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Application Guidelines
Strain Gauge Measurement Using excom®

Technical Support Document

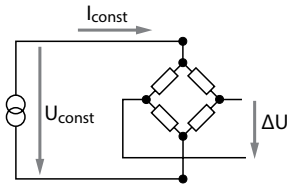
1 Overview

The application described in this document relates to the possibility of operating strain gauges with the excom remote I/O system.

2 Principle

A strain gauge can be used to measure force, weight, torque, mechanical tension and variables deriving from these measurements. The values are based on the strain exerted on an electrical conductor and the resulting proportional change in electrical resistance. The change in resistance is therefore a measure of the force exerted on a strain gauge transducer.

The strain gauge transducer principle uses a strain gauge bridge circuit that receives a constant bridge voltage. This constant bridge voltage is the result of receiving a constant current. If the bridge becomes unbalanced, for example due to a force being exerted, the differential voltage across the bridge (ΔU) changes proportionally to the change in force.

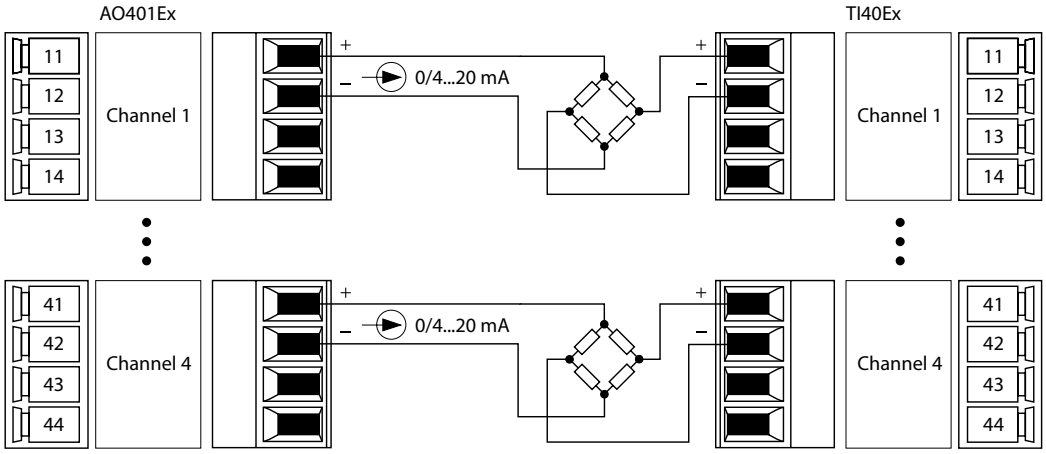


The bridge voltage (Uconst) is the product of the constant current (Iconst) and the equivalent resistance of the bridge (parallel/series arrangement of the four individual resistors). For example, if a constant current source of 20 mA is supplying the circuit, there will be a bridge voltage of 15 V with a bridge resistance of 750 Ω.

The ΔU is the result of the change in the bridge resistances, and is proportional to the force exerted. This is measured as the quotient of ΔU/Uconst, expressed in mV/V. In the example above, if the bridge has a value of 2 mV/V with a 15 V supply voltage, this will result in a voltage change of 30 mV above the measuring range of the strain gauge transducer.

3 Strain Gauge Evaluation Using the AO401Ex and TI40Ex

The diagram below shows the interconnection of the AO401Ex and TI40Ex modules for the evaluation of strain gauge bridges. Up to four bridges can be evaluated following the principle described above via the TI40Ex four-channel temperature input module. Due to the galvanic isolation, channels that are not used for strain gauge measurement can be used for other outputs.



As it is supplied to the bridge, the output current of the AO401Ex output module is set to ensure that the maximum permissible compliance voltage of the AO401Ex module is not exceeded (15 VDC). Furthermore, the maximum permissible supply voltage of the bridge must not be exceeded.

The strain gauge bridge is evaluated by the TI40Ex module in configuration TI40.T with the measuring range set at -75…+75 mV.

To ensure accuracy, the entire measuring span of the strain gauge bridge must be evaluated in proportion to the measuring span of the TI40Ex input. In the example above, a ΔV of 30 mV should be observed for the bridge in proportion to the 150 mV measuring range. As a result, one fifth of the measurement range of the TI40Ex temperature input module is used. Based on the 150 mV measuring range, the guaranteed linearity deviation of the TI40Ex module (< 0.05 %) is 75 µV. In this example, this would result in a linearity deviation of < 0.25 % based on the maximum differential voltage for the strain gauge.

NOTE
The interconnection described in this section may only be used in non-Ex areas or in zone 2.
For the constant current supply used in this application, the cell must be designed to ensure that the total resistance of the measuring cells is constant across the measuring range.

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