NUC240 ADC, PWM with PID Control

Example Code Introduction for 32-bit NuMicro® Family

Information

Application	NUC240 uses PID Controller to adjust PWM output DC voltage in RC filter and read ADC value
BSP Version	NUC240_BSP_CMSIS_v3.01.001
Hardware	NuEdu-EVB NUC240 V2.1 with NuEdu-Basic01 V2.0

1 Function Description

1.1 Introduction

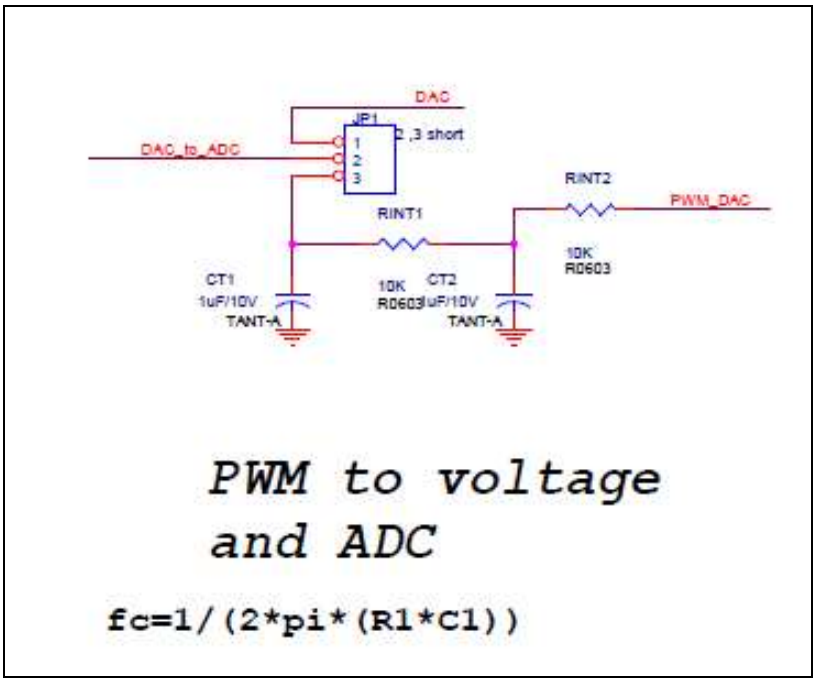
The PWM CH4 waveform to filters output the DC voltage via the RC filter circuit, the voltage is read by the ADC CH1, and the feedback voltage is gradually adjusted to a predetermined value using the PID controller. The code preset is SET = 1.5V for target voltage.

1.2 Principle

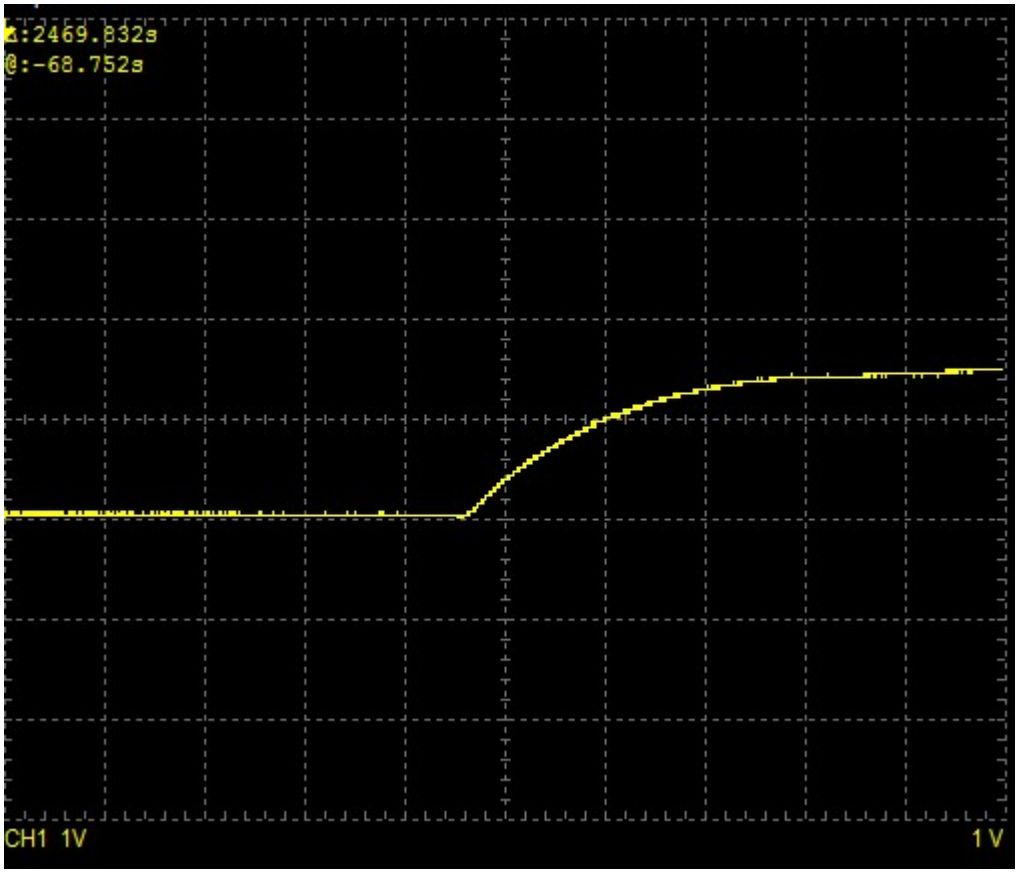
PID formal is: out =(kp*E)+(ki*se)+(kd*de)
kp: proportional constant
ki: integral constant
kd: differential constant
E: current error
se: cumulative error
de: last error

1.3 Demo Result

In NuEdu-Basic01 V2.0
The PWM_DAC(PWM CH4) output 1Khz to RC filter circuit, the RC filter output DC voltage in DAC_ADC (ADC CH1)



Output 1.5V in ADC CH1 pin



2 Code Description

The ADC1 channel gets current voltage and current error, the code gets PWM output value by PID code formal, The PWM out for new duty for output voltage.

```
while (1){
        //Get Volume Knob Data
        temp = Get_ADC1_Knob();                 //Volume Range: 0 ~ 4095
        voltage = 3.27 / 4095.0 * temp;         //desire voltage
        printf("voltage=%f\n\r", voltage);
        E = (SET - voltage) / (3.27 / 4095);
        printf("e=%f\n\r", E);
        se += E;
        de = E - le;
        out = (kp * E) + (ki * se) + (kd * de); //PID formal
        le = E;
        printf("out=%f\n\r", out);
        Write_PWMDAC(1, out / 4095);
}
```

3 Software and Hardware Environment

Software Environment

- BSP version
  - NUC240_BSP_CMSIS_v3.01.001
- IDE version
  - Keil uVersion 5.22

Hardware Environment

- Circuit components
  - NuEdu-EVB NUC240 V2.1 with NuEdu-Basic01 V2.0

4 Directory Information

- EC_NUC240_ADC_PWM_PID_V1.00
  - 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 ADC_PWM_PID.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
Oct. 1, 2019	1.00	1. Initially issued.

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