Use ACMP to Reverse UART Tx Signal

Example Code Introduction for 32-bit NuMicro® Family

Information

Application	This code uses ACMP as an inverter to reverse UART Tx signal.
BSP Version	NUC230_240 Series BSP CMSIS V3.01.001
Hardware	NuTiny-EVB-NUC240 V1.2

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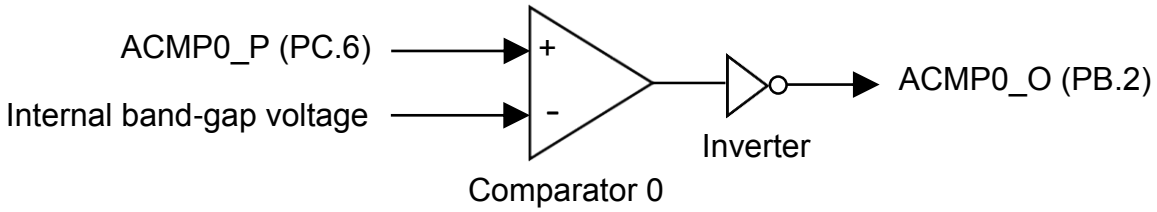
1 Function Description

1.1 Introduction

The ACMP inside MCU is used as an inverter. The ACMP positive input is UART Tx signal and the negative input is internal band-gap reference voltage. The output of ACMP is set to reverse signal.

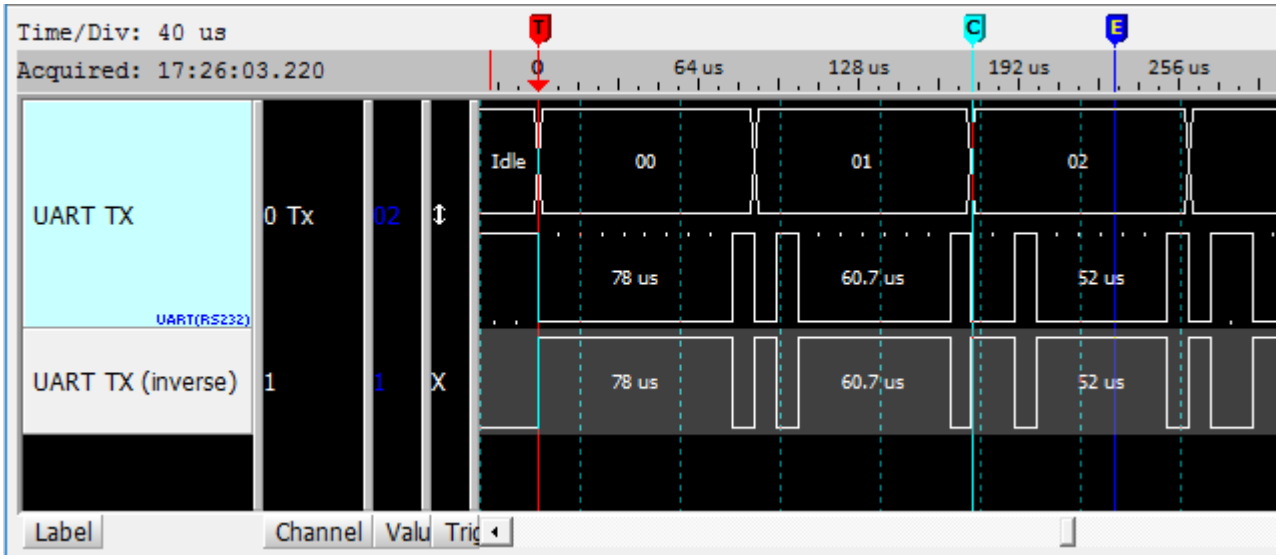
1.2 Principle

The comparator output is logic 1 when positive input voltage is greater than negative input voltage; otherwise the output is logic 0. The ACMP output signal can be selected as reverse signal in NUC240.



1.3 Demo Result

The channel 1 is UART Tx signal (PB.1). It is connected to ACMP positive input (PC.6). The channel 2 is ACMP output signal. The inversed UART Tx signal can be measured form channel 2.



2 Code Description

Configure ACMP multiple function pin. Select PC.6 as positive input and PB.2 as output. Disable their digital input paths.

```
    /* Set PC.6 multi-function pin for ACMP0 positive input pin */
    SYS->GPC_MFP = (SYS->GPC_MFP & (~SYS_GPC_MFP_PC6_Msk)) | SYS_GPC_MFP_PC6_ACMP0_P;
    SYS->ALT_MFP = (SYS->ALT_MFP & (~SYS_ALT_MFP_PC6_Msk)) | SYS_ALT_MFP_PC6_ACMP0_P;
    SYS->ALT_MFP1 = (SYS->ALT_MFP1 & (~SYS_ALT_MFP1_PC6_Msk)) | SYS_ALT_MFP1_PC6_ACMP0_P;

    /* Disable digital input path of analog pin ACMP0_P to prevent leakage */
    GPIO_DISABLE_DIGITAL_PATH(PC, BIT6);

    /* Set PB multi-function pins ACMP0 output */
    SYS->GPB_MFP = (SYS->GPB_MFP & (~SYS_GPB_MFP_PB2_Msk)) | SYS_GPB_MFP_PB2_ACMP0_O;
    SYS->ALT_MFP = (SYS->ALT_MFP & (~SYS_ALT_MFP_PB2_Msk)) | SYS_ALT_MFP_PB2_ACMP0_O;
    SYS->ALT_MFP2 = (SYS->ALT_MFP2 & (~SYS_ALT_MFP2_PB2_Msk)) | SYS_ALT_MFP2_PB2_ACMP0_O;

    /* Disable digital input path of analog pin ACMP0_O to prevent leakage */
    GPIO_DISABLE_DIGITAL_PATH(PB, BIT2);
```

Configure ACMP. Enable ACMP and select negative input as internal reference voltage. The Hysteresis function is not used and the output signal is inverse.

```
    /* Configure ACMP0.
       Enable ACMP0 and select internal reference voltage as negative input. */
    ACMP_Open(ACMP, 0, ACMP_CR_VNEG_BANDGAP, ACMP_CR_HYSTERESIS_DISABLE);

    /* Enable ACMP output inverse */
    ACMP_ENABLE_OUTPUT_INVERSE(ACMP,0);
```

Send UART character 0x0~0x2.

```
    /* UART send character 0x0~0x2 */
    for(u32Idx=0; u32Idx<3; u32Idx++)
    {
        SendChar_ToUART(u32Idx);
    }
```

3 Software and Hardware Environment

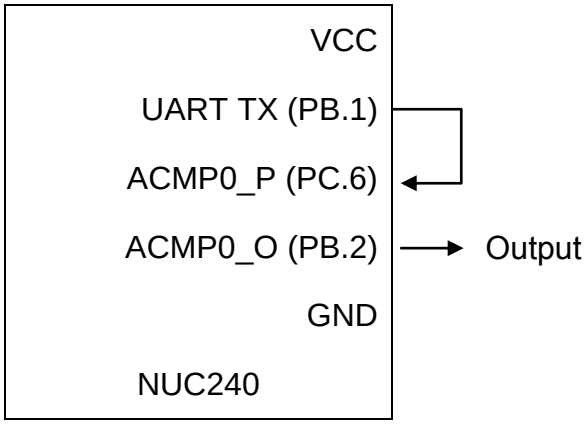
Software Environment

- BSP version
  - NUC230_240 Series BSP CMSIS V3.01.001
- IDE version
  - Keil uVersion 5.28

Hardware Environment

- Circuit components
  - NuTiny-EVB-NUC240 V1.2
- Diagram

UART Tx signal (PB.1) is connected to ACMP positive input (PC.6). The ACMP output is PB.2.



4 Directory Information

- EC_NUC240_ACMP_Reverse_UART_Tx_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 NUC240_ACMP_Reverse_UART_Tx.uvproj.
2. Enter Keil compile mode
   a. Build
   b. Download
3. Enter debug mode
   a. Run

6 Revision History

Date	Revision	Description
Jul. 31, 2019	1.00	1. Initially issued.

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