NUC240 Controls DS3231 via I^{2}C

Example Code Introduction for 32-bit NuMicro® Family

Information

Application	The example use NUC240 to control DS3231 by using I^{2}C
BSP Version	NUC230_240 Series BSP CMSIS v3.01.001
Hardware	NuEdu-EVB-NUC240 v1.0

1 Function Description

1.1 Introduction

The example is the driver of DS3231 based on NUC240 series. NUC240 series read RTC information from DS3231 via I^{2}C interface, and display on the terminal. This sample code provides two API for user:

API	Function
void DS3231_RTC_Write(uint8_t u8Reg, uint8_t u8Value)	Set the time to DS3231
uint8_t DS3231_RTC_Read(uint8_t u8Reg)	Get the time from DS3231

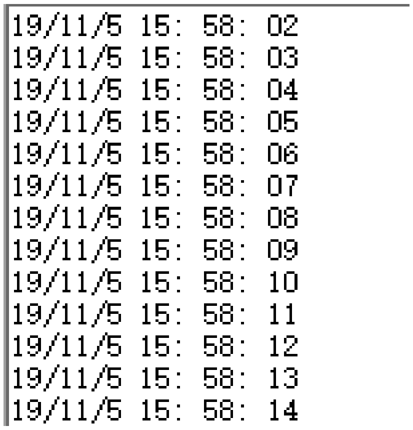
1.2 Principle

DS3231 features:

- Low cost high accuracy real time clock.
- Real time clock generator for seconds, minutes, hours, day of week, date, month, and year timing.
- I^{2}C interface
- The accuracy from 0 °C to +40 °C is ±2 ppm and -40 °C to +85 °C is ±3.5 ppm.

1.3 Demo Result

NUC240 controls DS3231 via I^{2}C interface. Compile the project and enter debug mode, the serial window UART #1 will show the current time continuously.



```
19/11/5 15: 58: 02
19/11/5 15: 58: 03
19/11/5 15: 58: 04
19/11/5 15: 58: 05
19/11/5 15: 58: 06
19/11/5 15: 58: 07
19/11/5 15: 58: 08
19/11/5 15: 58: 09
19/11/5 15: 58: 10
19/11/5 15: 58: 11
19/11/5 15: 58: 12
19/11/5 15: 58: 13
19/11/5 15: 58: 14
```

2 Code Description

2.1 Write time to DS3231

Use DS3231_RTC_Write() function to set DS3231 default information. DS3231 has an I^{2}C address 0x68 by default and cannot be changed.

```
void DS3231_RTC_Write(uint8_t u8Reg, uint8_t u8Value)
{
    /* DS3231 I2C slave address */
    g_u8DeviceAddr = 0x68;

    /* DS3231 address map */
    g_au8TxData[0] = u8Reg;

    /* Write data to DS3231 */
    g_au8TxData[1] = dec_to_bcd(u8Value);
    g_u8DataLen = 0;
    g_u8EndFlag = 0;

    /* I2C function to write data to slave */
    s_I2C0HandlerFn = (I2C_FUNC)I2C_MasterTx;

    /* I2C as master sends START signal */
    I2C_SET_CONTROL_REG(I2C0, I2C_I2CON_STA);

    /* Wait I2C Tx Finish */
    while (g_u8EndFlag == 0);

    g_u8EndFlag = 0;
}
```

2.2 Read time from DS3231

Use DS3231_RTC_Read() function to get the information from DS3231. It will update the correct time and display on the terminal continuously.

```
uint8_t DS3231_RTC_Read(uint8_t u8Reg)
{
    /* DS3231 I2C slave address */
    g_u8DeviceAddr = 0x68;
    /* DS3231 address map */
    g_au8TxData[0] = u8Reg;

    g_u8DataLen = 0;
    g_u8EndFlag = 0;

    /* I2C function to read data from slave */
    s_I2C0HandlerFn = (I2C_FUNC)I2C_MasterRx;

    /* I2C as master sends START signal */
    I2C_SET_CONTROL_REG(I2C0, I2C_I2CON_STA);

    /* Wait I2C Rx Finish */
    while (g_u8EndFlag == 0);

    g_u8EndFlag = 0;

    return bcd_to_dec(g_u8RxData);
}
```

3 Software and Hardware Environment

- **Software Environment**
  - BSP version
    - NUC230_240 Series BSP CMSIS v3.01.001
  - IDE version
    - Keil uVersion 4.74
- **Hardware Environment**
  - Circuit components
    - NuEdu-EVB-NUC240 V1.0
    - DS3231
  - Diagram

The pin connections between the NUC240 and the DS3231 are detailed below.

NUC240		DS3231
VCC	↔	VCC
I2C0_SCL (PA.9)	↔	SCL
I2C0_SDA (PA.8)	↔	SDA
GND	↔	GND

4 Directory Information

🗁 EC_NUC240_I2C_DS3231_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
🗁 NuEdu	Library for NuEdu-SDK-NUC240 board
🗁 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_I2C_DS3231.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
Nov. 01, 2019	1.00	1. Initially issued.

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