

Designing software- versus hardware-configurable multi-RTD measurement systems

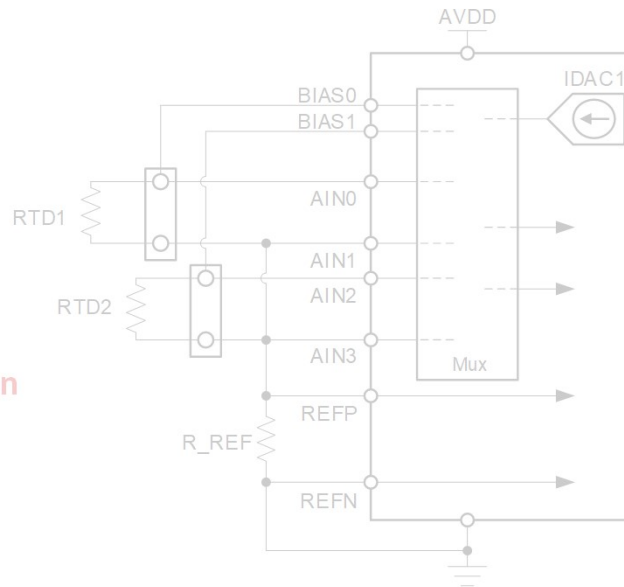
TI Precision Labs – ADCs

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Presented by Josh Brown

Types of multi-RTD measurement systems

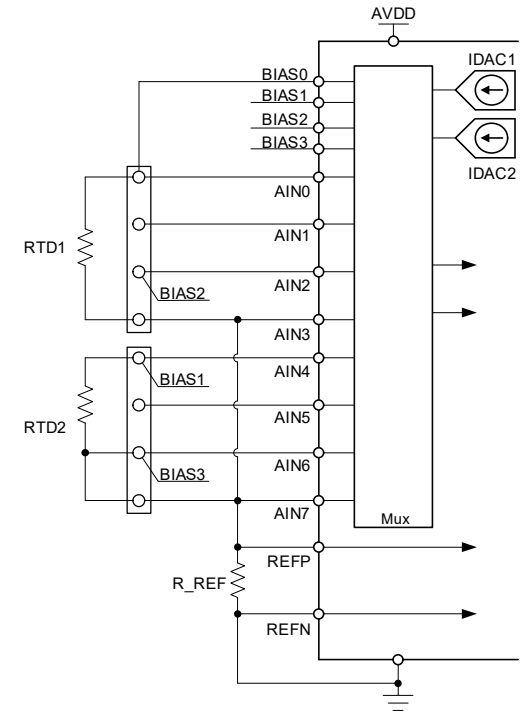
Same **wiring configuration** for all RTDs



- ✓ Simple to implement, fewer ADC channels required
- ✗ Measure one RTD wiring configuration e.g. 2-wire only

of wires, not RTD type
e.g. platinum, nickel, etc.

Different **wiring configuration** for all RTDs



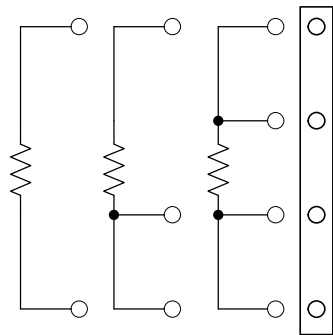
- ✓ Can measure 2-, 3-, or 4-wire RTDs with the same hardware
- ✗ Requires more inputs per RTD and potentially external jumpers

Discussed in a previous Precision Labs module

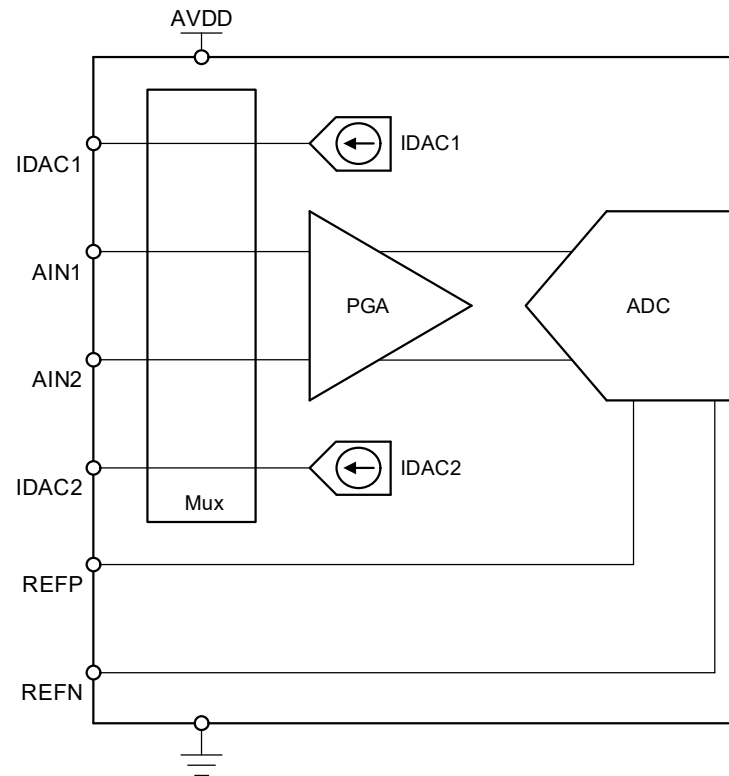
Discussed in **this Precision Labs module**

Measuring multiple RTDs (different wiring configs)

Typical design goal: create a system that can measure 2-, 3-, or 4-wire RTDs on the same channel

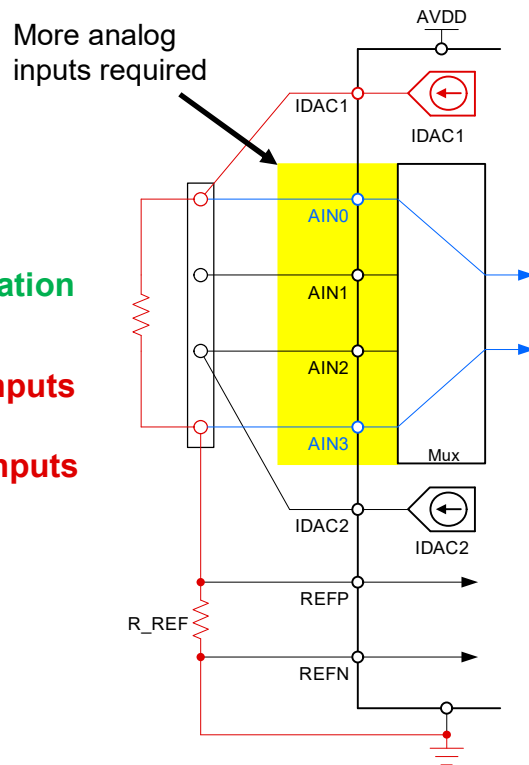


Connections depend on design choice: software- or hardware-configurable?



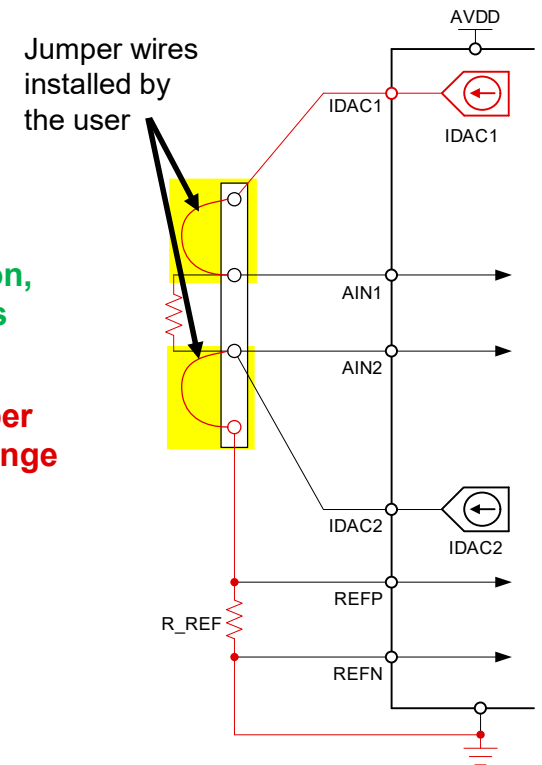
Software- versus hardware-configurable systems

Software (SW) configurable 2-wire RTD



- ✓ Change RTD configuration on-the-fly
- ✗ Requires more ADC inputs to measure each combination of RTD inputs

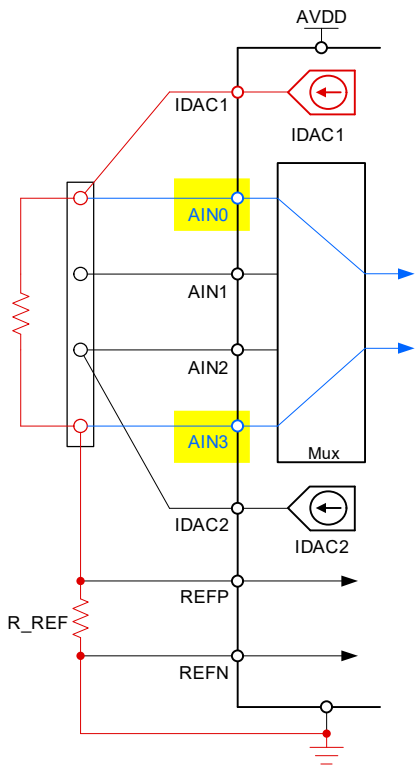
Hardware (HW) configurable 2-wire RTD



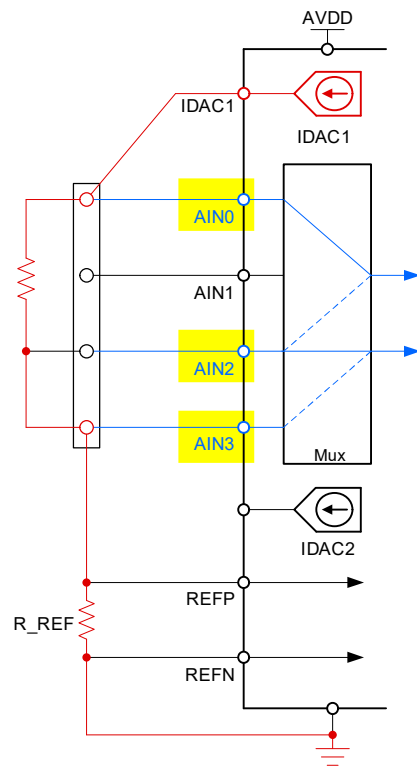
- ✓ Simpler implementation, uses fewer ADC inputs
- ✗ Requires the user to physically install jumper wires or shunts to change the RTD configuration

SW configurable RTD connections

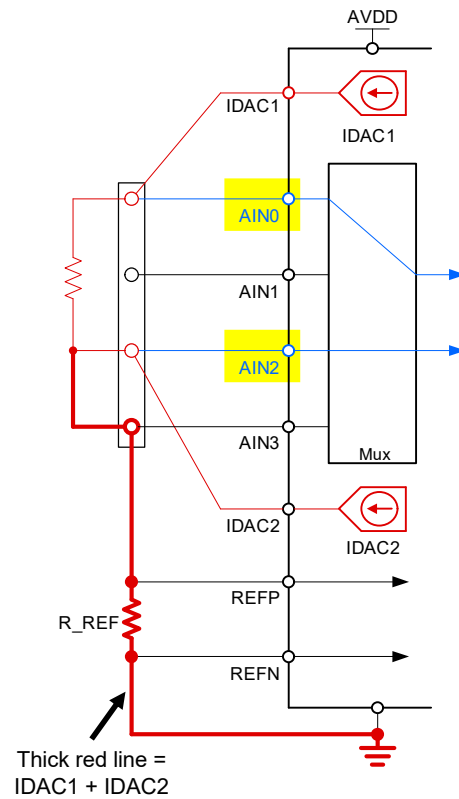
2-wire RTD



3-wire RTD (1x IDAC)

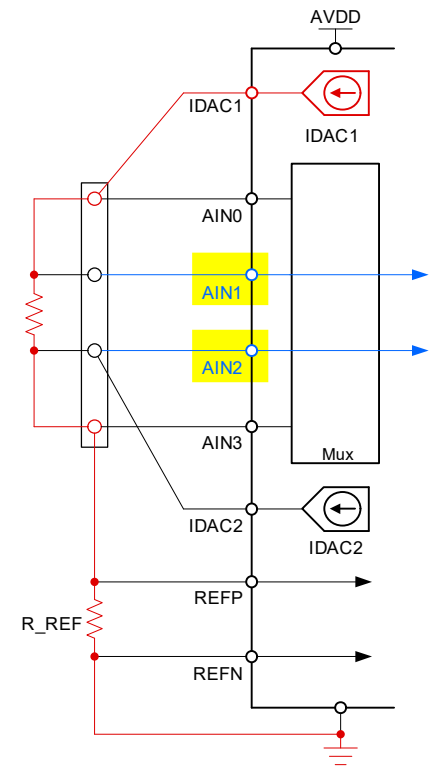


3-wire RTD (2x IDACs)



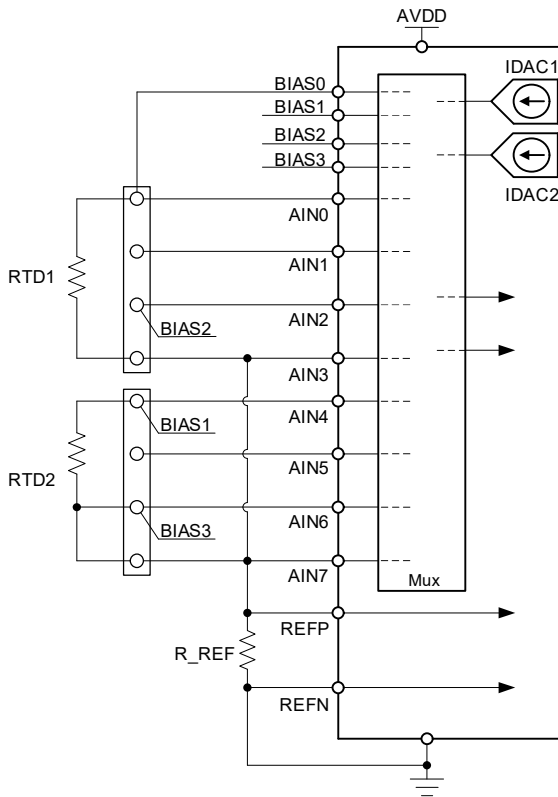
Thick red line =
IDAC1 + IDAC2

4-wire RTD



Measuring multiple RTDs (SW configurable)

Two RTD, SW-configurable measurement system



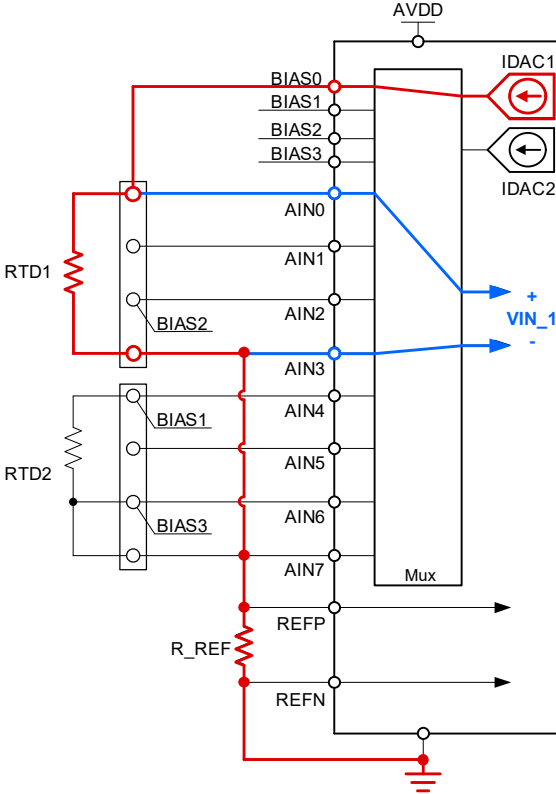
System requirements:

- 4x analog inputs (AINx) per RTD
- 1x IDAC output (BIASx) per RTD
 - Additional IDAC output (shown) per RTD required for measuring 3-wire RTDs using 2x IDACs
- 1x external reference inputs (REFx) common to all RTDs
- Common return current path through R_REF

Multi-RTD measurement process (SW configurable)

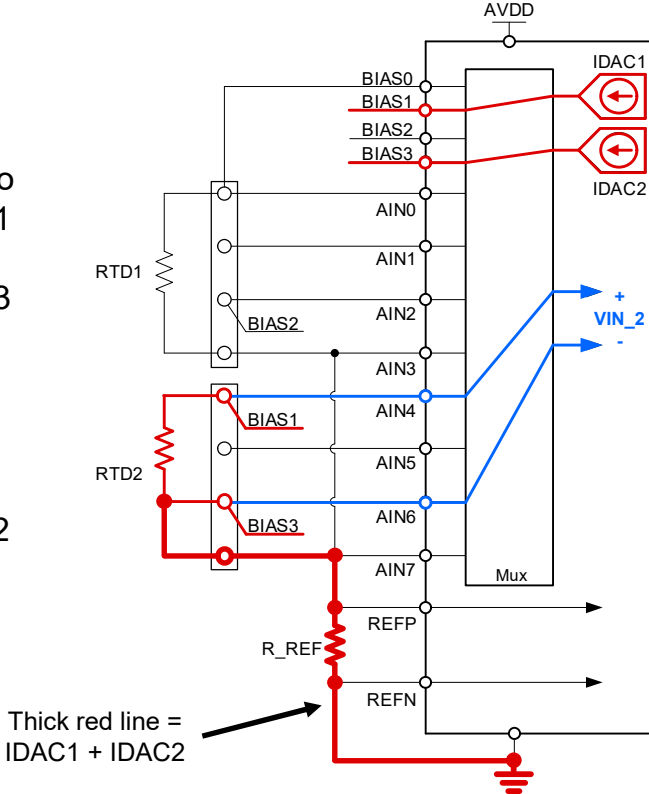
Measuring RTD1 (2-wire)

- Select IDAC1 to output to BIAS0
- Select analog inputs as AIN0 and AIN3
- Measure VIN_1

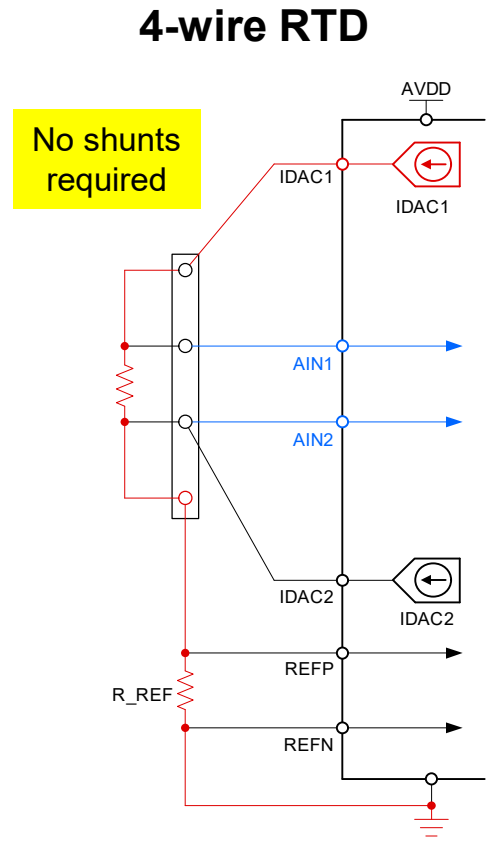
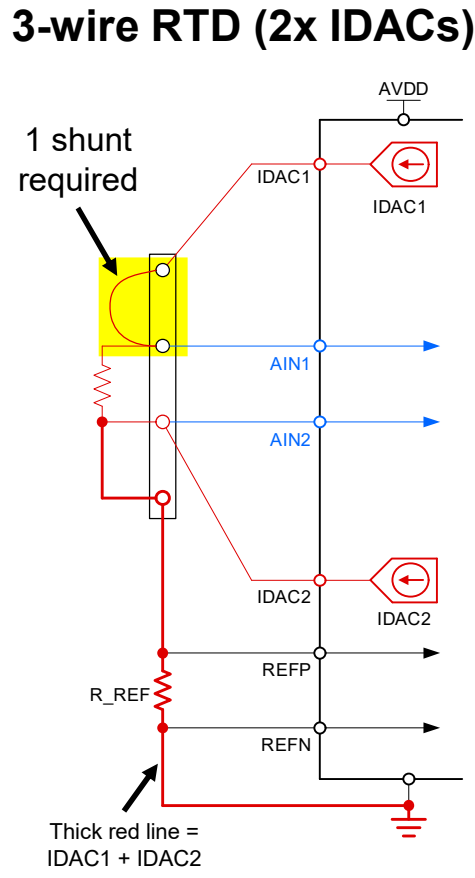
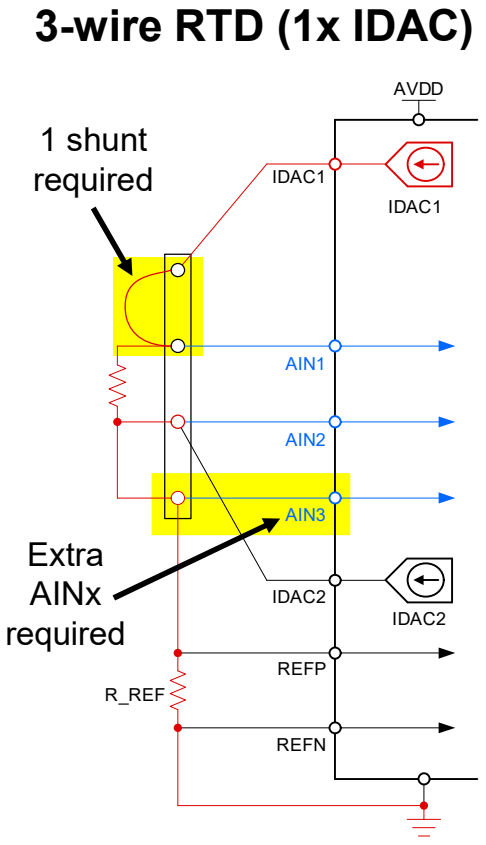
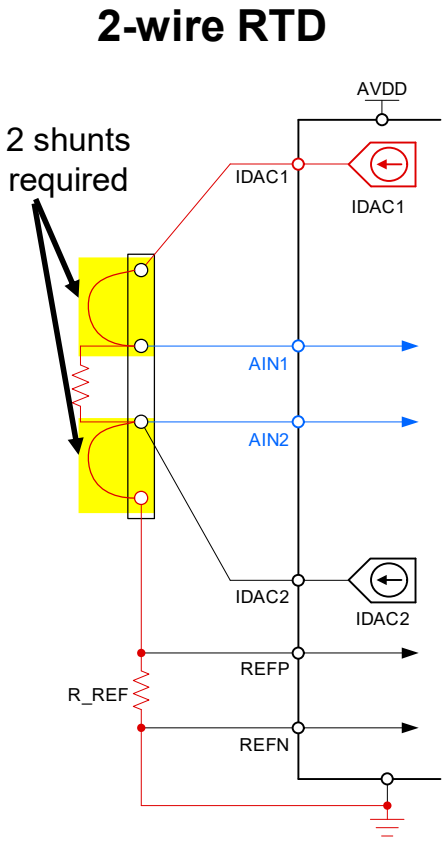


Measuring RTD2 (3-wire, 2x IDACs)

- Select IDAC1 to output to BIAS1 and IDAC2 to output to BIAS3
- Select analog inputs as AIN4 and AIN6
- Measure VIN_2

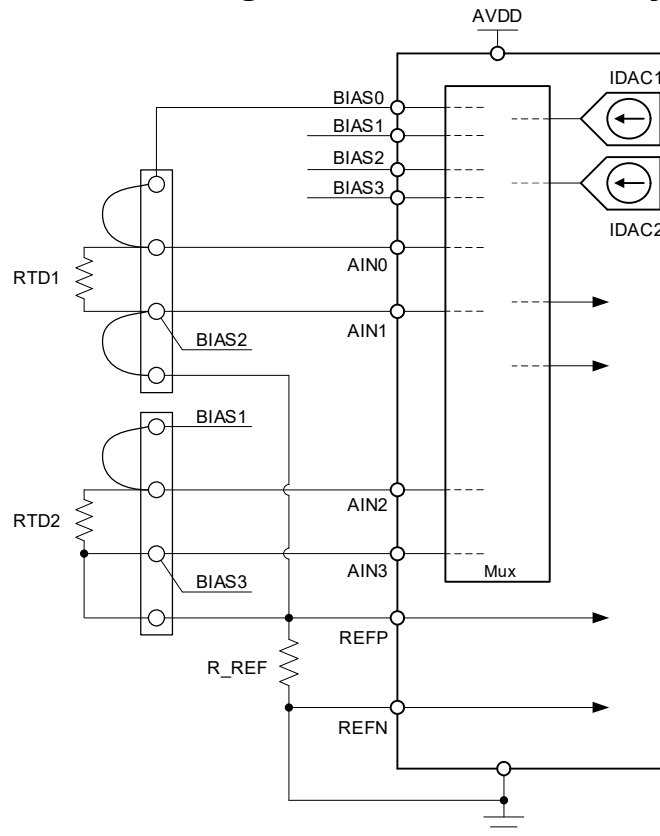


HW configurable RTD connections



Measuring multiple RTDs (HW configurable)

Two RTD, HW-configurable measurement system



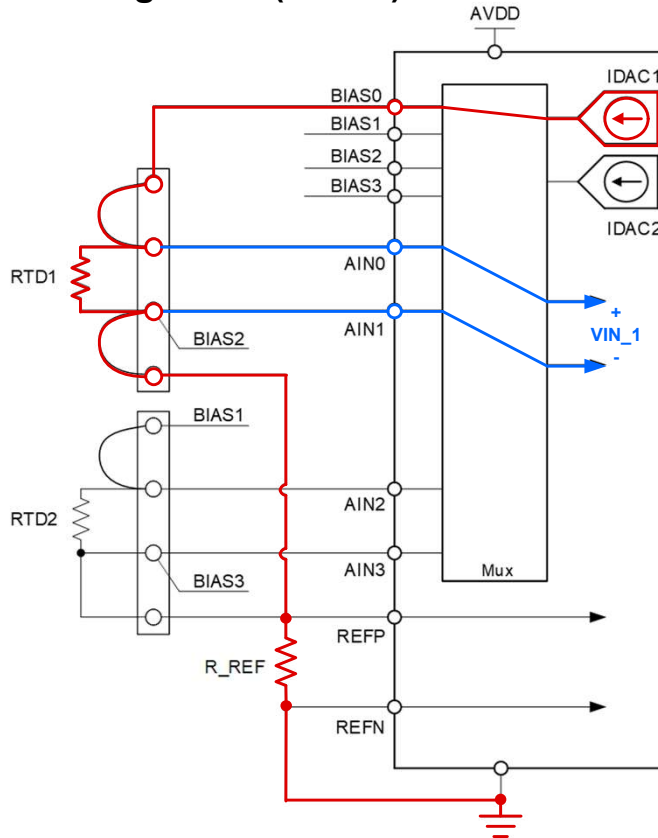
System requirements:

- 2x analog inputs (AINx) per RTD
 - Additional analog input (not shown) per RTD required for measuring 3-wire RTDs using 1x IDAC
- 1x IDAC output (BIASx) per RTD
 - Additional IDAC output (shown) per RTD required for measuring 3-wire RTDs using 2x IDACs
- 1x external reference inputs (REFx) common to all RTDs
- Common return current path through R_REF

Multi-RTD measurement process (HW configurable)

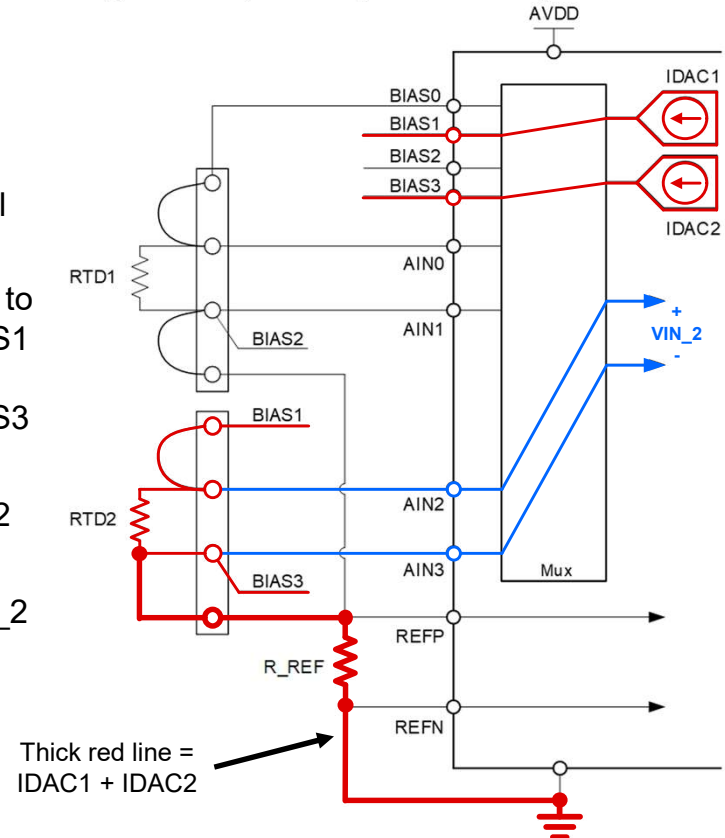
Measuring RTD1 (2-wire)

- Apply external shunts
- Select IDAC1 to output to BIAS0
- Select analog inputs as AIN0 and AIN1
- Measure VIN_1



Measuring RTD2 (3-wire, 2x IDACs)

- Apply external shunt
- Select IDAC1 to output to BIAS1 and IDAC2 to output to BIAS3
- Select analog inputs as AIN2 and AIN3
- Measure VIN_2



Thanks for your time!
Please try the quiz.

Quiz: Multiple RTDs & conversion latency

1. What is the advantage of a software configurable multi-RTD system over a hardware configurable?
 - a) The software configurable system converts temperature faster
 - b) The software configurable system uses fewer multiplexer inputs on the ADC
 - c) The software configurable system does not require any additional jumper wires
 - d) The software configurable system is more accurate
2. (True/False) When an ADC is connected to multiple RTDs, it is common practice to multiplex the IDAC current to each RTD separately.
 - a) True
 - b) False

Thanks for your time!



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