Never stop thinking

PMA71xx/PMA51xx

SmartLEWIS™ MCU

PMA Starter Kit

PMA RF USB Stick v2.x

User Guide

2.1, 2010-04-20

Wireless Control

Edition 2010-04-20

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PMA Starter Kit
Revision History: 2010-04-20, 2.1

Previous Revision: 2.0

Page	Subjects (major changes since last revision)
all	Major rework of all sections
all	Transformed from PowerPoint into book format
7	Section about "The PMA RF USB Stick Hardware" added
18	Section about "PMA RF USB Stick as Flash Programmer for external PMA Systems" added
21	Section about "Pre-installed PMA Test Software" added
10-17, 19, 20	Updated document for Keil µVision4

Table of Contents

Introduction

The PMA Starter Kit is a perfect starting point to experience the capabilities of the SmartLEWIS™ MCU product family. Implemented in a USB-stick format it can be easily connected to a PC and includes all ingredients for a complete wireless transmitter system. Using the Keil development environment all software features of the PMA IC can be explored. As a special feature, this USB-stick provides a rechargeable Li-Ion-battery which allows wireless operation after disconnection from the PC. Furthermore, this USB stick may be used as Flash programming interface for your external PMA application.

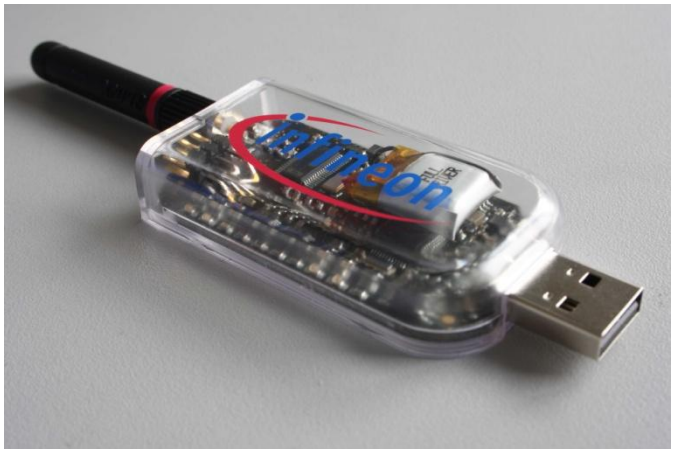


Figure 1 Photo of the PMA RF USB Stick

The features of the PMA Starter Kit are as follows:

- Equipped with the PMA5110 which is the most advanced type out of this product family offering the maximum feature set[1]
- RF-matching network for 50 Ohm SMA connector (315 MHz, 434 MHz or 868MHz carrier frequency and 5 dBm, 8 dBm or 10 dBm output power available)
- External ¼ lambda antenna attached to SMA connector
- Rechargeable Li-ion battery for autonomous operation after disconnecting from USB port
- USB interface with hot-plug capability (based on FTDI FT2232)
- Fully integrated into Keil C51 development suite (incl. software download to PMA-integrated Flash memory and debugging support)
- 3 status LEDs (battery charging, power supply, USB activity)
- 2 user LEDs connected to PMA GPIOs
- 4 general-purpose I/Os available on connector for external push buttons, LEDs, or digital sensors

This document refers to PMA RF USB Stick Version 2.x. The version of your PMA RF USB Stick may be easily identified by a green label on the backside of the USB-stick's PCB (e.g. "V 2.0").

In the following chapters you will find instructions to setup the complete tool chain.

[1] Due to physical limitations of the USB stick housing this tool does not provide any access to the PMA's ADC and LF-receiver. Please use the PMA Evaluation Kit (sold separately) to have full access to all hardware features of the PMA IC.

1 Documentation Links

Latest versions of all datasheets, application notes and other documents related to this product family may be downloaded from the Infineon Technologies internet web-site.

Detailed information about the SmartLEWIS™ MCU product family members PMA71xx and PMA51xx is available for download at **http://www.infineon.com/PMA**.

Most important documents are the product data sheets and the PMA function library guide:

- PMA51xx Datasheet
- PMA71xx Datasheet
- PMA51xx Function Library Guide
- PMA71xx Function Library Guide (named PMA71xx ROM Library Guide in earlier versions)

General information about the development tools for this PMA product family is available at **http://www.infineon.com/pma_tooling**.

All the documentation and software for this PMA Starter Kit with the PMA RF USB Stick is available at **www.infineon.com/pma_starterkit**.

2 The PMA RF USB Stick Hardware

The most important components and connectors of the PMA RF USB Stick are illustrated in Figure 2 and Figure 3 below.

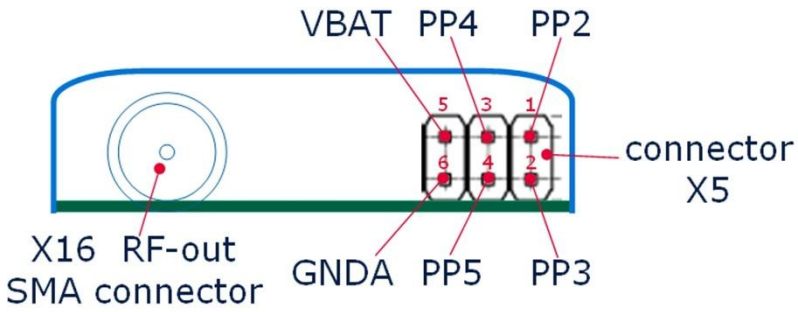


Figure 2 PMA RF USB stick – external connector

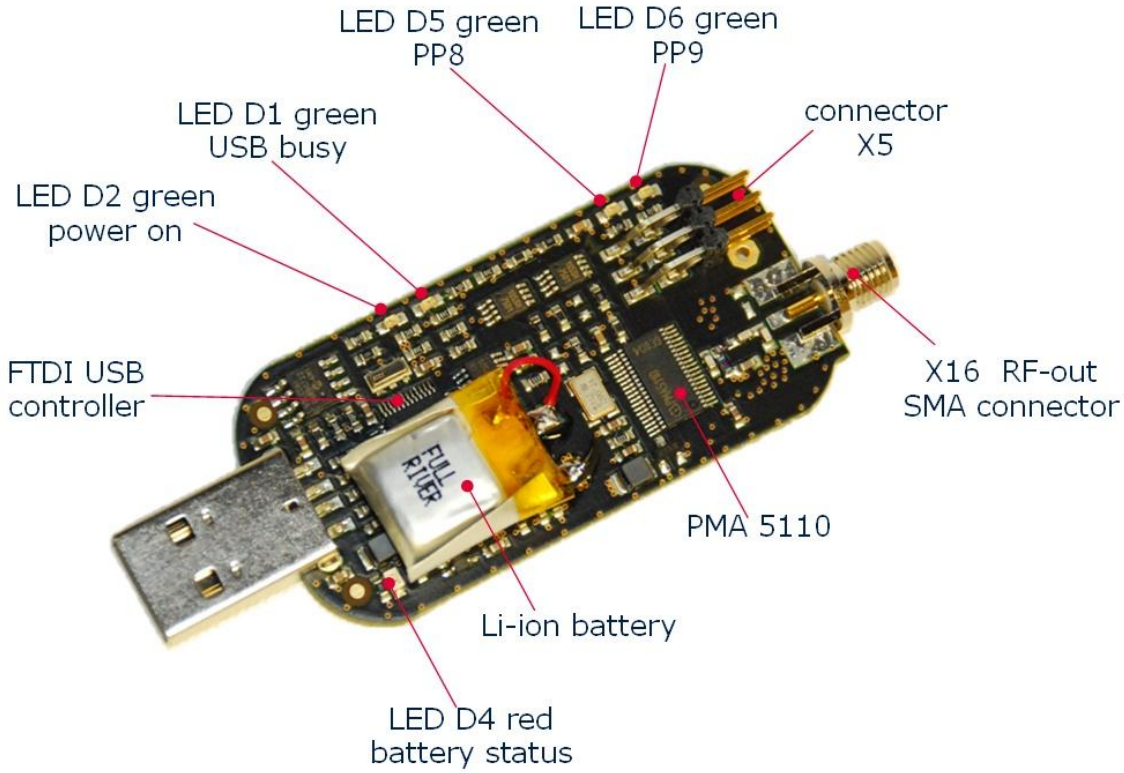


Figure 3 PMA RF USB stick – important components

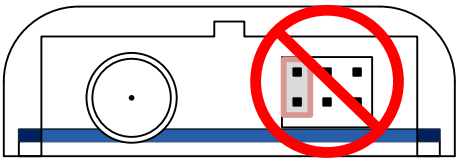
2.1 GPIO Assignment

In the PMA RF USB stick the general purpose input- / output-lines (GPIO) are assigned as follows:

Table 1 PMA RF USB stick – GPIO assignment

PMA GPIO signal	PMA RF USB stick usage
PP0	used for PC communication during program download and debugging (I2C clock)
PP1	used for PC communication during program download and debugging (I2C data)
PP2	connector X5 – pin 1
PP3	connector X5 – pin 2
PP4	connector X5 – pin 3
PP5	connector X5 – pin 4
PP6	not connected
PP7	not connected
PP8	LED D5 (green)
PP9	LED D6 (green)

Note: Don't ever connect Pin 1 and 4 with a jumper as this would shortcut the power supply and may damage your PMA USB RF Stick.



2.2 Rechargeable Battery

The PMA RF USB Stick is equipped with a rechargeable Li-Ion-battery. As soon as the USB stick is connected to a powered USB interface the recharging process will automatically be started. An ongoing recharge process is indicated by the red LED D4 near the USB connector.

There may be two reasons why D4 is off while the USB stick is powered via USB:

- The battery is already fully charged.
- The battery has been exhaustively discharged what may occur in rare cases. Keep the USB powered for some longer time until the regular charge process will start. A discharged battery does not influence any other functionality of the PMA RF USB Stick and normal operation is possible via USB power supply.

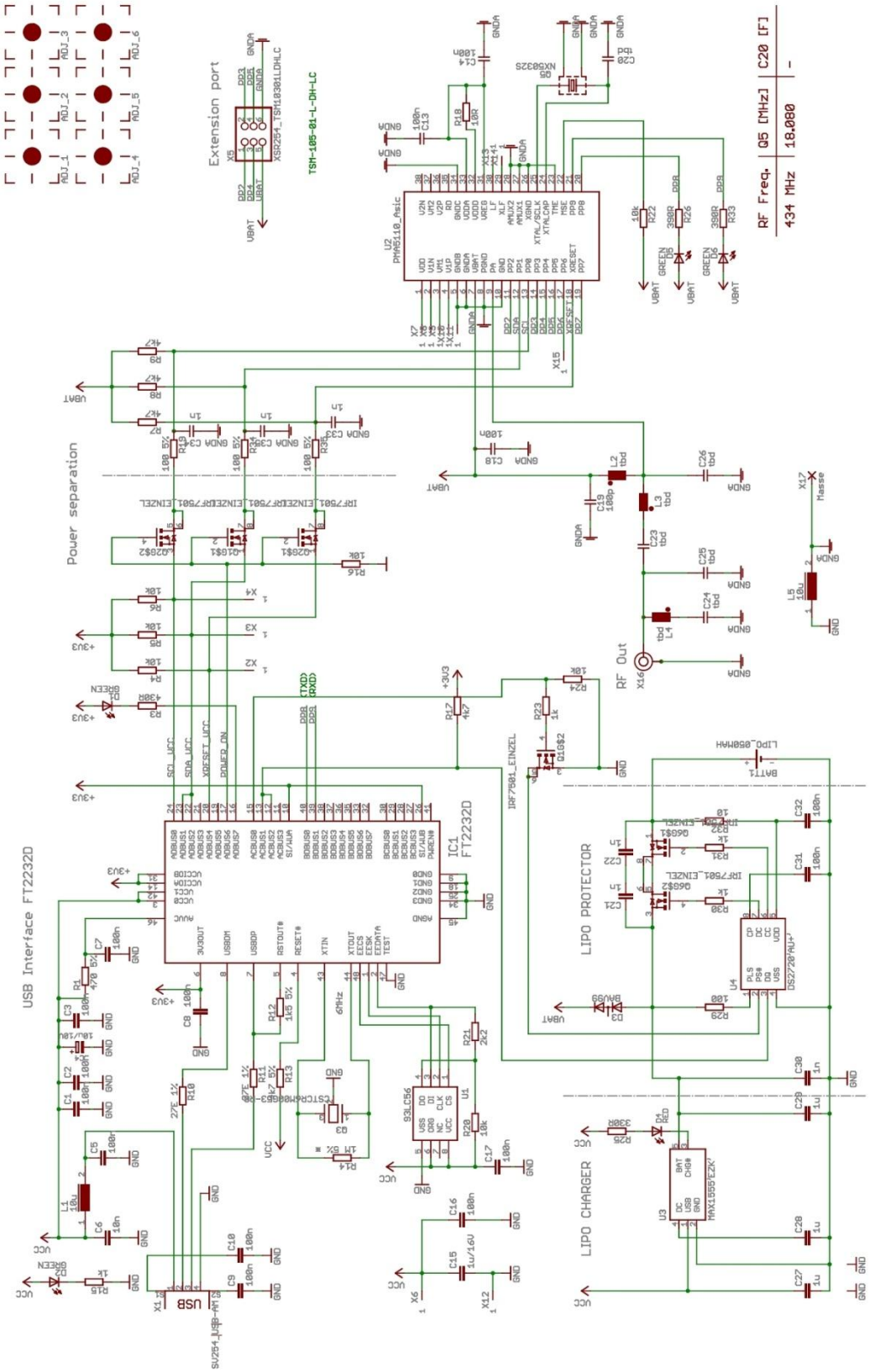


Figure 4 Schematic of PMA RF USB Stick

3 Setup of Software Development Tools

This chapter will guide you step-by-step through the installation of the tool environment. This process consists of the following steps which will be explained in full detail below:

- Download and install Keil C51 µVISION4 Tool Chain
- Download and install Infineon's PMA STARTER KIT SOFTWARE
- Setting up a new software project in the Keil development suite
- Debugger usage

3.1 Step 1 – Download and install Keil C51 µVISION4 Tool Chain

The Keil µVISION4 Integrated Development Environment is a state-of-the-art software development suite available for the majority of microcontroller types on the market. The SmartLEWIS MCU family is perfectly integrated into this environment. The tool chain provides following key features:

- Project Management
- Device Initialization
- Source Code Editing
- Target Debugging
- C51 ANSI C optimizing Compiler supports all PMA71xx/PMA51xx devices

Follow these steps to install the Keil C51 µVISION4 Tool Chain:

1. Install the Keil Development Environment for C51 **https://www.keil.com/c51/demo/eval/c51.htm** (user registration required). At the time of creation of this document the latest version is 9.00 as of 1/2010. This demo version of the Keil development environment is limited to a maximum code size of 2 Kbyte. The full flash memory size of the PMA IC may be utilized by purchasing a full version from Keil.
2. Select *Install Evaluation Software* from the setup menu.
3. Select *C51 Compiler (Eval Tools)* to install Keil µVISION4 and follow the instructions in the installation routine.

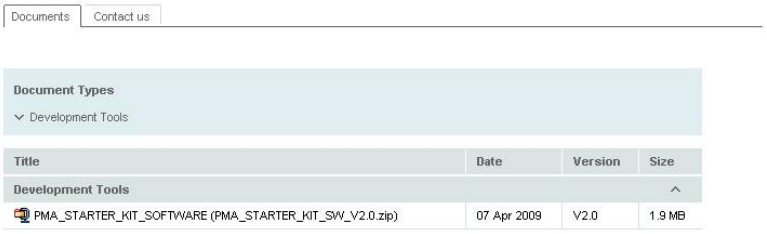
For details please refer to the online documentation from Keil.

Note: It is assumed that the default installation folder (C:\Keil) is used. If any other installation folder is selected during the Keil µVision installation process please replace C:\Keil with your custom installation folder throughout the rest of the installation process.

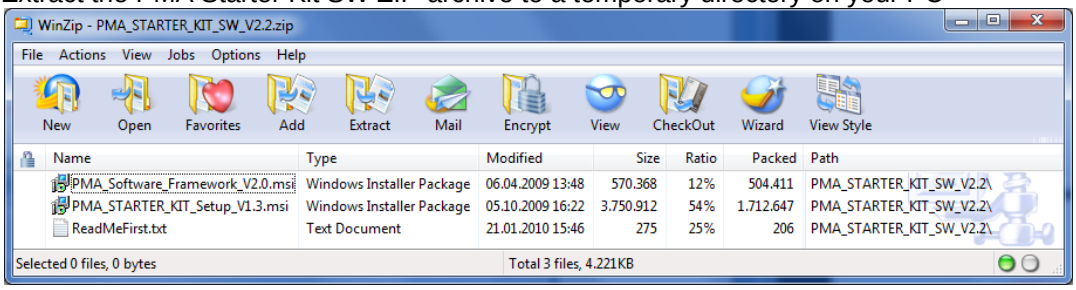
3.2 Step 2 – Download and install PMA STARTER KIT SOFTWARE

For the integration of the PMA71xx/PMA51xx devices into Keil µVISION4 and the installation of some software examples you have to download and install Infineon's PMA STARTER KIT SOFTWARE:

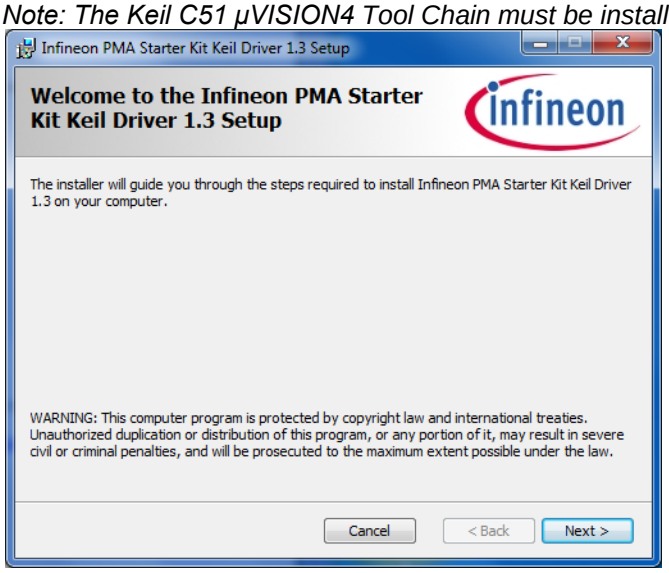
4. Go to **http://www.infineon.com/pma_starterkit** and download the PMA Starter Kit SW package (PMA_STARTER_KIT_SW_Vx.y.zip).



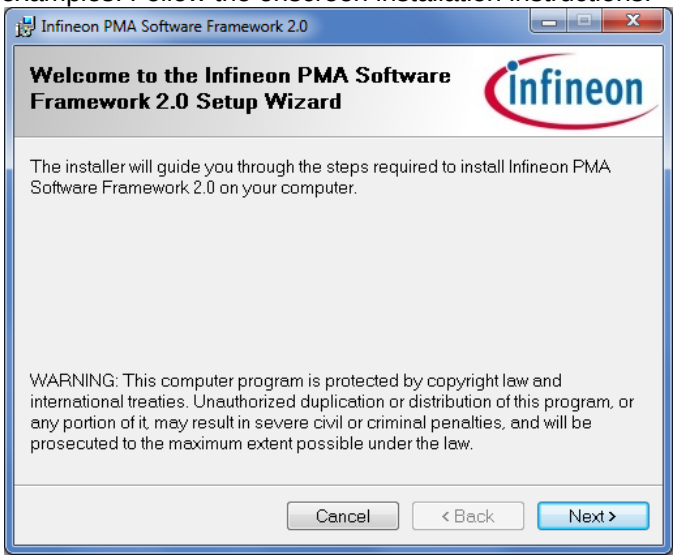
5. Extract the PMA Starter Kit SW ZIP-archive to a temporary directory on your PC



6. Start PMA_STARTER_KIT_Setup_Vx.y.msi to integrate the PMA product family into the Keil C51 µVISION4 Tool Chain. Follow the onscreen installation instructions.
Note: The Keil C51 µVISION4 Tool Chain must be installed BEFORE this step!



7. Start PMA_Software_Framework_Vx.y.msi to install the PMA Software Framework with typical coding examples. Follow the onscreen installation instructions.

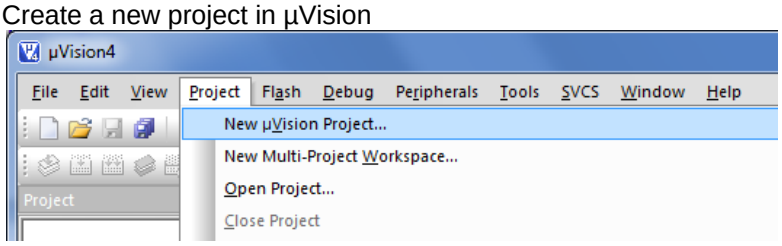


Note: If you don't have .Net Framework 1.1 installed on your PC you will get an error message during install. The Net Framework 1.1 can be downloaded from Microsoft's website:
http://www.microsoft.com/downloads/details.aspx?FamilyID=262D25E3-F589-4842-8157-034D1E7CF3A3&displaylang=en

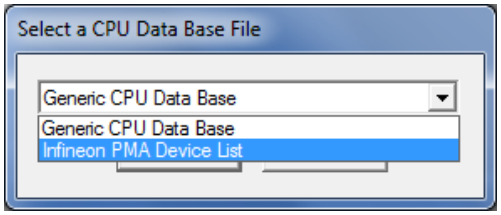
3.3 Step 3 – Setting up a Software Project in Keil C51 µVISION4

You can work directly in the example projects of the PMA Software Framework, or you can setup your own software project for PMA71xx/PMA51xx in Keil C51 µVISION4:

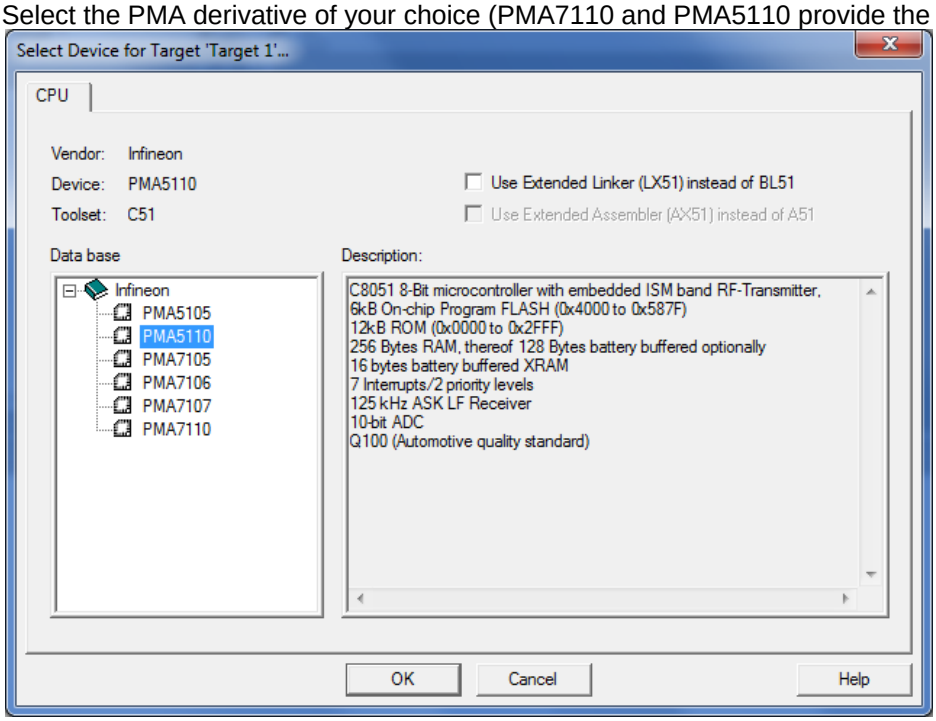
1. Create a new project in µVision



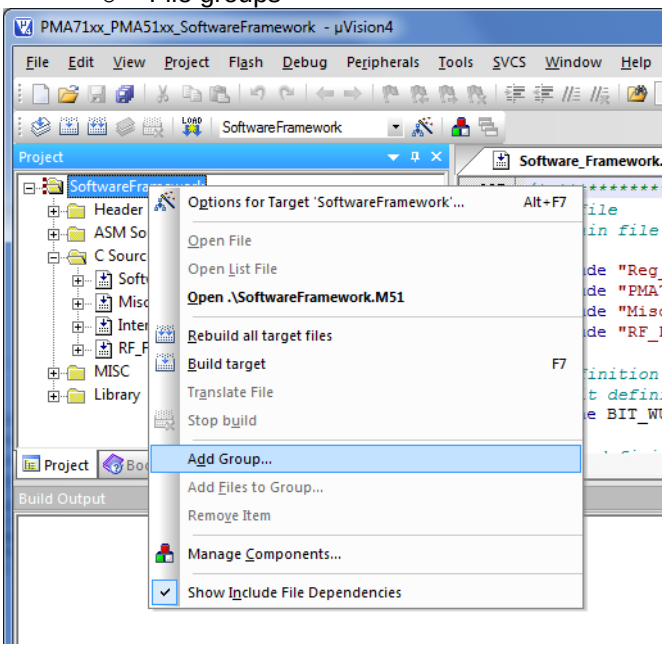
2. Select your CPU type. After installation of the PMA STARTER KIT SOFTWARE you should be able to select the Infineon PMA Device List.



Select the PMA derivative of your choice (PMA7110 and PMA5110 provide the full features set).



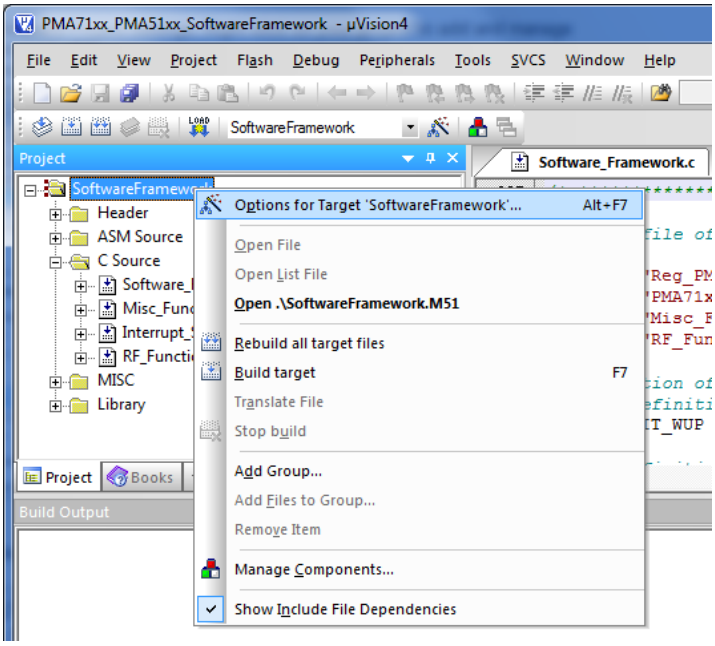
3. Configure your initial Software Project settings. Right click on your project to add and manage
   - source files (.c / .a51)
   - header files (.h)
   - File groups



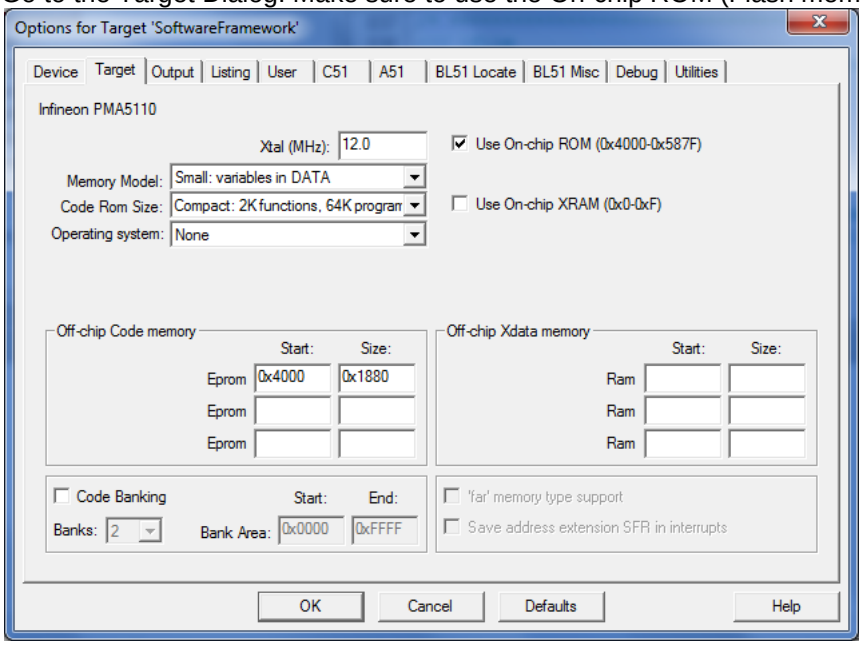
Typically, following files being part of the PMA Software Framework must be added to a PMA Software Project:

- STARTUP_PMA71xx_PMA51xx.A51
- Reg_PMA71xx_PMA51xx.h
- PMA71xx_PMA51xx_Library.h
- PMA71xx_PMA51xx_Library.LIB

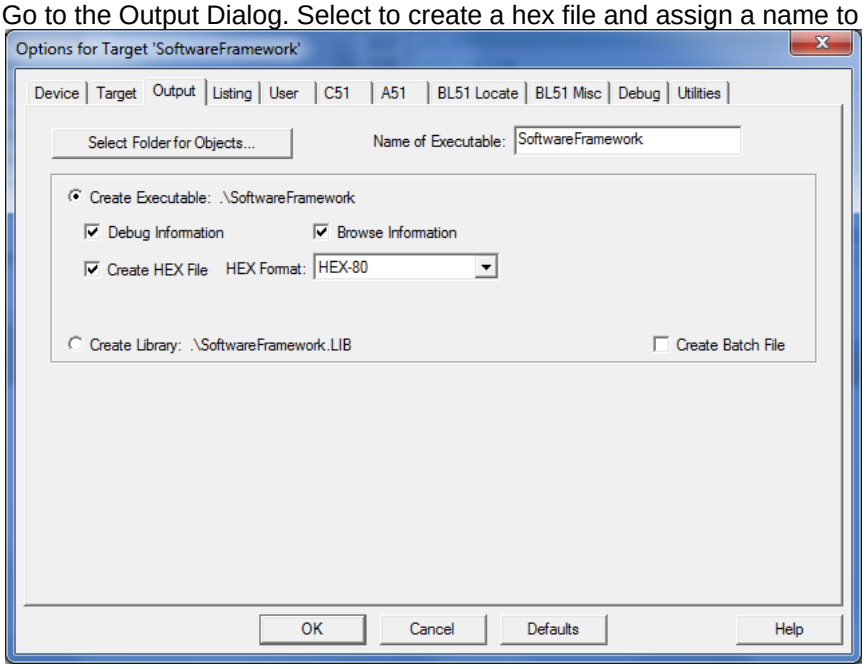
4. Adjust the settings for your project: Right click on your project and click **Options for Target.**



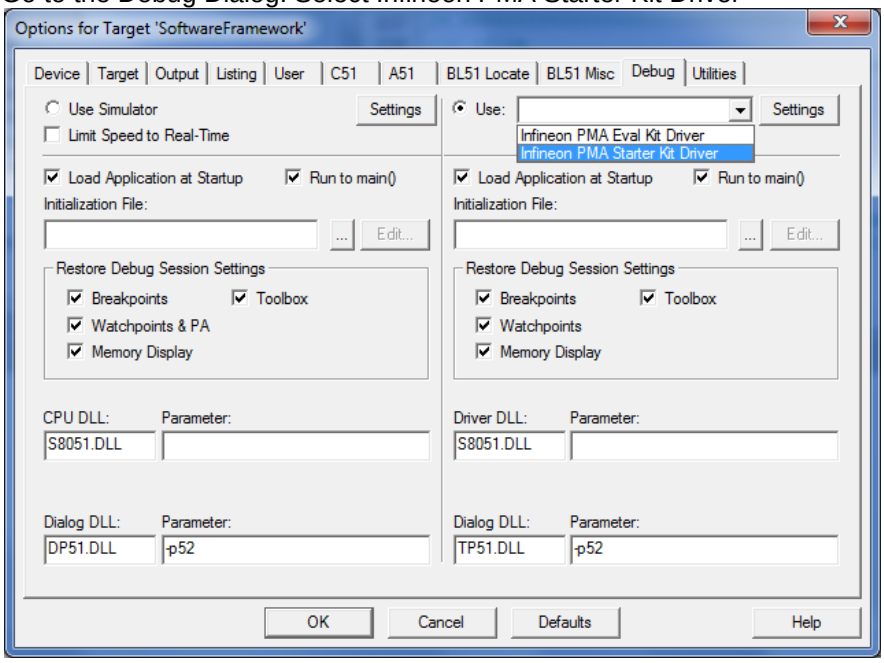
5. Go to the Target Dialog. Make sure to use the On-chip ROM (Flash memory) for code development.



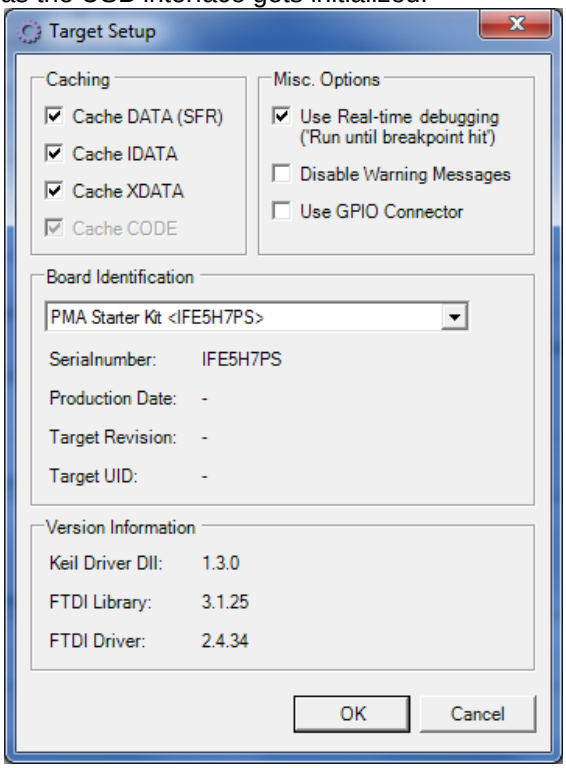
6. Go to the Output Dialog. Select to create a hex file and assign a name to it.



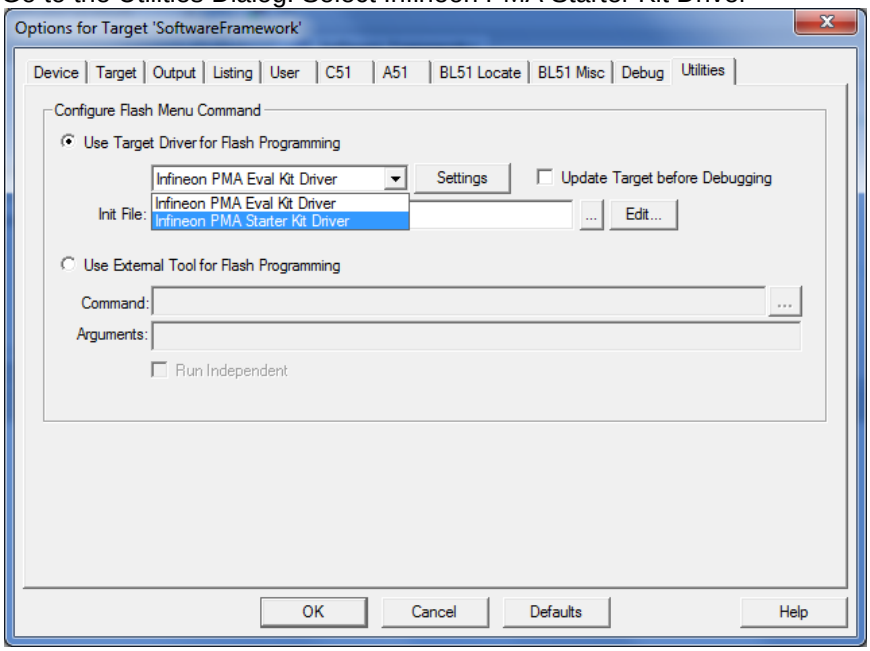
7. Go to the Debug Dialog. Select Infineon PMA Starter Kit Driver



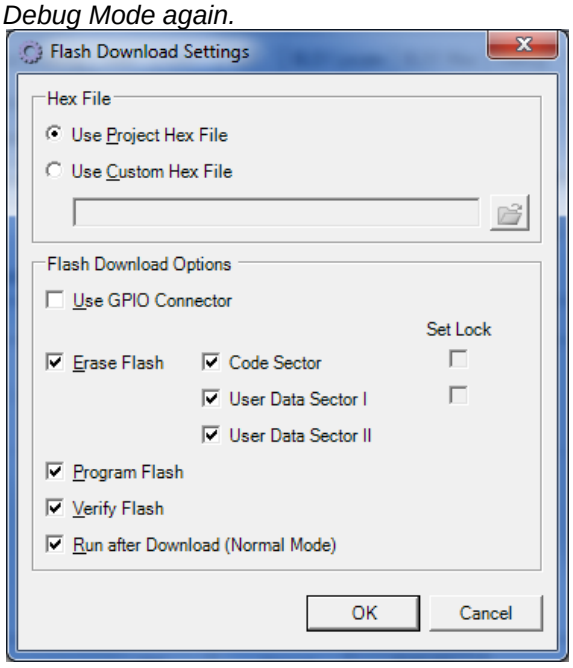
8. Press the Settings button: Note: If it is the first time after connecting your board this may take a few seconds as the USB interface gets initialized.



9. Go to the Utilities Dialog. Select Infineon PMA Starter Kit Driver



10. Press the Settings button. Select the Program Flash option. Don‘t forget to erase the Flash before downloading (default setting). *Note: If you select the Set Lock option you cannot re-enter Programming- or Debug Mode again.*



3.4 Step 4 – Use of the PMA on-chip Debugger

The Keil C51 µVISION4 Tool Chain provides a powerful debugger which is directly accessing the PMA hardware. Following features are available:

- Multi- or single step execution
- Run until cursor line
- Step over
- Up to 25 breakpoints
- Run interruptible (Run/Stop)
- Real-time Run (‚Run until Breakpoint‘)
    - Not interruptible
    - One breakpoint
- Memory r/w access possible (SFR, IData)

Following restrictions apply when using the PMA on-chip Debugger:

3.4.1 Hardware Breakpoints: Real Time debugging

The on-chip debug handler on the PMA51xx/PMA71xx is based on two hardware breakpoints. As a consequence the debugger functions *Run (F5)*, *Step Over (F10), Run to Cursor line (Strg+F10)* are internally a rapid sequence of *Step (F11).* This single stepping will not execute the instructions in the same execution time as in *Normal Mode*.

RF transmission or bus transfer will show a slower baud rate, timers keep running on full speed whilst code execution is delayed. This may cause the system to be incompatible to *Normal Mode* environment.

Full-speed debugging can be achieved by setting the *Use Real-time debugging* flag. Be aware that if the hardware breakpoint is not hit the communication to the target is lost.

3.4.2 Hardware Breakpoints: Debugging of interrupt functions

The two hardware breakpoints are provided to help debug program execution. It is not possible to display interrupt handling during debugging using the functions *Run (F5)*, *Step Over (F10), Run to Cursor line (Strg+F10).*

In this way it is possible to debug the code not in real-time whilst time-critical functions are handled in interrupt service routines in real-time between the (rapid) single steps. Be aware that interrupt service routines may alter SFRs and variables.

When an interrupt service routine shall be debugged a Breakpoint has to be set into the Interrupt service routine and the option *Use Real-time debugging* has to be selected. Once the interrupt service routine is active (Breakpoint hit) single stepping can be continued.

3.4.3 Debugging of Clear-on-Read SFRs

The Debugger fetches SFRs for displaying in the Watch window. SFRs that contain Clear-on-Read flags will be displayed correctly in the Watch window of the Debugger, nevertheless the fetch for the Watch window clears the flag contents and will cause the instructions to be executed invalid.

3.4.4 Debugging of functions out of the PMA Function Library

Debugging of the PMA Function Library is blocked. It is not possible to step through the lines of code that are stored in the ROM. The debugger automatically steps thru the PMA Function Library without interaction to the Debugger. After the return instruction in the ROM the debugging can be continued. It is possible to execute functions out of the PMA Function Library in real-time debugging mode by *Use Real-time debugging* and *Run to Breakpoint*.

4 PMA RF USB Stick as Flash Programmer for external PMA Systems

The PMA RF USB Stick may be used as a Flash Programming Interface for in-circuit-programming of an external PMA IC.

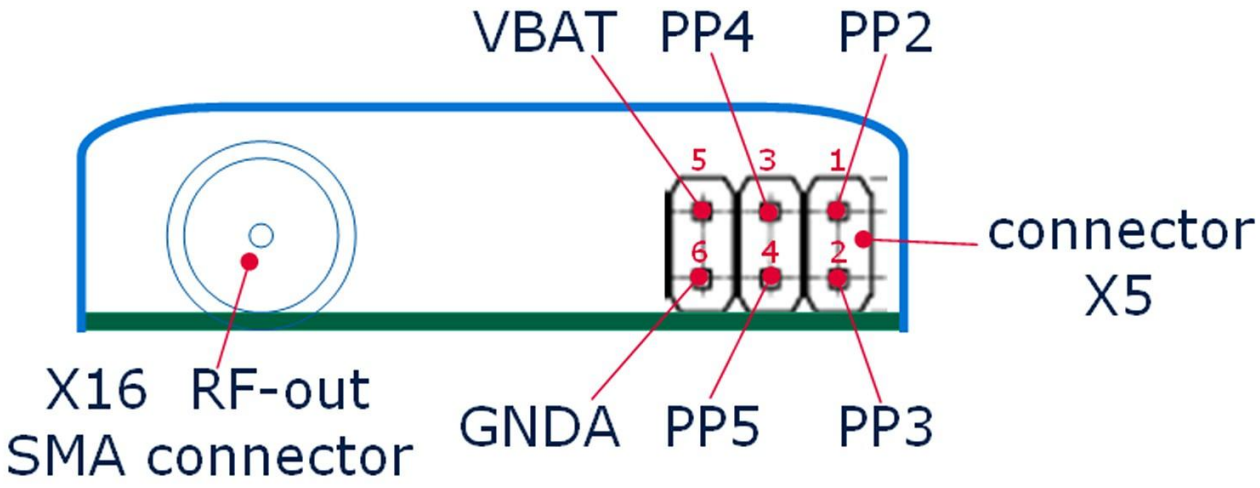
4.1 Hardware Setup

For that purpose, the GPIO-signals available on connector X5 of the PMA RF USB Stick have to be connected to some pins on the PMA-IC to programmed:

Table 2 Signal to be connected for using the PMA RF USB Stick as Programmer

PMA RF USB stick (connector X5)		PMA IC to be programmed		signal function
Pin #	**Signal name**	**IC pin #**	**Signal name**	
1	PP2		PP0	I²C clock
2	PP3		PP1	I²C data
3	PP4		xReset	reset
4	PP5		MSE	mode select enable
5	VBAT	not connected	n.a.	
6	GNDA		GND	

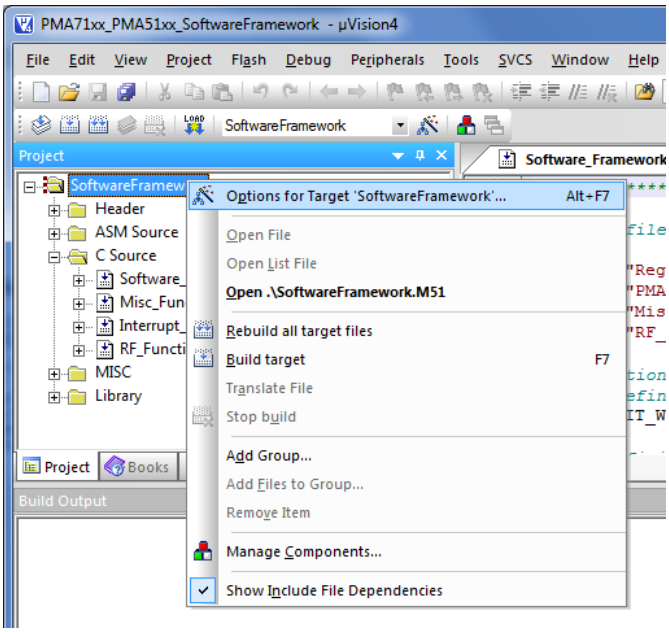
The power supply of the external PMA device to be programmed must be provided from an external source. It is not recommended to supply the external IC using the VBAT output provided on pin 5 of connector X5 of the PMA RF USB stick.



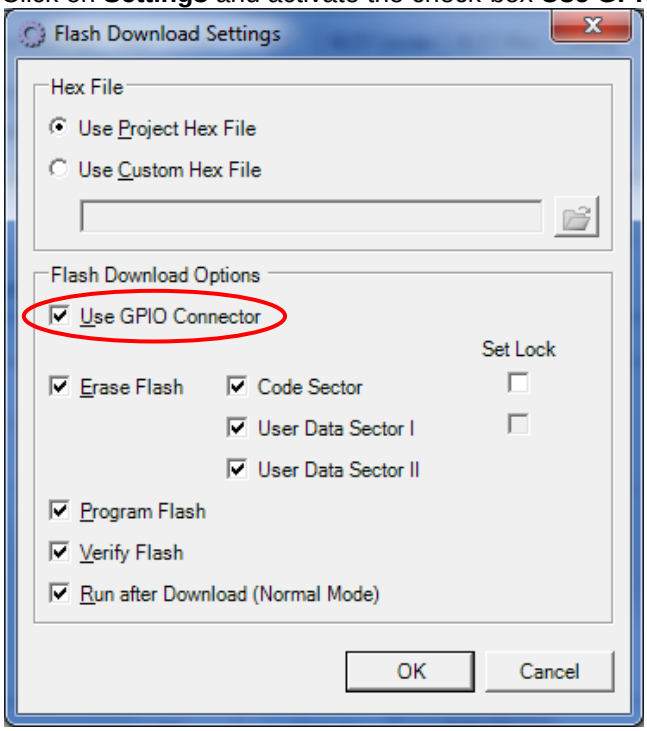
4.2 Software Setup

If you want to download code to an external PMA system connected to your PMA RF USB Stick you have to configure the Keil C51 µVISION4 Tool Chain as follows:

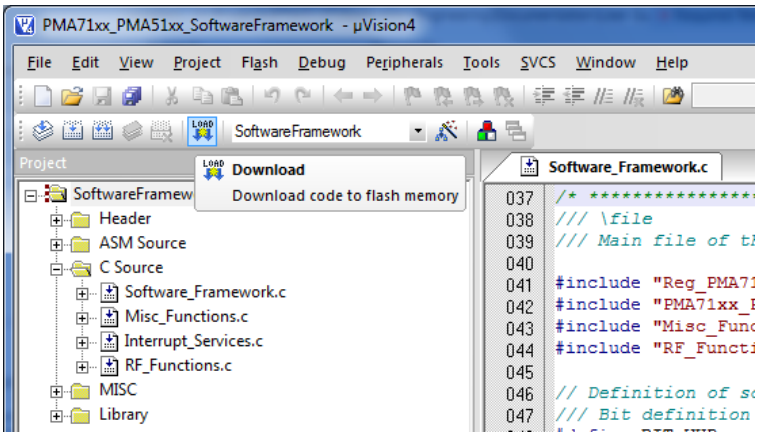
1. Adjust the settings for your project: Right click on your project and click **Options for Target.**



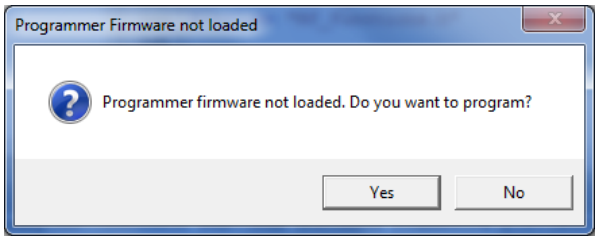
2. Go to the **Utilities** dialog and select **Infineon PMA Starter Kit Driver** as your Target Driver for Flash Programming.
3. Click on **Settings** and activate the check-box **Use GPIO Connector**.



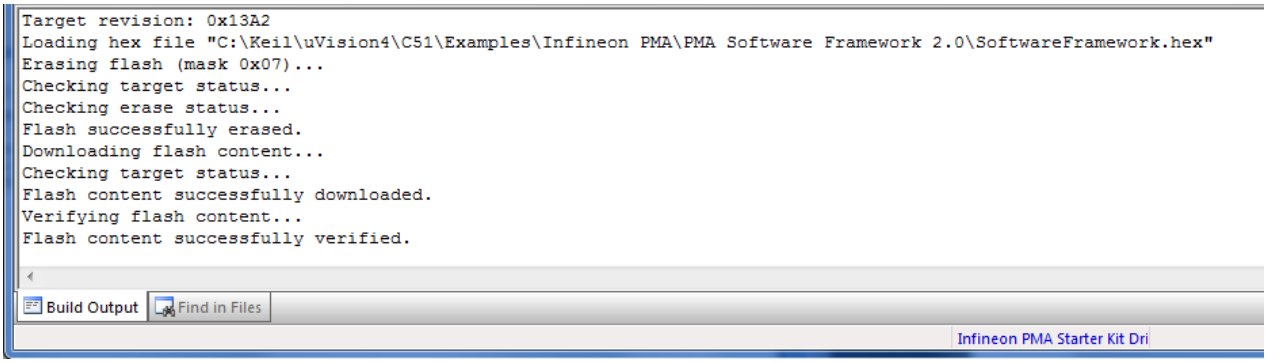
4. Download your program code by pressing the **Load** button.



5. When hitting the **Load** button for the first time, there will be a Flash programming firmware automatically loaded into the PMA RF USB Stick. You have to confirm by hitting the **Yes** button:



6. Flash programming of the external PMA system is finished after a few seconds with the message *Flash content successfully verified*.



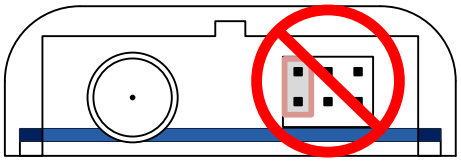
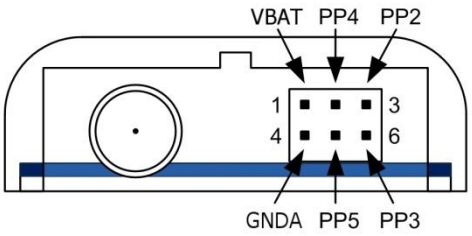
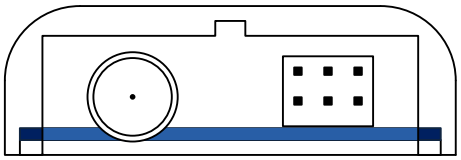
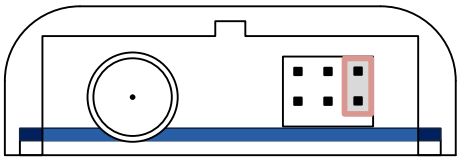
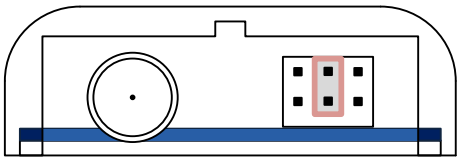
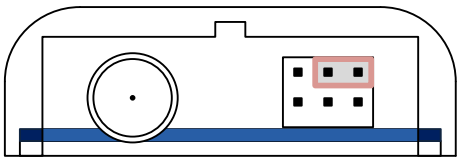
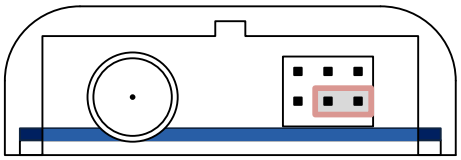
5 Pre-installed PMA Test Software

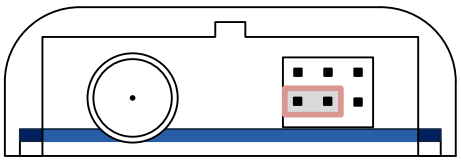
Upon shipment of the PMA Starter Kit there is a test software stored in the PMA Flash memory. This program code will be executed automatically after first power-on.

Main features are

- LED flashing
- RF Continuous Wave Output
- PMA IC Revision indication.

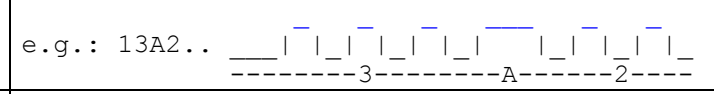
The different test modes may be selected by setting a jumper on the related position of connector X5:

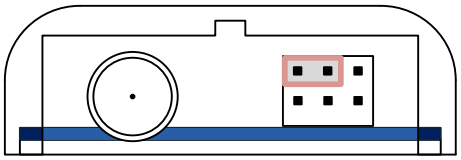
	Do not connect Pin 1 and 4 with a jumper as this would shortcut the power supply and may damage your PMA USB RF Stick
	Pin out of the PMA USB RF Stick
	LED D5 and D6 are blinking
	Continuous 315MHz
	Continuous 434MHz
	Continuous 815MHz
	Continuous 915MHz



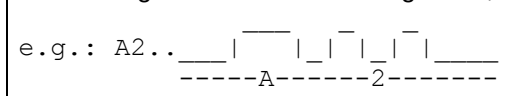
Software (ROM) Revision number is displayed on LD 6 (PP9):

First digit is not shown!
Second digit: Short flash counting: 1→1, 2→2, ….
Third digit: Long flash counting: 1→A, 2→B, …
Fourth digit: Short flash counting: 1→1, 2→2, ….





ASIC Revision number is displayed on LD 5 (PP8):
First digit: Long flash counting: 1→A, 2→B, …
Second digit: Short flash counting: 1→1, 2→2, ….



All other possible jumper settings don’t have any test mode assigned. LED D5 and D6 will flash alternately.

w w w . i n f i n e o n . c o m

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