# P5102
## Universal Two-wire Programmable Transmitters

- **One type of transmitter for all regular resistance and thermocouple sensors.**
- **Linearized output signal 4 to 20 mA.**
- **Accuracy up to 0.07 % of set range.**
- **Adjustable span 1 to 100 % of input range**
- **Temperature indication on optional LCD in the whole input range with 0.1 or 1 °C resolution.**
- **Adjusting by set-up unit or PC software.**
- **Optional RS232C interface communication.**
- **High immunity against interference (industrial environment).**


### Application

P5102 transmitters convert a resistance or a voltage signal from a temperature sensor into a current, linear output signal of 4 to 20 mA current loop. The transmitters are produced in versions for mounting into head of temperature sensor, for DIN rail mounting and for wall mounting. Versions for rail and wall mounting can be ordered also with an optional display and they are suitable for application in systems where the local indication of the measured temperature is needed.

### Description

The input signal is converted by an A/D converter to a digital signal, which is converted by a microprocessor to a primary value (temperature) according to the set parameters and then to an output current according to the set range. A version with a display indicates a primary variable in the whole input range independently of the current output status. A resistance sensor can be connected in a two-, three or four-wire connection. Lead resistance is fully compensated by the four-wire connection. The three-wire connection must have all leads to the sensor with identical resistance values. With the two-wire connection of a resistance sensor, the lead resistance can be compensated by entering a constant resistance value in a configuration sheet with the order or by a set-up program. A voltage sensor (a thermocouple) should be connected in a two-wire connection. A temperature compensation of cold junction is either internal (by measuring of terminal board temperature) or by entered constant temperature. Used sensor guarantees a maximum accuracy and stability of comparative temperature measurement.

A potentiometer position is measured in percent. The start position is 0 % and the end position is 100 % independently of the total resistance value. After consultation with the manufacturer and on certain conditions it is possible to measure also a potentiometer with value out of the specified input range. If it were necessary to measure a position of the potentiometer as resistance, it is possible to use a connection for measuring of resistance.

Communication with the transmitter through the RS232C interface requires a KA-01 communication cable with a galvanic isolation. For the interface description see the separate data sheet. The configuration can be done by a PC and by NPT-02 set-up program. Changing of range and calibration can be also done by a easy set-up unit NJ-14 or with optional display by push-buttons on the transmitter directly in the field. Changing of parameters can be disabled by the set-up unit.

### Technical specifications

**Input ranges:**
see table 1

**Input accuracy:**
see digital accuracy in table 1

**Input signal:**

resistance signal of temperature sensor or potentiometer, voltage signal of thermocouple (only option H10, L10, L20, S20).

**Sensor connection:**

| | |
|---|---|
| resistance range | two, three and four-wire |
| voltage range | two-wire |
| potentiometer | three or four-wire |

**Maximum wire resistance for resistance ranges:**

20 Ω (each connecting wire)

**Current through resistance sensor:**
< 0.15 mA

Output signal:
two-wire current 4 to 20 mA or 20 to 4 mA

**D/A conversion error:**
≤ ±0.05 % SR

**Current output total error:**

$$\leq \pm \left( \frac{\text{digital accuracy}}{SR} \times 100 + 0{,}05 \right) [\%]$$

**Table1:**

| Code of input setting | Configuration of input | Linearization standard | Input range | Minimal span | Digital accuracy | Display resolution | units |
|---|---|---|---|---|---|---|---|
| R01 | Resistor | | 0 to 400 Ω | 4 | 0.08 | 0.1 | Ω |
| R02 | Resistor | | 0 to 4000 Ω | 40 | 0.8 | 1 | Ω |
| R03 | Potentiometer max. 400 Ω | | 0 to 100 % | 1 | 0.1 | 0.1 | % |
| R04 | Potentiometer max. 4000 Ω | | 0 to 100 % | 1 | 0.1 | 0.1 | % |
| R05 | Voltage | | -15 to 60 mV | 0.75 | 0.02 | 0.01 | mV |
| R11 | Pt100 | IEC 751 | -200 to 850 °C | 11 | 0.2 | 0.1 | °C |
| R12 | Pt500 | IEC 751 | -200 to 850 °C | 11 | 0.2 | 0.1 | °C |
| R13 | Pt1000 | IEC 751 | -200 to 850 °C | 11 | 0.2 | 0.1 | °C |
| R14 | Ni100 | DIN 43760 | -60 to 250 °C | 4 | 0.2 | 0.1 | °C |
| R15 | Ni1000 | DIN 43760 | -60 to 250 °C | 4 | 0.2 | 0.1 | °C |
| R57 | Thermocouple B | IEC 584 | 100 to 1000 °C<br>1000 to 1800 °C | 18 | 3<br>1 | 1 | °C |
| R58 | Thermocouple E | IEC 584 | -200 to 0 °C<br>0 to 800 °C | 12 | 1<br>0.3 | 1 | °C |
| R51 | Thermocouple J | IEC 584 | -200 to 0 °C<br>0 to 1000 °C | 12 | 1<br>0.3 | 1 | °C |
| R52 | Thermocouple K | IEC 584 | -200 to 0 °C<br>0 to 1300 °C | 15 | 1<br>0.6 | 1 | °C |
| R59 | Thermocouple L | DIN 43710 | -200 to 900 °C | 11 | 0.5 | 0.1 | °C |
| R53 | Thermocouple N | IEC 584 | -200 to 0 °C<br>0 to 1300 °C | 15 | 1<br>0.6 | 1 | °C |
| R54 | Thermocouple R | IEC 584 | -50 to 1700 °C | 18 | 2 | 1 | °C |
| R55 | Thermocouple S | IEC 584 | -50 to 1700 °C | 18 | 2 | 1 | °C |
| R56 | Thermocouple T | IEC 584 | -250 to -100 °C<br>-100 to 400 °C | 7 | 2<br>0.5 | 0.1 | °C |
| R11 C8 | Difference of two Pt100 (max. sum of resistors 400 Ω) | IEC 751 | -200 to 850 °C | 11 | 0.4 | 0.1 | °C |
| R13 C8 | Difference of two Pt1000 (max. sum of resistors 4000 Ω) | IEC 751 | -200 to 850 °C | 11 | 0.4 | 0.1 | °C |

Digital accuracy specifies an error of measured value at the RS232 digital output. Display of the transmitter indicates digital value rounded according to the resolution of the display.

**Transfer function:**
linear with temperature or linear with input variable, other on request.

**Cold junction compensation error:**
< ±0.5 °C (H10, L10, L20, S10, S20 versions only)

**Range of span setting:**
±1% to ±100 % of input range span

**Start setting:**
within input range, see table 1

**Damping (95%):**
adjustable 0.5 to 60 s (4 measurements per second)

**Supply voltage:**
normal version 11 to 36 V DC

**Recommended power supply:**
normal version ZS-010, ZS-011, ZS-020,

**Load resistance:**
$R_L$ [Ω] ≤ ($U_N$ [V] -11) / 0.022

**Sensor break indication:**
display indication of error code
output selectable > 21 mA or < 3.6 mA

## Supplementary parameters

**Output current limit:**
approximately 3.8 to 20.5 mA
error current limit approx. 23 mA

**Display (only for L20, L21, S20, S21)**
4-digit LCD with sign

**Effect of supply voltage:**
≤ ±0.002 % of span / V

**Effect of ambient temperature:**
≤± 0.05 % SR / 10 °C

**Effect of wire resistance for resistance ranges:**
two-wire connection
can be compensated by constant value
three-wire connection
no effect with identical values of wire resistance
four-wire connection
no effect with specified wire resistance range

**Effect of sensor inner resistance for voltage input:**
≤ 0.004 mV / 1 kΩ

**Long-term stability:**
≤ ±0.1 % SR / 2 years

**EMC (Electromagnetic compatibility):**
according to EN 61326-1

SR ... Span of set range

## Operating conditions

Transmitters must be powered by safe power supplies. They are protected against reversing of polarity and peak voltage overload. Their input and output circuits are not galvanic isolated, therefore with powering of more transmitters from a common power supply it is necessary that connected sensors and cables have a high insulation resistance. However, with this type of connection it is recommended to insert a galvanic isolation into supply circuits. If the power supply is designed for a higher load current (>100 mA) it is recommended to insert FAST 50mA fuse or a current-limiting resistor into supply circuits.

**Operating temperature:**

| | |
|---|---|
| P5102 H1x, L1x | -40 to 85 °C |
| P5102 S1x | -40 to 70 °C |
| P5102 L2x, S2x | -10 to 55 °C |

**Humidity:**

| | |
|---|---|
| P5102 H1x, L1x | 0 to 100 % rh with condensation (after headmounting) |
| P5102 L1x, L2x | 5 to 95 % rh |
| P5102 S1x, S2x | 0 to 100 % rh with condensation |

**Elevation:**

up to 2000 m above sea level

## Other specifications

**Housing:**

| | |
|---|---|
| P5102 H1x | IP 40, terminals IP 00 (after headmounting according to the head) |
| P5102 L1x, L2x | IP 40, terminals IP 20 |
| P5102 L2x, S2x | IP 55 |

**Weight:**

| | |
|---|---|
| P5102 H1x | 40 g |
| P5102 L1x | 65 g |
| P5102 L2x | 150 g |
| P5102 S1x, S2x | 275 g |

**Material of boxes:**

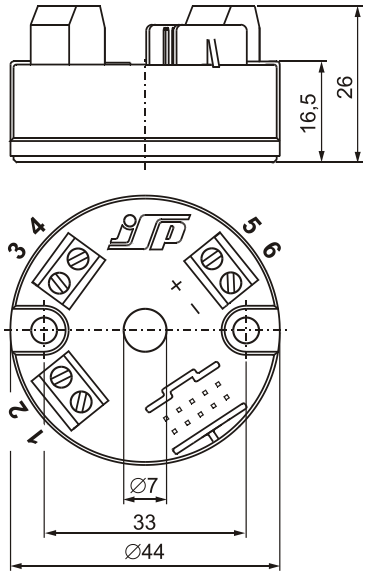
| | |
|---|---|
| P5102 H1x | Polycarbonate |
| P5102 L1x, L2x | Polyamide |
| P5102 S1x, S2x | PVC |

**Warranty:**

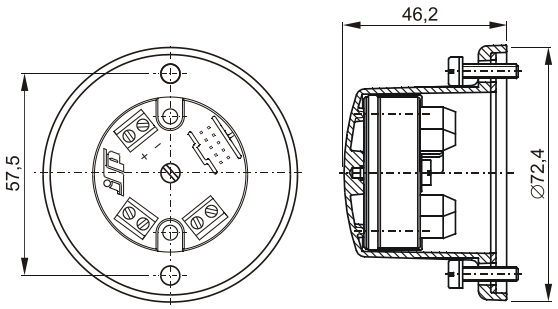
3 years

## Dimensional drawings

**Version P5102 H10, H11**



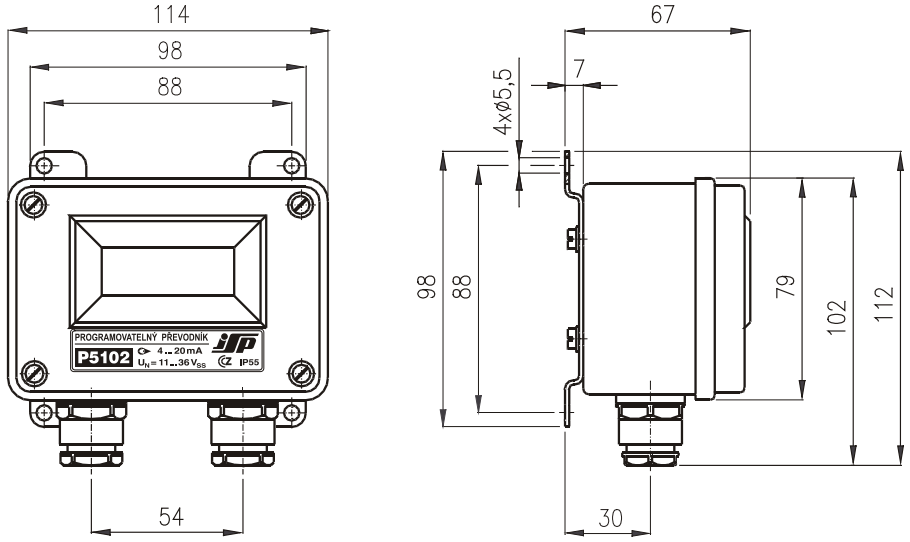

**P5102 H10, H11 in cap VH1 for head form B acc. to DIN**
(mounting bolts M5 for pitch 57 to 58 mm)




Screw terminals are used for connection of wires with cross-section 0.5 to 1.5 mm$^2$.

# *P5102 Universal Two-wire Programmable Transmitters*

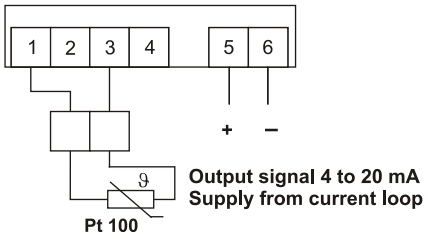
**Version P5102 S2x**




Screw terminals are used for connection of wires with cross-section 0.5 to 1.5 mm²

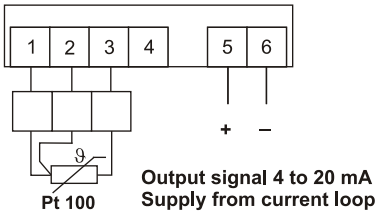
## Electrical connection

**Two-wire Connection of Resistance Sensor (Code C1)**

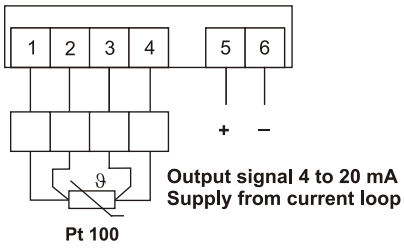



Possibilities of Wire Resistance Compensation:
Enter total wire resistance Rt
(included in the set-up program or in the config. sheet).

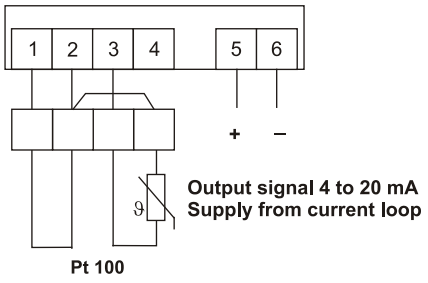
**Three-wire Connection of Resistance Sensor (Code C2)**



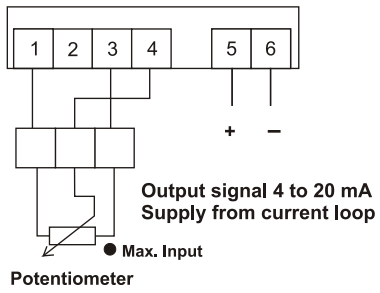

**Four-wire Connection of Resistance Sensor (Code C3)**



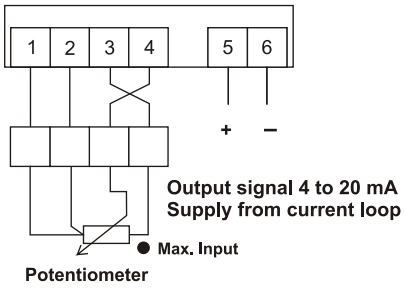

**Three-wire Sensor Connection with Compensating Loop (Code C2)**



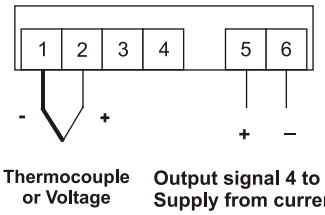

**Potentiometer Connection without Wire Resistance Compensation (Code C4)**



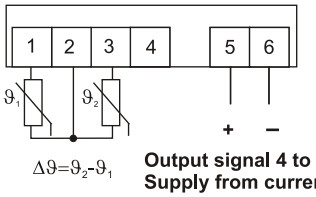

**Potentiometer Connection with Wire Resistance Compensation (Codes C3, C5)**




**RTD or T/C Connection (Codes C6, C7)**

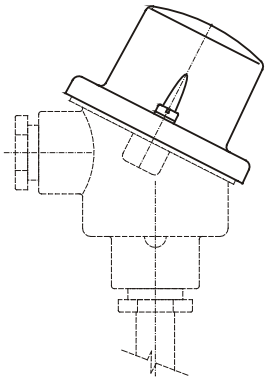



**Temperature Difference of Two Two-wire Resistance Sensors (Code C8)**

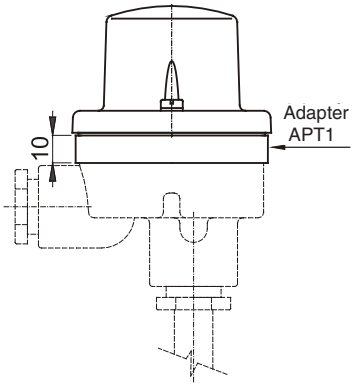


**Installation of P5102 H1x in cap VH1 for different types of heads**

**Oblique head**

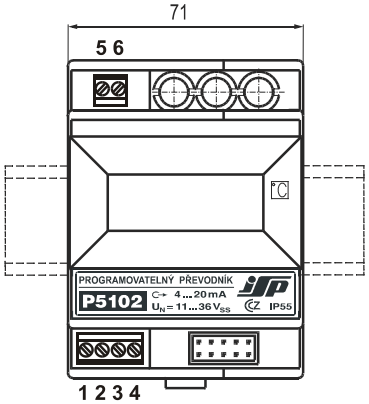


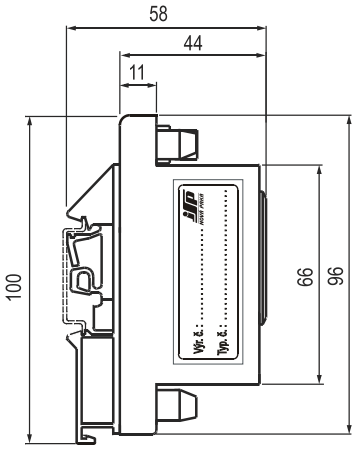
**Straight head with asymmetric position of terminal board**




**Version P5102 L1x**


**P5102 L2x**

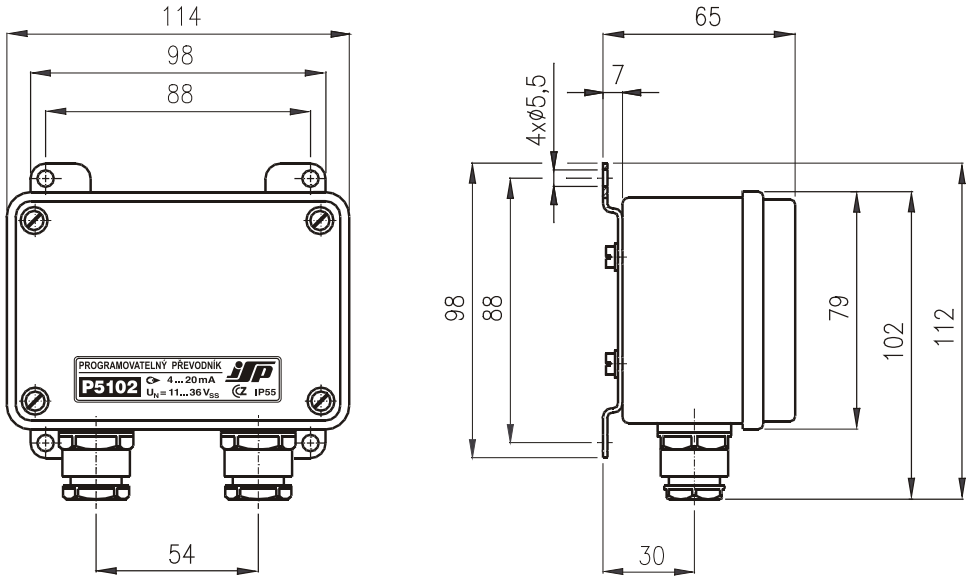



**Appropriate mounting rails:**
35 x 27 x 7.5 mm EN 50022
35 x 24 x 15 mm EN 50022
35 x 27 x 15 mm
32 mm EN 50035 G-32

Screw terminals are used for connection of wires with cross-section 0.5 to 1.5 mm².

**Version P5102 S1x**




Screw terminals are used for connection of wires with cross-section 0.5 to 1.5 mm²

| Type | Description | |
|---|---|---|
| P5102 | Universal two-wire programmable transmitter, output signal 4 to 20 mA | |
| **Code** | **Version** | |
| H10 | Mounting on thermometer head form B according to DIN, universal for RTDs and thermocouples | |
| H11 | Mounting on thermometer head form B according to DIN, for RTDs only (codes R01 to R04, R06, R07, R11 to R15, R91 to R94, R96, R97) | |
| L10 | Rail mounted transmitter, DIN rail TS 35, universal for RTDs and thermocouples | |
| L11 | Rail mounted transmitter, DIN rail TS 35, for RTDs only (codes R01 to R04, R06, R07, R11 to R15, R91 to R94, R96, R97) | |
| L20 | Wide version of rail mounted transmitter, DIN rail TS 35, LCD display, universal for RTDs and thermocouples | |
| L21 | Wide version of rail mounted transmitter, DIN rail TS 35, LCD display, for RTDs only (codes R01 to R04, R06, R07, R11 to R15, R91 to R94, R96, R97) | |
| S10 | Wall mounted transmitter without display, universal for RTDs and thermocouples | |
| S11 | Wall mounted transmitter without display, for RTDs only (codes R01 to R04, R06, R07, R11 to R15, R91 to R94, R96, R97) | |
| S20 | Wall mounted transmitter with LCD display, universal for RTDs and thermocouples | |
| S21 | Wall mounted transmitter with LCD display, for RTDs only (codes R01 to R04, R06, R07, R11 to R15, R91 to R94, R96, R97) | |
| **Code** | **Input setting** | |
| NR | Presetting of range and input (R11 C3 RL -200 °C RH 850 °C ECH) | |
| QR | Detailed customer specified setting according to configuration sheet (configuration sheet is required with order) | |
| R01 | Resistance sensor (0 to 400 Ω) without conversion to temperature | |
| R02 | Resistance sensor (0 to 4000 Ω) without conversion to temperature | |
| R03 | Potentiometer (total resistance 40 to 400 Ω, range in %, limit values 0 % and 100 %) | |
| R04 | Potentiometer (total resistance 400 to 4000 Ω, range in %, limit values 0 % and 100 %) | |
| R05 | Voltage sensor (-15 to 60 mV) without conversion to temperature | |
| R06 | Difference of two resistance sensors (max. total resistance 400 Ω) | |
| R07 | Difference of two resistance Sensors (max. total resistance 4000 Ω) | |
| R11 | Pt100 (-200 to 850 °C) with linearization | |
| R12 | Pt500 (-200 to 850 °C) with linearization | |
| R13 | Pt1000 (-200 to 850 °C) with linearization | |
| R14 | Ni100 (-60 to 250 °C) with linearization | |
| R15 | Ni1000 (-60 to 250 °C) with linearization | |
| R51 | Thermocouple "J" (-200 to 1000 °C) with linearization | |
| R52 | Thermocouple "K" (-200 to 1300 °C) with linearization | |
| R53 | Thermocouple "N" (-200 to 1300 °C) with linearization | |
| R54 | Thermocouple "R" (-50 to 1700 °C) with linearization | |
| R55 | Thermocouple "S" (-50 to 1700 °C) with linearization | |
| R56 | Thermocouple "T" (-250 to 400 °C) with linearization | |
| R57 | Thermocouple "B" (0 to 1800 °C) with linearization from 50 °C | |
| R58 | Thermocouple "E" (-200 to 800 °C) with linearization | |
| R59 | Thermocouple "L" (-200 to 900 °C) with linearization | |
| R91 * | Other linearization for resistance sensor (0 to 400 Ω) | |
| R92 * | Other linearization for resistance sensor (0 to 4000 Ω) | |
| R93 * | Other linearization for potentiometer (R <= 400 Ω) | |
| R94 * | Other linearization for potentiometer (R <= 4000 Ω) | |
| R95 * | Other linearization for other voltage sensor (thermocouple) | |
| R96 * | Other linearization for difference of two resistance sensors (max. total resistance 400 Ω) | |
| R97 * | Other linearization for difference of two resistance sensors (max. total resistance 4000 Ω) | |
| **Code** | **Sensor connection** | **For input setting** |
| C1 | Two-wire connection of resistance sensor | R01, R02, R11-15, R91, R92 |
| C2 | Three-wire connection of resistance sensor | R01, R02, R11-15, R91, R92 |
| C3 | Four-wire connection of resistance sensor | R01, R02, R11-15, R91, R92 |
| C4 | Connection of potentiometer without wire resistance compensation | R03, R04, R93, R94 |
| C5 | Connection of potentiometer with wire resistance compensation | R03, R04, R93, R94 |
| C6 | Connection of voltage sensor or T/C without compensation of terminal board temperature (comparative temperature 0 °C) | R05, R51-59, R95 |
| C7 | Connection of T/C with internal compensation of terminal board temperature | R51-59, R95 |
| C8 | Connection of two two-wire resistance sensors | R06, R07, R11-15, R96, R97 |
| **Code** | **Range setting** | |
| RL ** | Start of range (4 mA) (fill in value and units) | |
| RH ** | End of range (20 mA) (fill in value and units) | |
| **Code** | **Error signalization** | |
| ECL | Error current below 3.6 mA | |
| ECH | Error current above 21 mA | |
| **Code** | **Calibration** | |
| KPP5 | Transmitter calibration in five equally spaced points of input range | |
| **Code** | **Optional accessories** | |
| NJ-14 | Set-up Unit NJ-14 (for setting of range, damping and limit values of comparators) | |
| USB-RS232C | Communication interface for connecting KA-01 to USB port of the PC | |
| NPT-02 | Set-up PC program NPT-02 (for WIN95 and higher), cable KA-01 for connection to PC (RS232C) | |
| KA-01 | Communication adapter for connecting the transmitter to PC (RS232C) | |
| VH1 | Cap for head B for mounting of transmitter (H10 and H11 versions) | |
| APT1 | Adapter for straight head | |

**3-year warranty**

**Example of order: P5102 H11 R01 C2 RL 0 °C RH 350 °C ECL VH1**
**P5102 L11 NR (presetting: R11 C3 RL-200 °C RH 850 °C ECH)**
**P5102 H10 QR (configuration sheet is required with order)**

* linearization chart in required range must be added

** Fill in value and units (for ranges of potentiometer in percent)