压力容器数据记录模块

硬件设计文档

**Part1. MCU STM32L431RCT**

1. **元件信息**

**1基本属性：**

|  |  |
| --- | --- |
| **项目** | **值** |
| 型号 | STM32L431RCT |
| 封装 | LQFP |
| 引脚数 | 64 |
| 尺寸 | 12mil×12mil×1.6mil |

1. **初始化配置**

**1 全局：**

**1.1 Pinout Configuration**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **1** | **VBAT** |  | **33** |  |  |
| **2** | **PC13** |  | **34** |  |  |
| **3** | **PC14** |  | **35** |  |  |
| **4** | **PC15** |  | **36** |  |  |
| **5** | **PH0** |  | **37** |  |  |
| **6** | **PH1** |  | **38** |  |  |
| **7** | **NRST** |  | **39** |  |  |
| **8** | **PC0** |  | **40** |  |  |
| **9** | **PC1** |  | **41** |  |  |
| **10** | **PC2** |  | **42** |  |  |
| **11** | **PC3** |  | **43** |  |  |
| **12** | **VSSA** |  | **44** |  |  |
| **13** | **VDDA** |  | **45** |  |  |
| **14** | **PA0** |  | **46** |  |  |
| **15** | **PA1** |  | **47** |  |  |
| **16** | **PA2** |  | **48** |  |  |
| **17** |  |  | **49** |  |  |
| **18** |  |  | **50** |  |  |
| **19** |  |  | **51** |  |  |
| **20** |  |  | **52** |  |  |
| **21** |  |  | **53** |  |  |
| **22** |  |  | **54** |  |  |
| **23** |  |  | **55** |  |  |
| **24** |  |  | **56** |  |  |
| **25** |  |  | **57** |  |  |
| **26** |  |  | **58** |  |  |
| **27** |  |  | **59** |  |  |
| **28** |  |  | **60** |  |  |
| **29** |  |  | **61** |  |  |
| **30** |  |  | **62** |  |  |
| **31** |  |  | **63** |  |  |
| **32** |  |  | **64** |  |  |

**1.2 Clock Configuration:**

|  |  |
| --- | --- |
| **项目** | **值** |
| Enable CSS>>PLLCLK | True |
| HCLK(MHz) | 80 |
| I2C2 Clock Mux>>To ADC(MHz) | 12 |

1. **外设：**
2. **串口：**

**3.1 UART**

|  |  |  |  |
| --- | --- | --- | --- |
| **名称** | **TX端口** | **RX端口** | **功能** |
| **USART1** | **PA9** | **PA10** | **外部Modbus** |
| **USART2** |  |  | **外部RS232** |
| **LPUART1** | **PC1** | **PC0** | **内部NB-IoT** |

* + 1. **USART1**

**UASRT1用于外部Modbus协议通信，由于Modbus报文长度未知，此处使用HAL库DMA+空闲中断实现串口不定长数据接收。此处使用STM32CubeMx软件根据如下初始化配置的参数生成初始化代码。**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **配置项** | | | **值** | **描述** |
| Mode | | | Asynchronous |  |
| Baud Rate | | | 115200 |  |
| Word Length | | | 8 Bits (including Parity) |  |
| Parity | | | None |  |
| Stop Bits | | | 1 |  |
| USART1 global interrupt | | | Enabled | 开启全局串口中断 |
| DMA Settings | 1 | DMA Request | USART1\_RX | 开启DMA接收 |
| Mode | Normal |
| NVIC | USART1 global interrupt | Enabled | True | 配置中断分组 |
| Preemption Priority | 1 |
| Generate IRQ handler | false | 取消自动生成的USART1中断服务程序 |

**3.1.2 USART2**

|  |  |
| --- | --- |
| **项目** | **值** |
| Mode | Asynchronous |
| Baud Rate | 115200 |
| Word Length | 8 Bits (including Parity) |
| Parity | None |
| Stop Bits | 1 |

**3.1.2 LPUART1**

|  |  |
| --- | --- |
| **项目** | **值** |
| Mode | Asynchronous |
| Baud Rate | 115200 |
| Word Length | 8 Bits (including Parity) |
| Parity | None |
| Stop Bits | 1 |

**3.2 SPI**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **名称** | **NSS端口** | **SCK端口** | **MISO端口** | **MOSI端口** | **功能** |
| **SPI1** |  | **PA1** | **PA6** | **PA7** | **外部ADC通信** |

**3.2.1 SPI1**

|  |  |
| --- | --- |
| **项目** | **值** |
| Mode | Full-Duplex Master |
| Frame Format | Motorola |
| Data Size | 4 Bits |
| First Bit | MSB First |

1. **ADC：**

**基本**

|  |  |
| --- | --- |
| **项目** | **值** |
| 分辨率 | 12位 |
| 范围 | 0-4095 |

**Pinout & Configuration>>Parameter Settings>>ADC\_Settings**

|  |  |
| --- | --- |
| **项目** | **值** |
| Clock Prescaler | Asynchronous clock mode divided by 2 |
| Resolution | ADC 12-bit resolution |
| Continuous Conversion Mode | Enabled |
| DMA Continuous Requests | Enabled |

**Pinout & Configuration>>Parameter Settings>>ADC\_Regular\_ConversionMode**

|  |  |
| --- | --- |
| **项目** | **值** |
| Rank>>Sampling Time | 640.5 Cycles |

**Pinout & Configuration>>DMA Settings**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **DMA Request** | **Channel** | **Direction** | **Priority** | **Mode** | **Peripheral>>Data Width** | **Memory>>Data Width** |
| ADC1 | DMA1 Channel 1 | Peripheral To Memory | High | Circular | Word | Word |

**Part2. NB-IoT模块 China Mobile M5311**

1. **元件信息**
2. **基本属性：**

|  |  |
| --- | --- |
| **项目** | **值** |
| 型号 | 中国移动M5311 |
| 封装 | LCC |
| 引脚数 | 40 |
| 尺寸 | 16 mm × 18 mm × 2.2 mm |

**Part3. 高精度ADC**

1. **元件信息**
2. **ADC芯片基本属性：**

|  |  |
| --- | --- |
| **项目** | **值** |
| ADC芯片型号 | LTC2380-24 |
| 封装 | MSOP |
| 引脚数 | 16 |
| 位数 | 24位 |
| 通道数 | 1 |
| 工作频率 | 1.5MHz |
| 功耗 | 28mW |
| SNR典型值 | 100dB |
| 内部滤波器 | 16位实时平均（16个转换结果） |
| 接口 | SPI |

1. **精密基准电压源芯片基本属性：**

|  |  |
| --- | --- |
| **项目** | **值** |
| 芯片型号 | LTC6655 |
| 封装 | MSOP |
| 引脚数 | 8 |
| 基准电压 | 2.5V |
|  |  |

**Part4. 模块连接**

**1. 串口**

**(1) 分配：**

|  |  |  |  |
| --- | --- | --- | --- |
| **名称** | **TX端口** | **RX端口** | **功能** |
| USART1 | PA9 | PA10 | 外部RS232 |
| USART2 |  |  | 外部Modbus |
| LPUART1 | PC1 | PC0 | 内部NB-IoT |

**(2) USART1：**

**(3) USART2:**

**(4) LPUART1:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **项目** | | **值** | | |
| 连接对象 | | STM32-M5311 | | |
| 连接方式 | | 电平转换 | | |
| **项目** | **TX(MCU端)** | | **RX(MCU端)** | |
| **Designator** | LPUART\_TX | | LPUART\_RX | |
| **PIN(MCU)** | 9(PC1) | | 8(PC0) | |
| Tolerant | 5V | Tolerant | 5V |
| **PIN(M5311)** | 10(UART1\_RXD) | | 9(UART1\_TXD) | |
| Tolerant | 1.8V | Tolerant | 1.8V |
| VILmax | 0.6V | VOLmax | 0.4V |
| VIHmin | 1.6V | VOHmin | 1.62V |
| VIHmax | 1.98V | VOHmax | 1.98V |