from NXP.

The second option is to use some of the already generated files that are available in the NXP SDK (see folder path: **SDK_2.2.0_FRDM-KW41Z_16_01_2019** > **tools** > **wireless** > **binaries**).

1. Click **Upload** (1).



2. Select the controller **KW41Z** (2), which is used on PAN4620 device.
3. Click **OK** (3).

   ➔ The Test Tool 12 will flash the program to the PAN4620.

   ➔ Now the previously written application can be evaluated and used.

> Next to the Firmware Loader option, the NXP Test Tool 12 comes with additional functions like a Protocol Analyzer, a Radio Test or an OTA (Over The Air) Update section. For more information about the Test Tool see “Freescale Test Tool User’s Guide”.

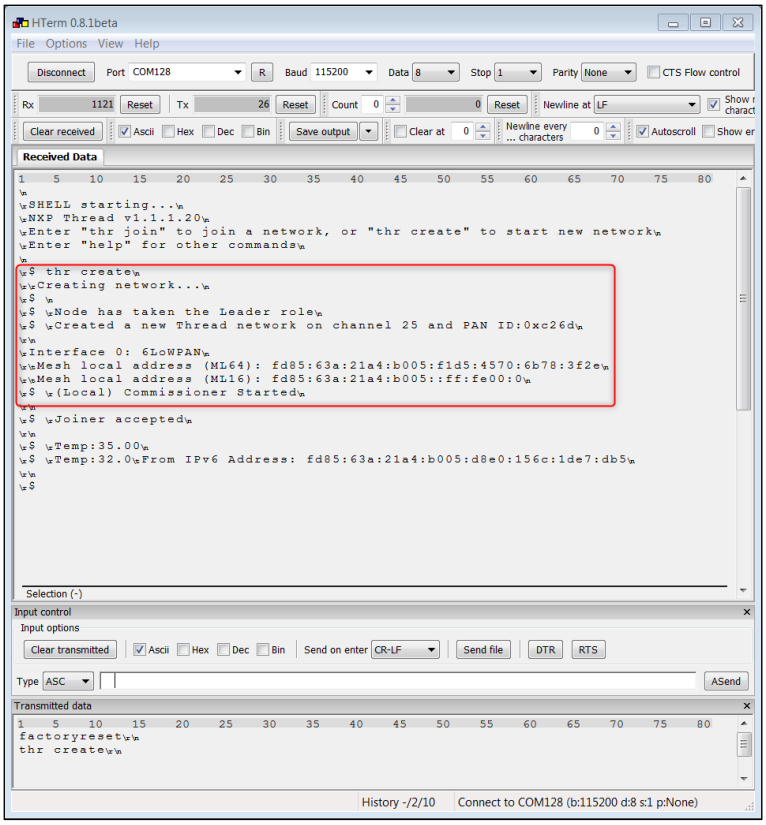
5.8 Using Thread Example Application

Flash at least two of the PAN4620 evaluation boards with the software (`frdmkw41z_wireless_examples_thread_router_eligible_device_freertos`) mentioned in the MCUXpresso section.

1. Open two terminal programs like **HTerm** and connect to the COM ports of both nodes. Use the serial configurations for the nodes (like the figures below will show).
2. On the first node enter the command `thr create` and press **Enter**.

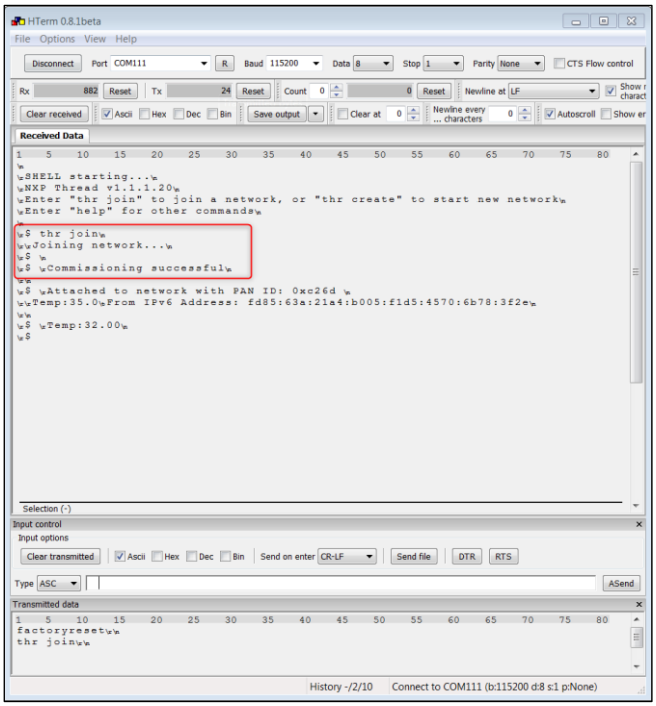
> Take care that there is always the **CR-LF** option selected at the menu **send on enter** in the section **Input control** of **HTerm** or similar terminal programs.

➔ Wait till the node has created the Thread network (here with the `ID 0xc26d`).



3. On the second node enter the command `thr join` and press **Enter**.

➔ The node will search for existing Thread networks (RGB LED5 will change colors fast) and connect to the previously created network automatically.

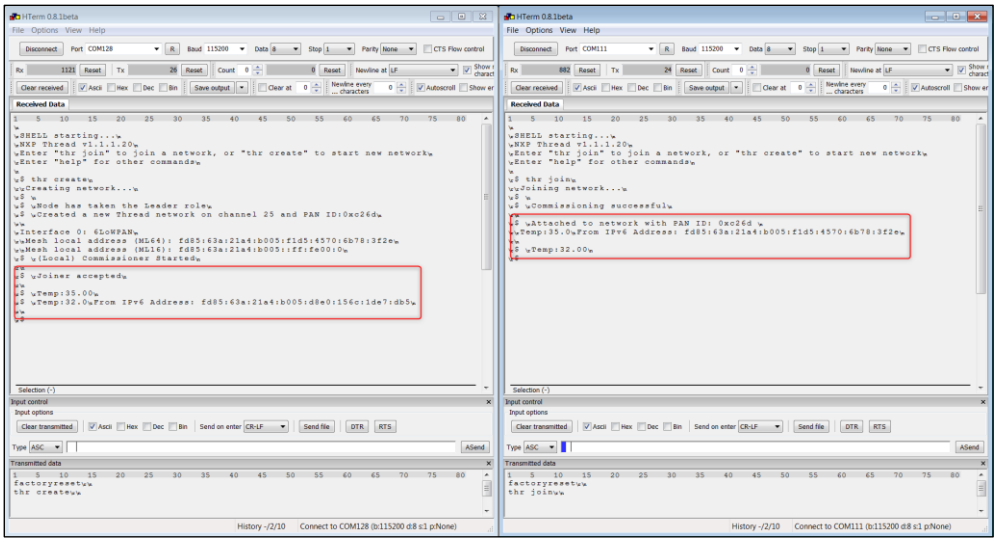


4. Press **SW2** on both PAN4620-ETU nodes, to change the color of the RGB LEDs on both nodes.

   ➔ Thread network is working.

5. Press the button **SW3**.

   ➔ Everything within the software is prepared and implemented to exchange the measured temperature between the nodes.



Get more information about the possibilities and commands, in Thread networks, with the commands `help` and `help thr`.

Please note that there is no thermistor mounted on the PAN4620-ETU. Just the software is prepared for this use case. To measure a correct temperature, it is recommended, to use the “thermistor measuring circuit” shown in “FRDM-KW41Z Freedom Development Board User's Guide” (chapter “Thermistor”).

The chosen Thread software example gives additionally the possibility, to use touch sensitive inputs on the Pins “PTC16 (TSI0_CH4)” and “PTC17 (TSI0_CH5)”. If PAN4620 evaluation board is delivered with already mounted pin headers for “JP2” and “JP5”, notice that these inputs can detect the human body by contact and affect the software.

6 Regulatory and Certification Information

Regulatory certification / tests were done using:

- SDK version 2.2
- BT version 1.2.X
- IEEE 802.15.4 version X???

The RF synthesizer within the PAN4620 can be configured to use any channel frequency between 2.36 GHz and 2.487 GHz. However, the information given in ⇨ 6 Regulatory and Certification Information is only valid within the ISM frequency band starting at 2.4 GHz. To not void all precertifications and to be sure you are not violating regulatory requirements, we recommend to use the certified Bluetooth LE, Thread, and Zigbee wireless stacks provided by NXP.

6.1 Federal Communications Commission (FCC) for US

To comply with FCC regulatory requirements, it is necessary to reduce the output power from 3.5 dBm to about 0 dBm on the highest 802.15.4 channel (channel 26 at 2480 MHz).

It is necessary to do this in the software of the end product and in the tool used during certification testing. The following example shows how to adjust this setting in the example code, which we recommend for certification testing. This example is included in the NXP SDK. Open the example project with the designation frdmkw41z_wireless_examples_smac_connectivity_test_freertos. Go into the folder **source** and open the file **connectivity_test_platform.c**, go to the function **ShortCutsParser** in line 164 and replace the code in case ‘q’, ‘w’, ‘a’ and case ‘s’ with the following code.

```
case 'q':
    if(testChannel == (channels_t)gTotalChannels)
    {
      testChannel = gChannel11_c;
    }
    else
    {
      testChannel++;
    }
    if((testChannel == 26)&&(testPower > 18)){
       testPower = 18;
    }
    break;
case 'w':
    if(testChannel == gChannel11_c)
```

```
    {
      testChannel = (channels_t)gTotalChannels;
    }
    else
    {
      testChannel--;
    }
    if((testChannel == 26)&&(testPower > 18)){
       testPower = 18;
    }
    break;
case 'a':
      testPower++;
      if(testChannel == 26){
             if((0x12 ) < testPower)
            {
              testPower = gMinOutputPower_c;
            }
      }else{
             if(gMaxOutputPower_c < testPower)
            {
              testPower = gMinOutputPower_c;
            }
      }
      break;
case 's':
        if(testChannel == 26){
               if(testPower == gMinOutputPower_c)
               {
                      testPower = 0x12;
               }
               else
               {
                      testPower--;
               }
        }else{
               if(testPower == gMinOutputPower_c)
               {
                      testPower = gMaxOutputPower_c;
               }
               else
               {
                      testPower--;
               }
        }
      break;
```

The OEM must ensure that FCC labelling requirements are met. This includes a clearly visible label on the outside of the OEM enclosure specifying the appropriate Panasonic FCC identifier for this product as well as the FCC Notice above.

The FCC identifier is **FCC ID: T7V4620**.

This FCC identifier is valid for the PAN4620. The end product must in any case be labelled on the exterior with:

"Contains FCC ID: T7V4620"

6.2 Innovation, Science, and Economic Development (ISED) for Canada

English

Labeling Requirements

The OEM must ensure that IC labelling requirements are met. This includes a clearly visible label on the outside of the OEM enclosure specifying the appropriate Panasonic IC identifier for this product as well as the IC Notice above.

The IC identifier is:

IC: 216Q-4620

This IC identifier is valid for all PAN4620 modules. In any case, the end product must be labelled on the exterior with:

"Contains IC: 216Q-4620".

French

Obligations d'étiquetage

Les fabricants d'équipements d'origine (FEO) – en anglais Original Equipment Manufacturer (OEM) – doivent s'assurer que les obligations d'étiquetage IC du produit final sont remplies. Ces obligations incluent une étiquette clairement visible à l'extérieur de l'emballage externe, comportant l'identifiant IC du module Panasonic inclus, ainsi que la notification ci-dessus.

L' identifiant IC est:

IC: 216Q-4620

Cet identifiant est valide pour tous les modules PAN4620. Dans tous les cas les produits finaux doivent indiquer sur leur emballage externe la mention suivante:

"Contient IC: 216Q-4620".

6.3 European Conformity According to RED (2014/53/EU)

As a result of the conformity assessment procedure described in 2014/53/EU Directive, the end customer equipment should be labelled as follows:

CE

7 Cautions

7.1 Restricted Use

7.1.1 Life Support Policy

This Panasonic Industrial Devices Europe GmbH product is not designed for use in life support appliances, devices, or systems where malfunction can reasonably be expected to result in a significant personal injury to the user, or as a critical component in any life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

Panasonic customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Panasonic Industrial Devices Europe GmbH for any damages resulting.

7.1.2 Restricted End Use

This Panasonic Industrial Devices Europe GmbH product is not designed for any restricted activity that supports the development, production, handling usage, maintenance, storage, inventory or proliferation of any weapons or military use.

Transfer, export, re-export, usage or reselling of this product to any destination, end-user or any end-use prohibited by the European Union, United States or any other applicable law is strictly prohibited.

8 Contact Details

8.1.1 Contact Us

Please contact your local Panasonic Sales office for details on additional product options and services:

For Panasonic Sales assistance in the **EU**, visit

https://eu.industrial.panasonic.com/about-us/contact-us

Email: wireless@eu.panasonic.com

For Panasonic Sales assistance in **North America**, visit the Panasonic Sales & Support Tool to find assistance near you at

https://na.industrial.panasonic.com/distributors

Please visit the **Panasonic Wireless Technical Forum** to submit a question at

https://forum.na.industrial.panasonic.com

8.1.2 Product Information

Please refer to the Panasonic Wireless Connectivity website for further information on our products and related documents:

For complete Panasonic product details in the **EU**, visit

http://pideu.panasonic.de/products/wireless-modules.html

For complete Panasonic product details in **North America**, visit

http://www.panasonic.com/rfmodules