

# Measure VDD And Temperature

Example Code Introduction for 32-bit NuMicro® Family

## Information

Application	Demonstrate measure internal temperature and supply voltage of IC using internal BandGap 2.5V voltage.
BSP Version	Nano100B Series BSP CMSIS V3.03.000
Hardware	NuTiny-EVB-Nano130-LQPF128

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## 1 Function Description

### 1.1 Introduction

Demonstrate measure internal temperature and supply voltage of IC using internal BandGap 2.5V voltage.

### 1.2 Principle

Use internal BandGap 2.5V voltage as IC internal reference voltage.

Enable internal ADC channel 14 and enable temperature detection register to measure IC internal temperature.

The calculate function show as below:

$$V_{temp}(mV) = 2.5 * 1000 * (ADC\_14 / 4096)$$

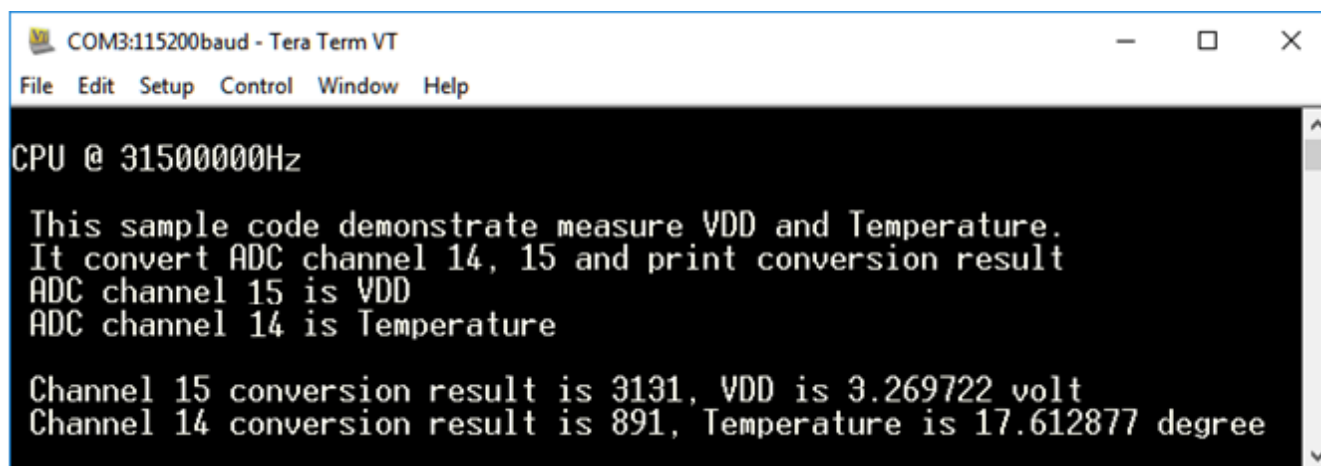
$$V_{temp} (mV) = -1.73 (mV/^{\circ}C) \times Temperature (^{\circ}C) + 740 (mV).$$

Measuring the supply voltage using ADC channel 15.

The calculate function show as below:

$$VDD = (4096 / ADC\_15) * 2.5V$$

### 1.3 Demo Result



```
COM3:115200baud - Tera Term VT
File Edit Setup Control Window Help

CPU @ 31500000Hz

This sample code demonstrate measure VDD and Temperature.
It convert ADC channel 14, 15 and print conversion result
ADC channel 15 is VDD
ADC channel 14 is Temperature

Channel 15 conversion result is 3131, VDD is 3.269722 volt
Channel 14 conversion result is 891, Temperature is 17.612877 degree
```

## 2 Code Description

Enable temperature sensor and BandGap :

```
SYS_EnableTempCtl(); // Enable Temperature Sensor
SYS_EnableIntVRefBGP(1); // Enable Vref is BGP
```

Set ADC and start the A/D conversion :

```
// Set ADC
ADC_Open(ADC, ADC_INPUT_MODE_SINGLE_END, ADC_OPERATION_MODE_SINGLE_CYCLE,
ADC_CH_14_MASK | ADC_CH_15_MASK);
ADC_SetExtraSampleTime(ADC, ADC_CH_14_MASK, 1024);

ADC_SetVrefVoltage(0); // Set Vref voltage

// Power on ADC
ADC_POWER_ON(ADC);

// Enable ADC ADC_IF interrupt
ADC_EnableInt(ADC, ADC_ADF_INT);
NVIC_EnableIRQ(ADC_IRQn);

ADC_START_CONV(ADC);
```

Get A/D conversion value and calculate VDD voltage and temperature :

```
u32Result = ADC_GET_CONVERSION_DATA(ADC, 15);
fAvdd = 2.5 * 0xffff / u32Result;
printf(" Channel 15 conversion result is %d, VDD is %f volt \n", u32Result, fAvdd);
u32Result = ADC_GET_CONVERSION_DATA(ADC, 14);
fTmp = (740 - (1000 * u32Result / 4096) * fAvdd) / 1.73 ;
printf(" Channel 14 conversion result is %d, Temperature is %f degree \n", u32Result,
fTmp);
```

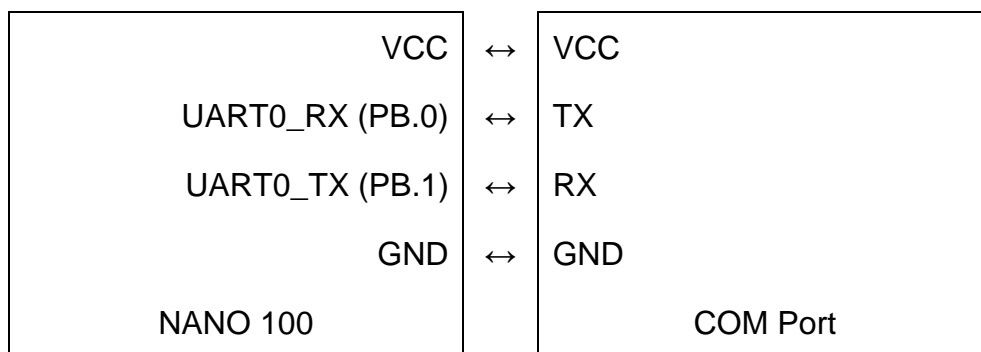
### 3 Software and Hardware Environment

- **Software Environment**

- BSP version
  - ◆ Nano100B Series BSP CMSIS V3.03.000
- IDE version
  - ◆ Keil uVersion 5.26

- **Hardware Environment**

- Circuit components
  - ◆ NuTiny-EVB-NANO130-LQPF128
- Diagram



## 4 Directory Information

 EC\_Nano100\_Use\_BandGap\_Measure\_VDD\_And\_Temperature

 Library

Sample code header and source files

 CMSIS

Cortex® Microcontroller Software Interface Standard (CMSIS) by Arm® Corp.

 Device

CMSIS compliant device header file

 StdDriver

All peripheral driver header and source files

 SampleCode

 ExampleCode

Source file of example code

## 5 How to Execute Example Code

1. Browsing into sample code folder by Directory Information (section 4) and double click Nano100\_Use\_BandGap\_Measure\_VDD\_And\_Temperature.uvproj.
2. Enter Keil compile mode
  - a. Build
  - b. Download
  - c. Start/Stop debug session
3. Enter debug mode
  - a. Run

## 6 Revision History

Date	Revision	Description
Jun. 26, 2019	1.00	1. Initially issued.

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