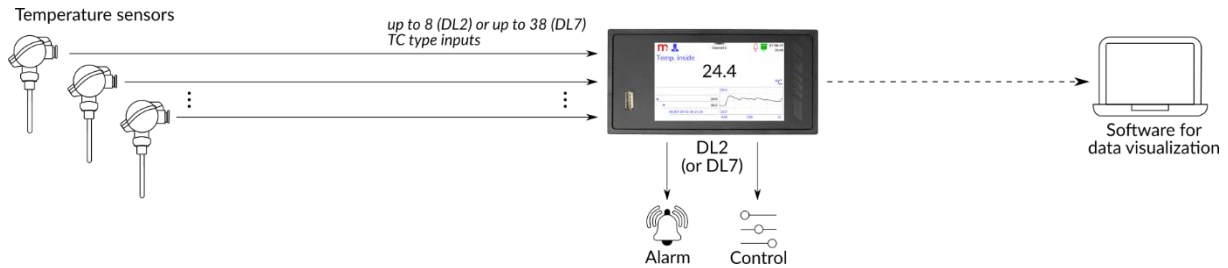


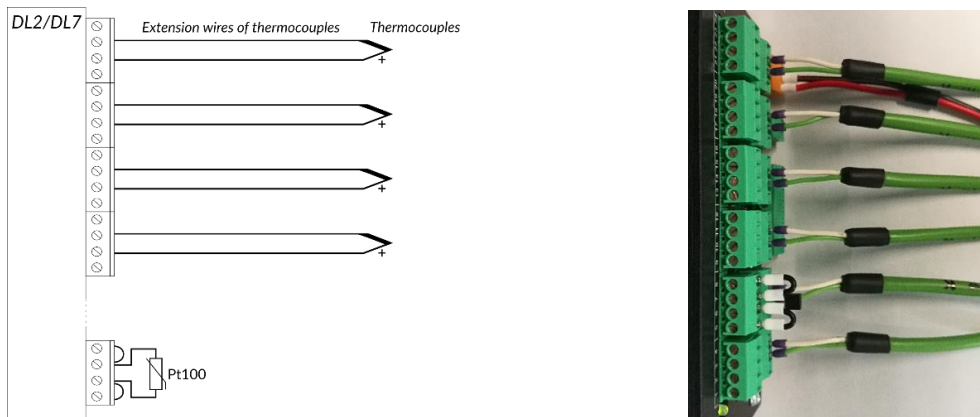
TEMPERATURE MEASUREMENT BASED ON THERMOCOUPLES AND COMPENSATION OF REFERENCE JUNCTION TEMPERATURE

Thermocouples are used in specialized applications and in systems where high temperatures are measured. The use of thermocouples is associated with the necessity to compensate the reference junction temperature, also known as "cold junction". Due to the maximum accuracy, it is necessary to measure the reference junction temperature in proper way. For this purpose, the method of measuring the reference junction temperature should be chosen: by internal sensor or by an additional resistance thermometer (e.g. Pt100). Thermocouples can be connected to the DL2/DL7 data logger terminal block or to a separate terminal block, which is connected with copper wires to the data logger. In specific application, it is possible to enter a constant value for the reference junction temperature. Various ways of compensation the reference junction temperature in the DL2 data logger are described below.



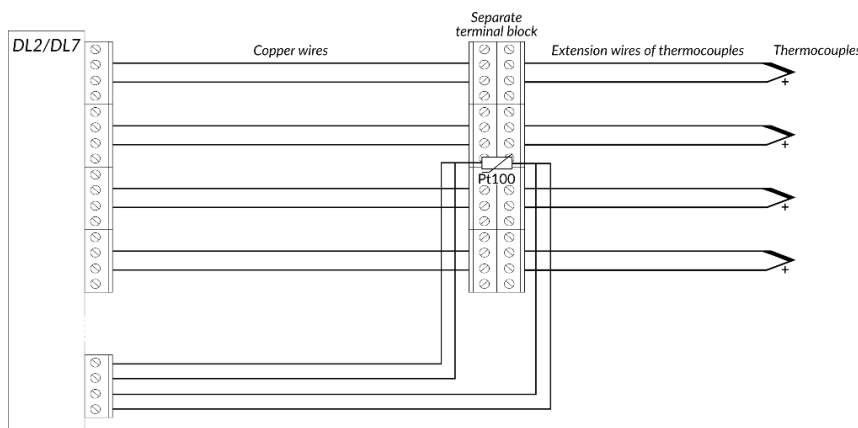
- **Measurement of reference junction temperature (without a separate terminal block)**

The thermocouple can be connected directly to the DL2/DL7 data logger terminal block. For measuring the reference junction temperature, it is recommended to use an internal sensor or a resistance thermometer (e.g. Pt100) connected directly to the device terminal block, then the natural phenomenon of electric devices heating is taken into account. The diagram below shows the system connection (2-wire RTD sensor). The picture below shows an example of application.



- **Measurement of reference junction temperature (with a remote terminal block)**

In industrial applications, where the place of temperature measurement is significantly distant from the DL2/DL7 data logger, for economic reasons it may be expedient to switch to copper wires and use an separate terminal block. In such applications, the reference junction temperature should be measured next to the separate terminal block, with using a resistance thermometer (e.g. Pt100). The diagram below shows the system connection (4-wire RTD sensor).






















- **Constant value of the reference junction temperature**

In some applications, where constant ambient conditions for the reference junction are ensured or high measurement precision is not required, in the DL2/DL7 data logger the constant "cold junction" temperature value can be entered. If the reference junction temperature changes, the value measured by the thermocouples will not be corrected for the difference between the declared and the actual temperature. It should be noted that the difference will cause a divergence in the temperature measured by the thermocouples to even up to several degrees.

- **Example configuration**

Application of the DL2 (or DL7) data logger with thermocouples and resistance thermometer requires installation and configuration of the module/modules dedicated for connecting TC (IN6TC, IN3) and RTD (IN3, IN6RTD, IN3RTD) sensors. The data logger can be configured using a PC dedicated program or from the device level.

An example configuration of the DL2 data logger in application with thermocouples and RTD sensor (for measuring the reference junction temperature) is presented below. Described configuration is performed from the device level. Installed modules: IN6TC, IN3.

1. Configuration is possible from the Administrator level:  →  → *Login* → **Login**.
2. Configure the measuring inputs and define way of compensation the reference junction temperature:
 - a. The IN3 module input to which the RTD sensor (e.g. Pt100) is connected should be configured in accordance with the sensor connection method (e.g. *RTD 3-wires*). The other inputs of the IN3 module can be used to measure temperature using thermocouples (during configuration the other inputs, select *TC mV* mode):
 →  → *Select the input* → **IO 1 / IO 2** → **Mode** → *RTD 3-wires* → **Adjustment** → *value* → ,
 - b. Inputs of the IN6TC module to which thermocouples are connected should be set in the *Enabled* mode. Select the way of compensation the reference junction temperature, i.e. the measuring channel (in the case of the measured reference junction temperature) or a constant value:  →  → *Select the input* → **IO 1 / IO 2** → **Mode** → *Enabled* → **Adjustment** → *value* → **Compensation** → *Constant (enter the value) / Channel 1 .. Channel 30* → .
3. Measurement results should be assigned to the channels. The DL2 data logger has 30 freely configurable channels:
 - a. Select the *Measurement* channel type and indicate the measurement input to which the temperature sensor is connected. The device automatically selects the characteristic as *Linear*. Select the type of sensor connected to the input from the list, for example *Pt100(°C)* or *K(°C)* (choose the same unit for TC and RTD sensors, e.g. °C for both sensors):  →  → **Inputs** → **Channel type** → *Measurement* → **Input** → *Select the measurement input* → **Characteristic** → *select the sensor characteristic from the list or enter the user characteristic*,
 - b. The input to which the RTD sensor (measuring the reference junction temperature) is connected must be assigned to the channel defined in the I/O settings window for the IN6TC module, i.e. in point 2.b.,
 - c. In the *General* tab it is possible to enable archiving of the process value:  →  → **General** → **Archiving** → → .
4. Enabled channels are displayed as single result windows (switching by using arrows). The results can be presented in the form of a result table (min and max values, totalizers, channel values) or trend graphs (only channel values):
 →  → **Result tables** → *configuration* → **Trends** → *configuration* → .
5. Define the archiving settings. Archive files are created in a daily, weekly or monthly mode. In the bottom part of the Archive settings window, an information regarding the current archiving status of channels and totalizers is displayed, the archived value is marked in green colour:  →  → *configuration* → .
6. Exit the menu and confirm the willingness of making changes. The device will reboot with the new settings.

Note: To start the archiving process, press the **START** button in the Archive window (the  icon on the menu bar).

Detailed information are in the data logger Operating Manual.

- **Measurement of reference junction temperature with an internal temperature sensor**

In the DL2 data logger with firmware 1.4.0.0 and higher and in the DL7/DL7L data logger with firmware 1.7.0.0 and higher it is possible to compensate junction temperature with using an internal temperature sensor (accuracy ± 2.5 °C, with the possibility of calibration). The measurement from the internal temperature sensor is assigned to the virtual measuring inputs CJC °C and CJC °F. Measurement of reference junction temperature with an internal temperature sensor can be used if thermocouples are connected directly to the module's terminal block.

During configuration, in the *I/O* window indicate the channel through which the compensation is performed for the TC measuring input. In the **Channels** window for the IN3 and IN6TC modules, the measuring inputs CJC °C and CJC °F are available (channel type: *measurement*). Select one of CJC inputs. For CJC inputs, the characteristic is typically selected as 1:1. It is possible to calibrate the compensation by entering the *Linear* characteristic, which increases or decreases the measured temperature by a fixed number of degrees, e.g. a characteristic that increases the indication of the internal sensor by 2 degrees:

$$\begin{aligned} 0\text{ }^{\circ}\text{C} &\rightarrow 2 \\ 100\text{ }^{\circ}\text{C} &\rightarrow 102 \end{aligned}$$

To calibrate the sensor indications it is possible to use the *User's characteristic*, which takes into account temperature changes in individual temperature ranges. The *User characteristics* contain many pairs of points, which enables precise sensor readings correction and multi-point calibration.

Each measuring input can have a different channel selected for compensation. Calibration of compensation channels (Linear or User characteristics) carried out separately for each input enables precise temperature measurement with using thermocouples.

The same units for the measured temperature and junction temperature (°C or °F) must be set.

- **Information from the Manufacturer**

All functions of the recorder are subject to modifications for the benefit of technical progress.

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