设计电路的体温测量范围为28~43度，水温测量范围为4~40度；理想状态下传感器温度值对应的电压值如下表所示(1℃=2mv；0.1℃=0.2mv)：

|  |  |  |  |
| --- | --- | --- | --- |
| 度数（1℃） | 28 | 38 | 43 |
| 电压值（mV） | 621 | 602 | 592 |

设计目标：

MCU的AD转换折算误差小于0.025度，运放电路的折算误差小于0.025度，传感器的温度折算误差小于0.05度。系统累计误差0.1度。

确定硬件系统参数

1. 确定体温放大电路的放大倍数：

由于单片机的参考电压为3.3V，那么单片机的采样电压范围最大为0V~3.3V，实际应用中我们需要预留一些余度；我们设计中单片机的采样电压范围固定为150mV~3150mV;温度28~43℃范围对应的电压范围为（621mV~592mV）

放大电路的放大倍数为：△U(采样电压范围)/△Tu（温度对应的电压范围）=（3150-150）/（621-592）=3000/29.

1. 确定水温放大电路的放大倍数：

设计电路的水温测量范围为2~42度，水温测量范围为2~42度；理想状态下传感器温度值

|  |  |  |  |
| --- | --- | --- | --- |
| 度数（1℃） | 2 | 25 | 42 |
| 电压值（mV） | 671.23 | 626.78 | 593.92 |

由于单片机的参考电压为3.3V，那么单片机的采样电压范围最大为0V~3.3V，实际应用中我们需要预留一些余度；我们设计中单片机的采样电压范围固定为150mV~3150mV;温度2~45℃范围对应的电压范围为（671.49mV~589.02mV）

放大电路的放大倍数为：△U(采样电压范围)/△Tu（温度对应的电压范围）=（3150-150）/（671.49-589.02）=3000/82.47=36.3768

隔离电路调试要求：

体温：输入端电压范围为1.9V~2.4V , 隔离后输出误差在2mV以下

水温：输入端电压范围为2.5V~3.15V , 隔离后输出误差在6mV以下

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 板1 | R43 | R44 | K1 | R50 | R45 | RP1 | K2 | K |
| ADC1 | 1K | 6.2K | 7.2 | 2.008K | 28.850K | |  | 3000/29 |
| ADC2 | 1K | 6.2K | 7.2 | 1K | 10K | 4.3673 |  | 3000/29 |
| ADC3 | 1k | 5.1k | 6.1 | 4.258K | 27.05K | 70.7 | 7.0257 |  |
|  | | | | | | | | |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 板2  蓝色 | R43 | R44 | K1 | R50 | R45 | RP1 | K2 | K |
| ADC1 | 1K | 6.198.4K | 7.2 | 1.0000K | 10.0000K | 4.3678k | 103.44816 | 103.448275 |
| ADC2 | 1K | 6.198.1K | 7.2 | 1000.5K | 10.0002K | 4.3585k | 103.329 | 103.448275 |
| ADC3 | 1k | 5.1k | 6.1 | 4.3K | 27.034K | 3.1767 | 7.0257 |  |
|  | | | | | | | | |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 板3新板 | R43 | R44 | K1 | R53 | R48 | RP1 | K2 | K |
| ADC1 | 1K | 6.198.4K | 7.2 | 1.0000K | 10.0000K | 4.3718k | 103.44816 | 103.448275 |
| ADC2 | 1K | 6.198.1K | 7.2 | 1000.5K | 10.0002K | 4.3654k | 103.329 | 103.448275 |
| ADC3 | 1.003k | 5.0973k | 6.082 | 4.3K | 10.003 | 1.9918 | 5.981 | 36.3768 |
|  | | | | | | | | |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 放大电路 | | | | 隔离电路 | | |  |  | |
|  | A1\_in  (mA) | A1\_out  (mA) | A2\_in (mA) | A2\_out (mA) | | A\_in | A\_out |  | |  |
| 体温1 | 623.04 | 151.3 | 583.02 | 3150.5 | |  |  |  | |  |
| 体温2 | 623.01 | 149.5 | 583.03 | 3151.6 | | 3150.6 | 31486 |  | |  |
| 水温 | 6630.1 | 150.8 | 593.02 | 3152.3 | |  |  |  | |  |
| A1 | 放大电路 | | | | 隔离电路 | | |  |  | |
|  | A1\_in  (mA) | A1\_out  (mA) | A2\_in (mA) | A2\_out (mA) | | A\_in | A\_out |  | |  |
| 体温1 | 623.01 | 149.4 | 583.02 | 3150.8 | |  |  |  | |  |
| 体温2 | 623.01 | 149.5 | 583.00 | 3151.6 | |  |  |  | |  |
| 水温 | 663.01 | 150.8 | 593.00 | 3148.0 | |  |  |  | |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 端口 | 测量值（V） | 端口 | 测量值（V） | 端口 | 测量值（V） | 端口 | 测量值（V） |
| VZ | 1.2061 | A+12V | 11.801 | C+12V | 12.014 | Vref | 3.2993 |
| Vcpu | 3.2904 | A-12V | -12.125 | C-12V | -12.246 | VDDA | 3.287 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Ain  （电压mV） | Temp （测量值） | Aout  （电压mV） | D1  （AD值） | D2  （AD值） | D3  （AD值） | D4  （AD值） | D5  （AD值） | Temp  (转换值) |
| Sensor1 |  |  |  |  |  |  |  |  |  |
| Sensor2 |  |  |  |  |  |  |  |  |  |
| Sensor3 |  |  |  |  |  |  |  |  |  |

传感器数据：

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| sense | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| VZ | 1.2061V | 1.2061V |  | 1.2061V | 1.2061V | 1.2061V | 1.2061V |
| R（K） | 5.1011 | 5.1011 |  | 5.1011 | 5.1011 | 5.1011 | 5.1011 |
| Vo(mV) | 601.86 | 604.42 |  | 602.07 | 601.69 | 601.96 | 601.18 |
| I | 116.7UA | 116.2UA |  | 116.8uA | 116.8UA | 116.8UA | 116.8UA |
| 温度℃ | 38.00 | 38.00 |  | 38.000 | 38.000 | 38.000 | 38.000 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| sense | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| VZ | 1.2061V | 1.2061V |  | 1.2061V | 1.2061V | 1.2061V | 1.2061V |
| R（K） | 5.1011 | 5.1011 |  | 5.1011 | 5.1011 | 5.1011 | 5.1011 |
| Vo(mV) | 620.92 | 623.38 |  | 621.17 | 621.05 | 621.03 | 620.76 |
| I | 112.7UA | 112.2UA |  | 112.8uA | 112.8UA | 112.8UA | 112.8UA |
| 温度℃ | 28.000 | 28.000 |  | 28.000 | 28.000 | 28.000 | 28.000 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| sense | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| VZ | 1.2061V | 1.2061V |  | 1.2061V | 1.2061V | 1.2061V | 1.2061V |
| R（K） | 5.1011 | 5.1011 |  | 5.1011 | 5.1011 | 5.1011 | 5.1011 |
| Vo(mV) | 591.83 | 594.64 |  | 592.21 | 592.25 | 591.99 | 591.70 |
| I | 118.4uA | 117.8UA |  | 118.3uA | 118.3UA | 118.3UA | 116.5UA |
| 温度℃ | 43.000 | 43.000 |  | 43.025 | 43.025 | 43.002 | 43.001 |