Measurement circuits for resistance thermometers
The temperature measurement with resistance thermometer are negatively affected by the resistance of the cable.

Two-lead circuit

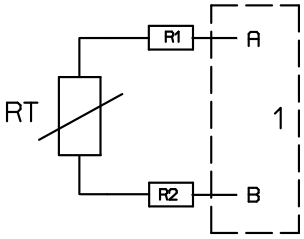

Figure 2: *Two-lead circuit*
R_1 , R_2 , *Lead resistances*
R_T *Temperature sensor*
1 *Evaluation unit*

Properties:
- The lead resistances go into the measurement result in their entirety.
- It is not possible to make a compensation measurement. $\mathbf{R_{Total} = R_1 + R_2 + R_T}$.
- During evaluation of a constant temperature, the influence of the lead resistance can be compensated by a temperature-independent line-compensation resistor, i.e. the resistance of the leads can be subtracted as a constant value.
- Temperature fluctuations change the lead resistance and cannot be taken into account.

Three-lead circuit

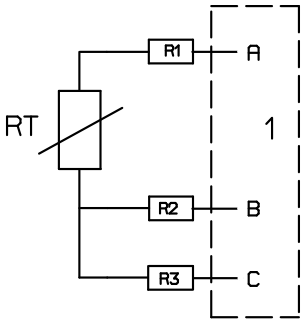

Figure 3: *Three-lead circuit*
R_1 , R_2 , R_3 *Lead resistances*
R_T *Temperature sensor*
1 *Evaluation unit*

Properties:
- Measurements are possible over significantly larger distances, as commercially available controllers offer an offset function. This function allows the user to enter compensation value or automatically compensates for the lead resistance when determining the resistance.
- The effect of the temperature of the leads is reduced. It is assumed that all lead resistances are the same, i.e. $R_1 = R_2 = R_3$
- The three-lead circuit is a compensation circuit for the lead resistances. It achieves a level of measurement precision that is completely sufficient for most practical applications.
- For the resistance measurement using an ohmmeter (measuring bridge), the value measured between points B-C must be subtracted from the value measured between points A-B, in order to get the effective resistance of the sensor:

$\mathbf{R_{Total} = R_1 + R_T + R_2 - (R_2 + R_3).}$

Four-lead circuit

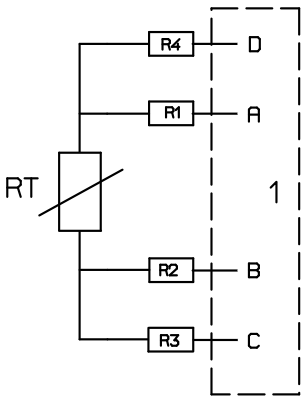

Figure 4: *Four-lead circuit*
R_1 , R_2 , R_3 , R_4 *Lead resistances*
R_T *Temperature sensor*
1 *Evaluation unit*

Properties.
- The four-lead circuit is capable of the most precise measurements.
- The influence of the temperature on the clamping points and the lead resistances is fully compensated.
- Compensation occurs in the evaluation unit.
- For the resistance measurement using an ohmmeter (measuring bridge) the value measured between points A-D or B-C must be subtracted from the value measured between points A-B, in order to get the effective resistance of the sensor.
- Assumption for this measurement : $\mathbf{R_1 = R_2 = R_3 = R_4}$

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