UM1568
User manual

MicroXplorer 3.1 graphical configuration tool

Introduction

MicroXplorer 3.1 is an intuitive graphical tool for STM32 MCU families with the following key features:

- Easy pinout configuration via the selection of the peripherals required by the application
- GPIO configuration (input, output or peripheral alternate function) and generation of corresponding initialization code
- Power consumption calculation for STM32L low-power family

MicroXplorer facilitates finding the MCUs most relevant for an application by filtering down the MCU portfolio according to the selection of peripherals required by the application.

MicroXplorer assigns the pins required based on the peripheral mode selected.

As STM32 MCUs allow the same pin to be used by different peripherals and functions (alternate functions), MicroXplorer searches for the pinout configuration that will best fit user's selection of peripherals and highlights conflicts when cannot be resolved.

On the pinout view, MicroXplorer provides two ways to configure the microcontroller:

- Selecting appropriate operating mode for each peripheral via the Peripherals panel
- For advanced users, manually mapping a peripheral function to a physical pin on the Chip view showing the pinout.

On the Power Consumption view, MicroXplorer allows the user to select a microcontroller part number and a battery type, define a sequence of steps representing his application cycle and automatically obtain power consumption and battery life results.

Table 1 lists the development tools concerned by this user manual.

Table 1. Applicable tools

Type	Applicable tools
Development tools	MicroXplorer

Figure 1. MicroXplorer graphical configuration tool

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1 Quick steps to install and run MicroXplorer

1.1 Installation

1. Double-click the MicroXplorer-Setup.exe file to launch the installation wizard that will guide you through the installation steps.
2. If you do not have a proper version of the Java Runtime Environment (1.6 update 7 minimum), the wizard proposes you to download it and stops. Restart the installation after the installation of Java.
3. When the installation is successful, a MicroXplorer icon is displayed on your desktop and the configuration files (.ioc files) are associated with it.

1.2 Run

From your desktop, double-click **MicroXplorer** shortcut.

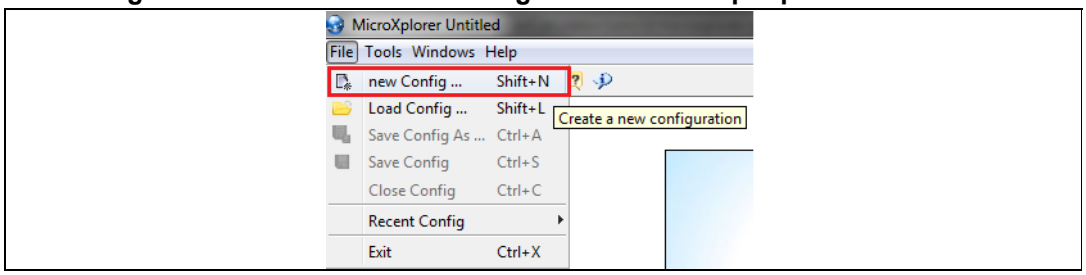
2 Getting started

2.1 Create a new configuration without peripheral(s) selection

MicroXplorer and its plugins are started once an MCU has been selected.

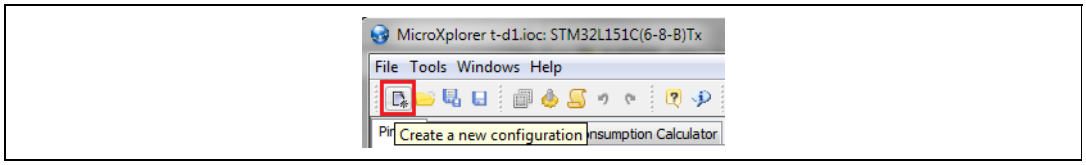
To create a new configuration, select the **new Config** submenu from the **File** menu (see *Figure 2*).

Figure 2. Creation of a new configuration without peripheral selection



Or use MicroXplorer **Create a new configuration** button (see *Figure 3*).

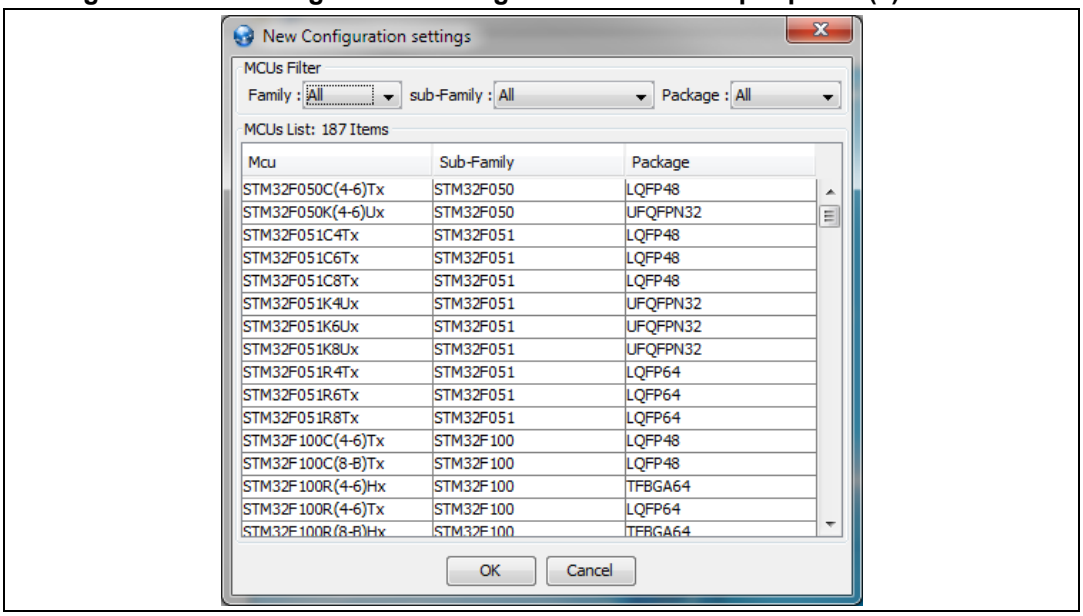
Figure 3. Creation of a new configuration without peripheral selection using menu button



Select an MCU by choosing in **New Configuration settings** window:

1. A **Family** (optional)
2. A **sub-Family** (optional)
3. A **Package** (optional)
4. A specific **MCU** from the **MCUs List** (see *Figure 4*)

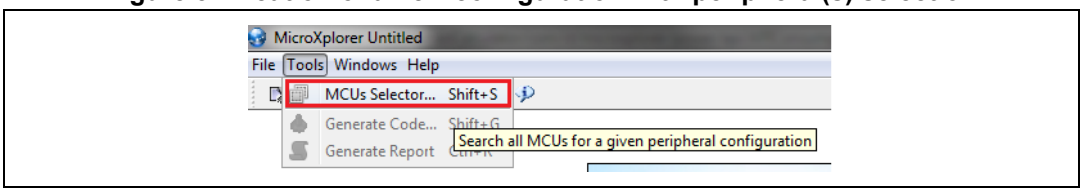
Figure 4. New Configuration settings window without peripheral(s) selection



2.2 Create a new configuration with peripheral(s) selection

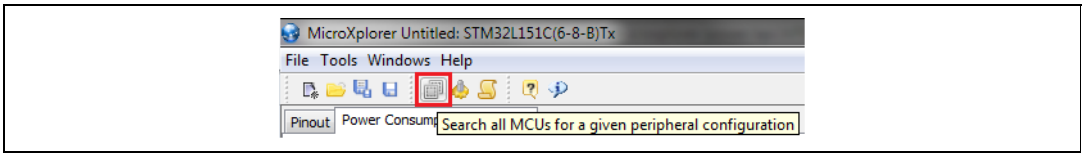
To create a new configuration with peripheral(s) selection, select **MCUs Selector** submenu from the **Tools** menu (see *Figure 5*):

Figure 5. Creation of a new configuration with peripheral(s) selection



Or use MicroXplorer **Search all MCUs for a given peripheral configuration** button (see *Figure 6*).

Figure 6. Creation of a new configuration with peripheral(s) selection using menu button

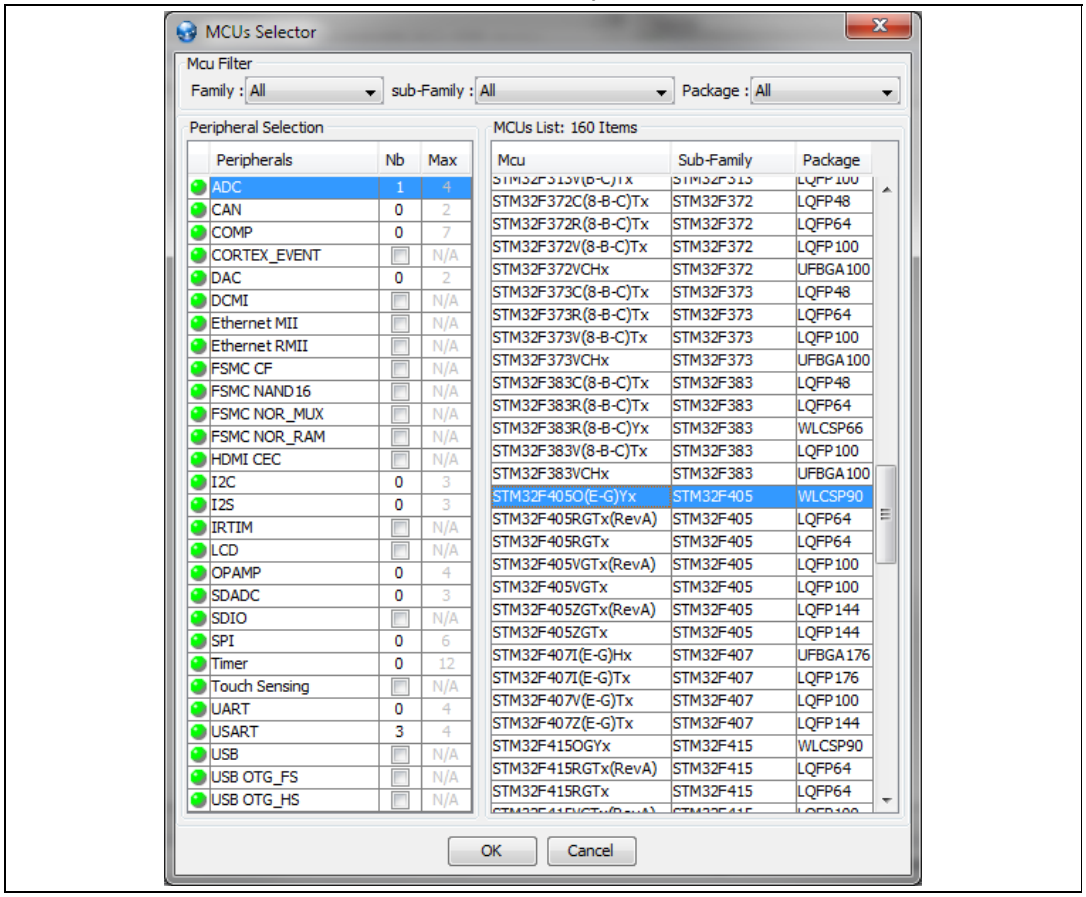


Select an MCU by choosing in **MCUs Selector** window:

1. A **Family** (optional)
2. A **sub-Family** (optional)
3. A **Package** (optional)
4. Peripheral(s) (optional) in **Peripheral Selection** by checking or indicating the number of peripherals required (lower or equal to the maximum authorized)
5. A specific **MCU** from the **MCUs List**

MCUs displayed are the ones compatible with the peripheral(s) selected (see *Figure 7*).

Figure 7. New configuration settings window with peripheral selection (MCUs Selector)

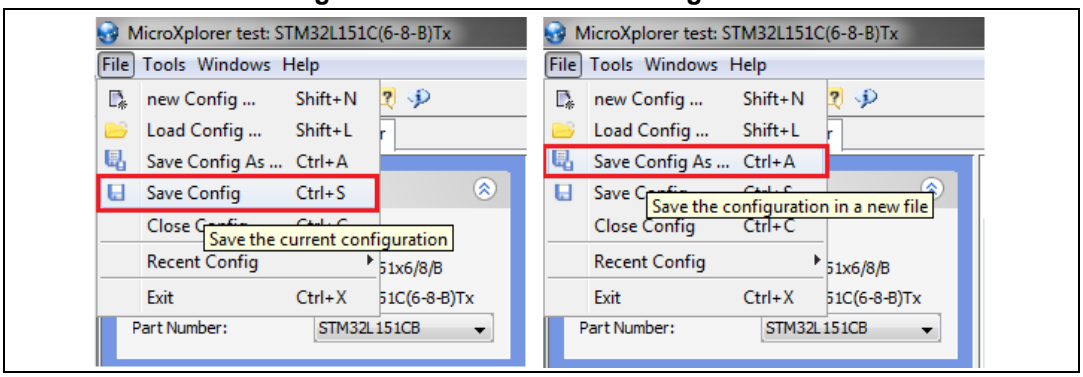


2.3 Save a configuration

To save a complete configuration (i.e. all the work done in MicroXplorer and its plugins views), perform here the sequence below:

1. Click on **Save Config** or on **Save Config As** submenu in the **File** menu (see *Figure 8*)
2. Browse to a user-defined location and give a proper name to the configuration file (*.ioc)
3. Click on **Save** button. The current configuration is stored as an "ioc" file with a fixed name and it can be loaded later on.

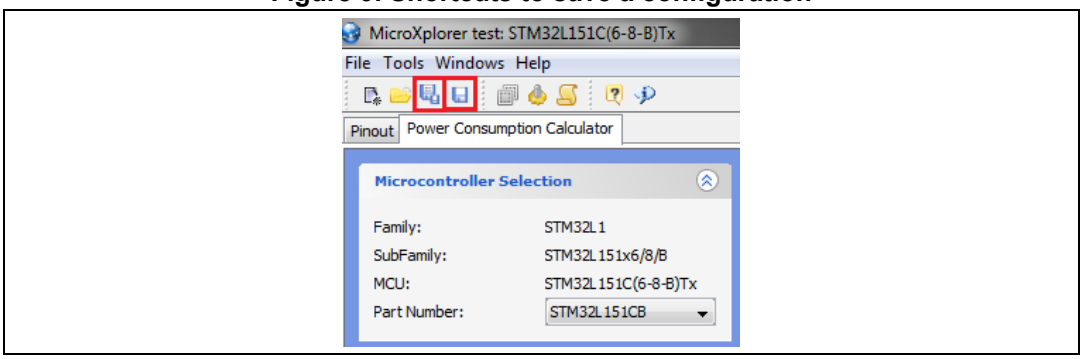
Figure 8. Menus to save a configuration



Note: The saved configuration can be reloaded later, either using File>Load Config menu, or double-clicking on the "ioc" file from Windows Explorer.

Shortcuts allow to perform the above actions (see *Figure 9*).

Figure 9. Shortcuts to save a configuration

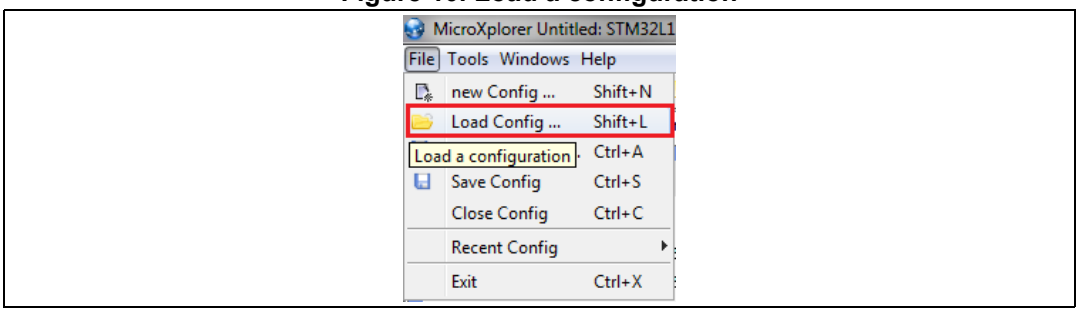


2.4 Load a previously saved configuration

From MicroXplorer, the user can browse previously saved configurations as .ioc files and select one to be loaded by the application.

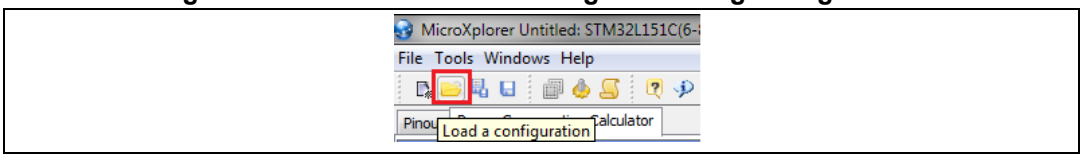
To load a configuration, select **Load Config** submenu under **File** menu (see *Figure 10*), browse to the directory holding the saved configurations and select the relevant .ioc file.

Figure 10. Load a configuration



Or use the **Load configuration** shortcut (see *Figure 11*).

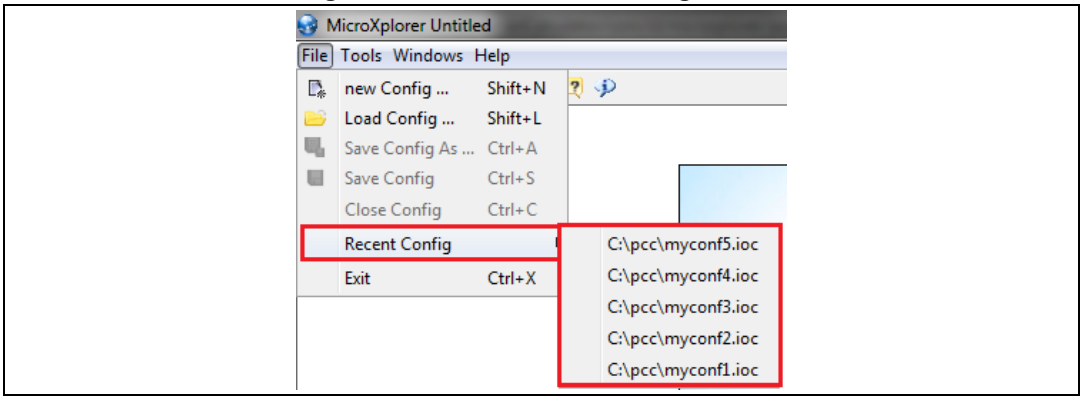
Figure 11. Shortcut to start loading an existing configuration



2.5 Load a recently saved configuration

To load a recent configuration, select **Recent Config** submenu under **File** menu and select a configuration from a list of recently saved configurations (see *Figure 12*).

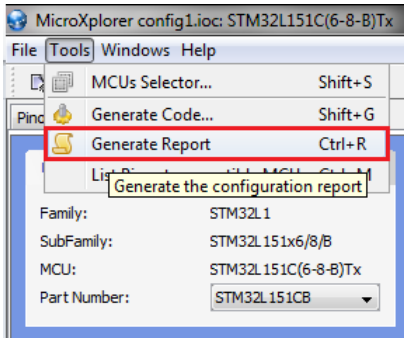
Figure 12. Load a recent configuration



2.6 Generate a PDF report

A PDF report of the current configuration can be generated at any moment, by selecting **Generate Report** submenu under the **Tools** menu (see *Figure 13*).

Figure 13. Generate Report



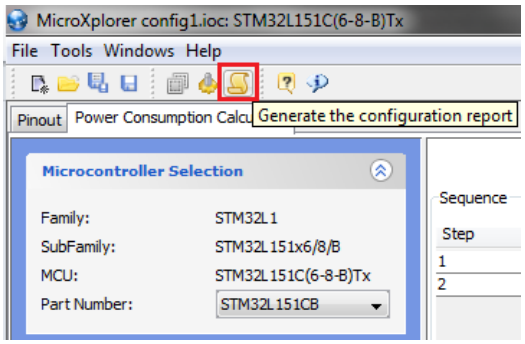
1. The report is generated to a fixed predefined location, the same location as the one selected by the user to store his configurations (see *Figure 14*).

Figure 14. Report Generation message

2. With Adobe Reader, open the PDF report containing chapters related to pinout and current plugins configuration.

A shortcut is also available to generate reports (see *Figure 15*).

Figure 15. Shortcut to generate a configuration PDF report

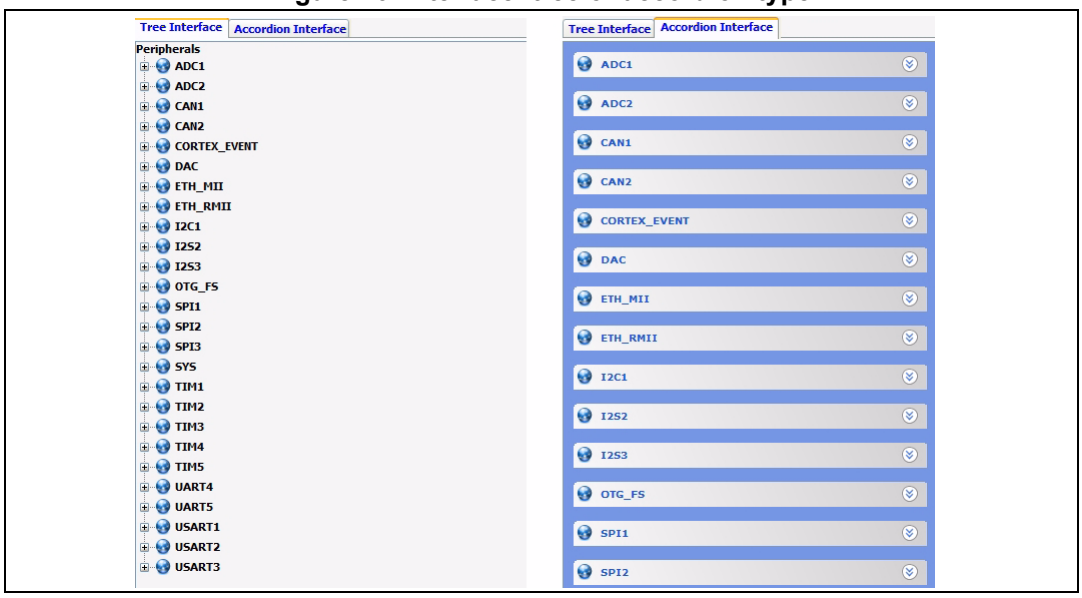


3 Main MicroXplorer components

3.1 Peripherals panel

The **Peripherals** panel can be displayed as a **Tree Interface** or as an **Accordion Interface**.

Figure 16. Interface: tree or accordion type



Use the **Peripherals** panel shown in the left window, to select the peripheral mode (e.g. SPI1 Full-duplex-master mode). Each time a mode is set, the Chip view shown in the right window displays the new state of the pin(s).

If the selected peripherals use the same pins, MicroXplorer tries to solve the conflicts by remapping these mode functions to other pins.

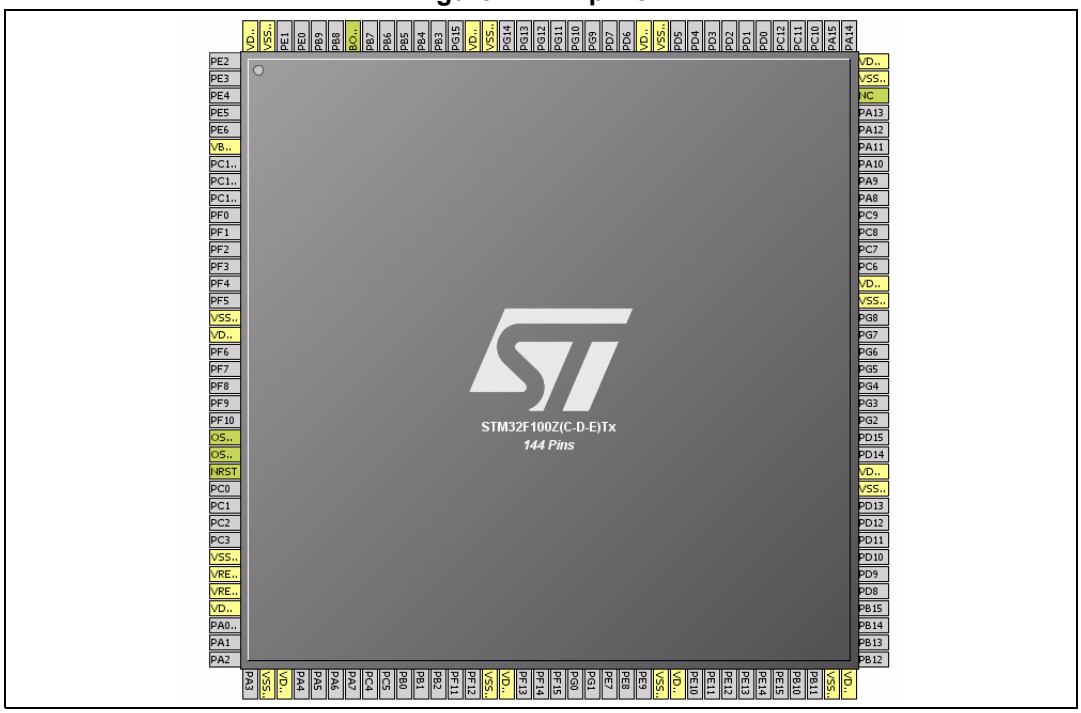
If the conflict cannot be solved by remapping this mode:

- Try to select the peripherals in a different sequence (**Keep User Placement** box is checked),
- Let MicroXplorer try all the remap combinations for all the blocks to find a solution (**Keep User Placement** box is unchecked).

If the conflict remains, MicroXplorer displays a Conflict message for the affected peripheral.

3.2 Chip view

Figure 17. Chip view



The Chip view, in the right window, shows a graphical representation of the pinout of the selected MCU for the selected package (BGA, QFP,...). Each pin is represented with its name (e.g. PC4) and its current function assignment (e.g. ETH_MII_RXD0).

Using the Chip view requires to have a knowledge of the MCU and of its pin assignment. In this view, individual pins can have specific functions assigned to them.

The basic functions you can use with the chip view are the following:

- Zoom in and zoom out using  . These functions are available from the toolbar or using the mouse wheel
- Move the chip view by clicking and dragging it
- Automatically best fit the view in the available space using  on the toolbar

Some basic controls, such as the coherence of blocks of pins, are built-in (see *Appendix A: Basic rules of the pin assignment*).

To modify a pin assignment:

1. Click the pin to show the list of all possiblities (other possible alternate functions) together with the current assignment highlighted in blue.
2. Select the new function to modify the pin assignment.

To manually remap a function to another pin:

1. Press the Ctrl key and click the pin. The possible remapping places are then highlighted in blue.
2. Drag the function to the target pin.

Manual remapping can be performed to try and solve mode conflicts when you cannot use the mode of a peripheral because one of the signals of that mode cannot be assigned to a free pin.

Caution: A pin assignment performed from the Chip view overwrites any previous assignment.

4 Tutorial

This tutorial gives a step-by-step presentation of an example on how to:

- Find and configure an STM32 Microcontroller (MCU), for example to use the Ethernet and USB peripherals
- Remap peripherals, save your current configuration and reload an older one
- Configure the GPIOs (input, output or peripheral alternate function)
- Automatically generate the corresponding initialization code.

4.1 Find an STM32 microcontroller (MCU) using the MCUs Selector

Follow the sequence below to find the subset of STM32 MCUs that contains all the peripherals that you need for your application. As an example, you should perform the following actions if you need one Ethernet MII and one USB OTG_FS:

1. Open the **Tools** menu.
2. Select the **MCUs Selector** submenu.
3. Select Ethernet MII and USB OTG_FS from the Peripheral Selection list on the left side of the **MCUs Selector** window (see *Figure 18*).
4. Select an MCU (for example **STM32F207VxTx)** from the **MCUs List** located on the right side of the **MCUs Selector** window (see *Figure 18*).

Caution: This window allows you to select an MCU that features all the required peripherals, but it does not guarantee that all the peripherals will be able to work at the same time with the modes that you will configure later.

5. Click **OK**. The main window opens for the given MCU (see *Figure 19*). It shows the MCU pinout together with the list of peripherals. In the lower part of the window, the **MCUs Selection** tab lists the MCUs, with a green check symbol in front of the selected one (see *Figure 20*).
6. Uncheck the **Windows/Outputs** menu to close the MCUs Selection Tab.

Figure 18. MCUs Selector

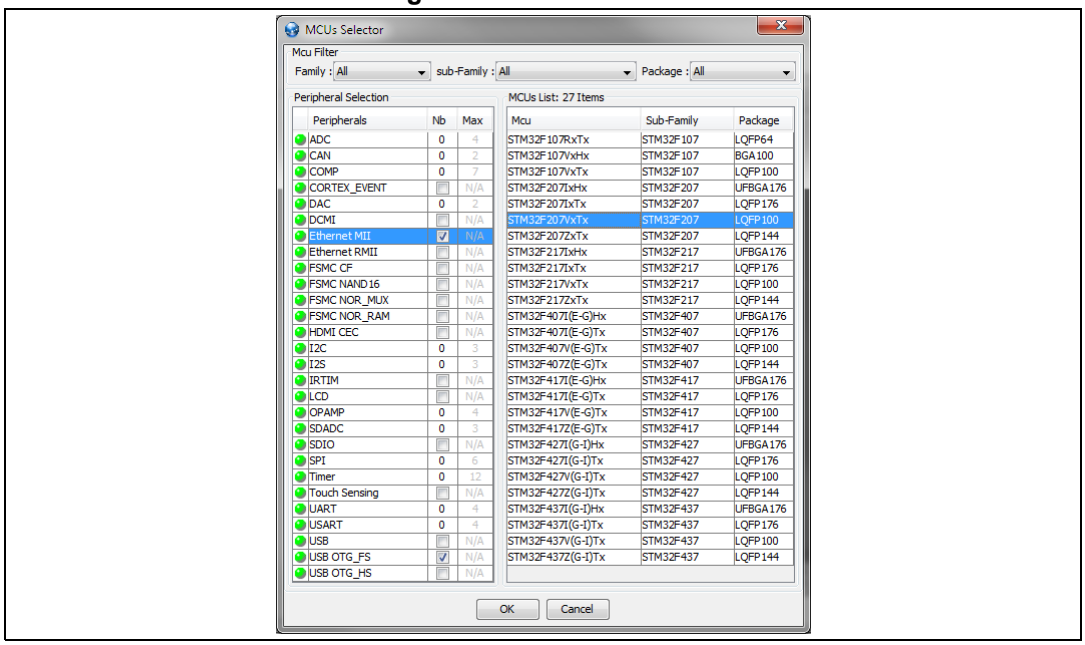


Figure 19. Main window

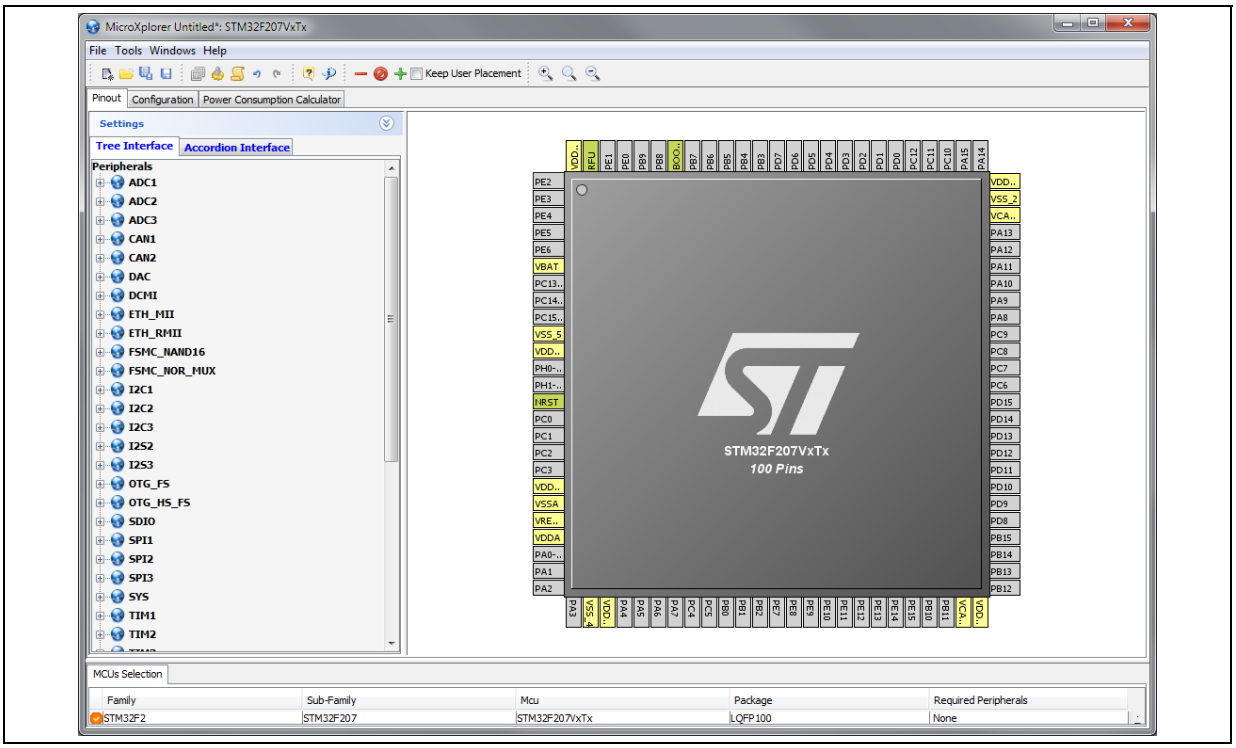
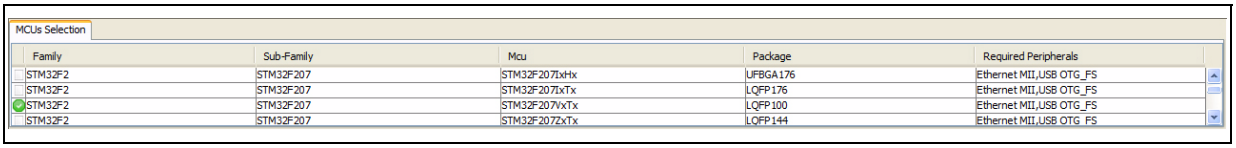


Figure 20. MCUs Selection tab



4.2 Map a peripheral using the Peripherals panel

4.2.1 Keep User Placement box checked

Configure the peripherals using the Peripherals panel.

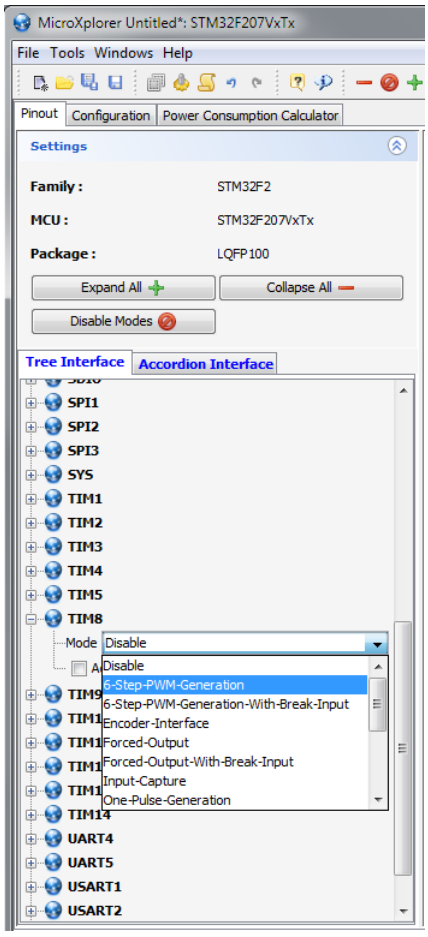
Keep User Placement means that, once it has been mapped, each peripheral function remains allocated (mapped) to a given pin.

1. Verify that **Keep User Placement** is checked (see *Figure 21*).

Figure 21. Keep User Placement box checked

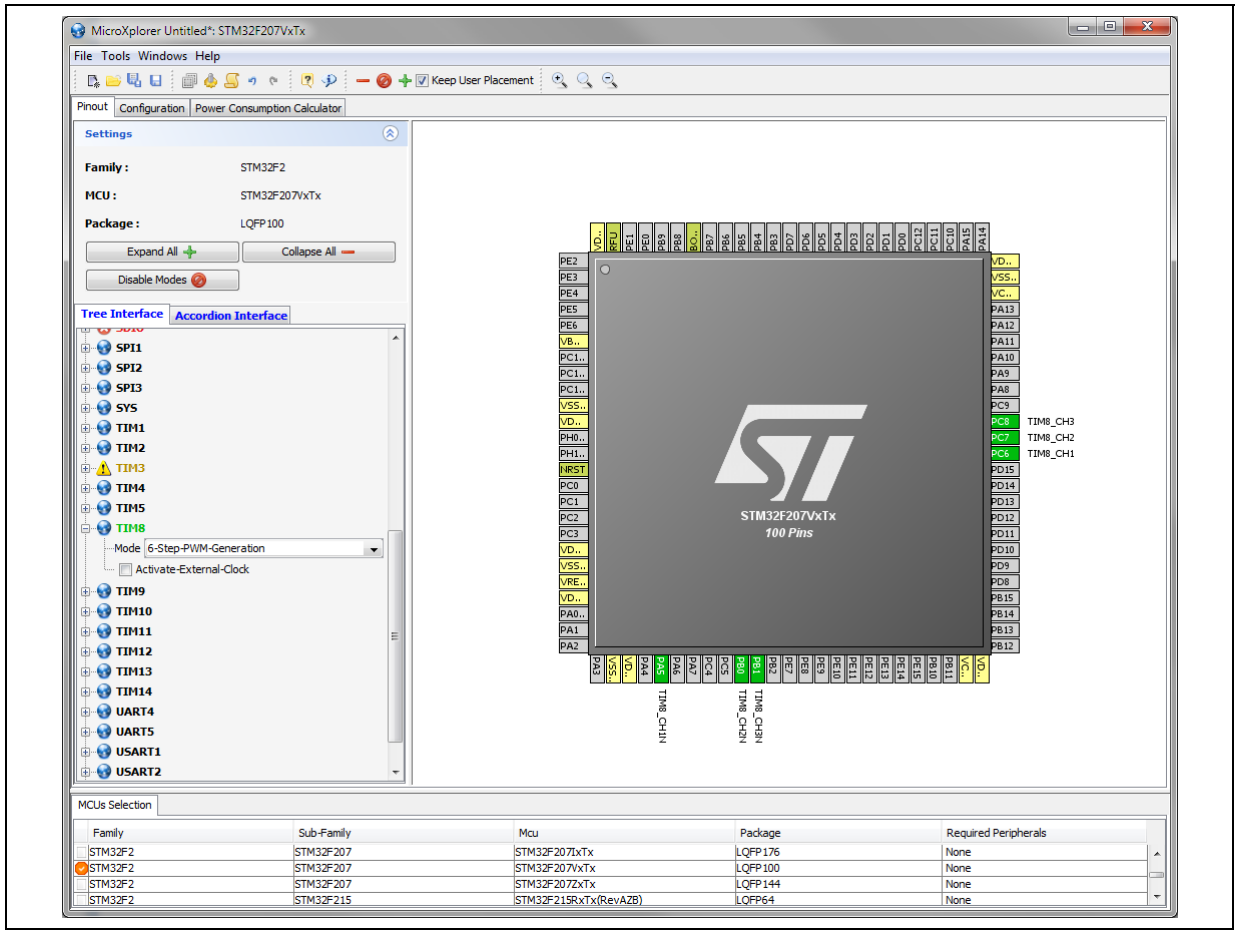
2. From the **Peripherals** panel (left window), select the **TIM8** peripheral to configure its mode in **6-step-PWM-Generation** mode (see *Figure 22*).

Figure 22. TIM8 configuration



You can then see in the Chip view that the functions needed by the **TIM8** peripheral to operate in **6-step-PWM-Generation** mode have been automatically mapped to the **PA5**, **PC6, PC7**, **PC8**, **PB0** and **PB1** pins (see *Figure 23*).

Figure 23. Automatic mapping of TIM8

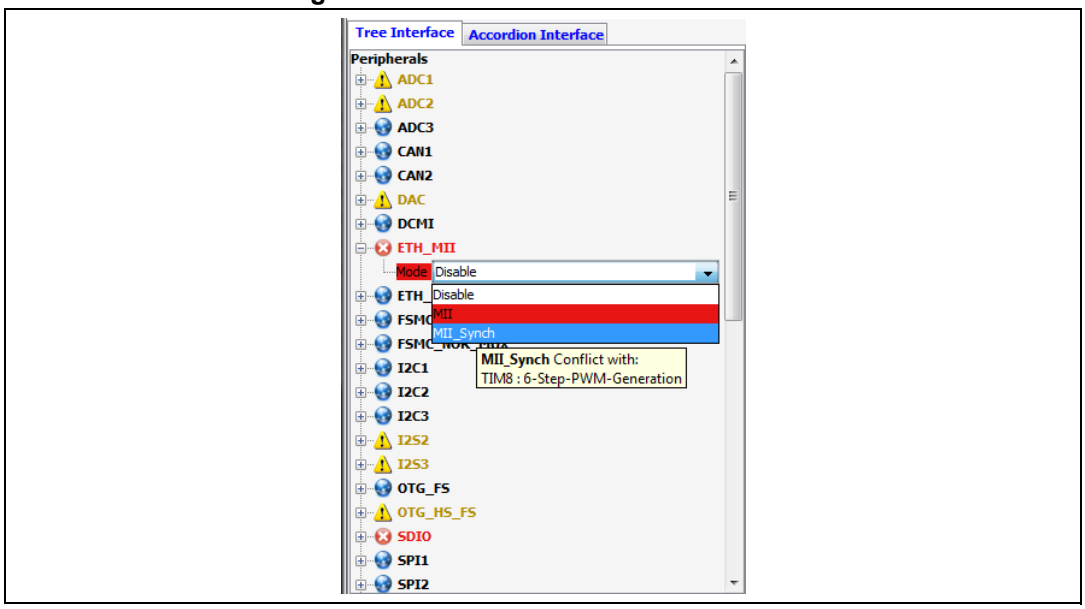


4.2.2 Keep User Placement box unchecked

Use the Peripherals panel to configure the peripherals without keeping the user placement. Unchecking the Keep User Placement box means that you allow any of the peripheral functions that have already been mapped to be moved to other pins by MicroXplorer.

The Ethernet **MII_Synch** mode is not available if you select it with the **Keep User Placement** box checked. The **MII_Synch** item is shown in red, and a Conflict pop-up message appears when the mouse pointer goes over it, indicating that there is a conflict with **TIM8** (see *Figure 24*).

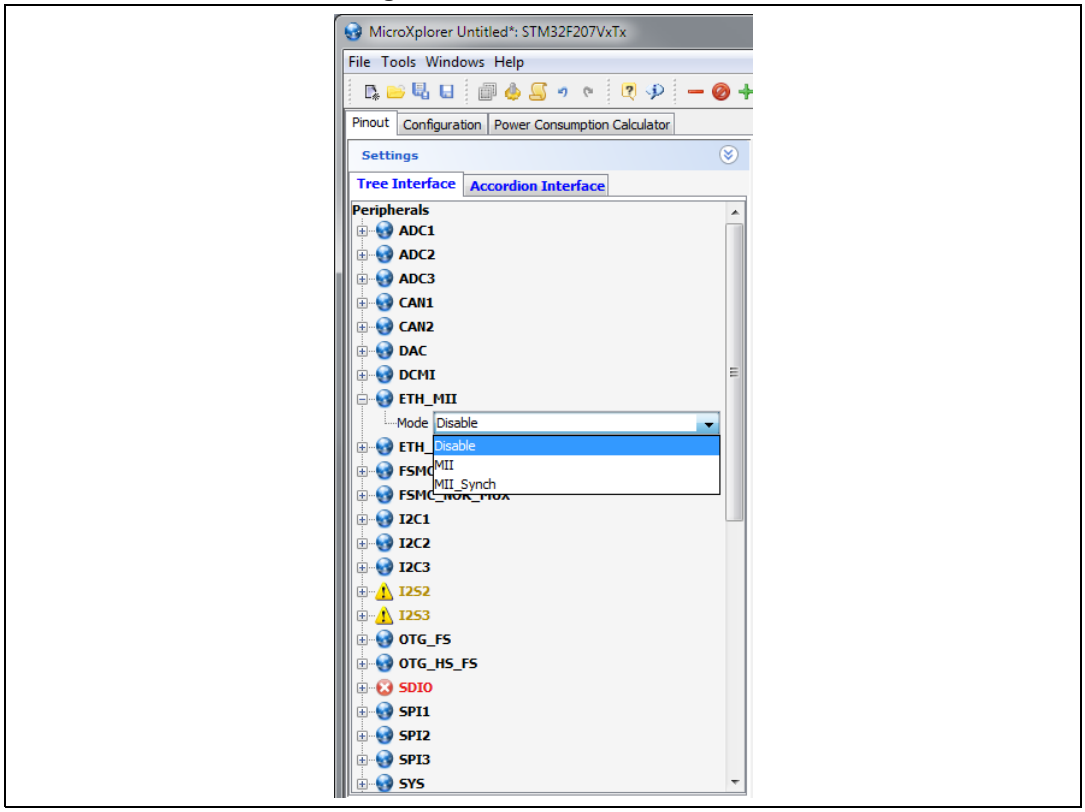
Figure 24. Conflict between MII and TIM8



To select the Ethernet MII mode:

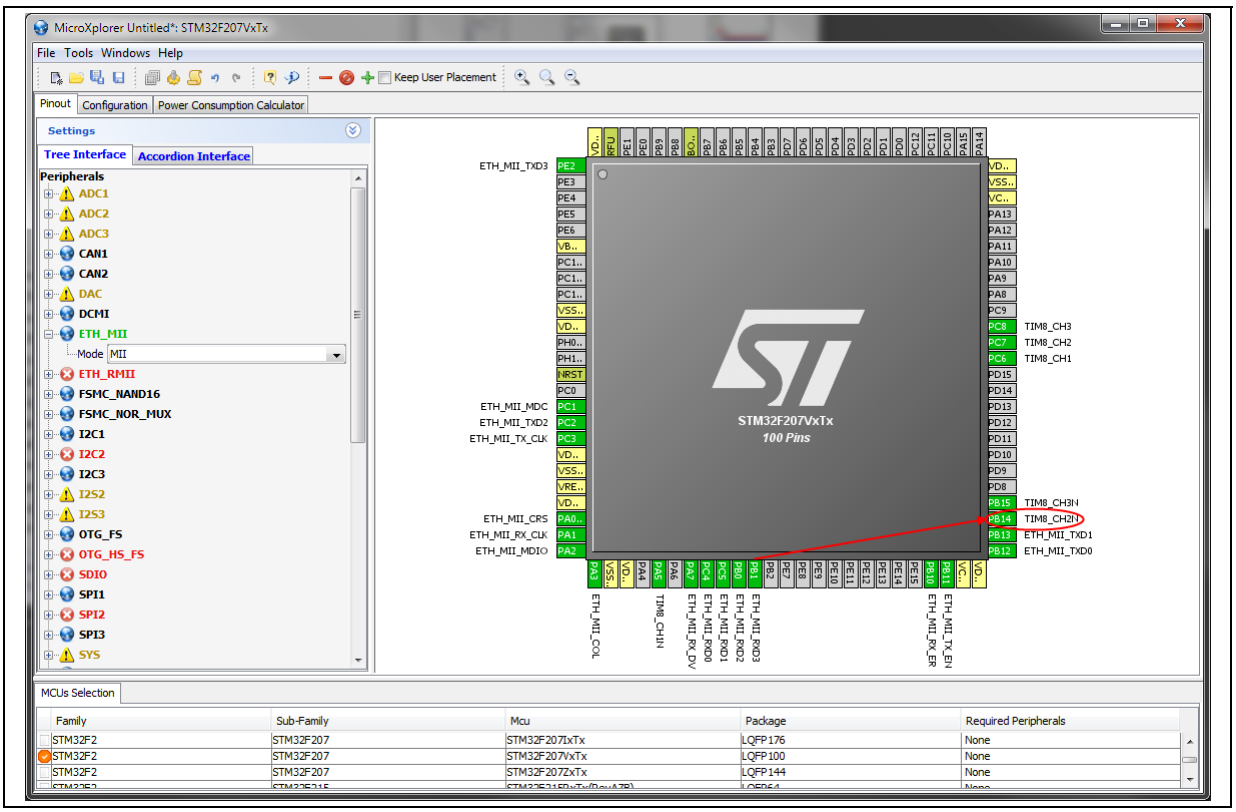
1. Since the Ethernet **MII** mode is not available, unselect the **Keep User Placement** checkbox. MicroXplorer then tries to find a solution by remapping all the selected peripheral modes. The Ethernet **MII** mode then becomes available (**MII** item in black, as in *Figure 25*) and you can select it.

Figure 25. MII mode selection



2. MicroXplorer shifts TIM8_CH3N signal from PB1 to PB15 pin, TIM8_CH2N signal from PB0 to PB14 pin, and then assigns PB1 to **MII** (see the result shown in *Figure 26*).

Figure 26. Signal reassignment



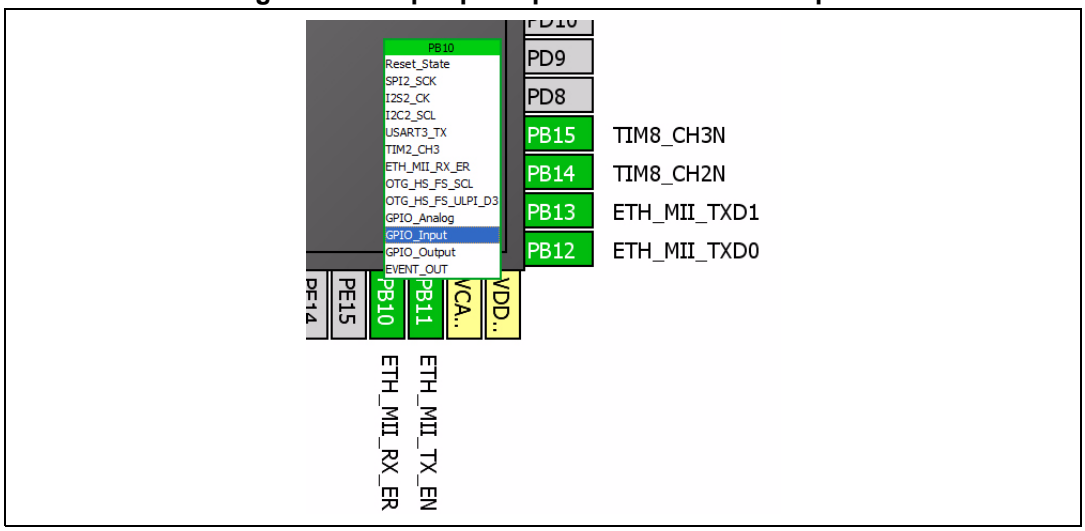
4.3 Map a function using the Chip view

Use the Chip view to “manually” allocate (map) a function or an I/O to a pin.

For example, map an I/O on **PB10**, and check that the previous **PB10** owner (**MII**) is unmapped:

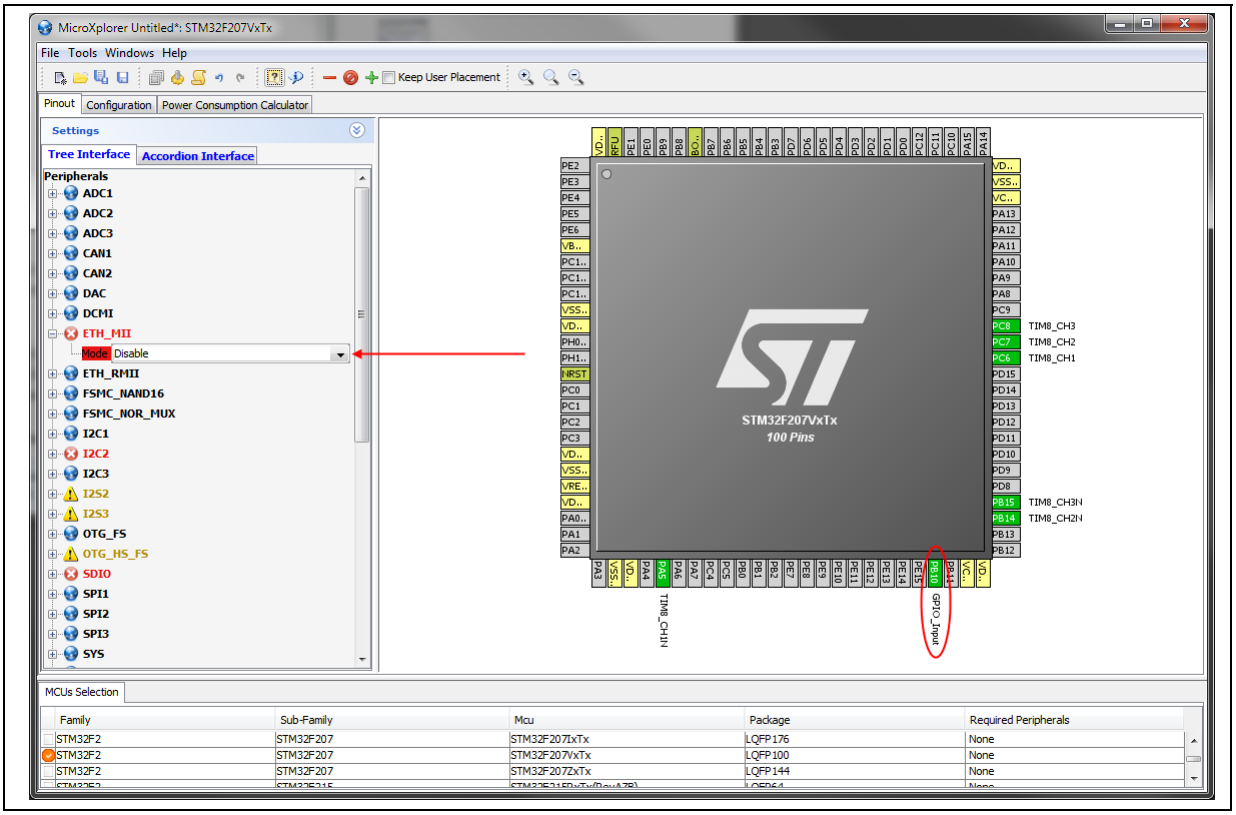
1. Zoom in on the package (use the mouse wheel).
2. Map the **PB10** pin as an **GPIO_Input** I/O: click **PB10**, and select **GPIO_Input** (see *Figure 27*).

Figure 27. Output push-pull selected on PB10 pin



The **GPIO_Input** I/O is now mapped to **PB10**, but MII is disabled and all MII pins have been unmapped, as you can see on *Figure 28*.

Figure 28. Ethernet MII pins unmapped

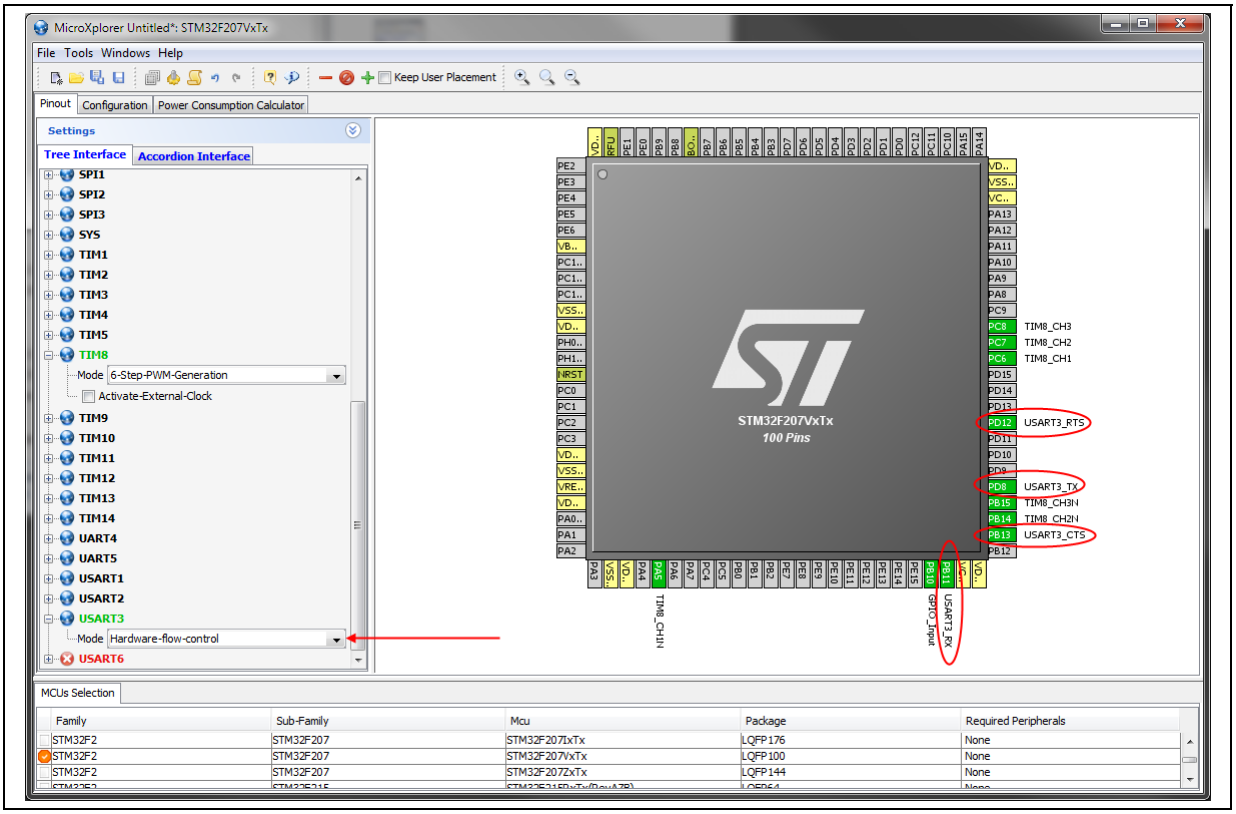


4.4 Remap a function to another pin using the Chip view

Use the Chip view to “manually” remap a function or an I/O to a pin. For example, graphically remap the **USART3_TX** function from **PD8** to **PC10**, and then map an I/O to **PD8**.

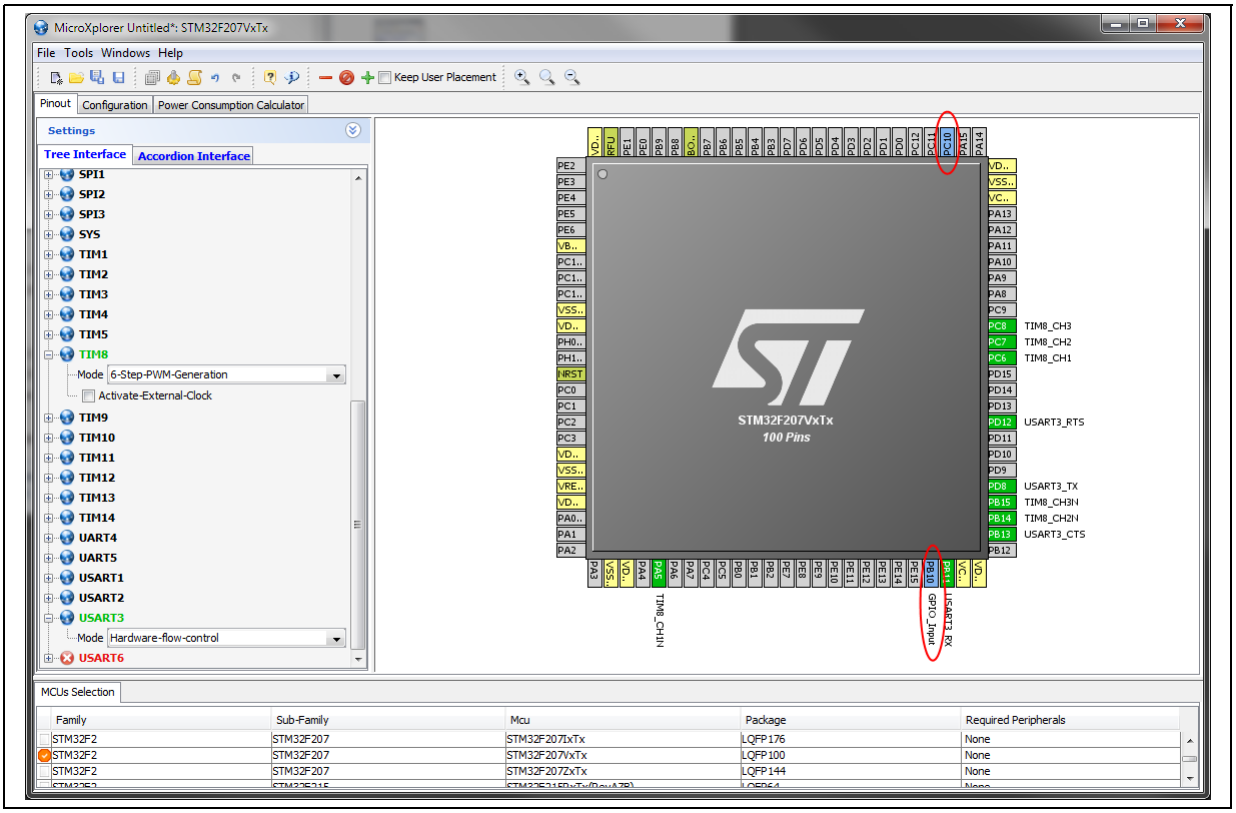
1. From the peripheral panel (left window), select USART3 and configure it to operate in **Hardware-flow-control** mode: PB11, PB13, PD8, and PD12 pins are then allocated to **USART3** (see *Figure 29*).

Figure 29. USART3 configuration



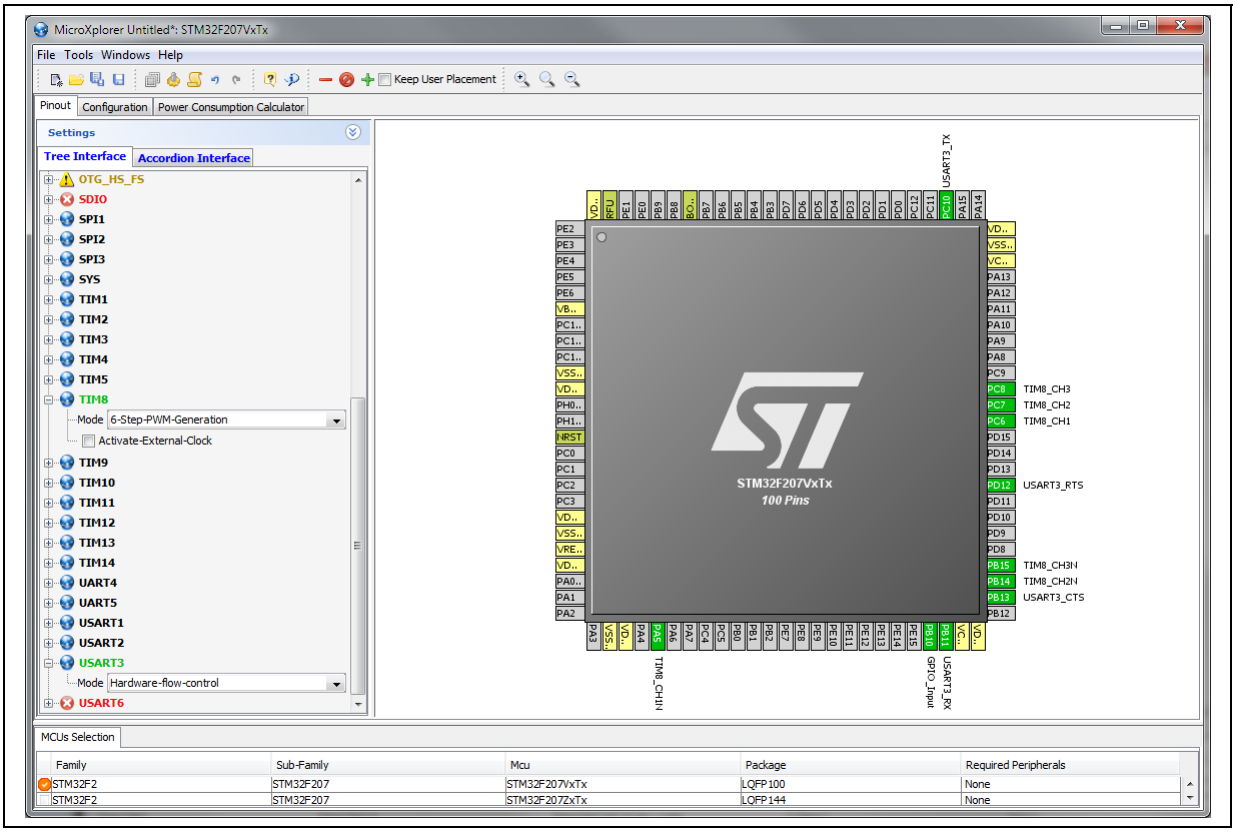
2. Try to free **PD8** by “manually” remapping **USART3_TX**: press the Ctrl key and click **PD8** simultaneously: the proposed remapped pins (PB10 and PC10) are shown in blue (see *Figure 30*).

Figure 30. Proposed remapped pins



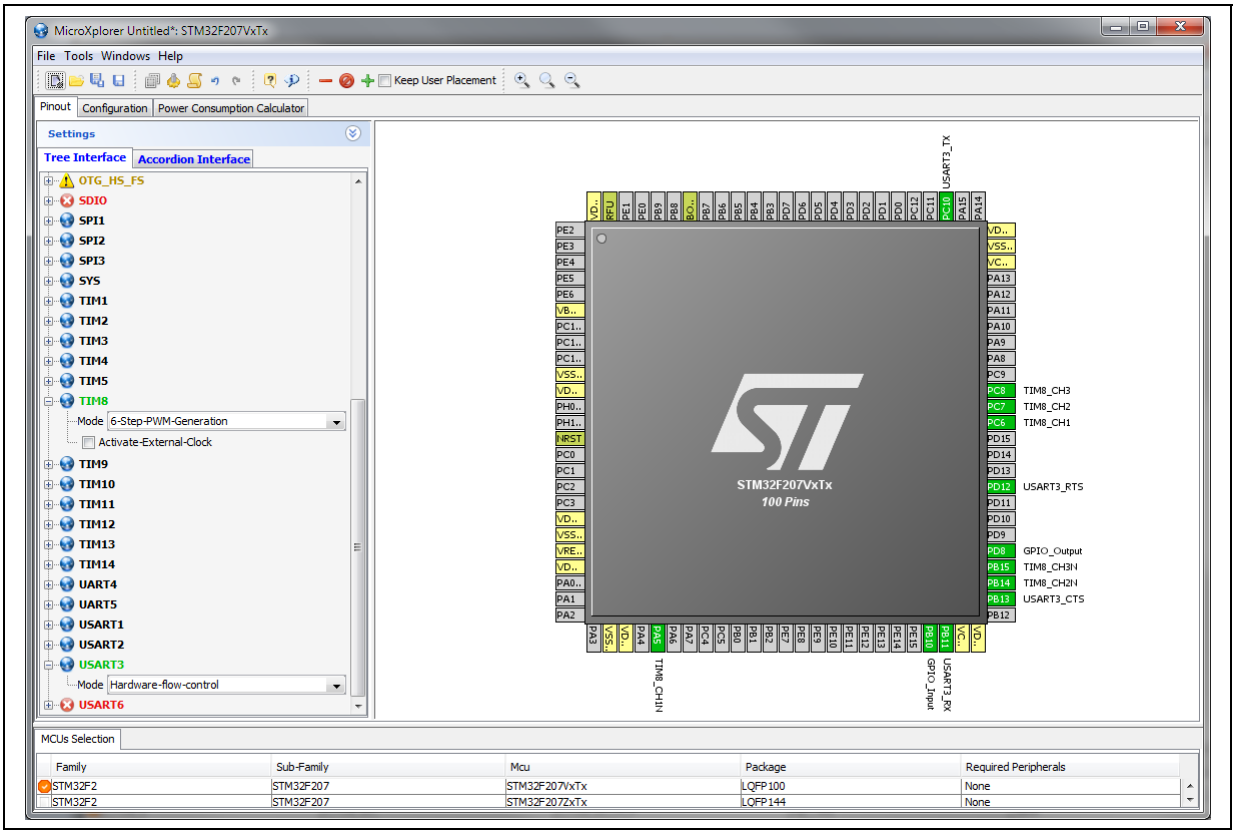
3. Since **PB10** is already mapped to GPIO_Input, move **USART3_TX** to **PC10**. Press the Crtl key and click **PD8**, then drag and drop it on PC10. Another way to proceed is to place the cursor on PC10, click to open the list of signals and select USART3_TX (see *Figure 31*).

Figure 31. Moving USART3_TX to PC10



4. Since **PD8** has been unmapped, you can now “physically” map the **PD8** pin as a **GPIO_Output** I/O (see *Figure 32*).

Figure 32. Mapping GPIO_Ouput to PD8



4.5 Map a peripheral mode using the Chip view

To map a signal to a pin, MicroXplorer map a peripheral mode if the signal being mapped is only used by the mode. For instance selecting the USART2_CK signal on PD7 sets the USART2 synchronous mode:

1. Map the USART2_CK to PD7 pin (see *Figure 33*).
2. Check the complete configuration (see *Figure 34*).

Figure 33. Mapping USART2_CK to PD7

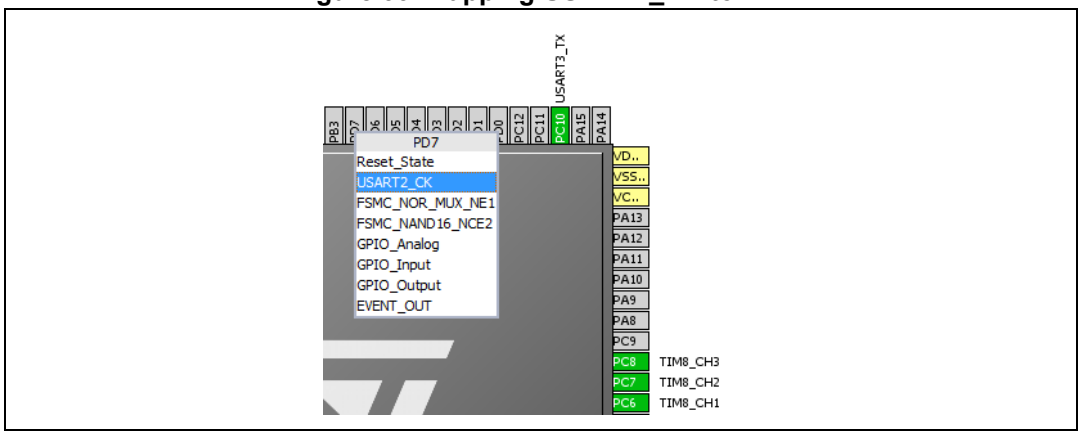
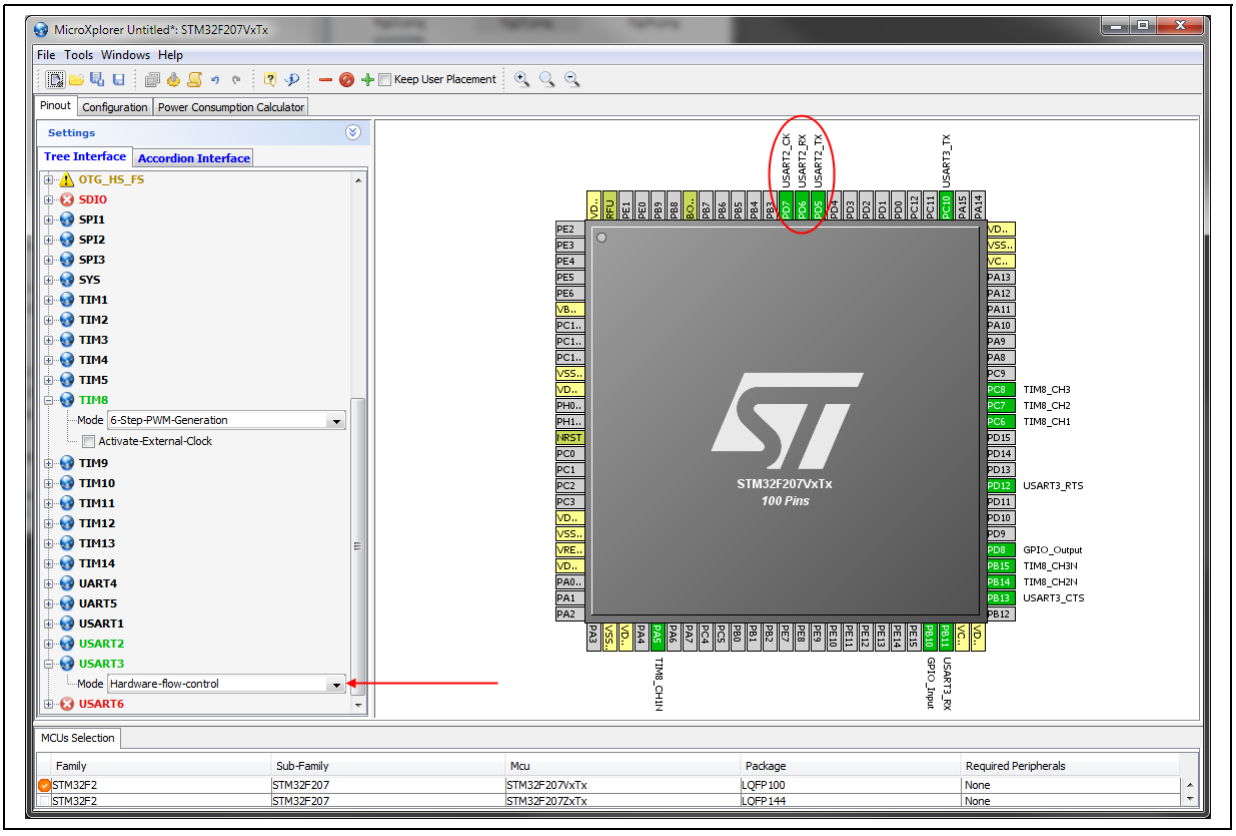


Figure 34. Complete configuration



Note: PD6 and PD5 pins initial selection must be cleared together with the peripheral modes that used them. After configuring the pinout, use the Undo/Redo mechanism to invalidate or replay the action.

4.6 Save and reload a configuration

To save your work in a file, and restore it later, perform the actions below:

1. Save your configuration (**File** > **Save Config As** menu) in myConfig.ioc.
2. The saved configuration can be reloaded later, either using the **File** > **Load Config** menu, or by double-clicking myConfig.ioc configuration file from Windows Explorer.

4.7 Generate a report

You can generate a report of the current configuration at any moment, by following the sequence below:

1. Select **Tools** > **Generate Report** menu: a Report Generation window opens, informing you that “myConfig.pdf (and .txt) configuration reports have been successfully generated”.
2. If a configuration file has not been created yet, you are prompted to save the configuration first. The Report file gets the same name (but you can choose to generate a Report alone).

The .pdf generated report can be loaded with Adobe Reader.

4.8 Code configuration and generation

The **Configuration tab** allows configuring all the parameters required for the code generation.

The list of all peripherals (one button for each one) displayed on the right of the window (see *Figure 35*) shows the configuration status of each peripheral. To open the configuration window, click the corresponding button. In release 3.1 of MicroXplorer, only the GPIO configuration is available. In the future, all the peripherals will be enabled and the corresponding code generation will be performed.

The Peripheral button color convention is the following:

- Black color (default):

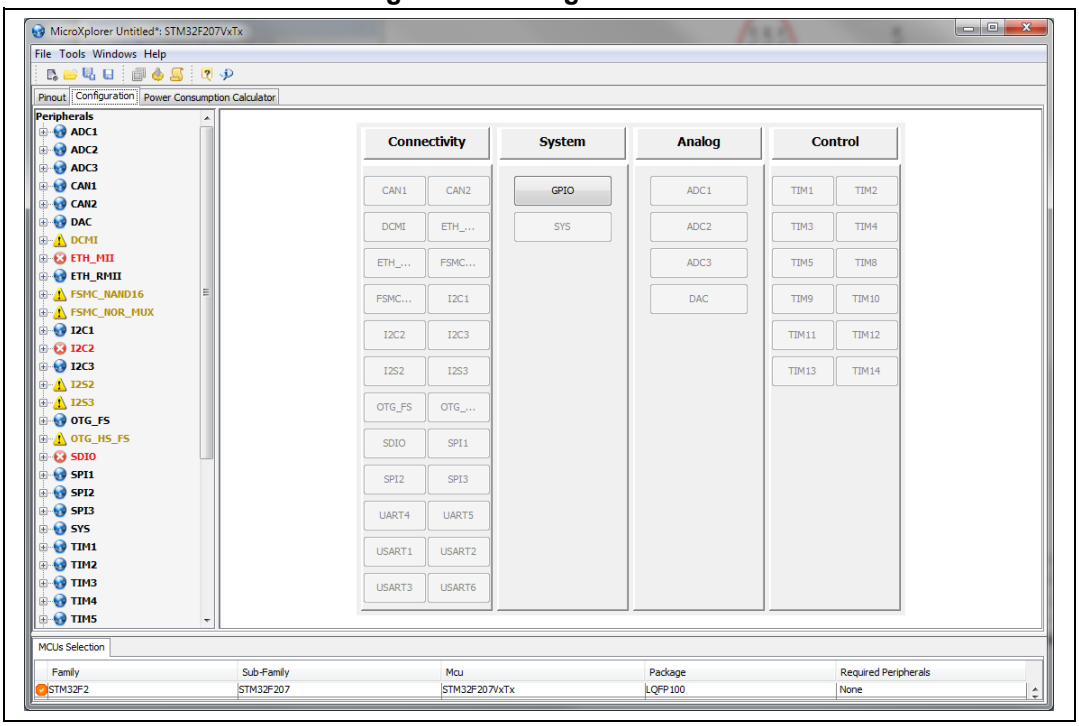
  The corresponding peripheral is not configured yet.
- Green

  The peripheral is configured.
- Yellow

  Something is incorrect in the configuration. For example in the GPIO service, a yellow color is displayed if you have mapped a signal to a pin but there is no associated peripheral mode. The signal is mapped but not used by any peripheral.

The tree view shown on the left on *Figure 35* gives a read-only view of the current configuration.

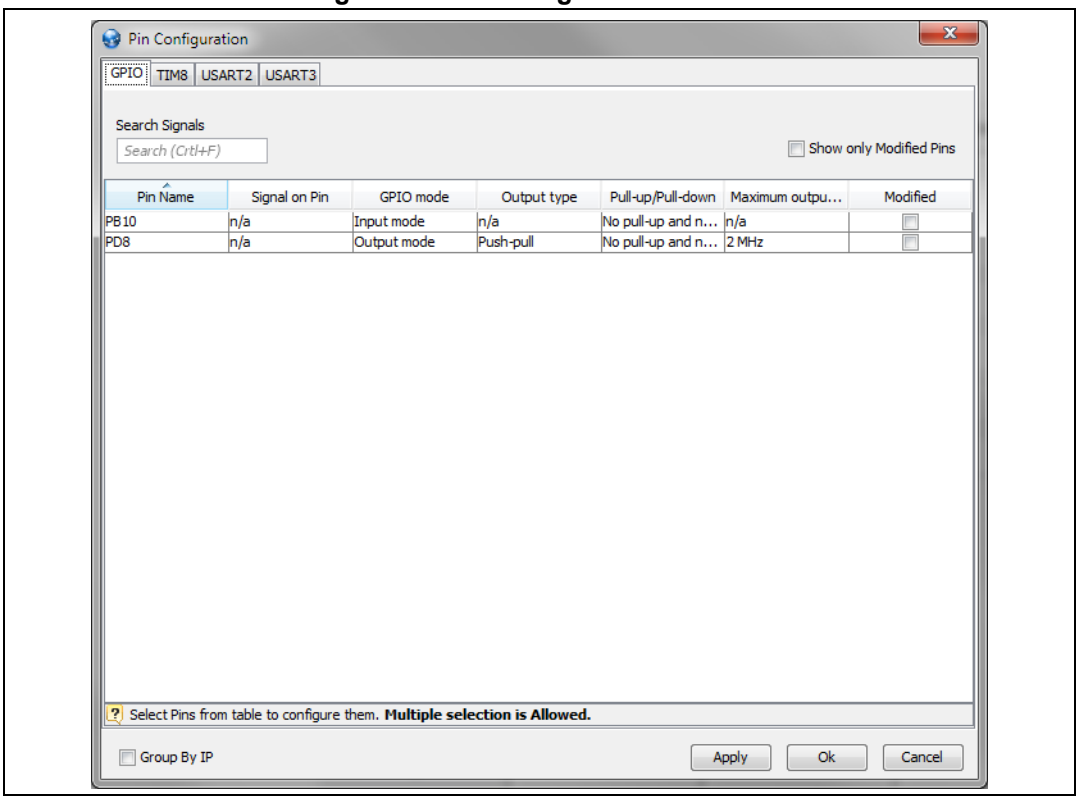
Figure 35. Configuration tab



4.8.1 GPIO configuration

When clicking the GPIO button, the following window is displayed:

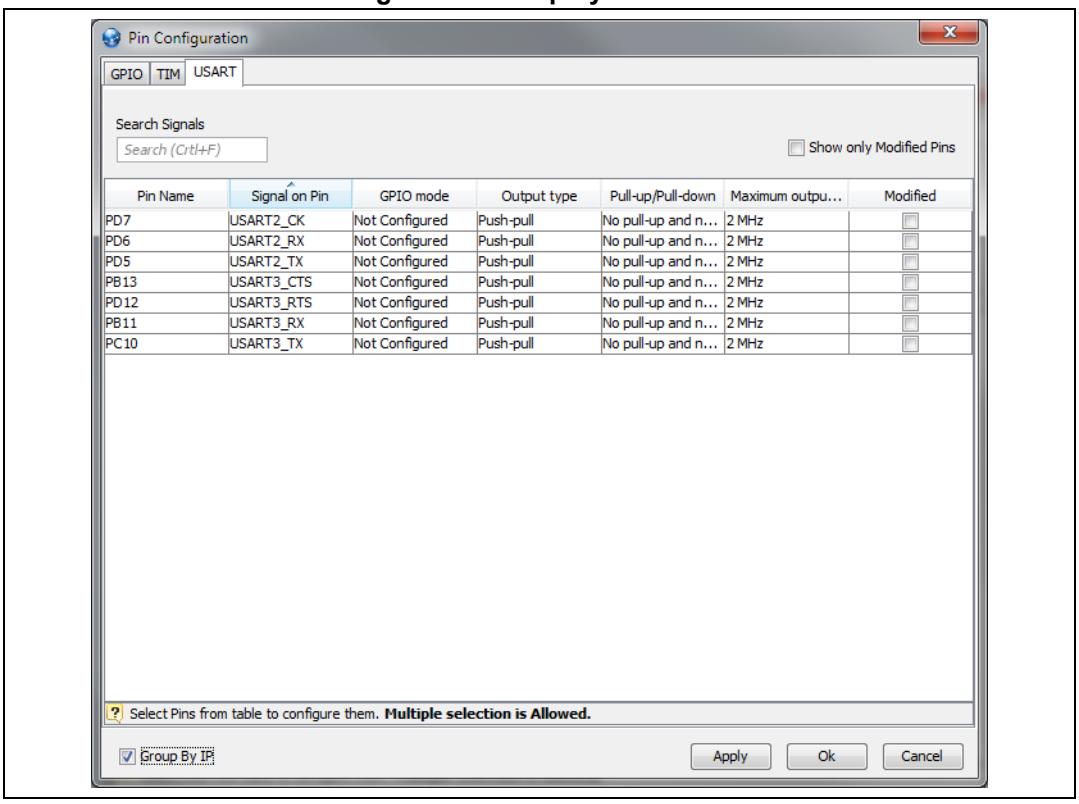
Figure 36. Pin configuration window



Checking the **Group by IP** box, groups the peripherals together by type (in the example shown in *Figure 37* USART2 and 3 are displayed with the signals grouped in the same tab).

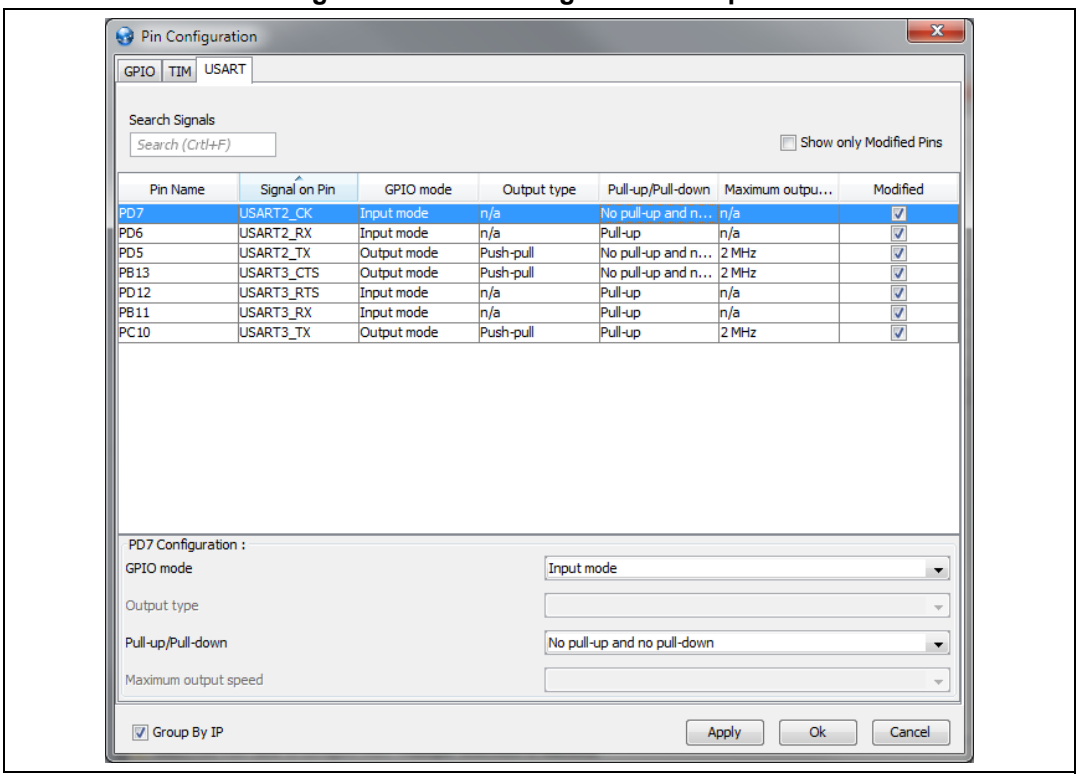
You can then select a pin or a group of pins and set the proper values for the different GPIO parameters associated with that pin.

Figure 37. Group by IP button



By clicking a row or selecting a set of rows, you can change the corresponding GPIO parameters. For example you can choose GPIO mode "Input Mode" for the USART2_CK signal on pin PD7 (see *Figure 38*).

Figure 38. GPIO configuration complete



When the GPIO configuration is complete, click the Ok button. The GPIO button is shown in green in the main window.

4.8.2 Code generation

To generate the initialization code corresponding to the pinout and GPIO configuration performed previously, select the Tools>Generate Code menu.

This menu asks you where to locate the generated code and generates the code in that directory.

The directory and file structure is similar to the one below:

```
inc
      mx_gpio.h
src
     mx_gpio.c
     mx_main.c
```

The generation includes a stub main file that calls the GPIO initialization function and the code to initialize the GPIO configuration.

Inside the mx_gpio.c and mx_main.c files, you can find comments such as:

```
/* USER CODE BEGIN 1 */
/* USER CODE END 1 */
```

You can put your own code between the USER CODE BEGIN and USER CODE END lines. At the next generation of code, your code is preserved.

If you modify code outside those lines, It will be overwritten at the next code generation.

5 Power Consumption Calculator plugin

5.1 Introduction

The MicroXplorer Power Consumption Calculator helps you estimate, in the context of your application, the power consumption of a chosen microcontroller as well as the attached battery lifetime for the configuration set.

By the selection of a power mode and the configuration of relevant parameters, the user obtains an estimation of:

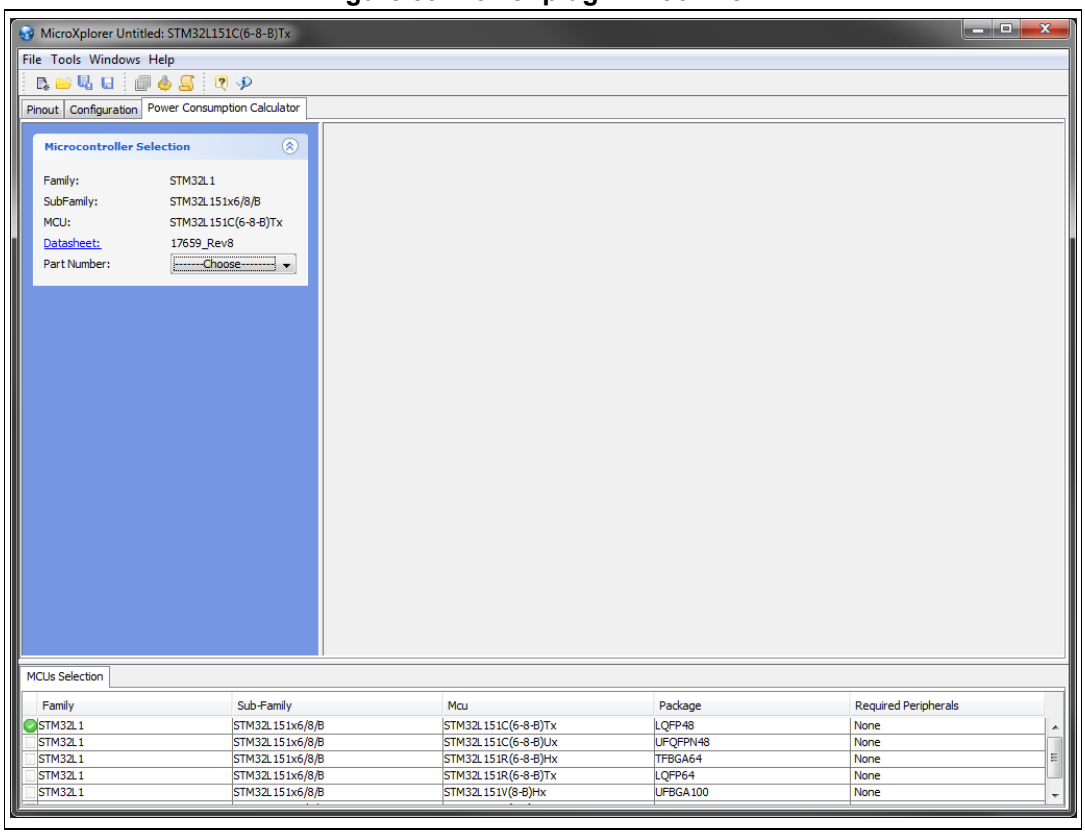
- the average power consumption
- the battery life
- the average DMIPS.

Power consumption and DMIPS data are directly taken from datasheets and are not interpolated or extrapolated.

5.2 Power Consumption Main User Interface

The Power Consumption Calculator plugin can be displayed by selecting the "Power Consumption Calculator" tab. If the microcontroller is supported, the following window appears (see *Figure 39*):

Figure 39. Power plugin initial view



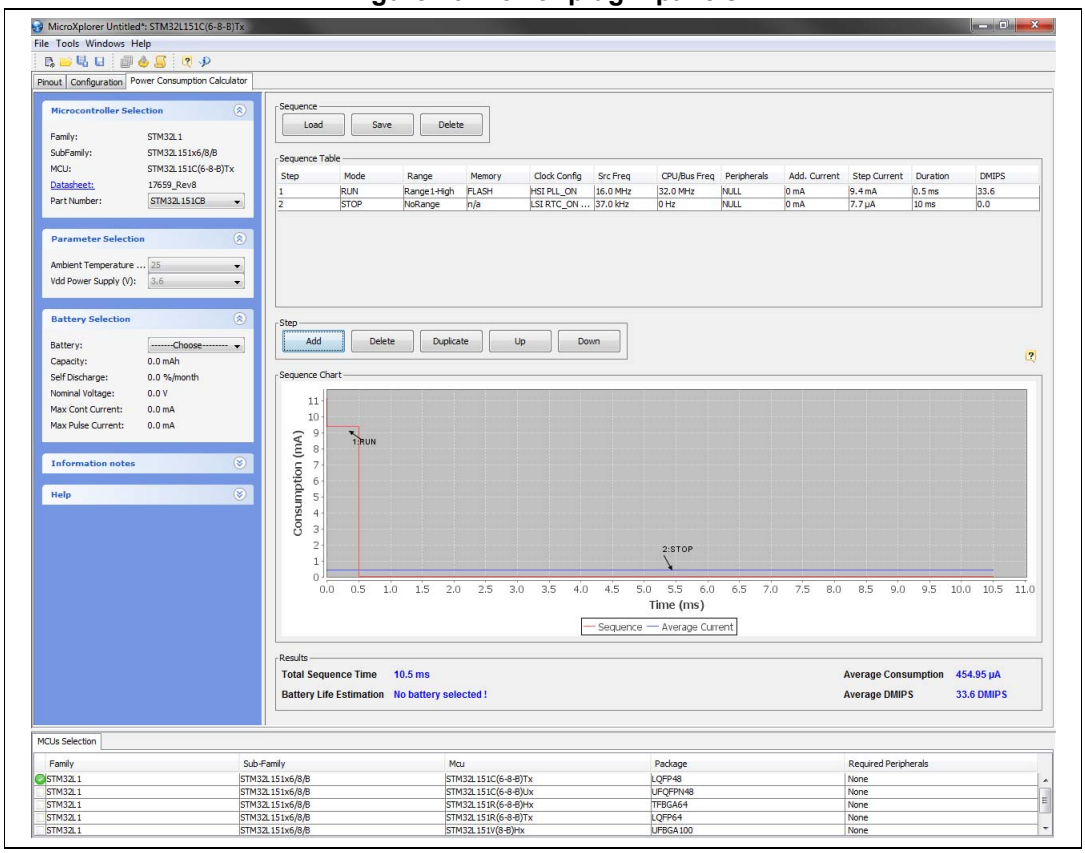
When a configuration is done, the Power plugin view provides access to 3 panels (see *Figure 40*).

- The left panel displays:
  - Global Power plugin parameters to be configured to initialize the plugin view (**MCU** Part Number, temperature, Vdd, battery model).
  - Power plugin version and Datasheets references.
  - Power information notes and Help.
- The bottom panel displays:
  - An **MCUs Selection** panel showing all possible **MCUs** for the selected **MCU** Family. It can be deactivated from the **Windows** menu.
- The right panel displays:
  - Power sequences, steps configuration and a view of the results.

As a general rule, when no choice is available for a parameter, the combo box is fixed to the parameter's default value and is grayed out.

The following chapters will guide you step by step to configure the Power Consumption Calculator.

Figure 40. Power plugin panels

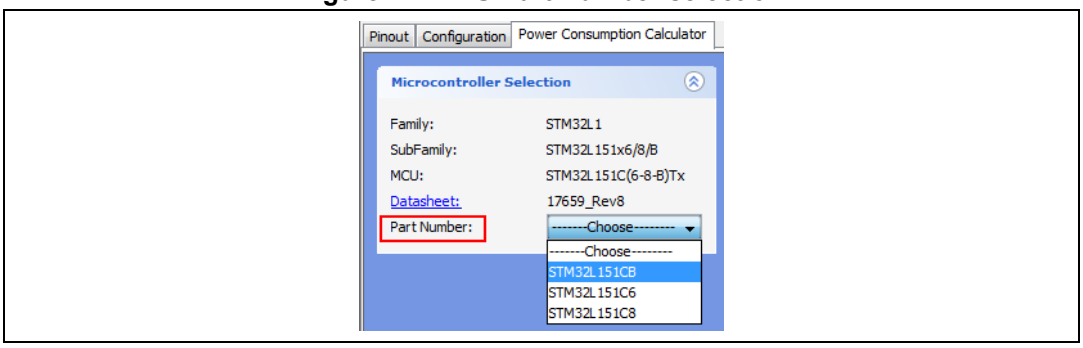


5.2.1 Step 1: Select a Part Number

The first step consists in choosing a **Part Number** covered by the selected **MCU** even though, in most cases, the power consumption is not impacted.

Click on the **Part Number** combo box to select the desired part number (see *Figure 41*):

Figure 41. MCU Part Number selection

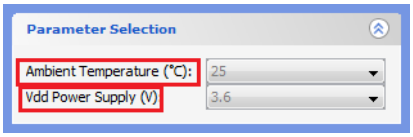


Once the part number is selected, the Power plugin is instantiated and ready to use.

5.2.2 Step 2: Select ambient temperature and Vdd Power Supply

If multiple choices are available, select the **Ambient Temperature** and **Vdd Power Supply** from combo boxes (see *Figure 42*).

Figure 42. Ambient Temperature and Vdd Power Supply selection



5.2.3 Step 3 or later: Select a battery model

At this stage, the Power plugin is ready for use.

The user can proceed in the sequence and step configuration with or without selecting the battery.

The **Battery Selection** section displays the main parameters of the selected battery (see *Figure 43*):

- Capacity (mAh):

  amount of energy that can be delivered in a single discharge.
- Self-discharge (%/month):

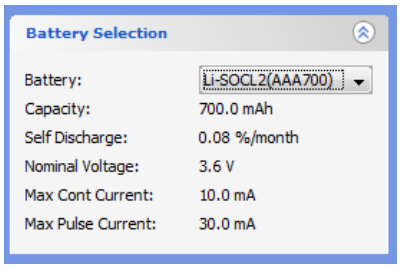
  this percentage, over a specified period, represents the loss of battery capacity when the battery is not in use (open-circuit conditions), as a result of internal leakage.
- Nominal voltage (V):

  voltage of a fully charged battery.
- Max. Continuous Current (mA):

  the value of the maximum current that can be delivered during the battery lifetime period without damaging the battery.
- Max. Pulse Current (mA):

  the value of the maximum pulse current that can be delivered exceptionally, for instance when the application is switched on during the starting phase.

Figure 43. Battery Selection



Note: A checking mechanism warns the user whenever the maximum continuous current of the battery selected is lower than the average current of at least one step.

5.3 Build Power Consumption step(s)

A Power plugin sequence is composed of at least one step. At each step definition, the Power plugin recalculates the power consumption of the current sequence. A step can be considered as the time in hours, minutes or seconds that the user application is in a given power mode with its associated configuration settings. In a sequence, when several steps share the same configuration settings, they can be grouped in a single step by adding the steps duration to maintain the same calculation.

There are two possible ways to build a step:

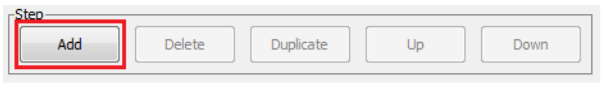
1. Build new steps from scratch.
2. Reuse already defined steps to build new ones (duplicate step or load a sequence).

5.3.1 Add a step

To add a new step, follow the sequence below:

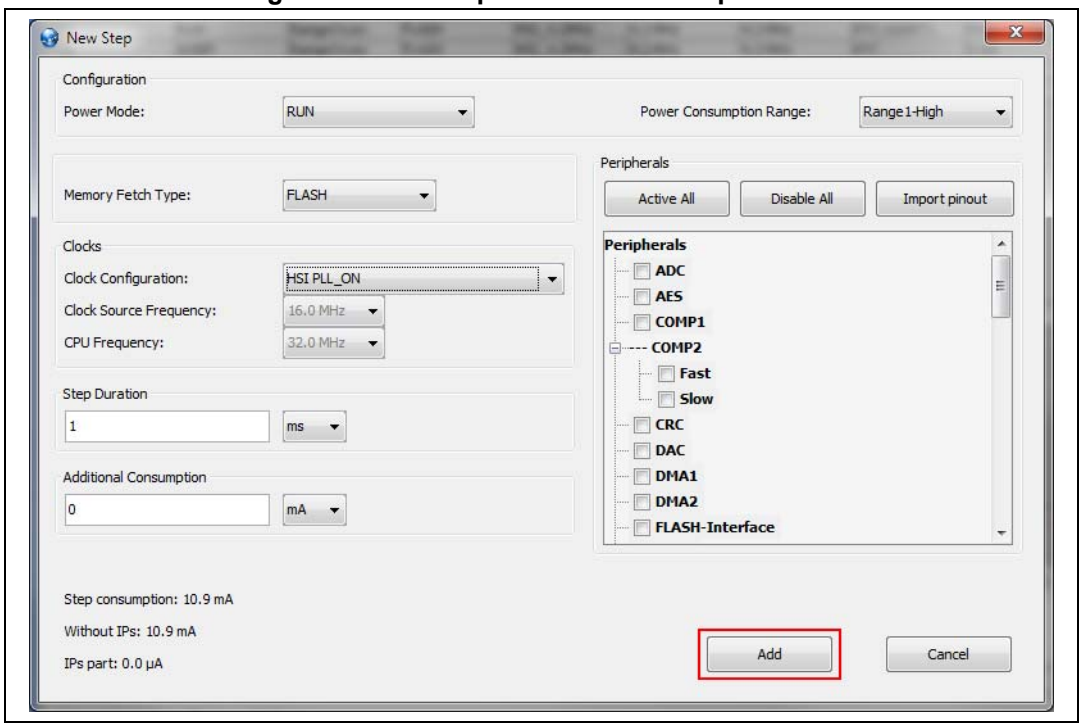
1. Click on the **Add** button in Step section to open the New Step window (see *Figure 44*).

Figure 44. Add Step



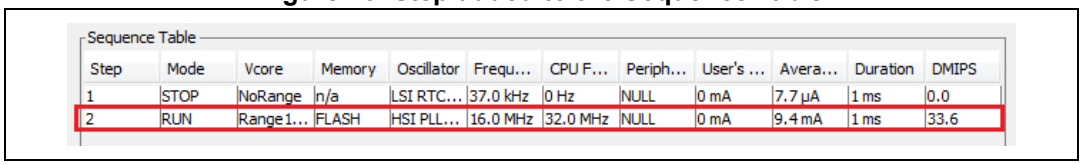
2. Configure the step (see *Section 5.6: Power plugin step configuration details*).
3. Click on the **Add** button from the New Step window (see *Figure 45*) to add the step with defined parameters into the current sequence.

Figure 45. Add Step from the New Step window



The step will be inserted at the end of the defined steps and numbered in "Step" column (see *Figure 46*).

Figure 46. Step added to the Sequence Table

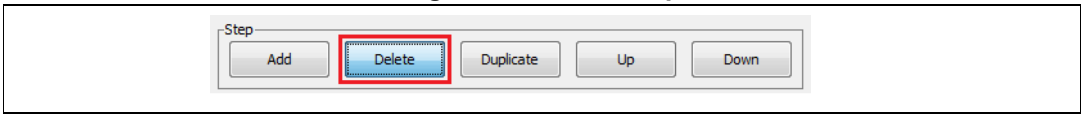


5.3.2 Delete a step

To remove an existing step, follow the sequence below:

1. Select the step to be removed in the sequence table.
2. Click on the **Delete** button (see *Figure 47*); the step is removed from the sequence.

Figure 47. Delete Step

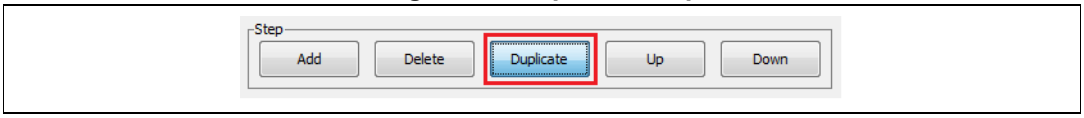


5.3.3 Duplicate a step

To duplicate an existing step, follow the sequence below:

1. Select the step to be duplicated in the sequence table.
2. Click on the **Duplicate** button (see *Figure 48*); the New step window is opened with the selected step configuration.
3. Keep the same configuration or update it.
4. Click on the **Add** button to insert the new step in the sequence table.

Figure 48. Duplicate Step



5.3.4 Move a step up or down

To move a step up or down in a sequence, select it in the sequence table and click the **Up** or **Down** button (see *Figure 49* and *Figure 50*).

Figure 49. Step Up

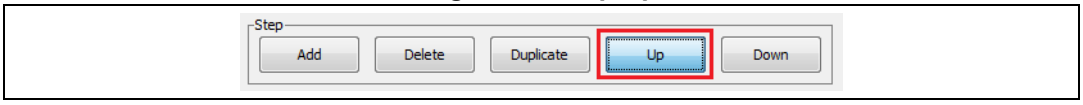
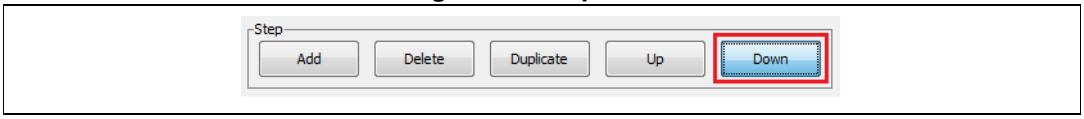


Figure 50. Step Down



Note: Moving a step has no effect on the power consumption calculation.

5.4 Build a sequence

A sequence is composed of at least one step. There are three ways to build a sequence:

1. Build a sequence from scratch.
2. Load an existent sequence.
3. Duplicate a sequence:
   a) Save the sequence and load it.
   b) Keep existing step(s) in the Sequence Table.

5.4.1 Save a sequence

A sequence already built can be saved for future use. The sequence table displayed is saved in a (***.pcs)** file that will be stored on a user-defined location.

To save a sequence, follow the steps below:

1. Click on the **Save Sequence** button (see *Figure 51*).

Figure 51. Save Sequence

2. Browse to a user defined location and give a proper name to the sequence file (*.pcs).
3. Click on the **Save** button.

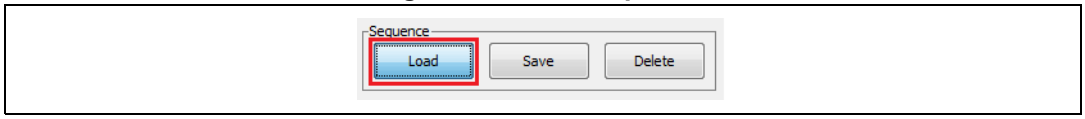
5.4.2 Load a sequence

Already saved sequences can be loaded and inserted at the end of the currently defined sequence.

To load a sequence, follow the steps below:

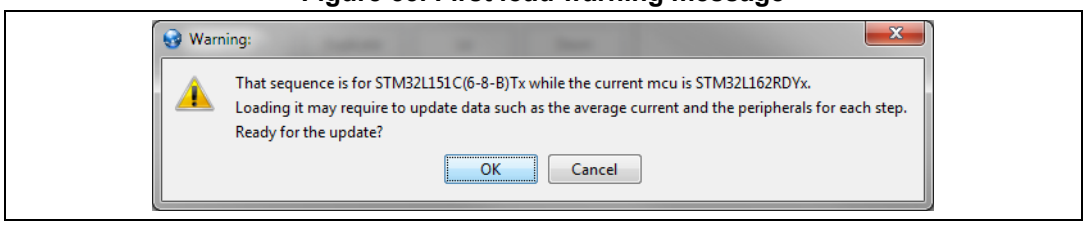
1. Click on the **Load Sequence** button (see *Figure 52*)

Figure 52. Load Sequence



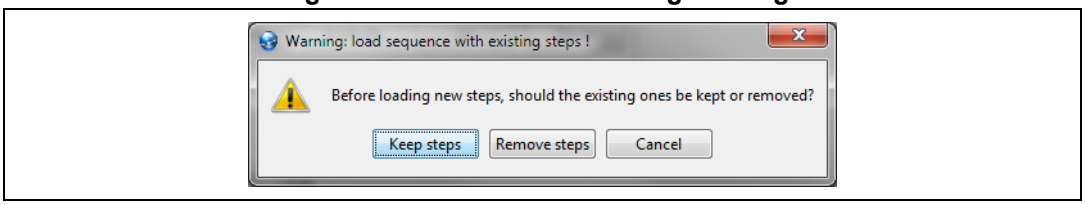
2. Browse a sequence file (*.pcs) and select it.
3. A warning message is displayed (see *Figure 53*). Click **Ok** to continue.

Figure 53. First load warning message



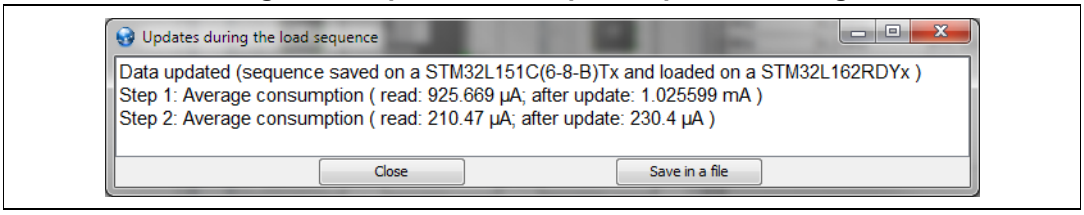
4. A second warning message is displayed (see *Figure 54*). Click the **Keep steps** button to keep the current steps or the **Remove steps** button to remove the current steps.

Figure 54. Second load warning message



4.Then all updates done upon loading the sequence are displayed in a dedicated window (see *Figure 55*). Click the **OK** button to finish the sequence loading.

Figure 55. Updates done upon sequence loading



The loaded sequence is inserted at the end of the sequence table and is taken into account for power consumption calculation.

Note: Loading several times the same sequence only impacts the sequence chart and the total sequence time. DMIPS, average power consumption and battery lifetime obviously remain unchanged.

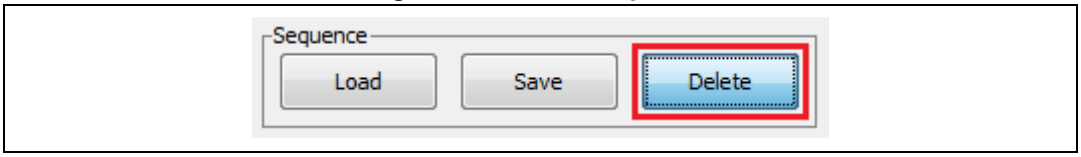
5.4.3 Delete a sequence

A sequence can be entirely deleted but this action must be carefully executed as this cannot be recovered.

To delete a sequence, follow the sequence below:

1.Click on the **Delete** Sequence button (see *Figure 56*).

Figure 56. Delete Sequence

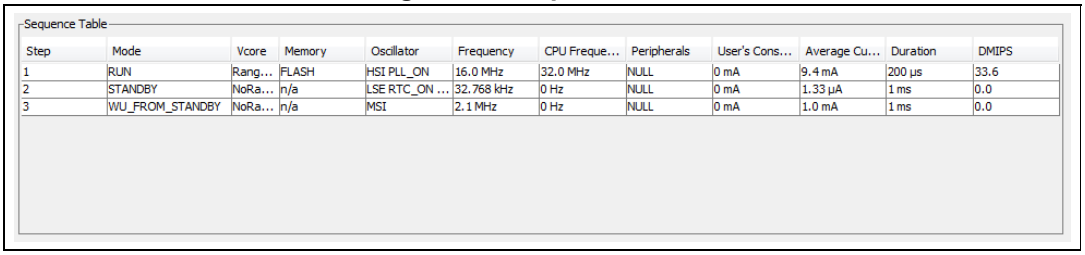


Once the sequence is deleted, the Sequence Table is empty.

5.5 Sequence Table

The **Sequence Table** contains all the information filled in by the user in the different configuration steps (see *Figure 57*). Each step is identified by its step number and its associated parameters. All the parameters will be taken into account for the final results.

Figure 57. Sequence Table



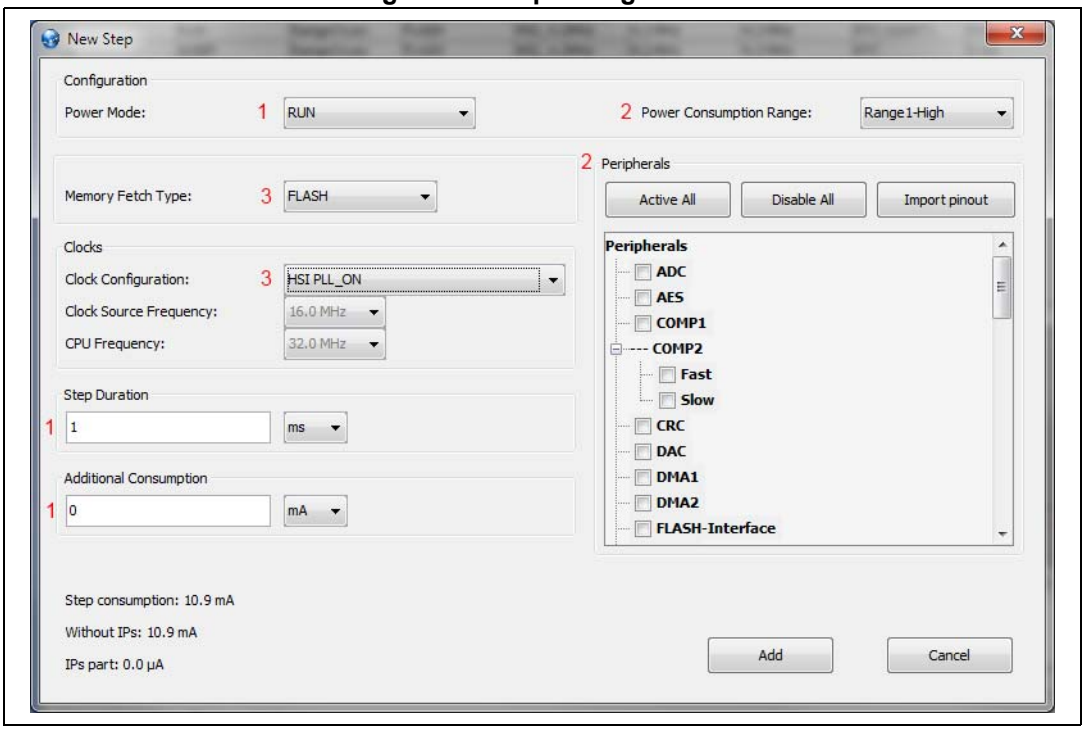
5.6 Power plugin step configuration details

The Power plugin step configuration can be done either from scratch or by using an already defined step. A step is configured by setting parameters in a pre-defined order. The parameters are set either by the user or by the Power plugin when there is only one possible value (in this case, the settings appear in grey).

To configure a step, perform the following actions (see *Figure 58*):

1. Select the **Power Mode**
   (Optional) Specify a **Step Duration** (default value is 1ms)
   (Optional) Specify an **Additional Consumption**
2. Select the **Peripherals**
   Select the **Power Consumption Range**
3. Select the **Memory Fetch Type**
   Select a **Clock Configuration**
   In a few cases, select a **Clock Source Frequency**

Figure 58. Step configuration



*Note: Changing the **Power Mode** or the **Power Consumption Range** discards all subsequent configurations done.*

5.6.1 Power Mode selection

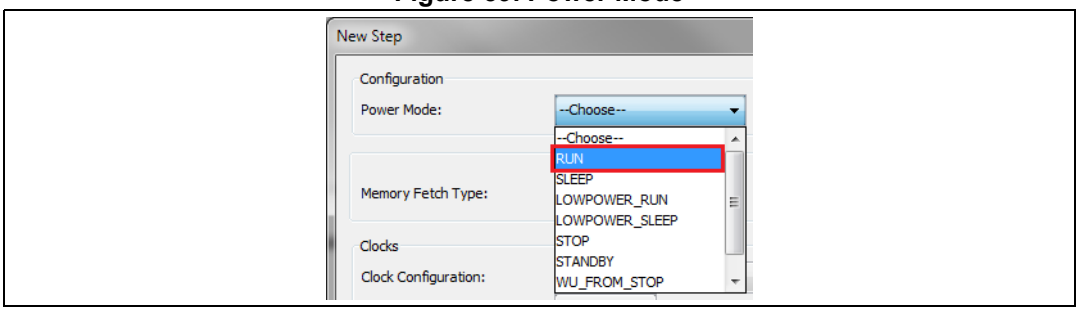
There are several power modes depending on the family. For more details about STM32L1 power modes for example, see *6: Glossary* in *Section C.1: Power Modes*.

In general and to save energy, the user switches the operating mode of the microcontroller from running mode, where a maximum power is required, to idle mode, where limited resources are needed. These different power modes, called steps, are grouped into a sequence that can be repeated indefinitely according to the user needs.

The power mode can be selected by the sequence below:

1. Click on the **Add** button or double-click on the step from the sequence table.
2. Open the **Power Mode** combo box (see *Figure 59*).
3. Select one Power Mode in the list.

Figure 59. Power Mode



Once the Power Mode has been selected, the peripherals are displayed. The step configuration can be continued either by selecting a **Power Consumption Range** or by selecting the **Peripherals** for this step.

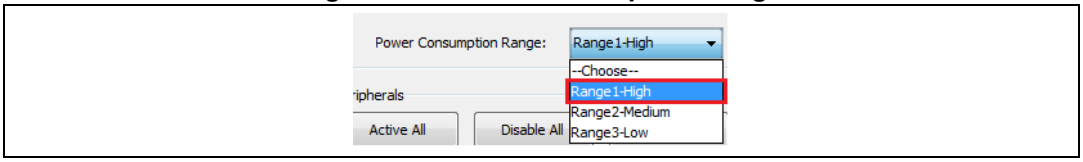
5.6.2 Power Consumption Range selection

There are several power ranges depending on the family. For more details about power ranges for an STM32L1 family for example, see *C.2: Power Consumption Ranges* in *6: Glossary*.

The Power Consumption Range can be selected by the sequence below:

1. If not already done, click on the **Add Step** button or double-click on the step from the sequence table.
2. As a prerequisite, Power Mode should be selected (see *Section 5.6.1: Power Mode selection*).
3. Open the **Power Consumption Range** combo box (see *Figure 60*).
4. Select one Power Consumption Range from the list.

Figure 60. Power Consumption Range



Once the Power Consumption Range has been selected, the Memory Fetch Type and the clock can be configured.

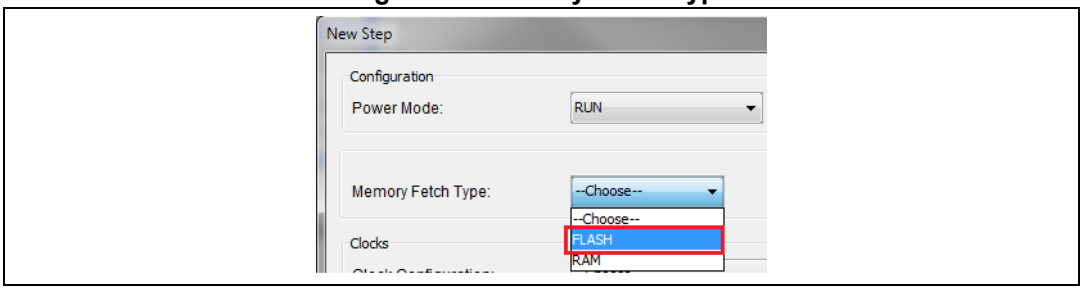
5.6.3 Memory Fetch Type selection

The user shall specify the memory location for application code execution by selecting FLASH or RAM under **Memory Fetch Type** combo box.

The Memory Fetch Type can be selected by the sequence below:

1. If not already done, click on the **Add** button or double-click on the step from the sequence table.
2. As a prerequisite, Power Consumption Range should be selected (*Section 5.6.2: Power Consumption Range selection*).
3. Open the **Memory Fetch Type** combo box (see *Figure 61*).
4. Select one Memory Fetch Type from the list.

Figure 61. Memory Fetch Type



5.6.4 Clock Configuration

The clock configuration consists in defining the CPU frequency based on the setting of clock parameters.

The clock configuration selection allows to choose among the different oscillator sources that can be internal or external to the device (Ex: MSI, HSI, LSI or HSE, LSE).

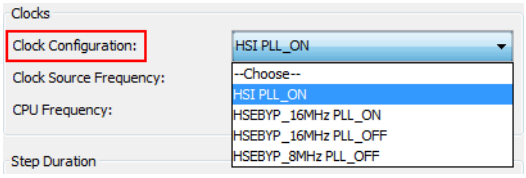
To complete the clock configuration, some other parameters have been added, such as PLL, LSE or HSE Bypass, AHB prescaler value, and some specific IPs such as RTC, LCD with duty, IWDG for STOP and STANDBY modes.

Whenever possible, the values of clock source frequency and CPU frequency will appear upon choosing a Clock Configuration.

The clock can be configured as follows:

1. If not already done, click on the **Add** button or double-click on the step from the sequence table.
2. As a prerequisite, Power Consumption Range should be selected (see *Section 5.6.2: Power Consumption Range selection*).
3. Open the **Clock Configuration** combo box.
4. Select one Clock Configuration from the list (see *Figure 62*).
5. If not already set, open the **Clock Source Frequency** combo box and select one Clock Source Frequency from the list.
6. If not already set, open the **CPU Frequency** combo box and select one Clock Source Frequency from the list.

Figure 62. Clock Configuration



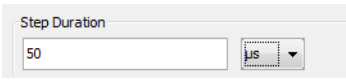
5.6.5 Step Duration

The user may enter the duration of the step (integer time unit) or use the 1 ms default value.

The Step Duration can be set as follows:

1. If not already done, click on the **Add** button or double-click on the step from the sequence table.
2. Enter a valid **Step Duration** value (positive number) in the **Step Duration** field (see *Figure 63*). If the user entry is not correct, it will be automatically discarded.

Figure 63. Step Duration



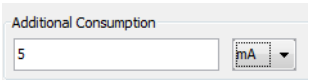
5.6.6 Additional Consumption (optional part)

The user may specify an additional consumption value to reflect, for example, external components used by the application (Ex: external regulator, external pull-up, LEDs or other displays). This current will be added to the microcontroller power consumption, to be taken into account in the final power consumption calculation.

The Additional Consumption can be set as follows:

1. If not already done, Click on the **Add** button or double-click on the step from the sequence table to open a New Step window.
2. In the New Step window, enter a valid **Additional Consumption** value (zero, positive or even negative number) in the **Additional Consumption** field (see *Figure 64*). If the user entry is not correct, it is automatically discarded.

Figure 64. Additional Consumption



5.6.7 Pinout Peripherals

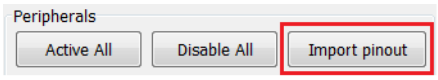
For a specific power mode, peripherals can be active or disabled. The user can choose to select only peripherals that are used by the application.

The purpose of the peripherals selection performed in the MicroXplorer **MCUs Selector** window is only to filter the MCUs supporting the selected peripherals. In order to be selected from the Power plugin peripheral tree, the peripherals first need to be configured in the

MicroXplorer Pinout Peripherals **Tree Interface** by selecting, for each one, the available peripheral mode.

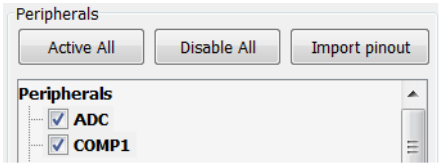
To take the peripherals already configured in the MicroXplorer GUI, press the **Import pinout** button (see *Figure 65*) from the Step configuration window.

Figure 65. Import pinout selection



When a peripheral is selected, the Power plugin calculates its consumption (see *Figure 66*).

Figure 66. Peripheral Selection



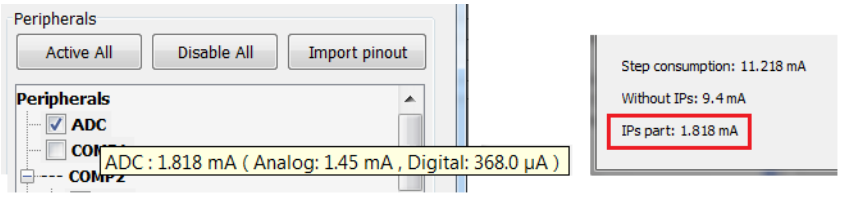
A peripheral configured in the MicroXplorer Pinout Peripherals **Tree Interface** will not be taken into account in the power consumption calculation unless it has been selected in the Peripherals section of the Power plugin view.

Note: Some peripherals are only available from the Power plugin GUI.

For a peripheral consumption measurement, a peripheral is just clocked and its consumption under this operating condition is indicated as an information tip (see the left part of *Figure 67*). The consumption due to peripherals activation is provided at the bottom left side of the Step window (see the right part of *Figure 67*).

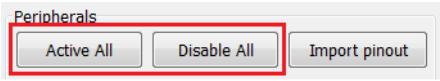
Note: The consumption of the Step configured is also given with and without peripherals consumption part.

Figure 67. Peripheral Consumption



Peripherals can all be selected or unselected using **Active All** or **Disable All** buttons (see *Figure 68*).

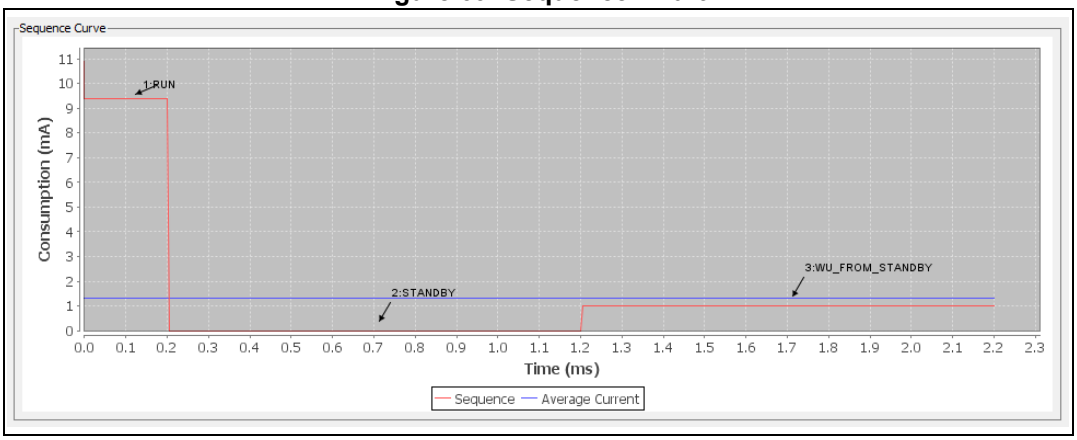
Figure 68. All Peripherals Activation or Deactivation



5.7 Sequence Chart

The power **Sequence Chart** shows the average power consumption and the sequence steps vs. time. The horizontal scale is the time in "ms" unit and the vertical one displays the power consumption in "mA" unit (see *Figure 69*).

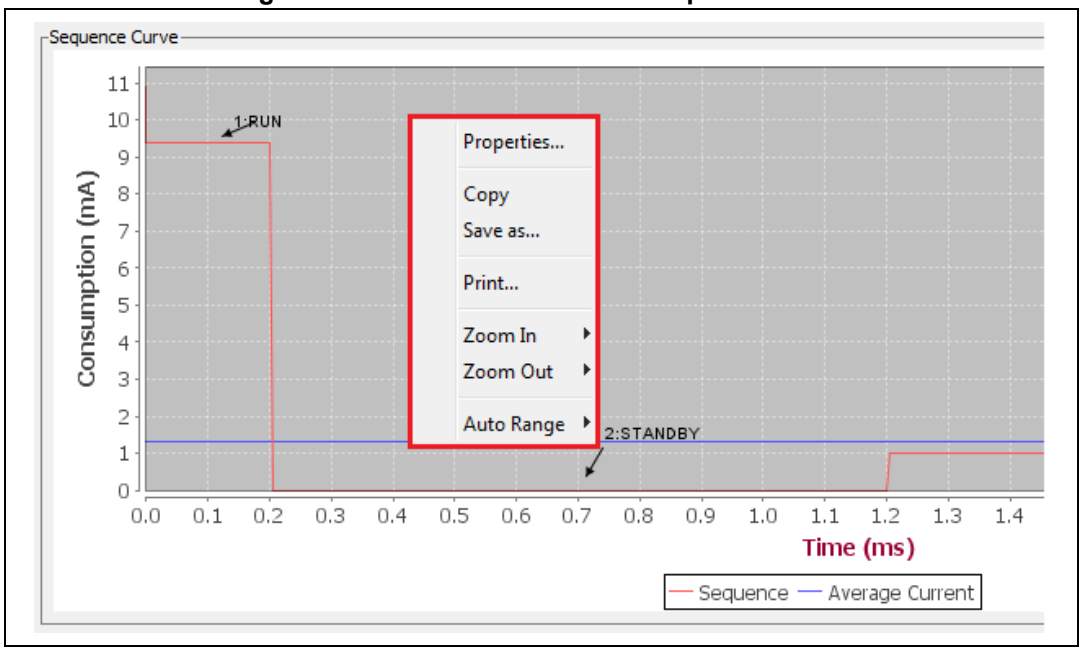
Figure 69. Sequence Chart



The contextual menu provides an access to some functions such as (see *Figure 70*):

- Chart properties settings.
- Copy the whole Sequence Chart.
- Save the current Sequence Chart in a PNG picture file.
- Print the current Sequence Chart on a printer.
- Zoom In the current Sequence Chart (This can also be done by selecting a zone in the chart to zoom in).
- Zoom Out in the current Sequence Chart.
- Reset zoom operations (This can also be done by moving the mouse from the right to the left of the Sequence Chart).

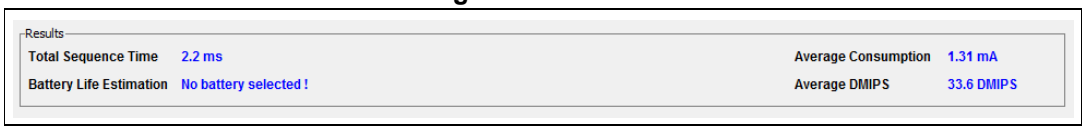
Figure 70. Contextual Menu of a Sequence Chart



5.8 Power Consumption Calculator results

Once a sequence has been completed and is visible in the Sequence Table, the Power plugin provides the results into a dedicated **Results** panel (see *Figure 71*).

Figure 71. Results



The following information is provided:

- **Total sequence time**:

  the sum of the different steps durations.

- **Average Consumption**:

  the MCU average power consumption value added to the user defined Additional Consumption weighted by the steps duration.

- **Average DMIPS**:

  the **Average DMIPS** (Dhrystone Million Instructions Per Second) based on Dhrystone benchmark. This information gives a vision of the global CPU performance for the sequence. This is intended to highlight the CPU performance according to the current consumption.

- **Battery Life Estimation**:

  This information is computed based on the average power consumption and the battery self-discharge.

6 Glossary

6.1 Block

A "block of pins" is a group of pins that can all be assigned together, to make a peripheral mode. For instance, PC1, PA1, PA2, PA7, PC4, PC5, PB11, PB12, PB13, PB5 for the RMII_sync mode of Ethernet Peripheral. A block coherency is needed for STM32F100x/ F101x/ F102x/ F103x and STM32F105x/ F107x.

6.2 Conflict colors and messages

6.2.1 Peripheral status according to its color

The peripheral color can be:

- Black: the peripheral is not configured (no mode is set), and all modes are available

- Green: the peripheral is configured (at least one mode is set), and all other modes are available

- Green with orange warning: the peripheral is configured (one mode is set), and at least one of its modes is not available

- Orange: the peripheral is not configured (no mode is set), and at least one of its modes is not available

- Red: the peripheral is not configured (no mode is set), and no mode is available

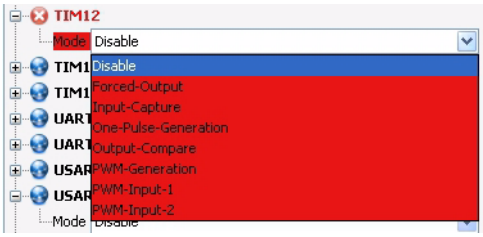
6.2.2 Mode status according to its highlighted color

The peripheral mode label color can be:

- No highlight: all peripheral modes are available

- Highlighted in orange: at least one peripheral mode is not available

- Highlighted in red: no peripheral mode is available

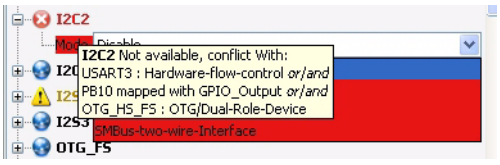


6.2.3 Peripheral “Partly disabled” pop-up warning

A pop-up message is displayed above the peripheral menu if at least one of its modes is not available. In the example below the ADC2 peripheral is not fully available and the message indicates that some of its pins are allocated to ADC1-IN4 signal.

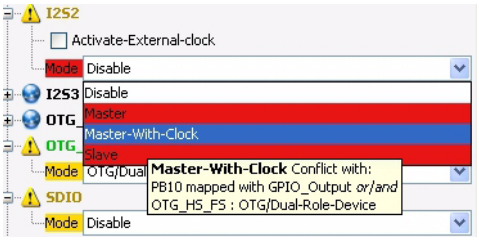
6.2.4 Peripheral “Not Available” pop-up warning

A pop-up message is displayed above the peripheral menu if none of its modes is available. In the example below, the I2C2 peripheral is not available because, for each mode, at least one of its functions has no (re)mapping available. The message indicates that some of the peripheral pins are allocated to USART3, and/or PB10 I/O, and/or OTG_HS_FS.



6.2.5 Mode pop-up warning

A pop-up message is displayed above the peripheral mode item if at least one of the mode functions is not available, i.e. if all its (remap) pins are already allocated



6.3 Keep User Placement (selected)

When the **Keep User Placement** checkbox is selected, all the functions for the chosen peripheral mode stay allocated (mapped) to a given pin. In this case, MicroXplorer cannot change the function allocation from one pin to another.

If a mode becomes unavailable (highlighted in red), try to find another remap of the pins used in this mode. To do so, follow the steps below:

1. Deselect the assigned functions via **Chip View** one by one untill the mode becomes available (no more shown in red).
2. When this is done, select the mode again in the new sequence (see *A.4: Block remapping (only for STM32F10x)* for an example). Since this operation is time consuming, it is recommended to unselect the **Keep User Placement** checkbox.

Keep User Placement

This can be useful when you have mapped a function to one pin from the Chip View, and need to maintain it fixed there.

You can also need to lock the pins of all the peripherals that you have already configured using the Peripherals panel.

Keep User Placement This operation can be selected/unselected at any time during the configuration.

6.4 Keep User Placement (not selected)

After unselecting the **Keep User Placement** checkbox, MicroXplorer finds a solution to meet your next request by remapping some of the previously mapped blocks. In this case, MicroXplorer is allowed to move previously mapped functions to other pins.

In other words, your next peripheral or function choice might cause some of your previous functions to be remapped.

Do not select **Keep User Placement** when you need to optimize the placement of your peripheral, i.e. if you need to maximize the number of peripherals and minimize the chip size.

Keep User Placement can be selected/unselected at any time during the configuration.

6.5 Manual remapping

You can manually remap a function to another pin from the Chip view by pressing the Ctrl key and clicking simultaneously on the source. The target pins then appear in blue, and you can move your function by dragging the mouse pointer from the source pin to the target pin.

6.6 Manual remapping with destination pin ambiguity

For MCUs with block coherence (STM32F100x/ F101x/ F102x/ F103x and STM32F105x/ F107x), the destination pin can be ambiguous, i.e. you can have more than one destination block including the destination pin. In this case, just move the mouse pointer slowly over the target pin to display all the possible alternative remapping blocks.

7 F.A.Q.

1. Why does MicroXplorer move some functions when I add a new peripheral mode?

   You may have unselected the Keep User Placement checkbox. In this case, MicroXplorer performs an automatic remapping to optimize your placement.

2. How can I manually force the remapping of a function?

   You should use the Manual Remapping feature.

3. Why are some pins highlighted in yellow or in light green in the Chip view?

   These pins are specific pins (power supply, BOOT, ..) which are not available as peripheral signals.

4. Why cannot I change the function of some pins? (when I click some pins, nothing happens)

   Some special pins such as power supply pins (shown in yellow) or Boot pins (shown in light green) are not available for peripheral signals.

5. How can I use MicroXplorer as an Eclipse plugin?

   Refer to the Install MicroXplorer Eclipse Plugin documentation available on the ST Internet site.

Appendix A Basic rules of the pin assignment

- Rule 1: Block coherence
- Rule 2: Block inter-dependency
- Rule 3: One block = one peripheral mode
- Rule 4: Block remapping (only for STM32F10x)
- Rule 5: Remapping the functions of a block (only for STM32F20x)
- Rule 6: Block shifting (only if Keep User Placement is unchecked)
- Rule 7: Setting or clearing a peripheral mode
- Rule 8: Mapping a function individually (if Keep User Placement is unchecked)
- Rule 9: Manual vs automatic I/O mapping

A.1 Block coherence

All pins in a block are mapped/unmapped simultaneously, provided that there is no ambiguity about the mode to be mapped/unmapped.

There is ambiguity about a block of pins in case there are several possible peripheral modes that can need this block.

Example 1: case of an USART 3 group not mapped to PB10, PB11 and PB12

If you set the USART3_CK function to PB12, then MicroXplorer sets the rest of the USART3 block: TX and RX to PB10 and PB11, respectively (see *Figure 72: Block coherence*).

Example 2: case of an USART3 group already mapped to PB10, PB11 and PB12

If you set TIM2-CH3 to PB10, then MicroXplorer unsets the USART3 block. You must then set USART3_CK to PC12 (see *Figure 73: Block remapping - example 1*).

Figure 72. Block coherence

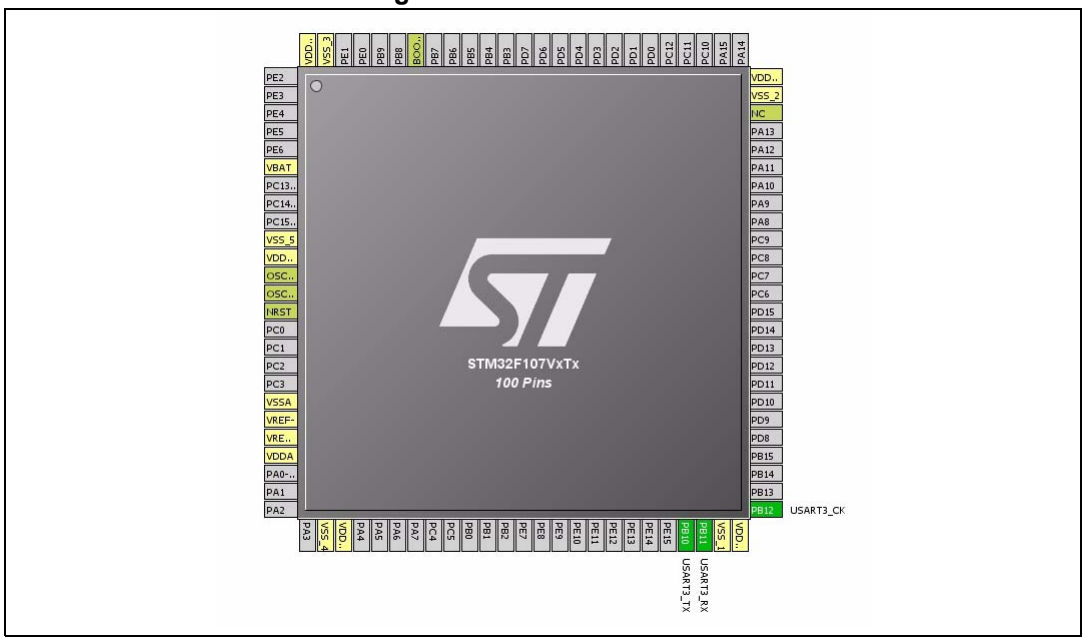
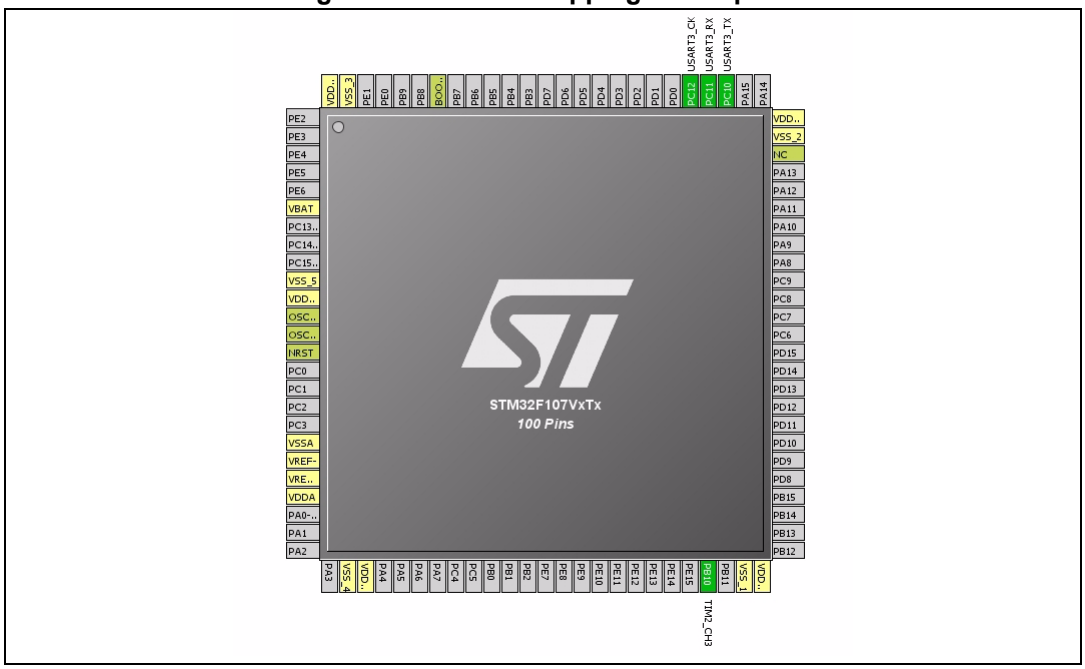


Figure 73. Block remapping - example 1



A.2 Block inter-dependency

Two blocks cannot be selected at the same time (alternate blocks are cleared).

Example

If the RMII_RXD0 function is set to PD9 and the user then sets it to PC4, MicroXplorer removes the RMII_RXD0 function from PD9 (MicroXplorer also moves any other assigned pins in the block (see *A.4: Block remapping (only for STM32F10x)*).

A.3 One block = one peripheral mode

When a pin block is assigned in the Chip view, the related peripheral mode is set in the Peripherals panel (left window).

Example

After assigning the RMII_PPS_OUT function on PB5, the RMII_Synch Ethernet mode is automatically selected in the left window.

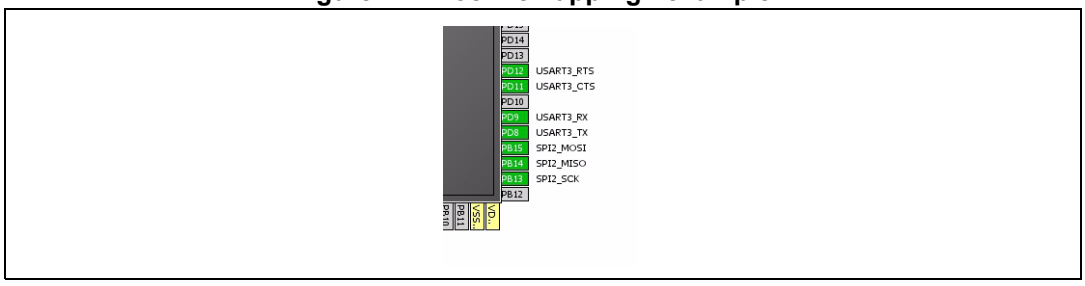
A.4 Block remapping (only for STM32F10x)

When trying to set a peripheral mode, if at least one pin in the default block is already in use, MicroXplorer tries to find a remap block.

Example

MicroXplorer remaps USART3 hardware-flow-control mode to the (PD8-PD9-PD11-PD12) block, because PB14, (part of its default block) is already allocated to the SPI2_MISO function (*Figure 74: Block remapping - example 2*).

Figure 74. Block remapping - example 2



If MicroXplorer cannot find a remap block, select either the functions in a different sequence, or uncheck the Keep User Placement box, and let MicroXplorer remap all the blocks to find a solution.

Note: For STM32F10x, all the functions of a block must be mapped to a pin with the same remap number.

A.5 Remapping the functions of a block (only for STM32F20x)

When trying to set a peripheral mode, if one pin of the default block is already in use, MicroXplorer tries to find a remap pin.

Note: For STM32F20x, each function in a block can be mapped separately to a pin with a different remap number.

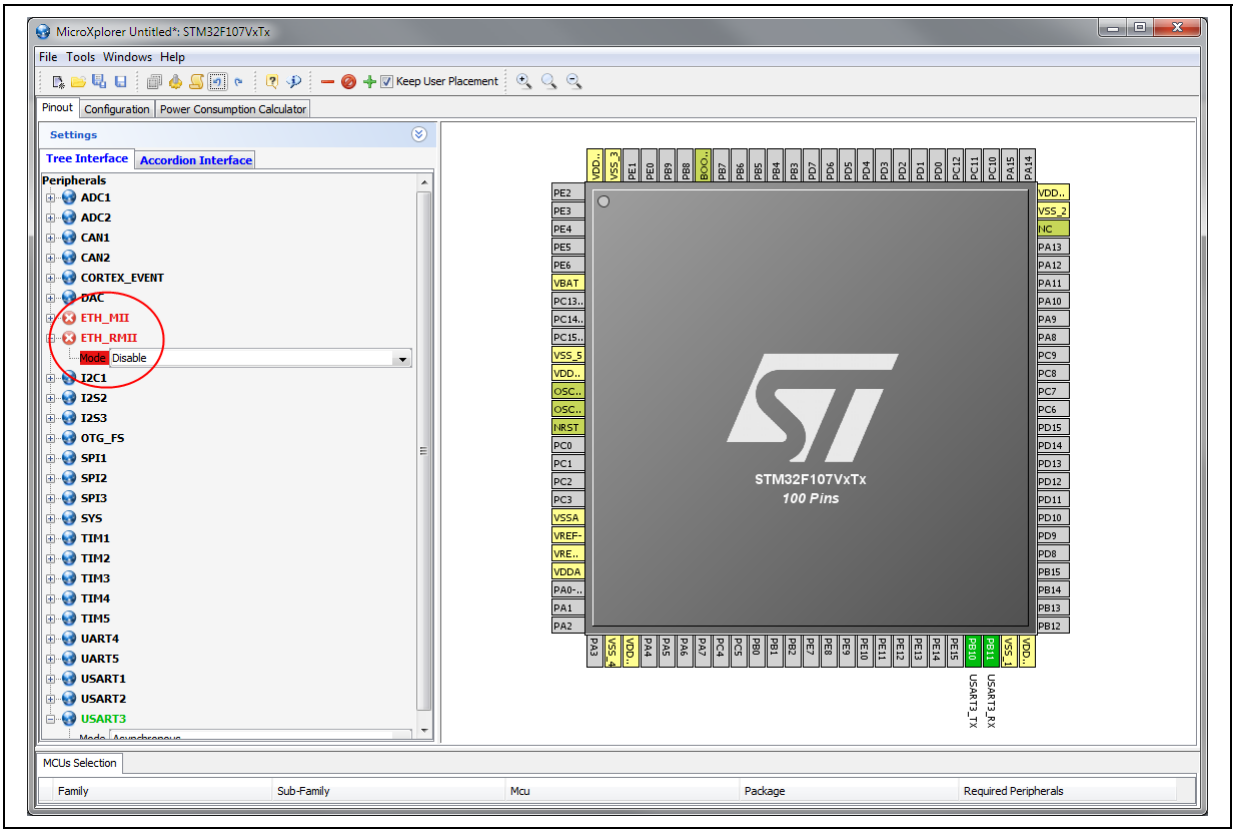
A.6 Block shifting (only if Keep User Placement is unchecked)

If a block cannot be mapped and there are no free alternate ones, MicroXplorer tries to remap all the peripheral modes impacted by the shared pin.

Example

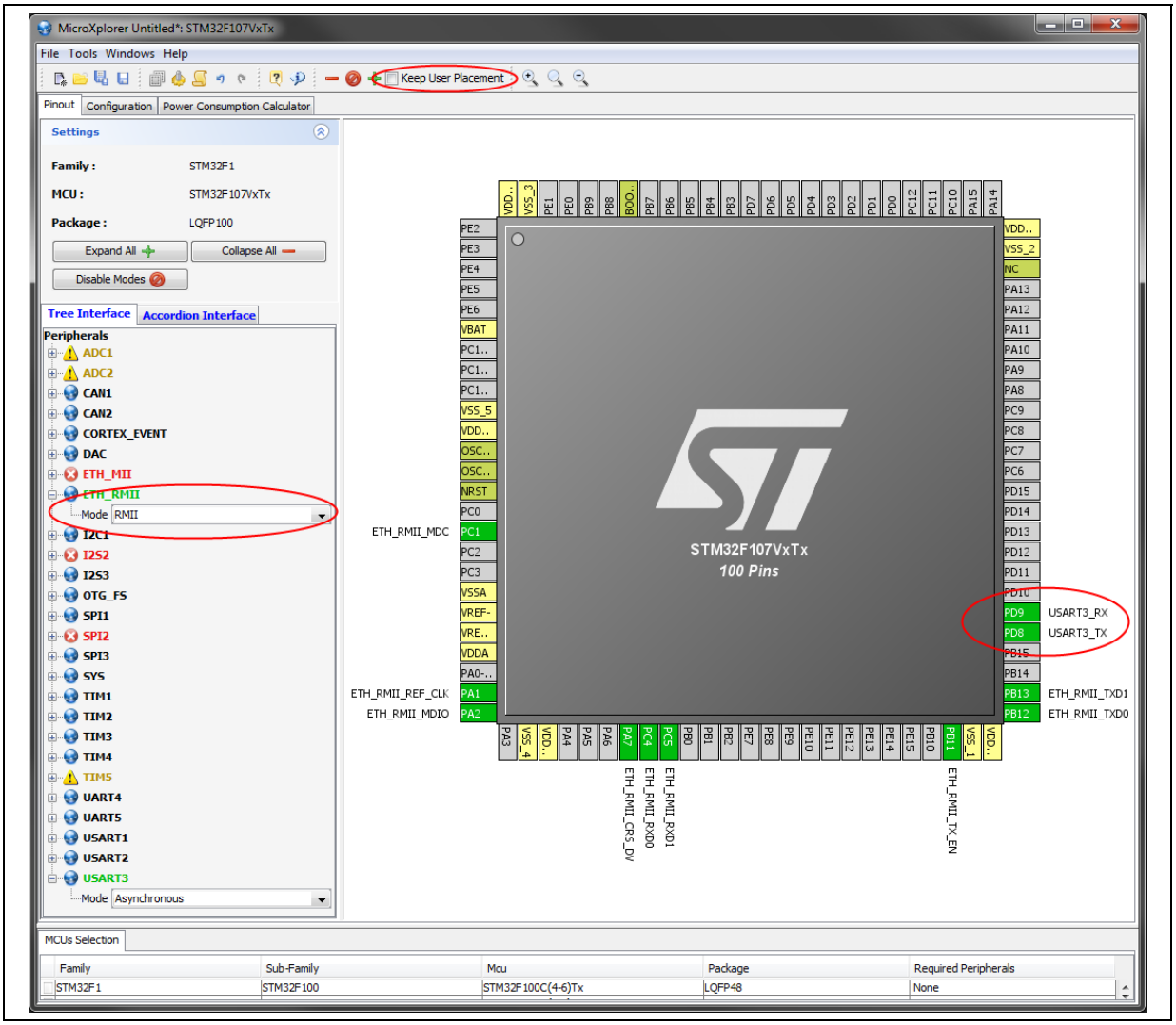
If you first set USART3 Asynchronous mode, then Asynchronous (PB10-PB11) default block is set, and ETH_MII becomes unavailable (in red) (see *Figure 75: Block shifting rule not applied*).

Figure 75. Block shifting rule not applied



If you then uncheck the Keep User Placement box, you are allowed to set the ETH_MII mode, but USART3 Asynchronous mode has been shifted to PD8-PD9 block by MicroXplorer (see *Figure 76: Block shifting rule applied*).

Figure 76. Block shifting rule applied



A.7 Setting or clearing a peripheral mode

There is a link between the Peripherals panel and the Chip view.

When a peripheral mode is set or cleared, all the pin functions of the block are set or cleared.

A.8 Mapping a function individually (if Keep User Placement is unchecked)

What happens to a Function that has been set individually (no peripheral mode is set) if MicroXplorer needs its pin?

- If the Keep User Placement box has been checked: MicroXplorer cannot change the pin location of the function, i.e. it cannot shift this function to another pin.
- If the Keep User Placement box has not been checked: MicroXplorer can change the pin location of the function.

A.9 Manual vs automatic I/O mapping

As an example GPIO_Input is manually mapped to PC5.

Using MicroXplorer, you can manually assign an I/O signal to a pin in the Chip view by following the sequence below:

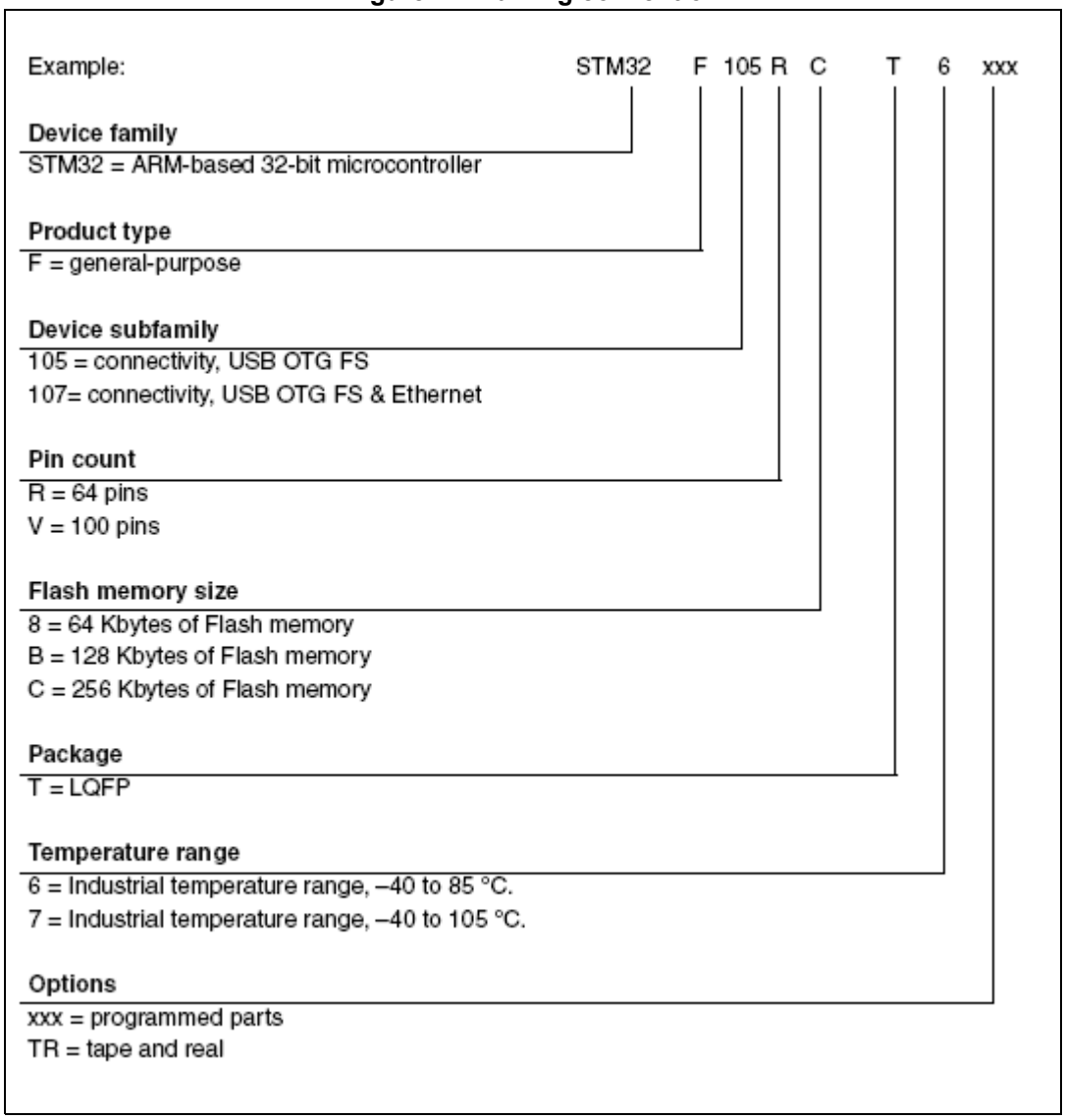
1. Click the pin.
2. Select one of the I/O modes (GPIO_Input, GPIO_Output, GPIO_Analog). When this is done, the corresponding pin is fixed on that I/O and cannot be assigned to another mode/signal. The automatic placement of signals does not use this pin anymore.

MicroXplorer cannot change the pin location of the I/O, i.e. MicroXplorer cannot shift this I/O to another pin.

Appendix B Microcontroller naming conventions

The STM32 microcontroller part numbering scheme is determined by convention, as shown below:

Figure 77. Naming convention



Appendix C STM32L1 power parameters specificities

C.1 Power Modes

The STM32 L1 family implements 6 power modes including 5 low-power modes:

- **RUN**:

  The purpose of this power mode using HSE/HSI is to reach highest performance with the CPU running up to 32 MHz. Program code is executed with the voltage regulator On.

- **SLEEP**:

  In this low-power mode using HSE/HSI, only the CPU is stopped but all peripherals continue to operate and can wake up the CPU. The vlotage regulator is On.

- **LOWPOWER_RUN**:

  This low-power mode is using MSI at 65 or 131 kHz with the voltage regulator in low power mode to minimize the regulator's operating current. The clock frequency and the number of enabled peripherals are both limited.

- **LOWPOWER_SLEEP**:

  This low-power mode is using MSI at 65 or 131 kHz with the voltage regulator in low power mode to minimize the regulator's operating current and by executing the WFI (wait for interrupt) or WFE (wait for event) instructions. The clock frequency and the number of enabled peripherals are both limited.

- **STOP**:

  This low-power mode using LSE/LSI at 32 kHz/37 kHz achieves a very low power consumption, the voltage regulator being in low power mode. The number of enabled peripherals is very limited. The RAM is preserved.

- **STANDBY**:

  This low-power mode using LSE/LSI at 32 kHz/37 kHz achieves the lowest power consumption. The voltage regulator is Off. The number of enabled peripherals is even more limited than in STOP mode. The RAM is not preserved.
  In addition to these 6 power modes, 2 transition modes have been added:

- **WU_FROM_STOP**:

  Wake-Up from Stop mode.

- **WU_FROM_STANDBY**:

  Wake-Up from Standby mode.

When devices are placed in low power modes such as STOP or STANDBY, the device needs to be woken up by a specific oscillator such as MSI, which is specified in the Clock Configuration combo box.

A special step called transition step should be inserted after these low power modes. Two transition steps are available: WU_FROM_STOP and WU_FROM_STANDBY.

Those transitions steps may have a significant impact on the global power consumption.

C.2 Power Consumption Ranges

The STM32L1 gives the possibility to select different Vcore ranges according to the power and MCU performance needed. Vcore is only available for STM32 devices and is the power supply for digital peripherals, SRAM and Flash memory. 3 Vcore voltages can be selected by software through different voltage ranges.

The power consumption ranges are defined as followed:

- **Range1**:

  Vdd [VDD range limited to 2.0 - 3.6 V]. Range 1 is the "high performance" range. The voltage regulator outputs a 1.8 V voltage (typical) as long as the VDD input voltage is above 2.0 V. Flash program and erase operations can be performed in this range.

- **Range2**:

  Vdd [full VDD range]. At 1.5 V, the Flash memory is still functional but with medium read access time. This is the "medium performance" range. Program and erase operations on the Flash memory are still possible.

- **Range3**:

  Vdd [full VDD range]. At 1.2 V, the Flash memory is still functional but with slow read access time. This is the "low performance" range. Program and erase operations on the Flash memory are not possible under these conditions.

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Revision history

Table 2. Document revision history

Date	Revision	Changes
15-Feb-2013	1	Initial release.
17-Apr-2013	2	Changed MicroXplorer 3.0 into MicroXplorer 3.1. Updated the *Introduction*. Added *Section 2: Getting started* and *Section 5: Power Consumption Calculator plugin*. Updated most figures from *Figure 18* to *Figure 76*.

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