ADC with STM32CubeMX and HAL

This tutorial will demonstrate how to utilize STM32CubeMX tool to initialize peripherals, build and generate C code using HAL libraries.

After this tutorial you will be able to:

- Create and configure STM32CubeMX project and generate initialization code
- Program and use HAL functions to collect ADC data from a selected analog channel (i.e. internal temperature sensor)

Hardware:

- Nucleo-L476RG board(64-pin),available at: www.st.com/en/evaluation-tools/nucleo-l476rg.html
- Standard-A -to- Mini USB cable

Literature:

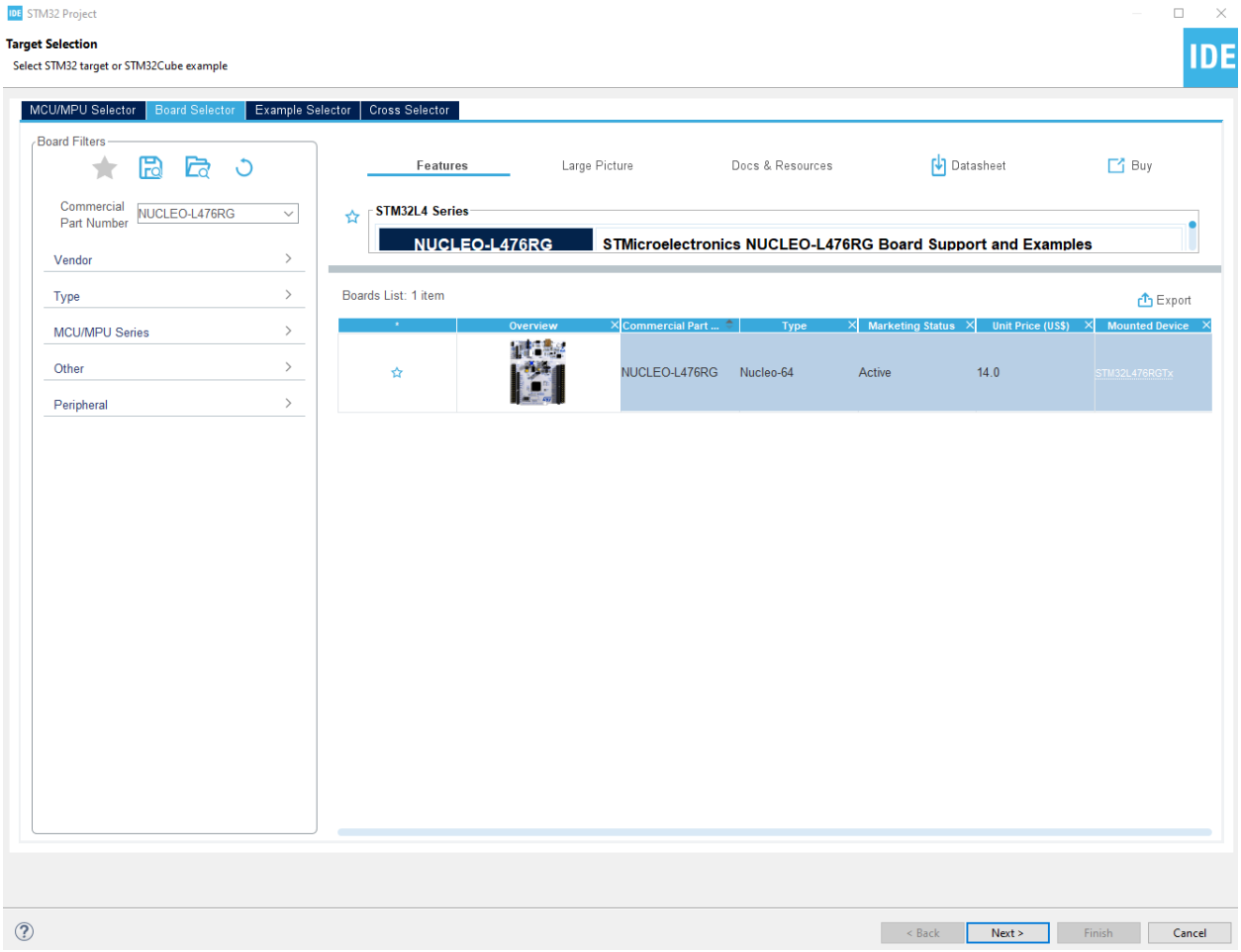
- STM32L476xx Datasheet
- UM1724 User manual STM32 Nucleo-64 boards
- UM1884 Description of STM32L4/L4+ HAL and low-layer drivers
- UM1718 User manual STM32CubeMX for STM32 configuration and initialization C code generation

Stages

- 1: Create New Project with STM32CubeMX
- 2: Pinout Configuration
- 3: Clock Configuration
- 4: Configure project and Generate Source Code
- 5: Edit main.c
- 6: Build Project
- 7: Debug the Project

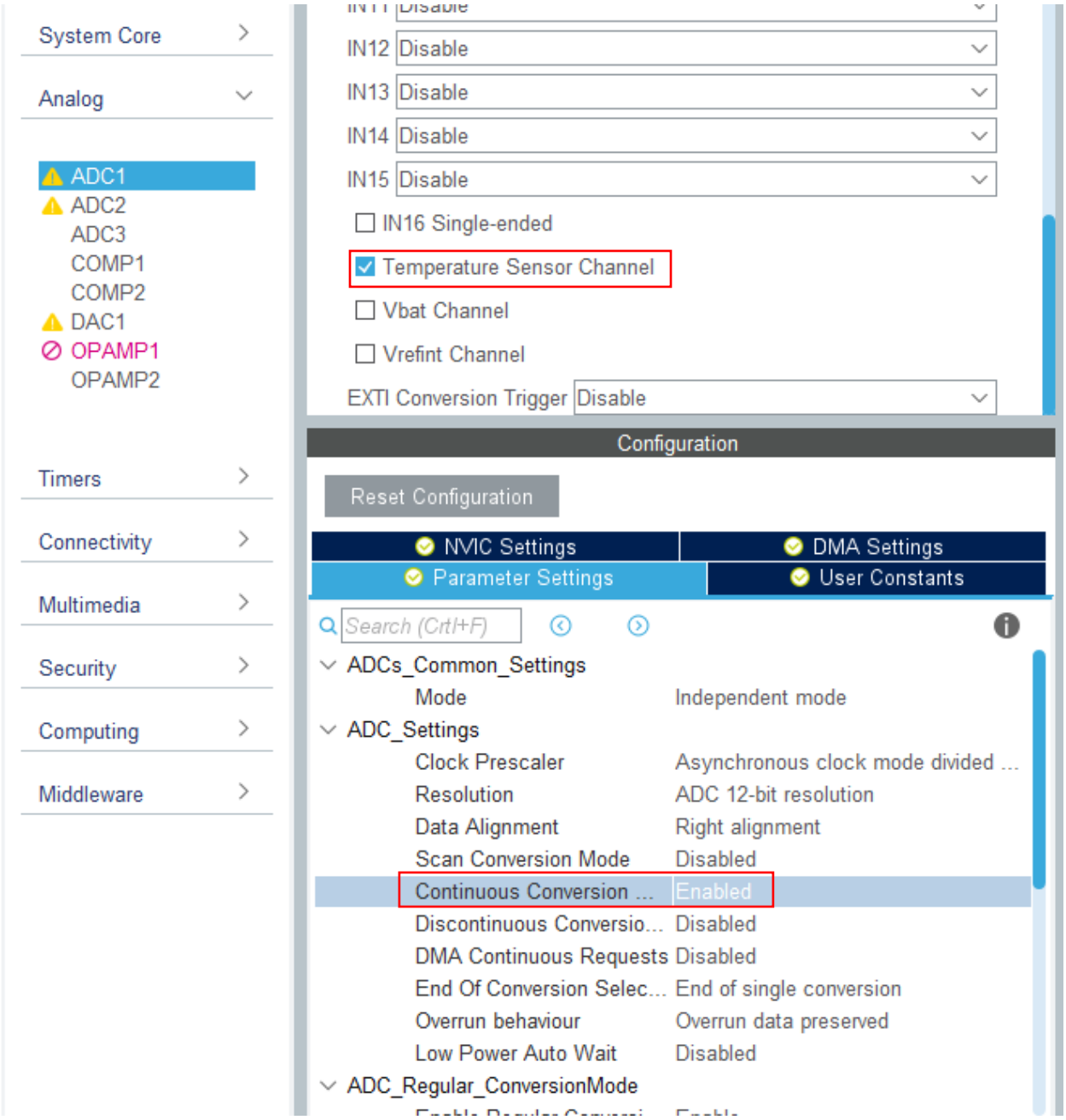
1: CREATE NEW PROJECT USING STM32CUBEMX:

- Open STM32CubeIDE
- Click *File -> New -> STM32 Project*. A target selection window will open.
- From Board Selector type *Nucleo-L476RG.* Select the board and click next.
- Name your project “Nucleo_L476RG_ADC” and click Finish.
- Answer “Yes” to “Initialize all peripherals with their default mode?” popup.

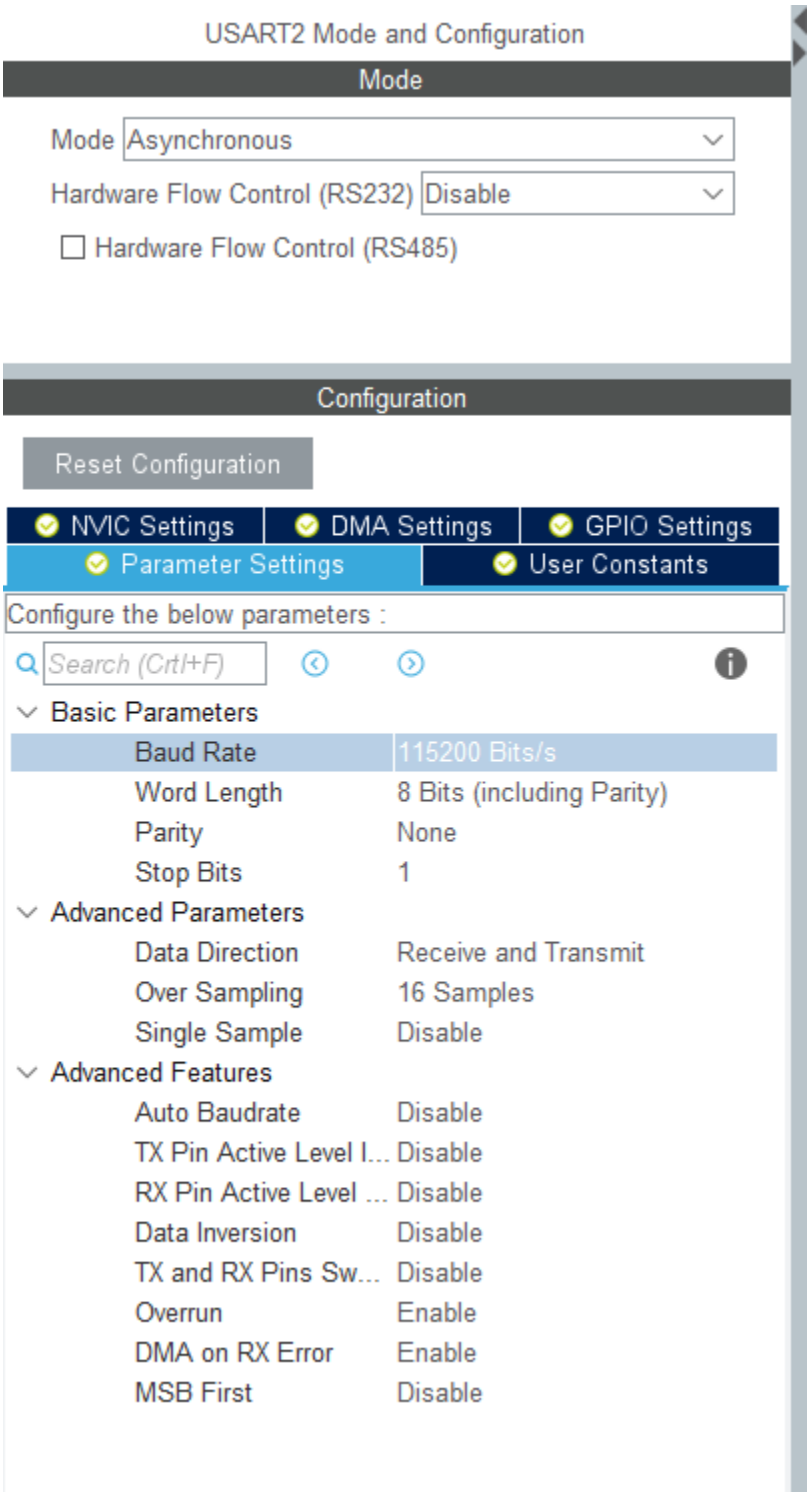


2: Pinout Configuration

Under Analog select ADC1. We want to enable Temperature Sensor Channel to read from the internal temperature sensor. Next enable *Continous Conversion Mode*



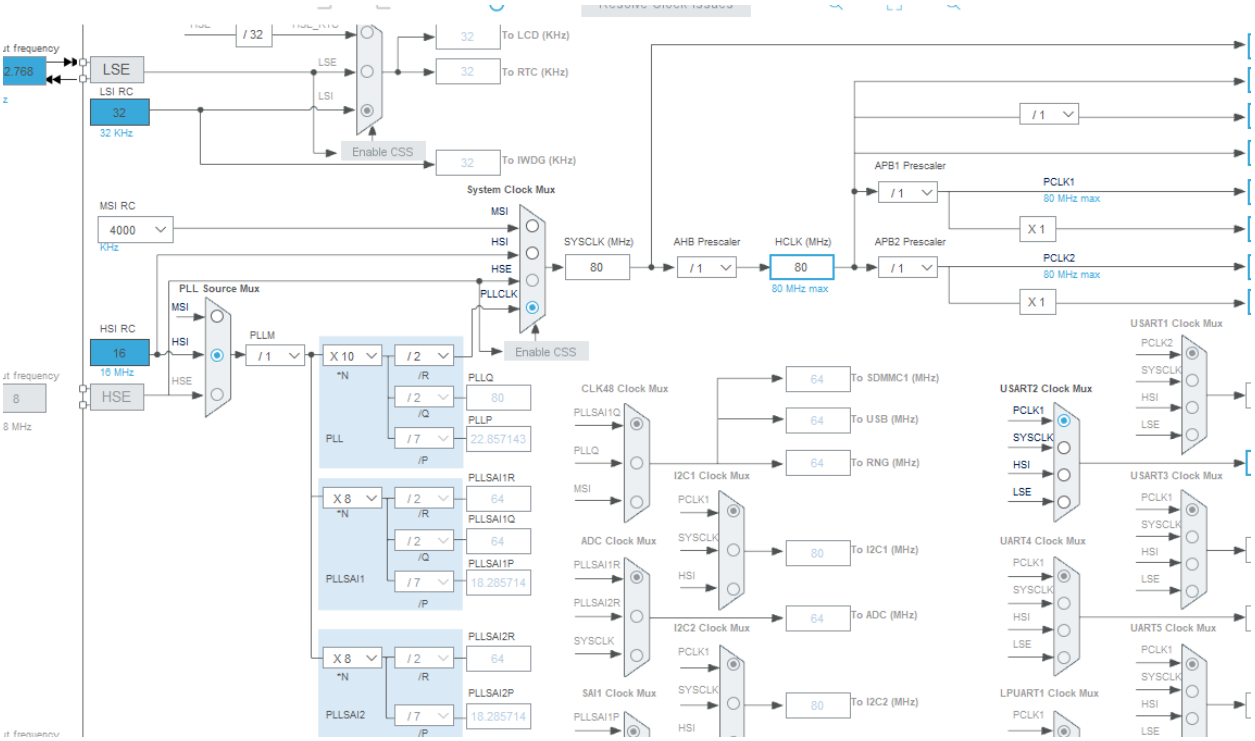
Under Connectivity, select USART2 and verify it is configured match the below image.



3. CLOCK CONFIGURATION

In the clock configuration tab you can see that STM32CubeMX automatically configures the internal oscillator in the clock system with PLL @80MHz. The HIS is selected as the PLL source and the PLLCLK is selected in the system clock mux.

HCLK is set to 80 MHz.



4: GENERATE CODE

We can now generate code. Click File->Save. You will be asked to generate code, press yes.

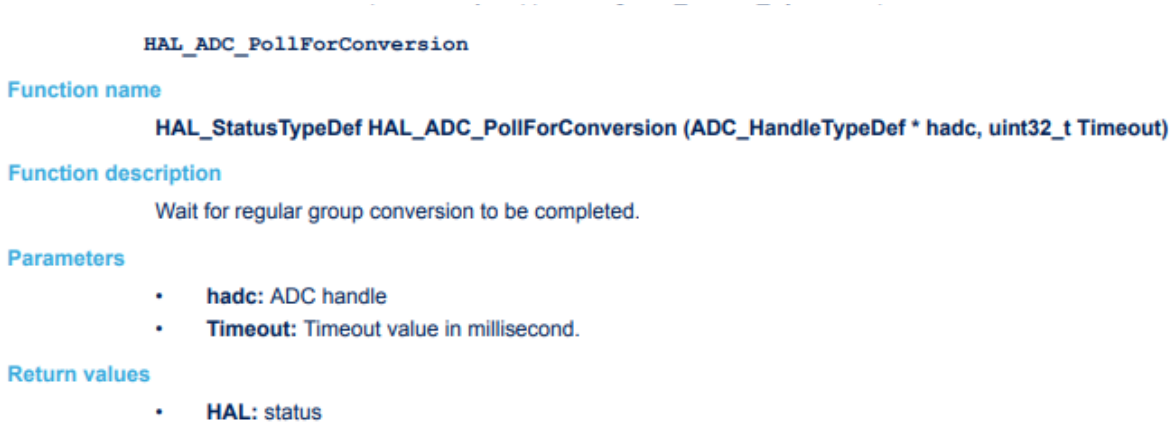
Under the project explorer navigate *to Core->Src->main.c*.

5: EDIT main.c

At the top of the file, add:

#include <string.h> and *#include<stdio.h>*

Referring to the UM1884 User manual we can use *HAL_ADC_PollForConverstion* to wait for conversion to be completed. We can specify a timeout value in milliseconds. We can use *HAL_MAX_DELAY* to wait for a very long time.



HAL_ADC_PollForConversion

Function name

HAL_StatusTypeDef HAL_ADC_PollForConversion (ADC_HandleTypeDef * hadc, uint32_t Timeout)

Function description

Wait for regular group conversion to be completed.

Parameters

- **hadc:** ADC handle
- **Timeout:** Timeout value in millisecond.

Return values

- **HAL:** status

HAL_ADC_GetValue will give us the raw conversion value. We can then use *HAL_UART_Transmit* to print our data to the terminal.

HAL_ADC_GetValue

Function name

uint32_t HAL_ADC_GetValue (ADC_HandleTypeDef * hadc)

Function description

Get ADC regular group conversion result.

Parameters

- **hadc:** ADC handle

Return values

- **ADC:** group regular conversion data

From the STM32L476xx datasheet we can get values for our raw value to temperature conversion.

- 4095 is max value for 12 bit conversion
- 3300 is reference voltage in millivolts
- 760 is voltage in millivolts at 30°C
- 2.5 is average slope in mV/°C

In int main():

```
  /* Initialize all configured peripherals */
  MX_GPIO_Init();
  MX_USART2_UART_Init();
  MX_ADC1_Init();
  /* USER CODE BEGIN 2 */

  /* Initialize all configured peripherals */
    MX_ADC1_Init();

    HAL_ADCEx_Calibration_Start(&hadc1, ADC_SINGLE_ENDED);

    HAL_ADC_Start(&hadc1);

    while (1) {
      char msg[20];
      uint16_t rawValue;
      float temp;

      HAL_ADC_PollForConversion(&hadc1, HAL_MAX_DELAY);

      rawValue = HAL_ADC_GetValue(&hadc1);
      temp = ((float)rawValue) / 4095 * 3300;
      temp = ((temp - 760.0) / 2.5) + 30;

      sprintf(msg, "rawValue: %hu\r\n", rawValue);
      HAL_UART_Transmit(&huart2, (uint8_t*) msg, strlen(msg), HAL_MAX_DELAY);

      sprintf(msg, "Temperature: %f\r\n", temp);
      HAL_UART_Transmit(&huart2, (uint8_t*) msg, strlen(msg), HAL_MAX_DELAY);
    }
  /* USER CODE END 3 */
}
```

6: BUILD THE PROJECT

Connect your USB cable from the computer to your Nucleo Board. Right click the project from the project explorer and click “Build project” to compile the project.

7: DEBUG THE PROJECT

Click on the Debug toolbar icon to start the debug session. Another way to debug is to *Run->Debug* . 

Click the Resume icon to continue the execution. Open a serial monitor such as Putty and select your com port with the appropriate baud rate (115200). We can now see the raw and converted temperature values.