



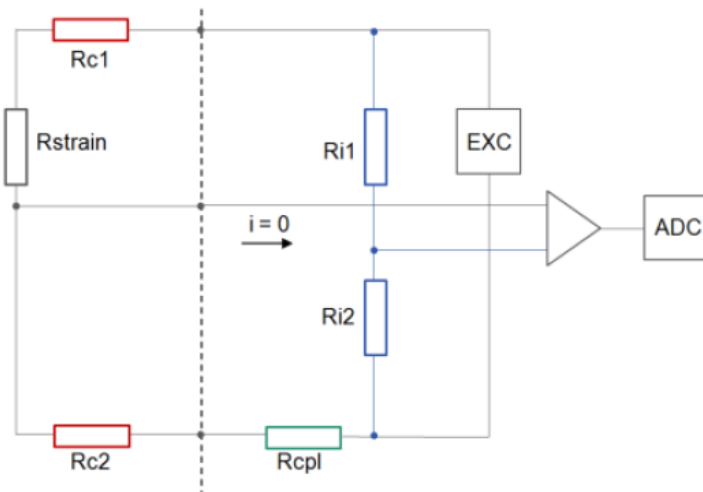
Q.Tip: Measuring Strain Gauges – Gantner Instruments DAQ System Highlight – A116

A116– Compact Strain Gauge Measurement Module

Highlights

- 8 x input channels for full, half, and quarter bridges
- Sensor connection with or without sense wire (3-/5-, 4-/6-Wire)
- Bridge completion for single strain gauges: 120Ω and 350Ω inside the module
- Shunt calibration: 100 kOhm
- Sensor excitation: 1 VDC or 4 VDC selectable
- Measuring ranges for strain gauges:
 - 1 mV/V (2000 μm/m)
 - 10 mV/V (20000 μm/m)
- Measuring range for full and half bridges:
 - ±2.5 mV/V
 - ±10 mV/V
- Frequency response: 0 to 1000 Hz
- Data rate: 10 kHz per channel, **no scanner**
- 24 bit sigma delta ADC each channel
- Selectable digital filter, 4th order
- Anti-aliasing filter, 1000 Hz and auto averaging

Error Caused by Cable Length: Standard 3-wire connection (NOT USED WITH A116)



Cable resistance of 1Ω results in an error of 0.283%

Formula:

$$V_{sig} [mV/V] = \frac{R_{cpl} + R_{c1}}{R_{cpl} + R_{c2} + R_{strain} + R_{c1}} - \frac{R_{i2}}{R_{i1} + R_{i2}}$$



Effect with a cable length of 125 m, 0.75 mm^2 ($R_{c1} = R_{c2} = 3 \Omega$):

$$V_{sig} \left[\frac{mV}{V} \right] = \frac{350 \Omega + 3 \Omega}{350 \Omega + 3 \Omega + 349,650 \Omega + 3 \Omega} - \frac{1000 \Omega}{1000 \Omega + 1000 \Omega} = 0,247998 \text{ mV/V}$$

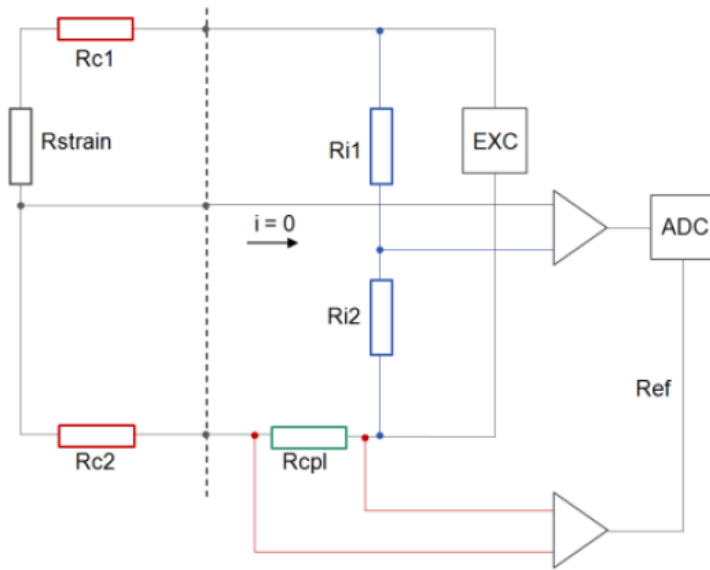
Error = 0.85%

A116 Method

With the A116, a compensation circuit is used to measure the voltage drop over the completion resistor, the voltage drop over the cable resistors, and provides a signal that compensates for the cable influence.

Tests and calculations confirm this statement.

Results: No error caused by cable resistance using an A116 compensation circuit.



Non-symmetrical cable results in an offset error that can be compensated by zeroing. This error is constant and will not change during the measurement, as long as the cable will not be modified during the test.

Non-symmetry of 0.01% for a 125 m, 0.75 mm^2 cable generates an offset of approximately $0.4 \mu\text{m/m}$.



Completion Resistor Influences (120Ω or 350Ω)

The completion resistor is used to complete the single strain gauge circuit in a quarter-bridge configuration. Any change of the completion resistor will have an effect on the measurement signal. For that reason, it is important to use an extremely stable resistor.

The temperature deviation of this resistor is usually measured in ppm/K.

1 ppm/K with a 350Ω resistor is 350 μΩ.

Related to the full scale signal of a strain gauge of 700 mΩ, it is 0.05 %/K or 0.5%/10K.

Other Guys: use 1 ppm/K resistor

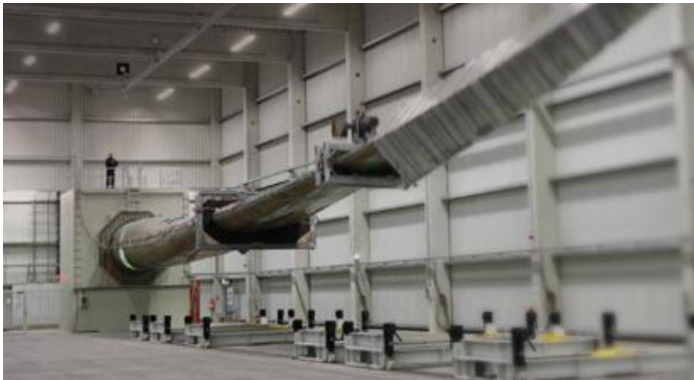
Deviation: 0.5 %/10K

Gantner A116: use a 0.05 ppm/K resistor

Deviation: 0.025 %/10K

Case Studies

1. BLAEST – Blade Test Center DK
Tested A116 module with 150 m cable along a wind blade.
A116 measurements show no difference between 1 m cable and 150 m cable.



2. Airbus Helicopters
2013 – Q.series system was selected as the new General Measurement and Control System for all fatigue test stands after a one year evaluation and testing period.

