

INSTRUCTION MANUAL SERIES TT-2000

"INTELLIGENT" Pt-100 TEMPERATURE TRANSMITTER



Manufactured by:

 **KLAY-INSTRUMENTS**

www.klay.nl

Nijverheidsweg 5
P.O. Box 13
Tel: +31 521-591550
Fax: +31 521-592046

7991 CZ DWINGELOO
7990 AA DWINGELOO
The Netherlands
E-Mail: info@klay.nl

CONTENTS

SECTION		PAGE
1	Introduction	3
1.1	Description Series TT-2000	3
2	Dimensions	3
3	Installation transmitter	3
3.1	Welding instruction	3
3.2	Mounting position	4
3.3	Calibration	4
3.4	Wiring	4
4	Remaining	4
4.1	Digital local indicator	4
4.2	CE / EMC - Rules	5
4.3	External load	5
4.4	Traceability year of manufacturing	6
4.5	Software revision	6
5	Functions of pushbuttons	6
6	Programming points (P101 t/m P110)	7
7	Reading on display	7
8	Explanation of programming points	7
	P101 Zero adjustments (4 mA)	8
	P102 Span adjustment (20 mA)	8
	P104 Adjustment temperature unit	8
	P105 Reverse output: (20-4 mA)	8
	P106 Damping adjustment	8
	P107 Free adjustment (5 points)	9
	P108 Configuration	9
	P109 Read out on Display	9
	P110 Current simulation (4-20 mA)	9
9	HART[®] Protocol	9
10	Precautions and warnings	10
	Attachment: EU-Declaration of Conformity	

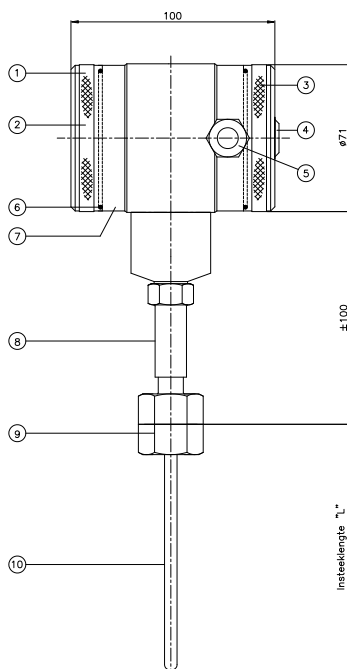
1 INLEIDING

The Series TT-2000 is a complete Stainless Steel temperature transmitter, based on a Pt-100 element (1/3 DIN class B). The range of standard elements can be set between -50 and 200 °C. Other ranges are available on request. The Pt-100 element is mounted in a stainless steel plug (sensor position 9). To obtain an accurate and fast measurement, the diameter of the insert part has to be chosen as small as possible. The resistance change of the Pt-100 element due to temperature change is converted into a proportional 4-20 mA signal (2-wire).

A great diversity in designs and process connections can be made including milk couplings (DN25, 40 and 50), Tri-clamp (1, 1 1/2 "or 2") and hygienic weld-on-nipples like 3/4 "BSP nut (diameter 28 mm).

Associated immersion tubes (Thermowell) fully welded and manufactured from execution (bar stock) are available in various designs and materials (on request).

2 DIMENSIONS



PARTS DESCRIPTION MATERIAL

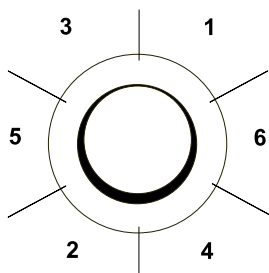
1.	Cover	AISI 304
2.	Pushbutton + Display	
3.	Cover with venting	AISI 304
4.	Venting	PA
5.	PG Cable gland	
6.	O-Ring (2 pcs)	EPDM
7.	Electronics housing	AISI 304
8.	Neck tube	AISI 304
9.	Process connection	AISI 304
10.	Insertion part Sensor tip	AISI 316

Specify Length **L** and Diameter **D**

3 INSTALLING WELD-ON NIPPLE

A skilled machinist or welder should perform installation of the weld-on nipple. Weld Argon, MIG or TIG with the smallest welding pin.

1. Cut a hole in the process vessel/pipe to accept the weld-on nipple.
2. Remove the weld-on nipple from the transmitter.
3. Position a welding mandrel into the weld-on nipple and screw it down.



WARNING

Never weld the entire nipple at once. Excessive heat input will deform the weld-on-nipple. Cool each and every well after each welding cycle.

4. Position the weld-on nipple in the vessel hole and tack six places.
5. The weld sequence is shown in the figure above. Weld the weld-on nipple in place using 0,03 to 0,045 in. (0,762 to 1,143 mm) stainless rod as filler material in the beveled area. Adjust amperage for penetration pliers (1/8").
6. Remove mandrel after the welding operation.

3.2 MOUNTING POSITION

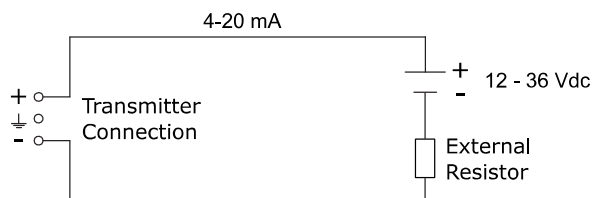
When the transmitter is mounted horizontally, the cable gland must be pointed downwards.

3.3 CALIBRATION

All transmitters are fully calibrated at the factory, to the conditions stipulated in users order. When the customer has not requested calibration, the transmitter will be calibrated 0-100 °C.

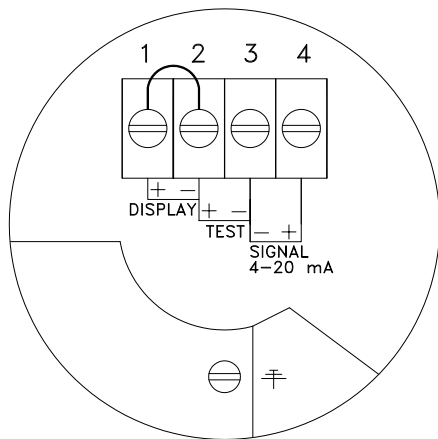
3.4 WIRING

Under the cover (3) you will find the terminal board. Under the other cover (1) are the buttons for the zero and span adjustment.



External loads must be placed in the negative leg of the 2-wire loop.

TERMINAL CONNECTION



The figure left shows the wiring connection of the transmitter. The 2-wires must be connected to 3 (-) and 4 (+) of the terminal board.

The signal wiring must be shielded and twisted pairs yield best results. Do **NOT** run signal wiring in open trays with power wiring, or near heavy electrical equipment (Frequency controller or heavy pumps). Shielding must always be connected at the side of the power supply.

In case the mounting position is already connected to earth (by tank or pipe line) do **NOT** connect the instrument to earth. Please ensure that the instrument is not connected to earth twice to prevent the occurrence of an 'earth loop'. In applications with synthetic mounting positions the case grounding terminal (internal or external) must be connected to earth.

Care must be taken to assure that the polarity of the power supply is correct, a reversal of wiring polarity will not damage the transmitter, but it will not function until the wiring is connected correctly.

4. REMAINING

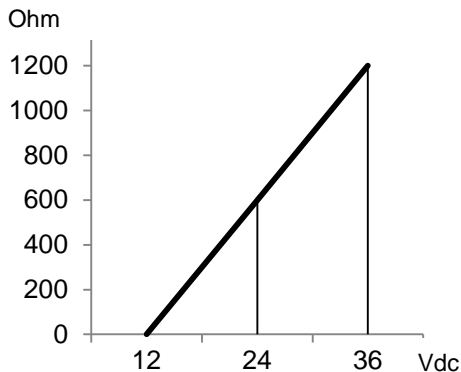
4.1 DIGITAL LOCAL INDICATOR

All temperature transmitters from the series TT-2000 are standard equipped with a digital display. In the standard version closed covers are used. The push buttons and the display are behind the cover (3). As an option an transparent cover can be delivered for the application as a local display in the process (Option: "I" extra price). The full-scale point may be set to any value between 0000 and 9999 (4 digit)

4.2 CE / EMC Rules

All transmitters are fitted with RFI filters, which provide optimum, trouble-free operation. Our products are in conformity with EMC-Directive 2014/30/EU based on test results using harmonized standards.

4.3 EXTERNE RESISTOR



The minimum power supply is based on the total circuit resistance. The maximum permissible load (R_i max.) in case of 24 Vdc is 600 Ω (Ohm).

By increasing the power supply, the external load can be increased to 1200 Ohm / 36 Vdc. (see figure left).

$$R_i \text{ max.} = \frac{\text{Supply} - 12 \text{ V (minimal supply)}}{20 \text{ mA}}$$



With a loop resistance of 250 Ω a power supply of at least 17 Vdc must be used.

4.4 TRACEBILITY YEAR OF MANUFACTURING

The year of manufacturing of the transmitter can be traced as follows: take the first two numbers from the serial number that is engraved in the transmitter and add 1970 to it.
 For example: if the 3902123. The year of manufacturing is 1970 + 39 = 2009.

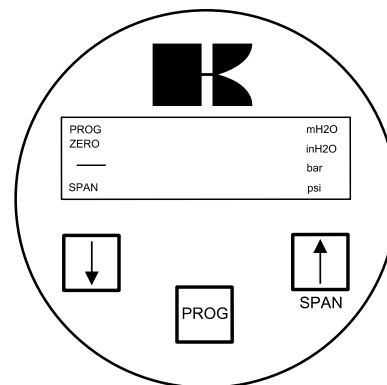
4.5 SOFTWARE REVISIES

Due to the improvements on the Series TT-2000, there are several software versions (revisions). For this reason it is possible the temperature transmitter you are working with does not support some options, which are discussed in this manual. Ask Klay Instruments BV.

5 EXPLANATION PUSHBUTTONS

The Series TT-2000 can be programmed easily by use of the 3 front panel pushbuttons (See picture right).
 On het display several engineering units can be used: °C, °F, mA and %

The functions of the three pushbuttons will be explained below.



This button has 2 functions:
 It can be directly used for adjusting the zero (zero / 4mA), with or without a test pressure. When the zero (4 mA) must be adjusted at 0 °C, the button must be held until the word "ZERO" appears on the display. The transmitter is now set to 4 mA.
 Test temperature should be 0 °C.

Also, this button must be used for stepping down in the programming menu or to decrease a value (-).



This button has 2 functions:
 It can be directly used for adjusting the span (20 mA), when using a test pressure (air). When a test pressure (50 °C) is supplied to the transmitter, the button must be held until the word "SPAN" appears on the display. The transmitter is adjusted at 0 - 50 °C.

Also, this button must be used for stepping up in the programming or to increase a value (+).



This button has 2 functions:
 It is used to adjust the 11 Programming Points (P101 to P111). Push it once and P100 is displayed, use the [↑] (SPAN) to step to P101 etc.

This button must also be used for confirming the adjustments (enter).

6. PROGRAMMING POINTS (P101 – P110)

The following points can be adjusted by means of the three push buttons. For an explanation of these points see the next pages of this manual.

To change one of these points you have to push on [PROG] until "100" appears on the display. To go to from a lower program (P101) to a higher one (P102), push on button [↑] (SPAN).

To confirm the adjustments you always have to press on [PROG].

*) Standard adjustments ex works.

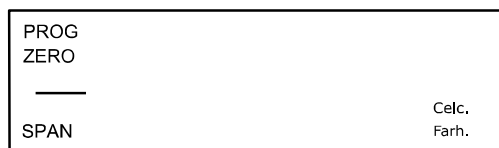
Programming points:	
P101	Zero adjustment (4 mA)
P102	Span adjustment (20 mA)
P104	Adjustment temperature unit on display (See conversion table)
P105	4 – 20 mA (*) 20 – 4 mA
P106	Damping adjustment (0 till 25 s.)
P107	Free adjustment (5 points)
P108	Configuration
P109	Readout display: 0 = Current (4 - 20 mA) 1 = Temperature unit (conversietabel) 2 = Percentage 3 = Ambient temperature
P110	Simulation of current

7. READING ON THE DISPLAY

On the standard built-in display several values can be shown.

During programming of the temperature transmitter the display shows all the information that is needed.

When the transmitter is in the process the display gives all the information of the process temperature.



On the display the following units can be shown: mA, percentages or in temperature (see also P108).

i The standard temperature TT-2000 transmitter is supplied with two "closed" covers shielding the buttons and the display. As an option an "open" cover (IP 65) can be fitted. The display can then be used as a local process display. (Option: "I" extra price).

8. UITLEG PROGRAMMEERPUNTEN P101 t/m P110

P101 NULPUNTS INSTELLING (ZERO, 4 mA) ZONDER TESTTEMPERATUUR
 The TT-2000 as standard is adjusted at 0 °C to 4.00 mA.
 It is also possible to adjust a zero-suppression or elevation..

For example: zero elevation of +10 °C.

1. Push at [PROG] until "100" is shown on the display.
2. Push once at [↑] / SPAN till "101".
3. Confirm this by pushing [PROG].
4. Now the display will show 0.00 and zero. Push at [↑] till 10.00 is on the display.
5. Confirm with [PROG].
6. The transmitter will automatically return to the set reading.

At a temperature of +10°C is 4.00 mA output.

Note: the measured value is not 4.00 mA at room temperature.

P102**SPAN ADJUSTMENT (20 mA) WITHOUT TEST TEMPERATURE**

Before adjusting the span take care the right temperature unit is selected.
(See also P104 and P108).

Example: Range 0 - 100 °C

1. Push [PROG] till "100" is shown on the display.
2. Push twice at [↑] / SPAN until "102" is on the display.
3. Confirm this by pushing [PROG].
4. Push [SPAN] (+) or [ZERO] (-) to select the measuring range that is required.
5. Confirm by pushing [PROG].
The TT-2000 is adjusted now.



P102 is the adjustment of the total span. When a compound range must be adjusted (for example -30 till +70 °C), a span of 100 °C must be programmed. At P101 (ZERO,4 mA), -30 °C must be adjusted. Now the transmitter is adjusted at: - 30 °C = 4 mA and +70 °C = 20 mA.

P104**ADJUSTMENT TEMPERATURE UNIT ON DISPLAY**

Several engineering units can be shown on the display by using a conversion factor.
(See conversion table below). As standard the read out from TT-2000 is set to 'Degr ' (degrees C). To change this setting, the following must be set:

1. Push at [PROG] till "100" is shown on the display.
2. Push 4 times at [↑], go to [P104].
3. Push at [PROG] to confirm this.
4. Push at [↑] / [SPAN] (+) and set it to Fahr (See conversion table below).
5. Push [PROG] to confirm.

The transmitter will now read out in 'Fahr'

For correct conversion between both temperature scales the following conversion calculation must be used.

Celsius naar Fahrenheit	$^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times \frac{5}{9}$
Fahrenheit naar Celsius	$^{\circ}\text{F} = ^{\circ}\text{C} \times \frac{9}{5} + 32$

When the value of the highest range is larger than 9999, "NA" will appear in the display (Not Applicable). Another unit must be chosen.

P105**REVERSE OUTPUT (20 - 4 mA or 4-20 mA)**

The transmitter as standard is adjusted to 4-20 mA.

Push on [PROG] and go to P105.

Push once at [↑] to change the output to 20-4 mA (Reverse output).

Push at [PROG] to confirm this.

P106**ADJUSTMENT DAMPING (0 till 25 s.)**

In P106 an electronic damping can be adjusted between 0 and 25 seconds.

This can be done with the push buttons [↑] (up) and [↓] (down).

Always confirm by pushing once at [PROG].

P107**FREE ADJUSTMENT (5 POINTS)**

1. Push on [PROG] and go to P107.
2. Push 7 times at [↑]/[SPAN] go to [P107].
3. Push at [PROG] to confirm this.
4. Adjust the desired points and push at [PROG] to confirm this.

P108**CONFIGURATION**

1. Push on [PROG] and go to P108.
2. Push 8 times at [↑]/[SPAN] go to [P108].
3. Push at [PROG] to confirm this.
4. Adjust the configuration and push at [PROG] to confirm this.

P109**READ OUT ON DISPLAY**

- | | |
|-------------------------|---------------------------------|
| 0 = Current | (4 - 20 mA) |
| 1 = Temperature unit | (See conversion table) |
| 2 = Percentage | (0 - 100%) |
| 3 = Ambient temperature | (Depending on conversion table) |

As standard the transmitter is delivered with read out in units(1).

To change this, follow the next steps:

1. Push [PROG] until "100" is shown on the display.
2. Push 9 times at [↑] / SPAN till "108" appears on the display.
3. Confirm with [PROG].
4. Push once at [↑].
5. Push [PROG] to confirm this.

The transmitter will now read (°C or °F)

Also the readout can be 0 - 100%. In this case select P108, option 2

P110**SIMULATION OF CURRENT (4-20 mA)**

The transmitter can be used as a simulator of a current between 4 - 20 mA.

9 HART[®] Protocol

The Series TT-2000 can be used with the HART[®] 5 protocol. To read the measurements, the generic HART commands can be used.



When using HART[®], the total resistance of the circuit must be at least 250 Ω. This is necessary for proper communication. In this case, the connected power supply must be at least 17 Vdc.

10. PRECAUTIONS and WARNINGS

- *Check if the specifications of the transmitter meet the needs of the process conditions*
- *Never weld the entire weldon nipple in one session.*
- *Once the wiring has been inserted and connected, make sure that the PG9 cable gland is hermetically sealed (screwed) so that no moisture can penetrate the cable gland into the electronic housing.*
- *Avoid high pressure water-jets pointed at the venting.*
- *The covers must be fully engaged, so that moisture cannot ingress into the electronic housing. The covers must only be capable of being released or removed with the aid of a tool.*
- *The warranty is 1 year from delivery date. Klay Instruments B.V. does not accept liability for consequential damage of any kind due to use or misuse of the Series TT-2000. Warranty will be given, to be decided by the manufacturer. Transmitter must be shipped prepaid to the factory on manufacturers authorization.*
- *Klay Instruments B.V. reserves the right to change its specifications at any time, without notice. Klay Instruments B.V. is not an expert in the customer's process (technical field) and therefore does not warrant the suitability of its product for the application selected by the customer.*

Manufactured by:

 **KLAY-INSTRUMENTS**
www.klay.nl

Nijverheidsweg 5
P.O. Box 13
Tel: +31 521-591550
Fax: +31 521-592046

7991 CZ DWINGELOO
7990 AA DWINGELOO
The Netherlands
E-Mail: info@klay.nl