Here is the **README** file for your **STM32F401RE LM34 Temperature Sensor with ADC1 & USART2** project.

You can save this as **README.md** (for GitHub) or **README.docx** (for a Word document).

**LM34 Temperature Sensor with STM32F401RE (ADC1 & USART2)**

This project reads temperature data from an **LM34 Fahrenheit temperature sensor** connected to **PC0 (ADC1 Channel 10)** on the **STM32F401RE** and sends the temperature value over **USART2** to a **serial terminal (Tera Term, PuTTY, etc.)**.

✅ **Reads LM34 sensor output voltage**  
✅ **Converts to Fahrenheit (°F) using ADC1**  
✅ **Prints temperature readings over USART2 (9600 baud)**

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**1. Overview**

* **MCU**: STM32F401RE (Nucleo-F401RE)
* **Sensor**: LM34 Fahrenheit Temperature Sensor
* **ADC**: **ADC1 Channel 10 (PC0)**
* **Serial Communication**: USART2 (PA2, TX)
* **Baud Rate**: 9600

**📏 LM34 Sensor Characteristics**

* **Output Voltage**: **10 mV per °F**
* **0°F corresponds to 0V**, **100°F = 1V**, **330°F = 3.3V**
* **ADC Value Calculation**: Temperature(°F)=(ADC Result4095×3.3V)×100\text{Temperature} (°F) = \left(\frac{\text{ADC Result}}{4095} \times 3.3V \right) \times 100

**2. Hardware Setup**

| **Peripheral** | **STM32F401RE Pin** | **Description** |
| --- | --- | --- |
| **LM34 Temperature Sensor** | **PC0 (ADC1 CH10)** | Analog input |
| **USART2 TX** | **PA2** | Sends data over ST-Link Virtual COM Port |

**🛠 Wiring for LM34 Sensor**

| **LM34 Pin** | **Connect To** |
| --- | --- |
| **VCC** | **3.3V** |
| **GND** | **GND** |
| **VOUT** | **PC0 (ADC1 Channel 10)** |

**3. Software Explanation**

**🟢 ADC1 (Temperature Reading)**

* **PC0 is configured as an analog input** (GPIOC->MODER |= 3;).
* **ADC1 is set to read Channel 10 (PC0)**.
* **ADC values are converted to Fahrenheit using temp = (result / 4095 \* 330);**.

**🟢 USART2 (Serial Output)**

* **TX (PA2) sends data to the ST-Link Virtual COM Port**.
* **Baud rate = 9600**.

**🟢 Data Flow**

ADC1 CH10 (PC0) → Reads LM34 Sensor → Converts to °F → Sends to USART2 → Serial Monitor

**4. Project Structure**

.

├── Inc/

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

├── Src/

│ └── main.c // Contains ADC1, LM34 reading, and USART2 logic

└── README.md // This file

**5. 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**

**6. Usage**

**1️⃣ Flash the code to the STM32F401RE**

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

**2️⃣ Open a Serial Terminal**

* **Tera Term** / **PuTTY** / **RealTerm**
* Select the **"STMicroelectronics STLink Virtual COM Port"**.
* **Set Baud Rate to 9600, 8N1** (8 data bits, No parity, 1 stop bit).

**3️⃣ Observe Temperature Readings**

✅ Every second, you will see:

ADC: 1820, Temp: 72.45°F

ADC: 1815, Temp: 72.20°F

✅ Temperature will **change** based on the LM34 sensor output.

**7. Troubleshooting**

**🔴 No Serial Output?**

✅ Ensure that the **ST-Link Virtual COM Port** is installed on your PC.  
✅ Check that **PA2 is configured as AF7 (USART2 TX)**.  
✅ Verify USART2 is enabled (USART2->CR1 |= (1U << 13);).

**⚠️ ADC Reads Incorrect Temperature?**

✅ Ensure **PC0 is set as an analog input**.  
✅ Double-check LM34 sensor connections.  
✅ Try **increasing ADC sampling time** (ADC1->SMPR1 = (3U << 24);) for better accuracy.

**⏳ Want Faster ADC Updates?**

✅ Decrease **delayMs(1000);** to sample faster than 1 second.

**8. License**

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

**9. 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)  
📄 [ADC Programming Guide](https://www.st.com/resource/en/programming_manual/dm00245755.pdf)  
📄 [LM34 Datasheet](https://www.ti.com/lit/ds/symlink/lm34.pdf)

**🚀 Summary**

✅ **Reads temperature from LM34 (ADC1 CH10 on PC0)**  
✅ **Converts ADC readings to Fahrenheit (°F)**  
✅ **Sends temperature data over USART2 at 9600 baud**  
✅ **No external components required except LM34 sensor!**

📡 **Enjoy real-time temperature monitoring with LM34 on STM32F401RE! 🎯**