ISE to Modbus RTU Converter – Design Specification

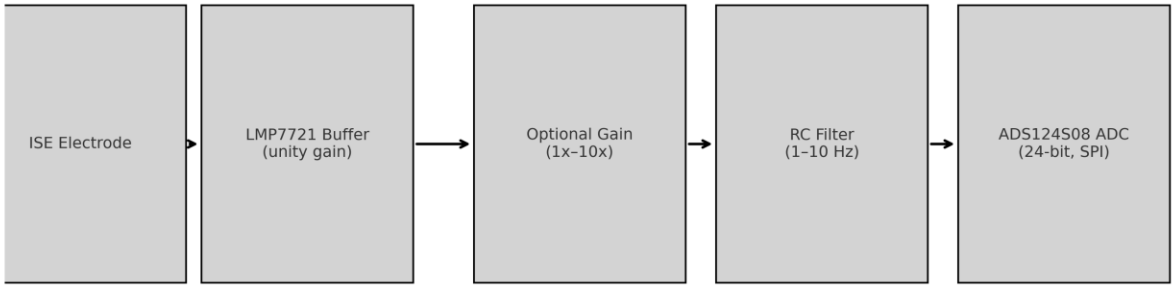
Project Summary

Design a 4-layer PCB that reads a high-impedance mV signal from an Ion-Selective Electrode (ISE), digitizes it using a high-resolution ADC, applies temperature compensation and calibration, and transmits the result via Modbus RTU over RS-485.

Confirmed Components

Function	Part
MCU	EFM32TG840F32 (QFN64)
ADC	ADS124S08 (24-bit, SPI)
Op-Amp	LMP7721 (ultra-low bias current)
RS-485 Transceiver	ADM2483 (isolated)
EEPROM	24AA025E48 (I^2C)
Temperature Sensor	DS18B20 (1-Wire digital)
PCB Stackup	4-layer

Signal Conditioning Path



Functional Blocks

- Signal Conditioning: LMP7721 buffer, optional gain stage (1x–10x), low-pass RC filter (~1–10 Hz).

- ADC: ADS124S08 24-bit SPI, differential input.

- MCU: EFM32TG840F32 with SPI, UART, I^2C.

- Temp Sensor: DS18B20 for compensation.

- RS-485: ADM2483, isolated, with TVS and 120Ω termination.

- EEPROM: 24AA025E48 to store calibration data and Modbus address.

- Power: 12V input, isolated DC-DC to 5V, LDO for analog.

Connectors

- Terminal blocks for ISE input, RS-485, 12V power.

- 1-Wire header for DS18B20.

- SWD header for MCU programming.

PCB Layout Notes

- 4-layer: Top (Signal), L2 (Ground), L3 (Power), Bottom (Signal).

- Isolated RS-485 domain.

- Ground separation: analog vs. digital.

- Low-noise routing from op-amp to ADC.

Deliverables Required

- Altium schematic and 4-layer PCB layout.

- BOM with complete part numbers.

- Gerber and drill files.

- Firmware (EFM32): ADC, EEPROM, DS18B20, Modbus RTU.

- Documentation: pinout, register map, calibration, wiring.