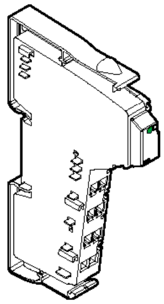
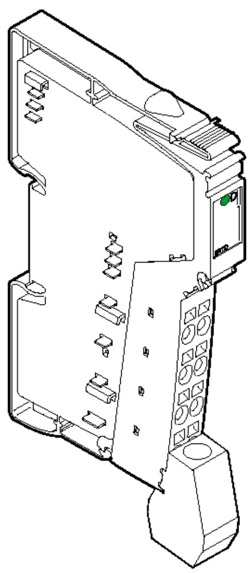


VersaPoint I/O Module

Analog In 16 Bit RTD 2 Channels
IC220ALG620

GFK-2013 January 2004

Module IC220ALG620 provides two-input channels for resistive temperature sensors. It supports platinum or nickel sensors according to the DIN standard and SAMA Directive. In addition, CU10, CU50, CU53, KTY81 and KTY84 sensors are supported.



Module with the I/O Terminal Strip plugged in

Module IC220ALG620 requires one (1) I/O Terminal Strip, IC220TBK061, ordered separately. See the ordering information below.

Features

- Two inputs for resistive temperature sensors
- Configuration of the independent channels
- Three data formats
- Connection of 2-, 3-, and 4-wire sensors

Ordering Information

IC220ALG620	Analog In 16 Bit RTD 2 Channels
IC220TBK061	I/O Terminal Strip with Shield, qty 5

Module Specifications	
Housing dimensions (width x height x depth)	12.2mm x 120mm x 66.6mm (0.480in. x 4.724in. x 2.622in.)
Connection style	2- , 3-, and 4-wire
Operating temperature	-25°C to +55°C (-13°F to +131°F)
Storage temperature	-25°C to +85°C (-13°F to +185°F)
Operating humidity	75% on average. Take appropriate measures against increased humidity (> 85%).
Storage humidity	75% on average
Degree of protection	IP20 according to IEC 60529
Class of protection	Class 3 according to VDE 0106, IEC 60536

Power Consumption	
Communications power U_L	7.5V
Current consumption from local bus U_L	43mA, typical
I/O supply voltage U_{ANA}	24VDC
Current consumption from analog bus U_{ANA}	11mA, typical
Total power consumption	0.59W, typical

Installation Instructions

High current flowing through the segment and main power busses raises the temperature of the components within the module. To keep the current flowing through the potential jumpers of the analog modules as low as possible, **a separate main circuit should be used for analog modules.** If analog modules must be used in a main circuit together with other modules place the analog modules to the right of the standard modules, at the end of the main circuit.

During installation, ensure that no isolating voltage is specified between the analog inputs and the bus. Provide signals with ***safe isolation*** for the thermistor detection, if required.

Connections

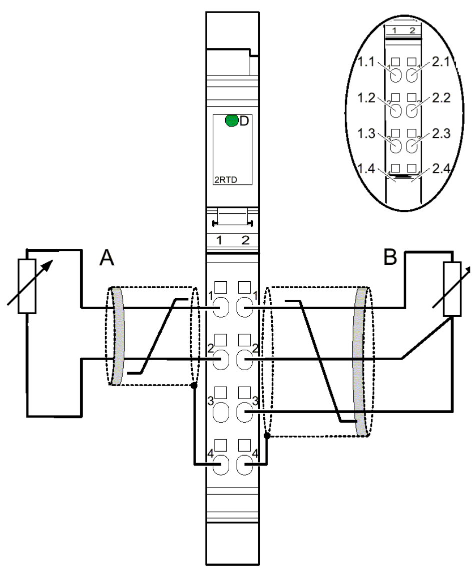
Always connect temperature shunts using shielded, twisted-pair cables.

Connect the shield at the module using the shield connector clamp. The clamp connects the shield directly to FE on the terminal side. Additional wiring is not necessary. Isolate the shield at the sensor. ,

A 4-wire sensor can only be connected to channel 1; only one 4-wire sensor can be connected to the module.

LED	Color	Meaning
D	Green	Bus diagnostics

Example: 2-Wire and 3-Wire Sensors

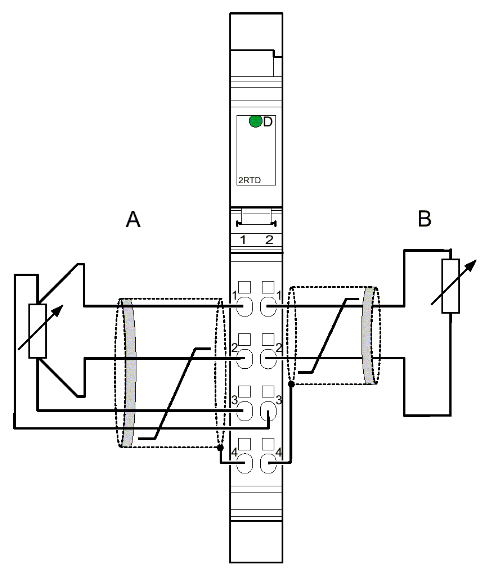


A. Channel 1: 2-wire sensor

B. Channel 2: 3-wire sensor

Terminal	Signal	Assignment
1.1	I1+	RTD sensor 1
1.2	I1-	Constant current supply
1.3	U1-	Measuring input sensor 1
2.1	I2+	RTD sensor 2
2.2	I2-	Constant current supply
2.3	U2-	Measuring input sensor 2
1.4, 2.4	Shield	Shield connection (ch 1 and 2)

Example: 4-Wire and 2-Wire Sensors

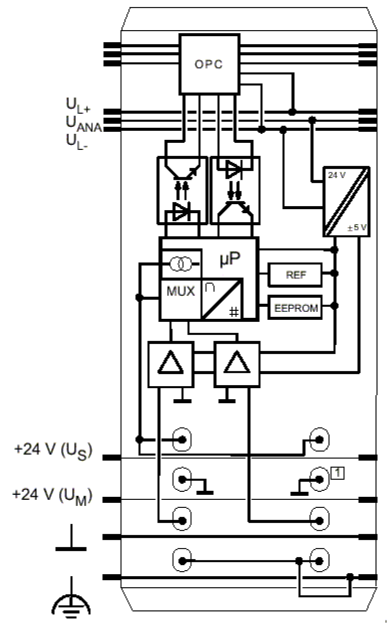


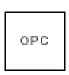
A. Channel 1: 4-wire sensor

B. Channel 2: 2-wire sensor

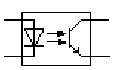
Terminal	Signal	Assignment
1.1	I1+	RTD sensor 1
1.2	I1-	Constant current supply
1.3	U1-	Measuring input sensor 1
2.1	U1+	Measuring input sensor 1
2.2	I2+	RTD sensor 2
2.3	I2-	Constant current supply
1.4, 2.4	Shield	Shield connection (ch 1 and 2)

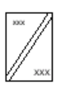
Internal Circuit Diagram

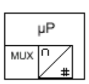




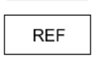
Protocol chip (bus logic including voltage conditioning)


Optocoupler


DC/DC converter with electrical isolation

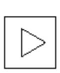


Microprocessor with multiplexer and analog/digital converter

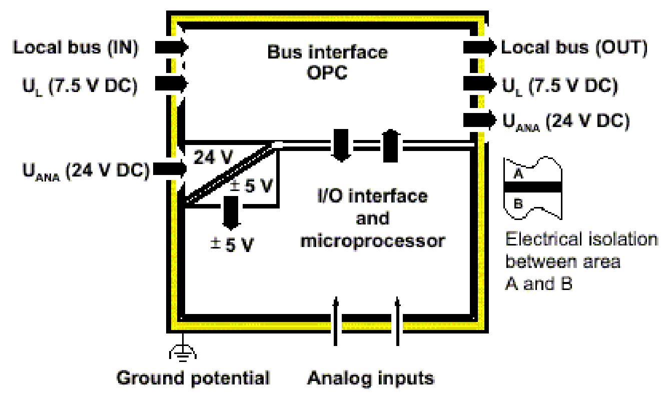


Reference voltage

Electrically erasable programmable read-only memory


Amplifier

Electrical Isolation



Programming Data

ID code	7F hex (127 decimal)
Length code	02 hex
Input address area	4 bytes
Output address area	4 bytes
Parameter channel (PCP)	0 bytes
Register length (bus)	4 bytes

Output Data Words for Channel Configuration

The module receives two output data words. These data words can be used to configure the module. The module's default configuration can be used without change, or each channel can be configured independently. This configuration setting is not saved, and must be transmitted in each logic scan.

Default channel configuration

Connection type:	3-wire sensors
Reference resistance:	100 Ohms
Resolution:	0.1 degree C.
Sensor type:	PT 100 (DIN)
Data format:	Extended diagnostics mode

The following parameters can be configured:

- Sensor connection type: 2-wire, 3-wire, or 4-wire *
- Value of the reference resistance
- Resolution
- Format for representing the measured values
- Sensor type

* Only channel 1 can be configured for a 4-wire sensor. If that is done, channel 2 can only be used for a 2-wire sensor.

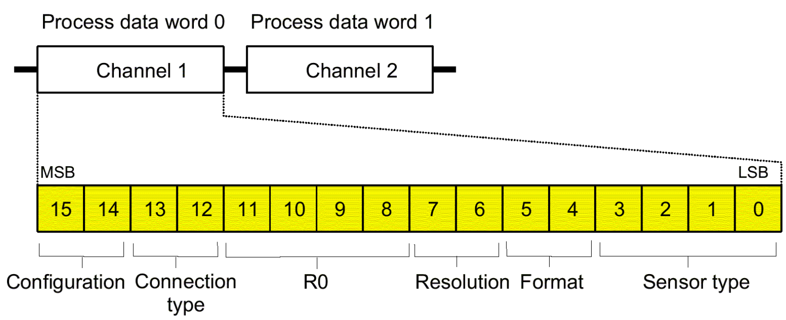
Configuration Diagnostics

In the default format, the following configuration errors are indicated by an error code. If the data format is changed, extended diagnostics are not available.

- After powerup, the message "measured value invalid" (error code 8004 hex) appears in the input data. After 1 second (maximum) the preset configuration is accepted and the first measured value is available.
- If the channel configuration is changed, the corresponding channel is re-initialized. The message "measured value invalid" (error code 8004 hex) appears in the input data for 100mS (maximum).
- If the configuration is invalid, the message "Configuration invalid" appears (error code 8010 hex).

Process Data Output Format

Each channel has one process data output word associated with it. You must set bit 15 of the corresponding output word to 1 to reconfigure the channel. **If bit 15 = 0, the default configuration is used.** Bit 14 should always be set to 0.



To configure a channel, set bit 15 of that output word to 1. If bit 15 is zero, the preset configuration is active.

<table>
<tr><th>Bit</th><th>Assignment</th><th>Decimal</th><th>Binary</th><th colspan="4">Description</th></tr>
<tr><td>15</td><td rowspan="3">Configuration</td><td>0</td><td>0</td><td colspan="4">Default configuration</td></tr>
<tr><td></td><td>1</td><td>1</td><td colspan="4">Change configuration data</td></tr>
<tr><td>14</td><td>0</td><td>0</td><td colspan="4">Must be zero.</td></tr>
<tr><td rowspan="4">13, 12</td><td rowspan="4">Connection type</td><td>0</td><td>00</td><td colspan="4">3-wire, Default</td></tr>
<tr><td>1</td><td>01</td><td colspan="4">2-wire, if channel 1 is 4-wire, channel 2 must be 2-wire</td></tr>
<tr><td>2</td><td>10</td><td colspan="4">4-wire, Channel 1 only</td></tr>
<tr><td>3</td><td>11</td><td colspan="4">reserved</td></tr>
<tr><td rowspan="16">11 - 8</td><td rowspan="16">Reference resistance (in Ohms), R_O</td><td>0</td><td>0000</td><td colspan="4">100 Ohms, Default</td></tr>
<tr><td>1</td><td>0001</td><td colspan="4">10</td></tr>
<tr><td>2</td><td>0010</td><td colspan="4">20</td></tr>
<tr><td>3</td><td>0011</td><td colspan="4">30</td></tr>
<tr><td>4</td><td>0100</td><td colspan="4">50</td></tr>
<tr><td>5</td><td>0101</td><td colspan="4">120</td></tr>
<tr><td>6</td><td>0110</td><td colspan="4">150</td></tr>
<tr><td>7</td><td>0111</td><td colspan="4">200</td></tr>
<tr><td>8</td><td>1000</td><td colspan="4">240</td></tr>
<tr><td>9</td><td>1001</td><td colspan="4">300</td></tr>
<tr><td>10</td><td>1010</td><td colspan="4">400</td></tr>
<tr><td>11</td><td>1011</td><td colspan="4">500</td></tr>
<tr><td>12</td><td>1100</td><td colspan="4">1000</td></tr>
<tr><td>13</td><td>1101</td><td colspan="4">1500</td></tr>
<tr><td>14</td><td>1110</td><td colspan="4">2000</td></tr>
<tr><td>15</td><td>1111</td><td colspan="4">3000 (adjustable)</td></tr>
<tr><td rowspan="7">7, 6</td><td rowspan="7">Resolution for sensor type: resolution depends on setting for sensor type in bits 3 – 0 (see below)</td><td rowspan="3"></td><td rowspan="3"></td><td colspan="4">Sensor type value in bits 3 – 0 is:</td></tr>
<tr><td>0 - 10</td><td>13</td><td>14</td><td>15</td></tr>
<tr><td colspan="4">Resolution is:</td></tr>
<tr><td>0</td><td>00</td><td>0.1 deg. C</td><td>1%</td><td>0.1 Ohm</td><td>1 Ohm</td></tr>
<tr><td>1</td><td>01</td><td>0.01deg. C</td><td>0.1%</td><td>0.01 Ohm</td><td>0.1 Ohm</td></tr>
<tr><td>2</td><td>10</td><td>0.1 deg. F</td><td colspan="3" rowspan="2">Reserved</td></tr>
<tr><td>3</td><td>11</td><td>0.01 deg F</td></tr>
<tr><td rowspan="4">5, 4</td><td rowspan="4">Format</td><td>0</td><td>00</td><td colspan="4">Signed, 15-bit resolution with extended diagnostics. Default</td></tr>
<tr><td>1</td><td>01</td><td colspan="4">12 bit resolution with 3 diagnostic bits</td></tr>
<tr><td>2</td><td>10</td><td colspan="4">Standardized Format: 15 bit resolution, no diagnostics</td></tr>
<tr><td>3</td><td>11</td><td colspan="4">Reserved</td></tr>
<tr><td rowspan="15">3 - 0</td><td rowspan="15">Sensor type</td><td>0</td><td>0000</td><td colspan="4">Pt DIN, Default</td></tr>
<tr><td>1</td><td>0001</td><td colspan="4">Pt SAMA</td></tr>
<tr><td>2</td><td>0010</td><td colspan="4">Ni DIN</td></tr>
<tr><td>3</td><td>0011</td><td colspan="4">Ni SAMA</td></tr>
<tr><td>4</td><td>0100</td><td colspan="4">Cu10</td></tr>
<tr><td>5</td><td>0101</td><td colspan="4">Cu50</td></tr>
<tr><td>6</td><td>0110</td><td colspan="4">Cu53</td></tr>
<tr><td>7</td><td>0111</td><td colspan="4">Ni 1000 (L & G)</td></tr>
<tr><td>8</td><td>1000</td><td colspan="4">Ni 500 (Viessmann)</td></tr>
<tr><td>9</td><td>1001</td><td colspan="4">KTY 81-110</td></tr>
<tr><td>10</td><td>1010</td><td colspan="4">KTY 84</td></tr>
<tr><td>11, 12</td><td>1011, 1100</td><td colspan="4">Reserved</td></tr>
<tr><td>13</td><td>1101</td><td colspan="4">Potentiometer (%)</td></tr>
<tr><td>14</td><td>1110</td><td colspan="4">Linear R: 0 through 400 Ohms</td></tr>
<tr><td>15</td><td>1111</td><td colspan="4">Linear R: 0 through 4000 Ohms</td></tr>
</table>

Process Data Input Words

The measured input values are transmitted, per channel, to the controller. The figure below shows the sequence of the input data words.

Channel 1 (2 bytes)	**Channel 2 (2 bytes)**

For each channel, the format of the input data can be independently configured in three input data formats as shown below and on the following pages.

Default Input Data Format: Signed, 15-Bit Resolution with Extended Diagnostics

This format can be selected for each channel using bits 5 and 4 (bit combination 0 0) of the corresponding process data output word. In the input data, bit 15 can be used as a sign bit; bits 14 to 0 contain the analog value.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Sign	Analog Value														

Channel Error Codes

The default format supports extended diagnostics. Values greater than 8000H indicate an error.

Hex	Decimal	Error
8001	-32767	Over range
8002	-32766	Open circuit or short circuit (available only in the temperature range)
8004	-32764	Measured value invalid or no valid measured value available
8010	-32752	Configuration invalid
8040	-32704	Module defective
8080	-32640	Under range

Open Circuit/Short-Circuit Detection

Open circuit is detected according to the conditions listed below:

Yes	open circuit/short circuit is detected
--	the cable is not connected for this type
No	open circuit/short circuit is not detected because the measured value is valid.

Faulty Sensor Cable	Temperature measuring Range			Resistance Measuring range		
	2-wire	3-wire	4-wire	2-wire	3-wire	4-wire
I+	Yes	Yes	Yes	Yes	Yes	No
I-	Yes	Yes	Yes	Yes	Yes	No
U+	--	--	Yes	--	--	Yes
U-	--	Yes	Yes	--	Yes	Yes

Significant Measured Values in the Default Data Format

The table below shows typical hexadecimal and corresponding decimal values in the default data format. Values are shown for the different combinations of configured sensor type and resolution.

Typical Input Values		**RTD inputs**		**Potentiometer %**		**Linear R : 0 –400 Ohms**		**Linear R; 0 – 4000 Ohms**	
Hex	Decimal	*0.1 degree resolution*	*0.01 degree resolution*	*1% resolution*	*0.1% resolution*	*0.1 Ohm resolution*	*0.01 Ohm resolution*	*1 Ohm resolution*	*0.1 Ohm resolution*
8002	-	open circuit	open circuit	-	-	-	-	-	-
8001	-	over range	>325.12 Over range	-	-	400	325.12	4000	3251.2
2710	10000	1000.0	100.00	-	1000.0 (10x R_0)	-	100.00	-	1000.0
0FA0	4000	400.0	-	4000 (40x R_0)	-	400	-	4000	-
03E8	4000	-	10.00	-	100.0 (1x R_0)	-	10.00	-	100.0
00A0	10	1.0	-	10.0 (0.10x R_0)	-	1.0	-	10	-
0001	1	0.1	0.01	1 (0.01x R_0)	0.1 (0.01xR_0)	0.1	0.01	1	0.1
0000	0	0	0	0	0	0	0	0	0
FFFF	-1	-0.1	-0.01	-	-	-	-	-	-
FC18	-1000	-100.0	-	-	-	-	-	-	-
D8F0	-10000	-	-100.00	-	-	-	-	-	-
8080	-	under range	under range	-	-	-	-	-	-
8002	-	short circuit	short circuit	-	-	-	-	-	-

Standardized Input Data Format: 15 Bit Resolution, No Diagnostics

This format can be selected for each channel using bits 5 and 4 (bit combination 1 0) of the corresponding process data output word. In this format, the measured value is represented in bits 14 to 0. Bit 15 is available as a sign bit.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Sign	Analog Value														

Significant Measured Values in Standardized Representation Format

The table below shows typical hexadecimal and corresponding decimal values in Standardized Representation format. Values are shown for the different combinations of configured sensor type and resolution.

Typical Input Values		RTD inputs		Linear R; 0 – 4000 Ohms	
Hex	Decimal	0.1 deg resolution	0.01 dec resolution	1 Ohm resolution	0.1 Ohm resolution
7FFF	32767	-	-	->2048	>4096
Upper limit value +1 LSB		over range	over range	-	-
7D00	32000	-	320.00	2000	4000
2710	10000	1000.0	100.0	625	1250
000A	10	1	-	0.625	-
0001	1	0.1	0.01	0.0625	0.125
0000	0	0	0	0	0
FFFF	-1	-0.1	-1.0	-	-
FC18	-1000	-100.0	-	-	-
D8F0	-10000	-	-100.00	-	-
lower limit value - 1 LSB		under range	under range	-	-
lower limit value -2 LSB		open / short circuit	open / short circuit	-	-

12-Bit Input Data with Diagnostics

This format can be selected for each channel using bits 5 and 4 (bit combination 0 1) of the corresponding process data output word. The measured value is represented in input bits 14 through 3. Input bit 15 is the sign bit. Bit 1 indicates open circuit/short circuit. For an open circuit or short circuit, bit 1 is set to 1. Bit 0 indicates an over range condition. If the measured value is outside the representation area of the process data, bit 0 is set to 1.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Sign	Analog Value												0	OC	OR

Significant Measured Values in 12-Bit Resolution Format

The table below compares typical hexadecimal and corresponding decimal values in 12-bit resolution format.

Typical Input Values		RTD inputs	
Hex	**Decimal**	**0.1 deg resolution**	**0.01 deg resolution**
xxxx xxxx xxxx xxx1$_{bin}$		Over range (Positive value as shown in the table on next page)	
2710	10000	1000.0	100.0
03E8	1000	100.0	10.00
0008	8	0.8	0.08
0000	0	0	0
FFF8	-8	-0.8	-0.08
FC18	-1000	-100.0	-10.00
xxxx xxxx xxxx xxx1$_{bin}$		Under range (Negative value as shown in the table on next page)	
xxxx xxxx xxxx xx1x$_{bin}$		Open circuit / short circuit (Negative value as shown in the table on next page)	

Measuring Ranges for Temperature Sensors

The module's measuring range for temperature sensors depends on the configured resolution. The resolution chosen should be appropriate for the expected temperature range of the sensors, as shown in the bottom table.

Resolution	Measuring Range
0.1 degree C	-273 degrees C to +3276.8 degrees C
0.01 degree C	-273 degrees C to +327.68 degrees C
0.1 degree F	-459 degrees F to +3276.8 degrees F
0.01 degree F	-459 degrees F to +327.68 degrees F

To convert Celsius measurements to Fahrenheit, the following formula can be used in the application:

Degrees F = Degrees C x (9/5 + 32)

Input Measuring Ranges

The ranges shown below are supported for the different types of configurable input measurements. If the input data format being used (see previous pages) supports diagnostics, input measurements that are outside the low and high limits are reported as under range or over range.

Sensor Type	Low Limit	High Limit
Pt R_0 10Ω to 3000Ω DIN, Default	**-200C (-328F)**	**+850C (+1562F)**
Pt R_0 10Ω to 3000Ω, SAMA	-200C (-328F)	+850C (+1562F)
Ni R_0 10Ω to 3000Ω, DIN	-60C (-76F)	+180C (+356F)
Ni R_0 10Ω to 3000Ω, SAMA	-60C (-76F)	+180C (+356F)
Cu10	-70C (-94F)	+500C (+932F)
Cu50	-50C (-58F)	+200C (+392F)
Cu53	-50C (-58F)	+180C (+356F)
Ni 1000 (L & G)	-50C (-58F)	+160C (+320F)
Ni 500 (Viessmann)	-60C (-76F)	+250C (+482F)
KTY 81-110	-55C (-67F)	+150C (+302F)
KTY 84	-40C (-40F)	+300C (+572F)
Reserved	-	-
Potentiometer (%)	0%	4kΩ / R_0 x100% (400% maximum)
Linear Resistance: 0 through 400 Ohms	0Ω	400Ω
Linear Resistance: 0 through 4000 Ohms	0Ω	4000Ω

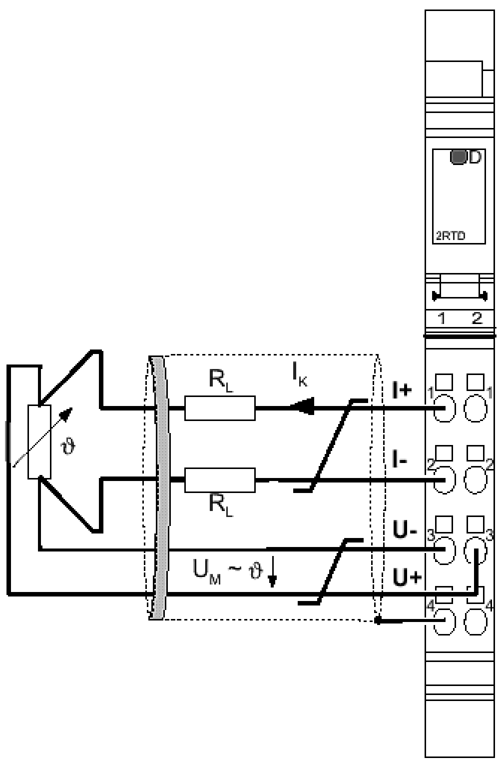
Measuring Errors

When measuring temperatures with resistance thermometers, measuring errors may cause incorrect results.

4-Wire Sensor Measurement Errors

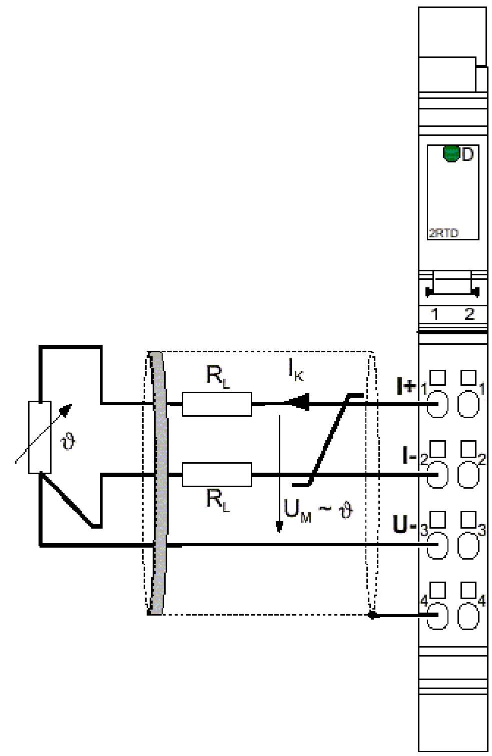
4-wire sensors provide the most precise measurements.

A constant current is sent through the sensor via the I+ and I- cables. Two additional cables, U+ and U-, can be used to tap and measure the temperature-related voltage at the sensor. The cable resistances have no effect on the measurement.



3-Wire Sensor Measurement Errors

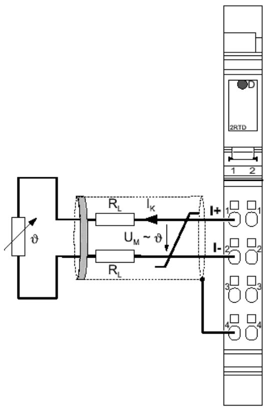
3-wire sensors provide measurements that are nearly as precise as measurements taken with 4-wire sensors. However, 3-wire sensors are more vulnerable to interference in noisy environments.



With 3-wire sensors, the effect of cable resistance on the measurements in the module is eliminated or minimized by multiple measuring of the temperature-related voltage and corresponding calculations.

2-Wire Sensor Measurement Errors

2-wire sensors provide cost-effective connections. The U+ and U- cable connections are not used. The temperature-related voltage is not directly measured at the sensor, so it is not affected by cable resistances R_L.



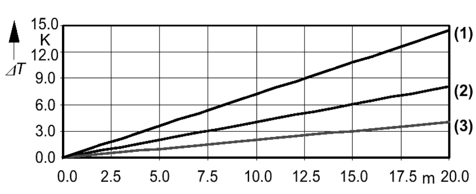
Measurement errors can occur with 2-wire sensors as a result of cable resistance. The following examples describe the impact of various installation factors on measurement accuracy. In each example, measurement error was found for:

PT 100 sensor
copper cable $\chi = 57 m/\Omega mm^2$,
temperature = 25 degrees C (77F)

In all cases, using PT 1000 sensors would improve measurement accuracy by ten times over the PT 100 sensor, due to the higher temperature coefficient of the PT 1000 sensor:

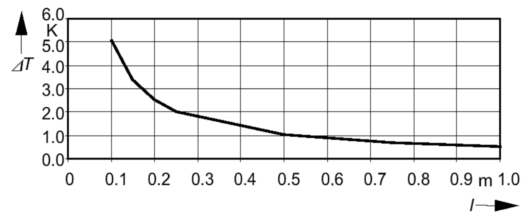
PT 100: ($\alpha = 0.385\Omega/K$)
PT 1000 ($\alpha = 3.85\ \Omega/K$)

Resistance increases with cable length, so cables should be kept as short as possible when using 2-wire sensors. The diagram below compares the increase in temperature measurement error (ΔT) with the increase in cable length for cables of three different diameters.

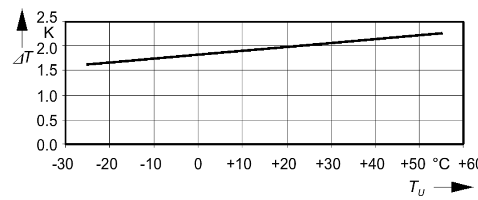


1. Diameter = $0.14 mm^2$ (AWG 26)
2. Diameter = $0.25 mm^2$ (AWG 24)
3. Diameter - $0.50 mm^2$ (AWG 20)

Measurement accuracy also increases as cable diameter increases. Using cables with a diameter less than $0.5 mm^2$ (20AWG) greatly increases measurement errors:



Finally, higher ambient temperature also increases cable resistance. However, the impact is slight.



Calculating Cable Resistance

Cable resistance can be calculated using the following equation:

$$R_L = R_{L20} \times \left(1 + 0.0043 \frac{1}{K} \times T_U\right)$$

$$R_L = \frac{l}{\chi \times A} \times \left(1 + 0.0043 \frac{1}{K} \times T_U\right)$$

Where:

R_L Cable resistance in Ohms
R_{L20}- Resistance at 20 deg. C (68F) in Ohms
l Cable length in m
χ Specific electrical resistance of copper in $\Omega mm^2/m$
A Cable diameter in mm^2
0.0043 1/K Temperature coefficient for copper
T_U Ambient (cable) temperature in deg C

Because there are two cable resistances in the measuring system (forward and return), the value must be doubled.

The absolute measuring error in Kelvin |K| is provided for platinum sensors according to DIN using the average temperature coefficient α ($\alpha = 0.385\Omega/K$ for PT 100; a = $3.85\Omega/K$ for PT1000).

Tolerance and Temperature Response

Typical Measuring Tolerances at 25C (77F)

	α at 100C (212F)	2-Wire Sensors		3-Wire Sensors		4-Wire Sensors	
		Relative (%)	Absolute	Relative (%)	Absolute	Relative (%)	Absolute
Temperature Sensors							
PT 100	0.385Ω/K	+/-0.03 + X	+/-0.26K + X	+/-0.03	+/-0.26K	+/-0.02	+/-0.2K
PT 1000	3.85Ω/K	+/-0.04 + X	+/-0.31K + X	+/-0.04	+/-0.31K	+/-0.03	+/-0.26K
Ni 100	0.617Ω/K	+/-0.09 + X	+/-0.16K + X	+/-0.09	+/-0.16K	+/-0.07	+/-0.12K
Ni 1000	6.17Ω/K	+/-0.11 + X	+/-0.2K + X	+/-0.11	+/-0.2K	+/-0.09	+/-0.16K
Cu 50	0.213Ω/K	+/-0.24 + X	+/-0.47K + X	+/-0.24	+/-0.47K	+/-0.18	+/-0.35K
Ni 1000 L&G	5.6Ω/K	+/-0.13 + X	+/-0.21K + X	+/-0.13	+/-0.21K	+/-0.11	+/-0.18K
Ni 500 Viessmann	2.8Ω/K	+/-0.17 X	+/-0.43K + X	+/-0.17	+/-0.43K	+/-0.14	+/-0.36K
KTY 81-110	10.7Ω/K	+/-0.07+ X	+/-0.11K + X	+/-0.07	+/-0.11K	+/-0.06	+/-0.09K
KTY 84	6.2Ω/K	+/-0.06 + X	+/-0.19K + X	+/-0.06	+/-0.19K	+/-0.05	+/-0.16K
Linear resistance							
0Ω to 400Ω		+/-0.025 + X	+/-100mΩ + X	+/-0.025	+/-100mΩ	+/-0.019	+/-75 mΩ
0Ω to 4kΩ		+/-0.03 + X	+/-1.2Ω + X	+/-0.03	+/-1.2Ω	+/-0.025	+/-1Ω

α = Average sensitivity for the calculation of tolerance values
χ = Additional error due to connection for 2-wire sensors

Maximum Measuring Tolerances at 25C (77F)

	α at 100C (212F)	2-Wire Sensors		3-Wire Sensors		4-Wire Sensors	
		Relative (%)	Absolute	Relative (%)	Absolute	Relative (%)	Absolute
Temperature Sensors							
PT 100	0.385Ω/K	+/-0.12 + X	+/-1.04K + X	+/-0.12	+/-1.04K	+/-0.10	+/-0.83K
PT 1000	3.85Ω/K	+/-0.15 + X	+/-1.3K + X	+/-0.15	+/-1.3K	+/-0.12	+/-1.04 K
Ni 100	0.617Ω/K	+/-0.36 + X	+/-0.65K + X	+/-0.36	+/-0.65K	+/-0.29	+/-0.52K
Ni 1000	6.17Ω/K	+/-0.45 + X	+/-0.81K + X	+/-0.45	+/-0.81K	+/-0.36	+/-0.65K
Cu 50	0.213Ω/K	+/-0.47 + X	+/-0.94K + X	+/-0.47	+/-0.94K	+/-0.38	+/-0.75K
Ni 1000 L&G	5.6Ω/K	+/-0.56 + X	+/-0.89K + X	+/-0.56	+/-0.89K	+/-0.44	+/-0.71K
Ni 500 Viessmann	2.8Ω/K	+/-0.72 + X	+/-1.79 K + X	+/-0.72	+/-1.79 K	+/-0.57	+/-1.43K
Y	10.7Ω/K	+/-0.31+ X	+/-0.47K + X	+/-0.31	+/-0.47K	+/-0.25	+/-0.37K
KTY 84	6.2Ω/K	+/-0.27 + X	+/-0.81K + X	+/-0.27	+/-0.81K	+/-0.22	+/-0.65K
Linear resistance							
0Ω to 400Ω		+/-0.10 + X	+/-400mΩ + X	+/-0.10	+/-400mΩ	+/-0.08	+/-320 mΩ
0Ω to 4kΩ		+/-0.13 + X	+/-5Ω + X	+/-0.13	+/-5Ω	+/-0.10	+/-4Ω

α = Average sensitivity for the calculation of tolerance values
χ = Additional error due to connection for 2-wire sensors

Temperature Response at -25C to 55C (-13F to 131F)

For 2, 3, and 4-wire sensors: Typical = +/- 12ppm/degree C/ Maximum = +/- 45ppm / degree C.

Technical Data

Analog Inputs	
Number	Two inputs for resistive temperature sensors
Connection of the signals	2, 3, or 4-wire, shielded sensor cable
Sensor types that can be used	Pt, Ni, Cu, KTY
Standards for characteristic curves	According to DIN / according to SAMA
Conversion time of the A/D converter	120µs typical
Process data update Both channels with 2-wire sensors One channel with 2-wire sensor and one channel with 4-wire sensor Both channels with 3-wire sensors	Depends on connection method 20mS 20mS 32mS

Safety Devices
None

Electrical Isolation	
To provide electrical isolation between the logic level and the I/O area it is necessary to supply the bus module and the sensors using a power terminal from separate power supplies. Interconnection of power supply units in the 24V range is not allowed. (For detailed information refer to the *NIU User's Manual*.)	
Common potentials	
24V main power, 24V segment voltage, and GND have the same potential. FE (functional earth ground) is a separate potential area.	
Isolated Voltages in the RTD Module	
- Test distance	*- Test voltage*
7.5V supply (bus logic) / 24V supply (analog I/O)	500VAC, 50Hz, 1min.
7.5V supply (bus logic) / functional earth ground	500VAC, 50Hz, 1min.
24V supply (analog I/O) / functional earth ground	500VAC, 50Hz, 1min.

Error Messages to the Control System	
Breakdown of the internal voltage supply	Yes
Failure or dropping of communications voltage	Yes, I/O error message to the NIU module

Error Messages via Process Data	
I/O error / user error	Yes