



**HD778TR1, HD978TR1, HD978TR2, HD778-TCAL**  
**4÷20mA CONFIGURABLE TEMPERATURE TRANSMITTERS FOR**  
**K-J-T-N TYPE THERMOCOUPLE. THERMOCOUPLE GENERATOR**  
**MANAGED BY PC THROUGH RS232C HD778-TCAL**

**HD 778TR1, HD 978TR1 and HD 978TR2** are 4...20mA two-wired configurable passive transmitters with microprocessor for **K, J, T** and **N** type thermocouple sensors. They convert the voltage value generated by the thermocouple into a linear current signal included in the range 4...20mA. The use of digital devices allows obtaining an excellent precision and stability in time. User can set the 4...20mA (or 20...4mA) output into any temperature range in the measuring range included in the measuring range of the single thermocouple with a **minimum range of 50°C**. The range and type of thermocouple are set by simply using one button. A led indicates the alarm situation (broken or not connected sensor) and it helps user during the programming. Moreover, transmitters are protected against polarity inversions. HD778TR1 is specifically designed to be installed in DIN B type connection heads, HD978TR1 and HD978TR2 are suitable for mounting on 35 mm DIN bars. Beyond 4...20mA output, HD978TR2 has a 3½ digit (Height 10 mm) display which allows displaying the measured temperature.

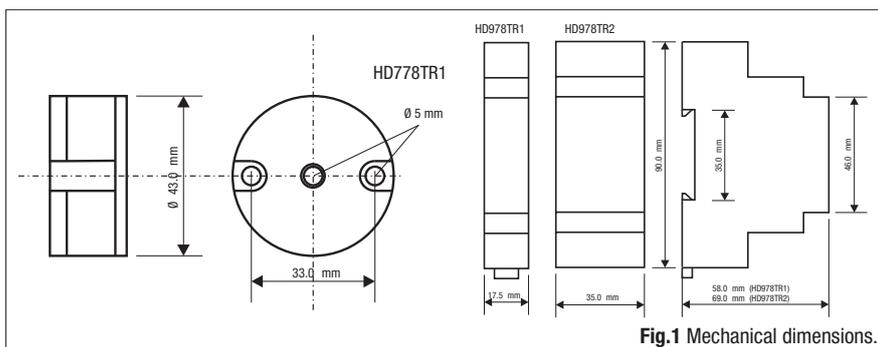


Fig.1 Mechanical dimensions.

**TECHNICAL DATA @ 25°C e 24Vdc**

| INPUT                                       | HD778TR1   | HD978TR1   | HD978TR2 |
|---|--|--|----------|
| Sensor                                      | Thermocouple type K, J, T and N  |  |          |
| Connection                                  | 2 wires passive transmitter  |  |          |
| Measuring range                             | Thermocouple K: -200°C ... +1200°C<br>Thermocouple J: -200°C ... +800°C<br>Thermocouple T: -200°C ... +300°C<br>Thermocouple N: -200°C ... +1200°C |  |          |
| Linearization                               | EN 60584-1-2<br>ASTM E 230 - ANSI (MC96-1)   |  |          |
| Default range                               | Tc = K - Range = 0...1000°C  |  |          |
| Minimum measuring range                     | 50°C   |  |          |
| Conversion speed                            | 2 measures per second  |  |          |
| Accuracy                                    | ±0,04%FS±0,04% of the reading or 0.5°C<br>(the greater of the two values)  |  |          |
| Operating temperature of the cold junction  | -30 ... +80°C  | 0 ... +70°C                                      |          |
| Operating temperature                       | -30 ... +80°C  | 0 ... +70°C                                      |          |
| Storage temperature                         | -40...+80°C  |  |          |
| <b>OUTPUT</b>                               |  |  |          |
| Type of output (note 1)                     | 4...20 mA (or 20...4 mA) two wires<br>22 mA if sensor is broken or not connected   |  |          |
| Resolution                                  | 4 µA   | 4 µA<br>Display:<br>0,1°C T<200°C<br>1°C T>200°C |          |
| Power voltage                               | 9...30V cc (protection against polarity inversion)   |  |          |
| Sensitivity to Vdc power voltage variations | 0,4 µA/V   |  |          |
| Load resistance                             | R <sub>i</sub> Max = (Vdc-9)/0.022<br>R <sub>i</sub> Max = 625Ω with Vcc = 24 Vdc  |  |          |
| Input/output galvanic insulation            | 50Vcc (verified at 250V)   |  |          |
| Red led                                     | It turns on while programming, when the probe is broken or not connected   |  |          |
| Heating time                                | 2 minutes  |  |          |

Note 1) If the measured temperature T goes out of the T1...T2 (T1<T2) set range, the transmitters linearly regulate the current for T<T1 and T>T2 for an interval of 10°C. (See the current diagram).

**Installation and connection**

Fig. 1 shows the mechanical dimensions of the HD778TR1 transmitter and highlights the holes of 5 mm diameter for fastening the DIN head and the central hole for the entrance of the wires in the thermocouple. Fig. 1 reports the mechanical dimensions of the HD978TR1 and of the HD978TR2.

The width of the HD978TR1 is a DIN (17,5 mm) module, the HD978TR2 is a 2 DIN (35mm) modules. The working temperature should be included in operating temperature declared. Fig. 4 and 5 report the wiring diagrams of the HD778TR1, HD978TR1 and HD978TR2. In order to obtain the maximum precision, the connection to the thermocouple should not exceed 3 meters long. In the diagrams reported, the RL (Load) symbol represents any device introduced in the current loop, that is to say any indicator, controller, data logger or recorder.

**CHOICE OF TYPE OF THERMOCOUPLE**

The transmitter accepts four types of thermocouple. The thermocouple set is highlighted by the number of flashes of the led when power is supplied.

| N° of led flashes | Type of thermocouple |
|-------------------|----------------------|
| 1                 | K                    |
| 2                 | J                    |
| 3                 | T                    |
| 4                 | N                    |

**Transmitters come with the default set K thermocouple and range 4...20mA = 0...1000°C.**

User can change the thermocouple type and the operating range according to the following procedure.

**Note: after changing the thermocouple type the operating range should be programmed.**

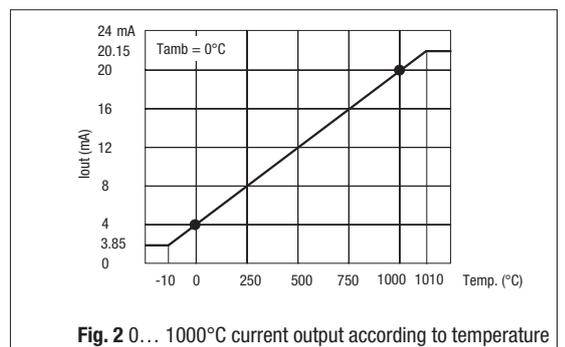


Fig. 2 0... 1000°C current output according to temperature

### HD778TR1 AND HD978TR1

Giving power to the transmitter, the led flashes for a number of times equal to the type of thermocouple previously configured.

In order to change the setting, remove and reapply supply to the transmitter **by keeping the button pressed**.

This way you enter the programming for choosing the type of thermocouple: if you chose the **thermocouple K**, the led flashes once.

If you release the button and press it again within 10 seconds, the led flashes twice: **thermocouple J** has been chosen.

If you press the button within 10 seconds, the led flashes 3 times: **thermocouple T** has been chosen.

If you press the button within 10 seconds, the led flashes 4 times: **thermocouple N** has been chosen.

If you press the button within 10 seconds again, the led flashes once indicating that you chose thermocouple K again and the cycle re-starts.

In order to save the selected type of thermocouple, wait for 15 seconds without touching any key: the transmitter saves the type of thermocouple and exits programming, the led flashes for the number of times equal to the type of thermocouple selected.

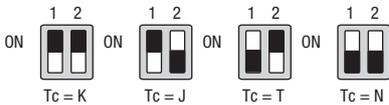
**If you changed the type of thermocouple, you have to re-programme the operating range: see paragraph "Programming the operating range".**

### HD978TR2

This transmitter has a double dip-switch for selecting the type of thermocouple. The selection must be set before ignition and is acquired when the instrument is on: **a change in the dip-switch when the instrument is powered has no effect until the next power cycle**.

Procedure:

when the instrument is off, select the type of thermocouple by setting the switches as shown in the figure below.



By powering the transmitter, the led flashes for a number of times equal to the type of thermocouple selected.

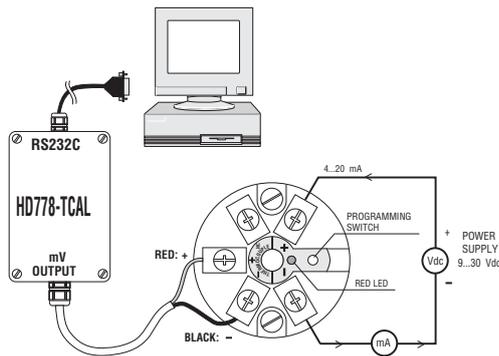
**If you changed the type of thermocouple, you have to re-programme the operating range: see paragraph "Programming the operating range".**

### Programming of the operating range

Transmitters HD778TR1, HD978TR1 and HD978TR2 are supplied by default with **K type thermocouple and range 0...1000°C**. The user can set a different range according to his requirements with a minimum span of 50°C. The correspondence between the read temperature and the output current can be direct (e.g. 4mA = 0°C and 20mA = 1000°C) or inverse (e.g. 4mA = 1000°C and 20mA = 0°C).

Acquire the following tools for programming:

- 9...30 Vdc direct current power source,
- thermocouple calibrator,
- copper connection cables
- precision ammeter with 0...25 mA minimum range.



Instead of the thermocouple calibrator, you can use the Delta Ohm **HD778-TCAL**: this instrument has to be connected to a serial port of the PC and, by means of a proper software, automates all the steps described below for programming the operating range.

If you have a thermocouple calibrator, the steps are:

in order to set the type of thermocouple, proceed as described in the paragraph "CHOICE OF THE TYPE OF THERMOCOUPLE".

**The voltage values generated by the calibrator must be uncompensated. The setting must be done with the instrument already powered.**

Set the calibrator with the output of the desired type of thermocouple (K, J, T or N), connect the calibrator to the transmitter thermocouple input according to the polarity. **(Pay attention to polarity)**.

Set the calibrator so that it generates the voltage corresponding to the temperature at 4mA, wait for 30 seconds for the voltage to stabilise.

**Press and hold the button** until the led flashes. Release the button. The instrument has acquired the first value of the transmitter working range, the led keeps on

flashing. The instrument is now awaiting the second data of the full scale range. Set the calibrator in order to generate a voltage corresponding to the temperature at 20mA.

**Press and hold the button** until the led stops flashing.

Release the button and wait **20 seconds, without changing the calibrator's data**, so that the transmitter saves the calibration data and is ready for working normally. The operation ends with a flashing of the led.

The instrument has acquired the second point corresponding to the range you want to set and is working normally.

**The minimum value accepted by the instrument span is 50°C**. If the user tries to insert a second value T2 with (T2-T1)<50, after entering the first value T1 of the range, the instrument does not accept it and remains in standby while the led flashing continuously.

**The HD778-TCAL is supplied with its software. Connected to the HD778-TCAL serial output of a PC, the user can configure the transmitter by following the instructions on the screen.**

### ORDERING CODES

**HD778TR1:** 4...20mA/20...4mA 2 wire temperature transmitter for K, J, T and N thermocouples, configurable with minimum amplitude range 50°C, in a container for DIN B 43760 heads.

**HD978TR1:** 4...20mA/20...4mA 2 wire temperature transmitter for K, J, T and N thermocouples, configurable with minimum amplitude range 50°C, in a container for 17,5 mm DIN bar connection, dimension 1 module.

**HD978TR2:** 4...20mA/20...4mA 2 wire temperature transmitter for K, J, T and N thermocouples, configurable with minimum amplitude range 50°C, in a container for 35 mm DIN bar connection dimension 2 modules, with 3½ digit display, height 10 mm.

**HD778-TCAL:** power generator in the range -60mV...+60mV, regulated by PC through RS232C serial port, DELTALOG7 software for setting K, J, T and N thermocouple transmitters.

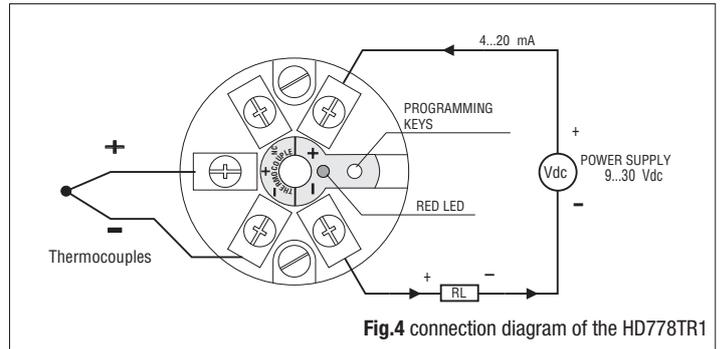


Fig.4 connection diagram of the HD778TR1

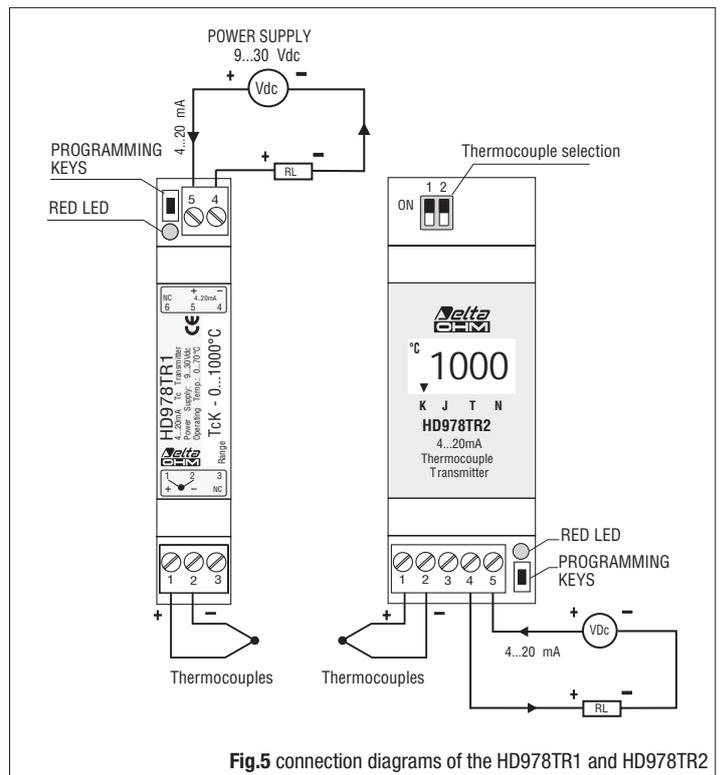


Fig.5 connection diagrams of the HD978TR1 and HD978TR2