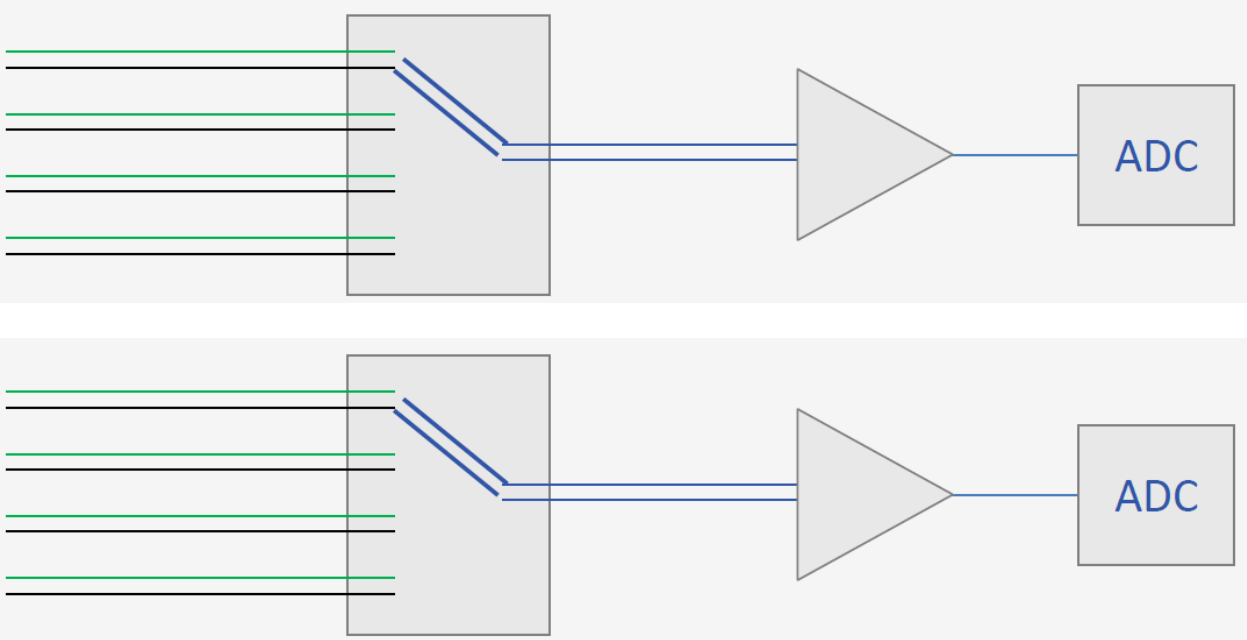
Q.Tip: Measuring Temperature – Gantner Instruments DAQ System Highlight – A104

A104 – Universal Thermocouple Measurement Module

Highlights

- 8 x input channels for thermocouples.
- Galvanic isolation: channel to channel, 100 VDC
- Galvanic isolation: channel to power supply or interface, 500 VDC
- Input range: ±80 mV
- CMR > 120 dB
- Adaptive linearization
- ADC 24 bit, 100 Hz/10 Hz
- Digital filter, averaging, min/max, alarm
- Cold junction compensation terminal block (2 x per module required)

1200 Hz each channel, channel to channel isolation: 100 VDC



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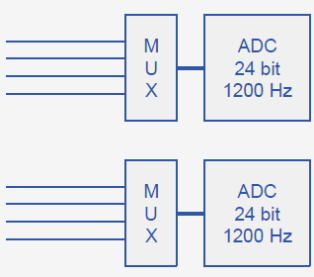
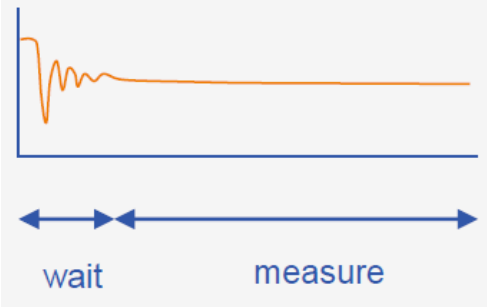
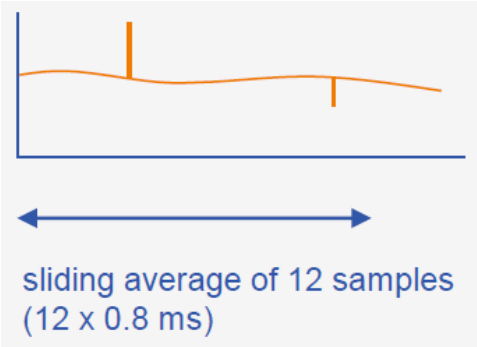
A104 provides a robust and stable measurement using the following method:



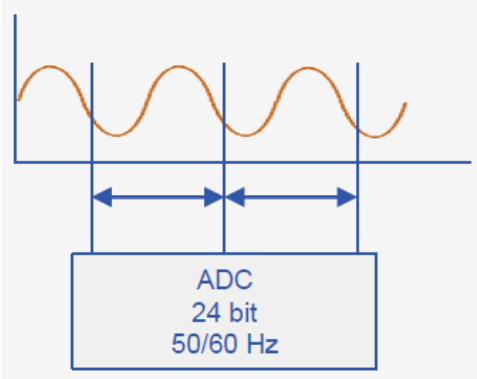
1. Wait for the signal to stabilize before measuring. That is why we specify 100 Hz per channel.



2. By removing the maximum and minimum values, we eliminate unwanted signals. A sliding average is performed.



3. The ADC rate can be set to either 50 Hz (20 ms) or 60 Hz (16.6666 ms) to eliminate main frequencies.



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Accuracy

1. *Thermocouple*: class 1 (±1.5 °C) for type K or class 0 (±0.5 °C) for type T

2. *Expansion Line*: cable never contains 100% of the sensor material (i.e. NiCr). Always includes a mix with copper, deviation ~1 °C

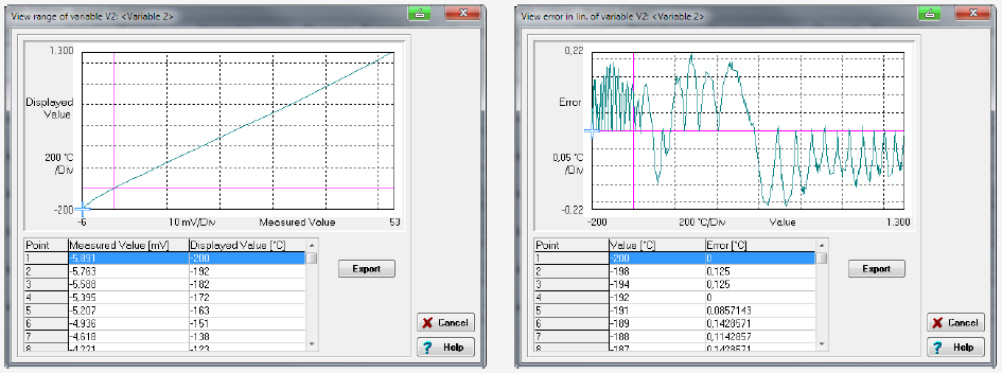
3. *Cold Junction Compensation*: to compensate for thermo voltages at the contacts, temperature is measured using a Pt1000; a CJC accuracy of 0.3 °C or better is provided

4. *Linearization*: thermocouples are non-linear, especially at low temperature ranges. The A104 does a 32 point linearization; the built-in sensor database includes 300 points. To provide a minimum linearity deviation, the 32 points are individually adjusted based on the measured range.

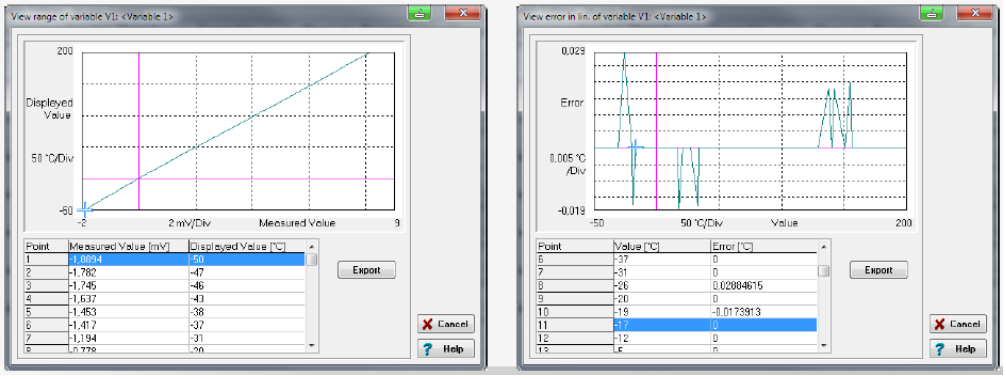
5. *Amplifier*: Maximum deviation of 10 µV (type K = 40.5 µV/°C) means 0.25 °C
   Ambient temperature effect on zero: better than 1 µV/10 K means 0.02 °C/10 K
   Ambient temperature effect on span: better than 0.005 %/10 K means 0.1 °C/10 K at full range

   Total Deviation:
   (@ constant ambient temp): $\sqrt{0.3\ °C^2 + 0.03\ °C^2 + 0.25\ °C^2} = 0.39\ °C^2$
   (@ change of ambient temp of 10 K): $\sqrt{0.3\ °C^2 + 0.03\ °C^2 + 0.25\ °C^2 + 0.02\ °C^2 + 0.1\ °C^2} = 0.4\ °C^2$

Example 1 (-200 to 1300 °C, maximum linearity deviation: ±0.25 °C):



Example 2 (-50 to 200 °C, maximum linearity deviation: ±0.03 °C):

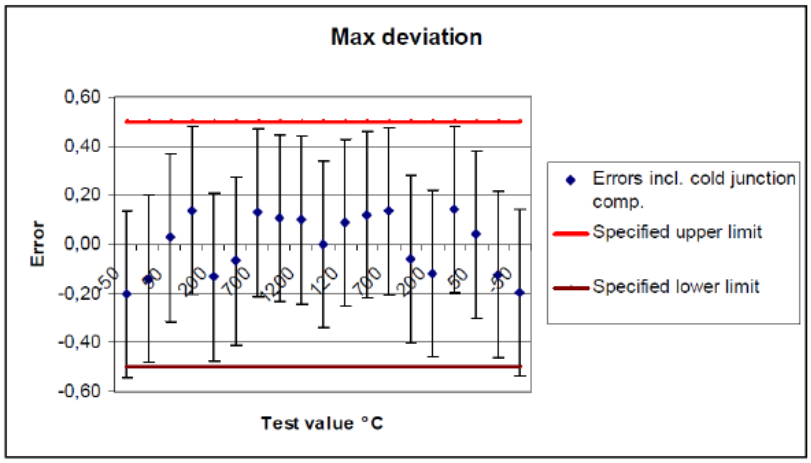


Case Studies

1. Mahle Behr Group: a leading company in automobile cooling and air conditioning is using the A104 module for climatic test chambers because:

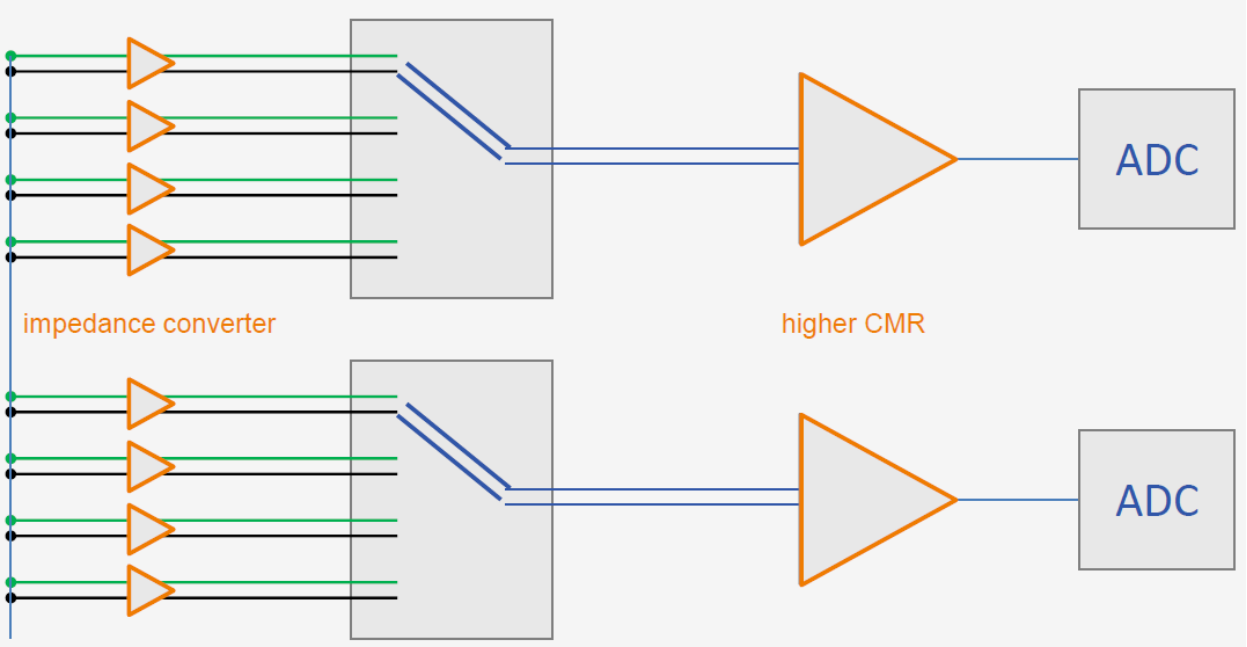
   "there is no better alternative"

2. Turbomeca has certified the A104 module for helicopter and turbo prop engine test stands.



Updates

For high resistive thermocouples and common input grounding:



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