**STM32F401RE: I2C1 Byte Read from DS1337 RTC**

**Overview**

This project configures **I2C1 as a Master** on the **STM32F401RE**, communicating with the **DS1337 Real-Time Clock (RTC)** to continuously **read the seconds register (0x00)** and toggle the **onboard LED (PA5) every second**.

**Features**

* **I2C1 Configured in Master Mode (Standard Mode, 100 kHz)**
* **Reads the DS1337 RTC Seconds Register (0x00) Continuously**
* **LED (PA5) Blinks Every Second Based on Bit 0 of the Read Data**
* **PB8 (SCL) and PB9 (SDA) Configured for I2C1**
* **Peripheral Clock: 16 MHz**

**Hardware Setup**

**I2C1 Pin Configuration**

| **Signal** | **STM32F401RE Pin** | **Description** |
| --- | --- | --- |
| **I2C1 SCL (Clock)** | **PB8** | I2C1 Clock Output |
| **I2C1 SDA (Data)** | **PB9** | I2C1 Data Line |

**Wiring for I2C1 to DS1337 RTC**

| **STM32F401RE (Master)** | **DS1337 RTC (Slave)** |
| --- | --- |
| **PB8 (SCL)** | **SCL** |
| **PB9 (SDA)** | **SDA** |
| **GND** | **GND** |
| **VCC (3.3V)** | **VCC** |

**LED Output (STM32F401RE)**

| **STM32F401RE Pin** | **Function** |
| --- | --- |
| **PA5** | LED Toggle Every Second |

**Software Explanation**

**I2C1 Master Initialization**

* **PB8 (SCL) and PB9 (SDA) Configured as Alternate Function (AF4).**
* **I2C1 Set to Standard Mode (100 kHz) with Peripheral Clock = 16 MHz.**
* **I2C1 Software Reset and Proper Enable Sequence Followed.**

**I2C1 Data Transmission**

* **Sends Start Condition Before Transmitting Data.**
* **Writes DS1337 RTC Slave Address (0x68) + Register Address (0x00).**
* **Reads a Single Byte from the Register (Seconds Value).**
* **Toggles LED (PA5) Based on LSB of Read Data.**

**Expected Behavior**

* **I2C1 Reads the DS1337 RTC at Address 0x68 via PB8 (SCL) & PB9 (SDA).**
* **Reads the Seconds Register (0x00) Every Second.**
* **LED (PA5) Turns ON for Odd Seconds and OFF for Even Seconds.**

**Project Structure**

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├── Inc/

│ └── stm32f4xx.h // CMSIS/Device headers

├── Src/

│ └── main.c // Contains I2C1 communication logic

└── README.md // This file

**Building and Uploading**

**Using Keil uVision / STM32CubeIDE**

1. **Open Keil uVision or STM32CubeIDE.**
2. **Create a New Project** for STM32F401RE.
3. **Copy main.c into the Src/ Directory.**
4. **Compile and Flash the Project** to **Nucleo-F401RE.**

**Usage**

**1️⃣ Flash the Code to the STM32F401RE**

* Use **Keil uVision** or **STM32CubeIDE**.

**2️⃣ Connect I2C1 to DS1337 RTC**

* **Wire PB8 (SCL) and PB9 (SDA) to the RTC.**
* Ensure the **GND and VCC (3.3V) Connections** Are Correct.

**3️⃣ Observe LED Blinking Every Second**

* The onboard LED (PA5) will **toggle based on the RTC seconds register (bit 0).**

**Troubleshooting**

**🔴 No I2C Communication?**

✅ **Ensure PB8 (SCL) and PB9 (SDA) Are Correctly Connected.**  
✅ **Confirm I2C1 Is Enabled (I2C1->CR1 |= (1U << 0);).**  
✅ **Check That Pull-Up Resistors (4.7kΩ) Are Connected to SDA/SCL.**

**⚠️ RTC Not Responding?**

✅ **Ensure the Correct I2C Slave Address (0x68) Is Used.**  
✅ **Check I2C Clock Polarity/Phase (Standard Mode).**

**License**

This project is licensed under the **MIT License**.  
You are free to **modify, distribute, and use** the code.

**References**

📄 [STM32F401RE Datasheet](https://www.st.com/en/microcontrollers-microprocessors/stm32f401re.html)  
📄 [STM32 Reference Manual (RM0368)](https://www.st.com/resource/en/reference_manual/dm00096844.pdf)  
📄 [I2C Programming Guide](https://www.st.com/resource/en/programming_manual/dm00245755.pdf)

**🚀 Summary**

✅ **I2C1 Configured as Master (PB8 SCL, PB9 SDA).**  
✅ **Reads from DS1337 RTC Using I2C1 at 100 kHz.**  
✅ **Proper Start, Restart, and Stop Condition Handling.**  
✅ **LED (PA5) Blinks Based on RTC Seconds Register.**

📡 **Enjoy I2C Communication with STM32F401RE! 🎯**