KLAY-INSTRUMENTS

INSTRUCTION MANUAL

SERIES TT4000

PROFIBUS PA

"Intelligent" Temperature transmitter

PROFI PROCESS FIELD BUS
PA PROFILE V 3.02

• Warning •
Read the recommendations and warnings in this manual before the instrument is installed. For personal safety, optimal use and maintenance of the temperature transmitters, these instructions should be studied carefully.

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CONTENTS

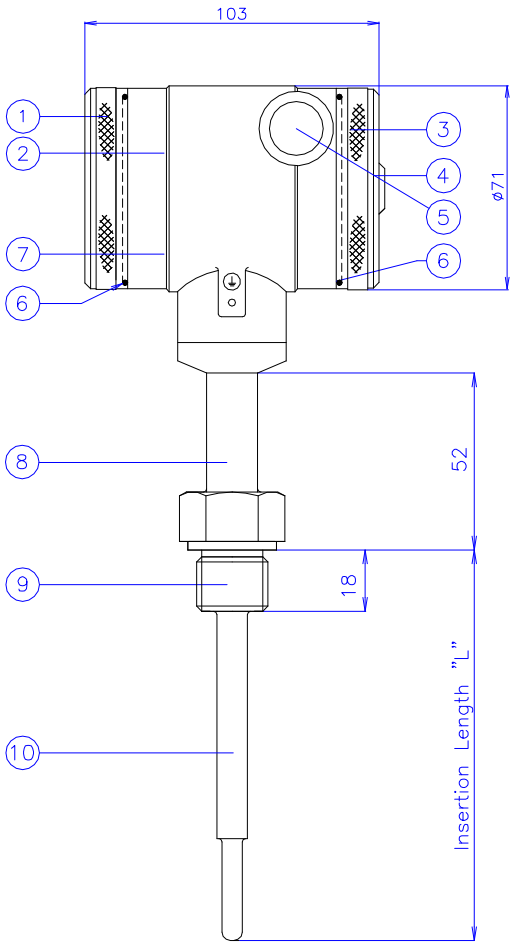
1. INTRODUCTION

The SERIES TT-4000 Profibus PA is a complete Stainless Steel temperature transmitter, based on a Pt100 element (⅓ DIN Class B). The range of standard elements can be set from -20 until 200 and -40 until 400°C. Other ranges are available on request. The Pt100 element is mounted in a stainless steel welding nipple (sensor position 9). To obtain an accurate and fast measurement, the diameter of the insert must be as small as possible. The resistance change of the Pt100 element due to temperature is converted into a proportional 4-20 mA signal (2-wire).

Various process connections can be made including milk couplings (DN25, 40 and 50), Tri-clamp (1, 1 ½" or 2") and hygienic weld-on-nipples (¾ "BSP, Ø 28 mm). Thermowells are fully welded and manufactured from bar stock. They are available in various designs and materials.

2. DIMENSIONAL DRAWINGS

Series TT-4000



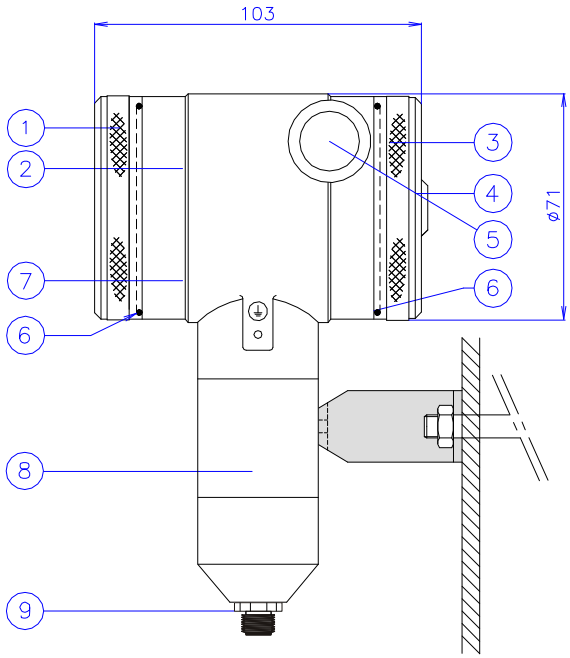
Front view: Transparent cover, option "I" (extra price)

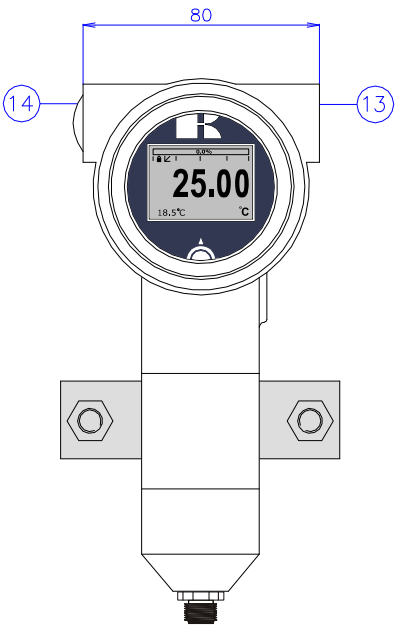
	Description	Material
①	Cover	SS 304
②	Display with navigation button	
③	Cover with venting	SS 304
④	Venting	PA
⑤	M20 x 1,5 cable entry (without gland) *	
⑥	O-Ring	EPDM
⑦	Electronic housing	SS 304

	Description	Material
⑧	Extended connection	SS 316
⑨	Process connection	SS 304
⑩	Insert	SS 316 L
⑬	M20 x 1.5 cable entry (without gland) *	
⑭	M20 x 1.5 cable entry (Blanking plug)	PE

** As standard the Series 4000 will be supplied with **two** cable entries M20 x 1,5. A cable gland can be supplied by request (extra costs).*

Series TT-4000 - Remote





	Description	Material
①	Cover	SS 304
②	Display with navigation button	
③	Cover with venting	SS 304
④	Venting	PA
⑤	M20 x 1,5 cable entry (without gland) *	
⑥	O-Ring	EPDM
⑦	Electronic housing	SS 304

	Description	Material
⑧	Extended connection	SS 316
⑨	M12 Connector	SS 304
⑬	M20 x 1.5 cable entry (without gland) *	
⑭	M20 x 1.5 cable entry (Blanking plug)	

** As standard the Series 4000 will be supplied with **two** cable entries M20 x 1,5. A cable gland can be supplied by request (extra costs).*

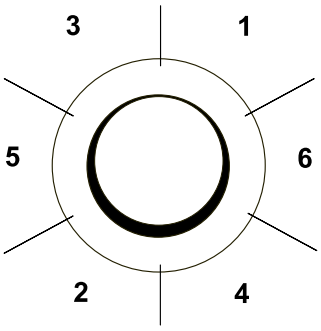
3. INSTALLING THE TRANSMITTER

The diaphragm of the transmitter is protected with a special protection cap. Protect the diaphragm until installation takes place. **Do not damage or bend the temperature sensor.**

3.1 INSTALLING WELD-ON NIPPLE

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

1. Cut a hole in the process vessel or pipe for a precise fit of the weld-on nipple. The hole should be a tight fit when coupled with the weld-on nipple.
2. Prepare the hole by bevelling the edge to accept filler material.
3. Remove the weld-on nipple from the transmitter.
   Remove the gasket and O-Ring out of the weld-on nipple!



WARNING
Improper installation may result in distortion of the weld-on nipple. Excessive heat will distort the weld-on nipple. Weld in sections as shown in the figure left. Allow adequate cooling between passes. To reduce the chances of distortion to the weld-on nipple, use a mandrel.

Determine (before welding) the position of the electronic housing, so that the cable entry and the venting are in the right position. After welding these positions are fixed.

4. Position the weld-on nipple in the vessel hole and tack six places. The weld sequence is shown in the figure above.
5. 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 bevelled area. Adjust amperage for penetration.
6. Remove the mandrel after the welding operation.

3.2 CALIBRATION

All transmitters are fully calibrated at the factory, to customer specified range. If the calibration is not specified, the transmitter will be calibrated at 0 – 100 °C.

3.3 PROFIBUS PA CABLE

Under the cover ③ you will find the terminal board. Special PROFIBUS® cable must be used for proper communication. For further detailed description of cable selection, see "*Guidelines for planning and commissioning PROFIBUS DP/PA*" and "*PROFIBUS PA User and Installation Guideline*" both on www.profibus.com and IEC 61158-2 on www.iec.ch.

Shielded Profibus cable

The PROFIBUS® standard defines two variations of bus cable: Type A and Type B. However it is recommended to use cable Type A in all new installations. Type A is recommended for high transmission speeds and permits a doubling of the network distance in comparison to Type B.

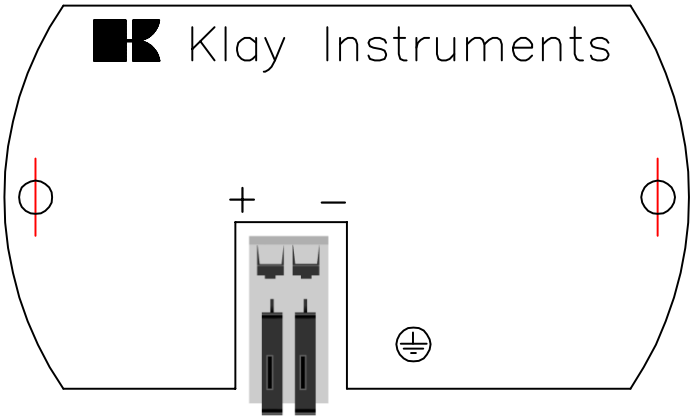
Type A Technical specification:

- **Impedance**: 35 up to 165 Ohm at frequencies from 3 to 20 Mhz.
- **Cable capacity**: < 30 pF per meter.
- **Core diameter**: > 0,34 mm², corresponds to AWG 22.
- **Cable type**: Twisted pair cable. 1x2 or 2x2 or 1x4 lines.
- **Resistance**: < 110 Ohm per km.
- **Signal damping**: max. 9 dB over total length of line section.
- **Shielding**: CU shielding braid or shielding braid and shielding foil.
- **Max. Bus length**: 200 m at 1500 kbit/s, up to 1,2 km at 93,75 kbit/s. (Extendable by repeaters)

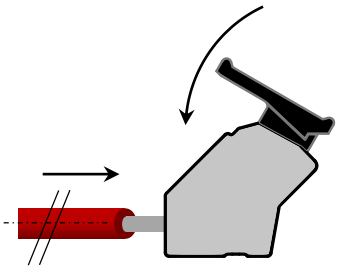
Using other types of cable will result in incorrect and disrupted transmissions in the PROFIBUS® network and is strongly discouraged. Do not run wiring in open trays with power wiring, or near heavy electrical equipment (for example frequency controllers or heavy pumps). To eliminate electromagnetic effects it is highly recommended to us a EMC Cable gland. (Option G73)

3.4 WIRING

Under the cover ③ you will find the terminal board.



Illustrative side view



Insert the wires into the connector and push the lever down by hand.

The figure above shows the wiring connection of the transmitter. The 2-wires must be connected to + and - on the terminal board. The wiring terminals can be operated without a screwdriver. The opening levers of the terminals can be lifted and pressed down by hand. Lift the opening levers of the terminals and insert the corresponding wires. Press down the levers by hand, the terminal spring will close and the wire is clamped. *Optionally a secondary 4-20 mA output is available on request.*

The transmitter is connected with standard two-wire shielded cable. Do not run signal wiring in open trays with power wiring, or near heavy electrical equipment (e.g. Frequency controllers or heavy pumps).

Reversing the polarity will not damage the transmitter, but the transmitter will not function until the **+** and **–** are properly connected.

3.5 GROUNDING

The transmitter must always be connected to ground. In case the process connection is already connected to ground (e.g. by the tank or pipe line) do not connect the instrument to ground.
Please ensure that the instrument is not connected to ground twice to prevent an "Earth loop".

3.6 TERMINATION

Termination of the bus prevents signal reflections on the PROFIBUS® cable. A terminator is a combination of a resistor and a capacitor. Wrong or missing termination results in transmission errors. At the end of each cable trunk a terminator must be used. In common a terminator is integrated in a segment coupler. When there is no integrated terminator present in the trunk, a separate terminator must be used.

4. REMAINING

4.1 CE / EMC-RULES

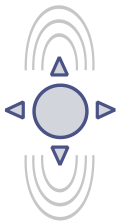
All Klay transmitters are manufactured in accordance with the RFI / EMC directives and comply with the CE standard. All transmitters are fitted with RFI filters, which provide optimum, trouble-free operation. Our products are in conformity with EMC-Directive 2014/30/EU based on test results using harmonized standards.

4.2 TRACEBILITY / YEAR OF MANUFACTURING

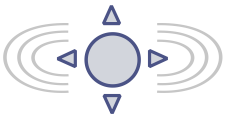
The year of manufacturing of the transmitter can be traced as follows: take the first two numbers from the serial number that is engraved in the transmitter and add 1970 to it.
Example: Serial Number 4302123. The year of manufacturing is 1970 + 43 = 2013.

5. GRAPHIC DISPLAY AND NAVIGATION BUTTON

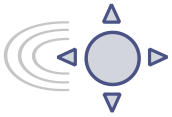
The Series 4000 has a multifunctional display where different values can be displayed simultaneously. The display is equipped with a backlight. The entire menu is controlled by a navigation button. The navigation button has the following possibilities of movement: up, down, left, and right. The navigation button needs to be pushed when conformation or saving is needed.



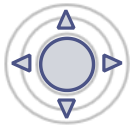
Move the navigation button up or down to browse through various menus. These movements can be distinct in choices of: program points, navigation through menu's and increase or decrease measurement value's.



Move the navigation button left or right to navigate horizontally through the menu or positions on the display.



It is always possible to return to the previous menu. Move the navigation button to the left to return to the previous menu.

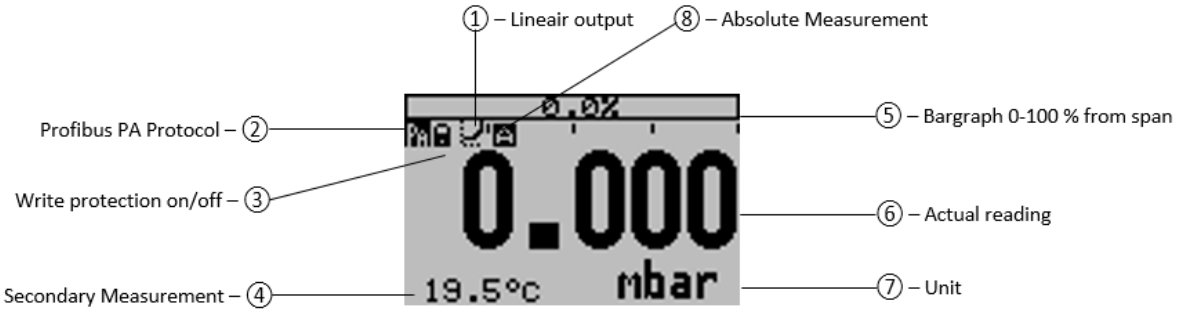


By pushing the navigation button each choice will be **confirmed** or a setting will be **saved**.

Figure 1. Display Series TT-4000, fully rotatable (360˚)

5.1 GRAPHIC DISPLAY READOUT

When the transmitter is powered, a flash screen with the name of the transmitter (Series 4000) and the software version appear for a few seconds. The **PROFIBUS® address** is shown at the bottom of the display. As standard (Unconfigured) the address is **126**. This address is used for configuration and commissioning purposes only. The address can be changed with Program point P103 or a Profibus Master device (Only Class 2).



EXPLANATION OF SYMBOLS:

1. – Linear output Straight line means no linearization is applied. When a linearization is applied a curve will be displayed.
2. – Profibus PA: Profibus PA Protocol applied
3. – Write protection on/off: Displays if protection against adjustments and configuration is on or off
4. – Secondary Measurement: Displays a secondary chosen measurement.
5. – Bargraph 0 - 100 % from span: Displays the percentage of the measured span.
6. – Measurement: Displays the actual reading, temperature or percentage
7. – Unit: Displays the selected unit (*a temperature transmitter will present °C*).
8. – Absolute: Appears when the measurement is in absolute range.

5.2 SUMMARY PROGRAMMING POINTS

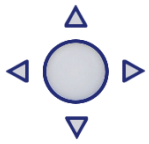
PROGRAM POINT	NAME	FUNCTION
P100	Menu-Exit menu	Start and exit
P101	ZERO value	Zero adjustment (ZERO 0%) with or without process temperature
P102	SPAN value	Span adjustment (SPAN 100%) with or without process temperature
P103	PA Adress	Selection of PA address 2 to 126 (factory setting 126)
P104	UNITS	Selection of engineering unit to be displayed
P105	REVERSE OUT	Output selection 0 – 100% or 100 %-0%
P106	DAMPING	Adjustable damping (0,00 till 25,00 s)
P107	LANGUAGE	Language choice between: English, Espanol,Dutch, French,German, Polish .
P108	DEVICE SETUP	Configuration of: Protection, Backlight, Read Temp Min/ Max, Secondary value, PA_OUTSCALE
P109	READOUT	Readout options on display: unit, percentage and Ambient Temperature
P110	INFORMATION	Contact information of Klay Instruments, made settings, and software revision
P111	FACTORY	Only available for the manufacturer
P112	FACTORY	Only available for the manufacturer

⚠ **Configuring the transmitter local and remote simultaneously will cause transmission errors and must be prevented.**

6. EXPLANATION PROGRAMMING POINTS

P101
Zero Value

6.1 ZERO ADJUSTMENT (ZERO, 0%)



The transmitter is set to 0 °C at 0%.
The **ZERO** can be adjusted at a lower or higher point. This will be explained step by step by an example.

Example: Increase ZERO till +10 °C.

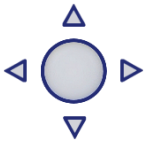
1. The measuring unit of the transmitter is set to Celsius degrees. If not this can be selected by choosing the right measuring unit in program point **P104 – UNITS (paragraph 6.4)**
2. Navigate to program point **P101 - ZERO Value**, and push the navigation button to enter the menu.
3. Two choices appear on the screen: "**set manual**" and "**use process**"
   Set manual = Configuration without test temperature.
   Use process = Configuration with process temperature.
4. Choose "S**et manual**", +000.0 (°C) will appear on the display.
5. Increase this value with the navigation button to +10 °C, at the bottom of the screen the URV is displayed and changes according to the adjusted zero. push to confirm, and select SAVE to save the setting.
6. The transmitter will return to the home screen. The zero (0%) is adjusted to +10°C.

The menu zero adjustment also has the choice of "**use process**". The transmitter can be adjusted to zero in a real process situation. When chosen, the transmitter will measure the temperature in an actual process. This measurement will be used as the zero value. (0%)

1. Navigate to program point **P101**, and push the button to enter the menu.
2. Choose "**use process**", and push to confirm. The transmitter will display the actual measured temperature.
3. Push the navigation button to confirm, and select SAVE to save the setting.
4. The transmitter will return to the main menu.

P102
Span Value

6.2 SPAN ADJUSTMENT (SPAN, 100%)



This setting can be used to adjust the range (SPAN) according to an entered value or adjusted with or without an applied temperature.
The maximum temperature which can be measured (100%) is the measurement at **ZERO (P101)** + the entered value **SPAN (P102)**. If the **ZERO (P101)** is increased, then the maximum measured value will automatically be set higher at same rate as the zero.
The following example will explained step by step.

1. Example: Measurement range +10 till +110 °C = 0 - 100%.
2. The **span** must be set at 100 °C.
3. The zero was set in the previous menu (**P101**) at +10°C.
4. Navigate to program point **P102 - SPAN Value**, and push the navigation button to enter the menu.
5. Two choices appear on the screen: **Set manual** and "**Use process**"
6. Choose **Set manual**, a value will appear on the screen.
7. Adjust the **SPAN** with the navigation button to +110 °C. and select SAVE to save the setting
8. The transmitter will return to the home screen.

The menu span adjustment also has the option of "**use process**". The transmitter can be adjusted to the span in a real process situation. When chosen, the transmitter will measure the temperature in an actual process. This measurement will be used as the span value. (100%)

1. Navigate to program point **P102**, and push the button to enter the menu.
2. Choose "**use process**", and push to confirm. The transmitter display the measured temperature.

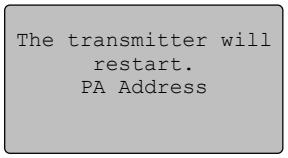
3. Push the navigation button to confirm, and select SAVE to save the setting.

P103
PA Address

6.3 PA ADDRESS

In this menu a PA Address from 2 till 126 can be selected.

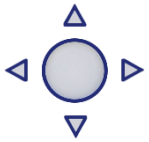
1. Navigate to program point **P103 - PA Address** and push the navigation button to enter the menu.
2. Select the address with the navigation button and push to confirm. Select SAVE to save the setting.
3. The following message appear on the display:
4. The transmitter will automatically restart
5. The changed address is displayed in the startup screen.



P104
Units

6.4 DISPLAY SETTING OF UNITS

Two engineering units can be displayed on the display.
Factory setting = °C (Celsius)



1. Navigate to program point **P104 – UNIT**, and push the navigation button to enter the menu.
2. Several engineering units can be selected. Each selected engineering unit is automatically converted to the correct value of the corresponding unit.
3. Navigate through this menu and choose the required unit, push to confirm.
4. The Save icon will be displayed to indicate that the setting is saved.
5. The transmitter will return to the main menu; the measured reading will be displayed in the chosen unit in the home screen.

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

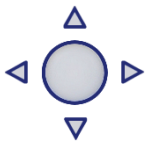
Celsius to Fahrenheit	$°C = (°F - 32) \times 5/9$
Fahrenheit to Celsius	$°F = °C \times 9/5 + 32$

CAUTION: The selected temperature unit is only visible on the display, when UNITS is chosen in P109 – Readout.

P105
Reverse mA

6.5 OUTPUT SELECTION 0-100 % or 100 – 0 %

The transmitter is standard set to 0-100%.

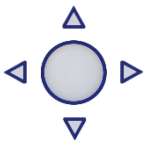


1. Navigate to program point **P105 – Reverse output**, and push the navigation button to
enter the menu.
2. Two choices appear on the screen 0-100% and 100 – 0 %
3. Make an output choice and push to confirm.
4. The Save icon will be displayed to indicate that the setting is saved.
5. The transmitter will return to the main menu.

P106
Damping

6.6 DAMPING ADJUSTMENT

The transmitter has an adjustable damping between 0,00 to 25,00 seconds. Factory setting = 0,00 seconds



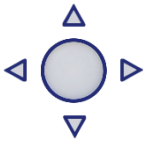
1. Navigate to program point **P106 – DAMPING**, and push the navigation button to enter the menu.
2. Two choices appear on the screen: **Set** and **Reset**
3. Make a choice and push to confirm.
   Choosing **Set** allows a value to be set between 0,00 and 25,00 seconds.
   - Select Set, and push the button to confirm.
   - Adjust the damping with the navigation button, push to confirm.
   - The Save icon will be displayed to indicate that the setting is saved.
   - The transmitter will return to the main menu.

   Choosing **Reset** will put the setting back to factory setting (0,0 seconds)
   - Select Reset, and push the button to confirm.
   - The Save icon will be displayed to indicate that the setting is saved, the setting will be put back to factory setting 0,00 s.
   - The transmitter will return to the main menu.

P107
Languages

6.7 LANGUAGE

In this menu the preferred menu language can be selected.

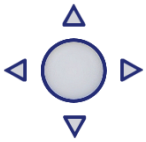


1. Navigate to program point **P107 - LANGUAGE**, and push the navigation button to enter the menu.
2. Five choices appear on the screen: English, Español, Dutch, French, German, Polish **.**
3. Make a choice and push to confirm.
4. The Save icon will be displayed to indicate that the setting is saved.
5. The transmitter will return to the main menu.

P108
Device Setup

6.8 DEVICE SETUP

In this menu, several operational settings can be made for the transmitter.



1. Navigate to program point **P108 – Device Setup**, and push the navigation button to enter the menu.
2. Eight choices appear on the screen: **Protection** - **Alarm output** - **Backlight** - **Temp units** – **Temp min/max** – **Sec. Value** - **Set Time** and **PA_OUT_SCALE.**
3. Choose the desired option, push to confirm.
4. Below are the choices displayed. They can be selected and configured using the navigation button.
   - **Protection**: **Local**: The local protection for adjusting settings locally on the transmitter.
   - **Backlight**: Choice between: **On**, **Sleep mode** (Turn off backlight after 5 minutes) and **Off**. The intensity of the backlight is depending on the output current.
   - **Temp min/max:** Two choices appear on the screen: **Readout** and **Reset**
     By choosing **Readout** the last measured minimum and maximum temperature values of process and ambient appear. For the process temperature, a new value is stored in a change of temperature more than 2 ˚ C. For the ambient

temperature this is 5˚ C. By choosing **Reset** the previous stored values will be deleted.

- **Sec. Value:** Four choices appear on the screen for the secondary readout on the main screen, **Unit**, **Rate** and **Ambient Temperature**.
- **PA_OUT_SCALE**: On this menu scaling options for analog Inpu Block (profibus Output) can be configurd locally on the transmitter. Two choices apperes on the screen Set **1:1 an set Manuel**

    - With option **Set 1:1** a scaling can be set with the following menu choices: **EU100**, **EU0** and **Unit**. As standard the values are the same as the last saved Zero, Span and engineering unit (P109 must be set to **unit** or **percentage**).
      Select **EU100** to enter a value for the 100% scaling point.
      Select **EU0** to enter a value for the 0% scaling point.
      Select **Unit** to enter the engineering unit code.
    - With option **Set manual** the current scaling configuration (Profibus output) is shown. Set manual should only be used for units not supported by the Series 4000, or when a different scaling then the local readout is needed on the Profibus output. **The engineering units can be found in the attachment of this manual or on www.klay.nl under section downloads.**

      The engineering units can be found in the attachment of this manual or in the digital version on www.klay.nl under section downloads.

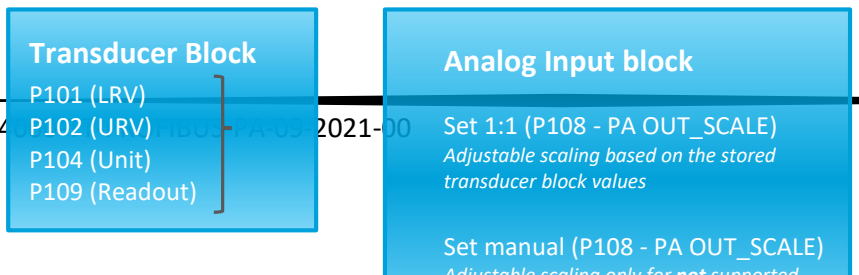
Profibus scaling will be explained step by step by the following examples:

Scaling Example - Temperature:

- Configure the Zero - P101 (If necessary)
- Configure the Span - P102 (If necessary)
- Select *Celeciusr* in program point P104 (or any other Temperature unit)
- Select *Unit* in program point P109
- Navigate to program point P108 and select **PA OUT_SCALE**
- Configure the scale with **Set 1:1**, navigate to save, to save the setting.
- The transmitter will restart to load the new scale.

Scaling Example - Percentage:

- Configure the Zero - P101 (If necessary)
- Configure the Span - P102 (If necessary)
- Select *Percentage* in program point P109
- Navigate to program point P108 and select **PA OUT_SCALE**
- Configure the scale with **Set 1:1**, navigate to save, to save the setting.
- The transmitter will restart to load the new scale.



Example Percentage: Analog input block Slot 1

Index 27 OUT (record)
Float, PV SCALE Engineering Units at 100% = 200.0
Float, PV SCALE Engineering Units at 0% = 0.0

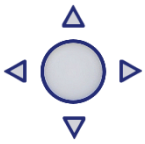
Index 28 OUT_SCALE (record)
Float, Engineering units at 100% = 100.0
Float, Engineering units at 0% = 0.0
Unsigned16, Units Index = 1001
Unsigned8, Decimal Point = 1

CAUTION: Do not change the Zero, Span, Unit or Readout (P109) after configuring the Profibus Out scaling, as described above. Changing will result in invalid Profibus communication.

P109 Readout

6.9 READOUT

In this menu, the readout on the display is determined. This is the type of measurement appearing on the home screen. Factory Setting = Unit

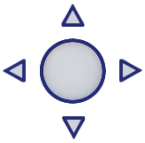


1. Navigate to program point **P109 – READOUT**, and push the navigation button to enter the menu.
2. Four choices appear on the screen:
   Temperature Unit = Unit as chosen in **P104**
   Percentage = 0-100%
   Ambient Temperature = Ambient temperature (Temperature inside the electronic housing)
3. Navigate to the desired choice, confirm the selection by pushing the navigation button. The Save icon will be displayed to indicate that the setting is saved.
4. The transmitter will return to the main menu.

P110 Information

6.10 INFORMATION

This menu shows a collection of information from the transmitter and contact information from the manufacturer.



1. Navigate to program point **P110 - Information** and push the button to confirm.
2. Push the navigation button up and down to see all of the information
3. Push the button to leave this menu.

Below is a representation of this information screen:

```
Klay Instruments
www.klay.nl
+31521591550
Version             -     Software revision
No:                 -     Serial number transmitter
Zero                -     Zero
Span                -     Span
Damping             -     Damping (in seconds)
Output              -     Output 0- 100% or 100 - 0 %
Local Prot          -     Protection On or Off
Sec. Value          -     Selected secondary configuration
Backlight           -     Backlight On, Sleep mode or Off
Temp                -     Temperature unit Celsius or Fahrenheit
```

PA version - Profibus version 3.02

P111

6.11 FACTORY

Only available for the manufacturer.

P112

6.12 FACTORY

Only available for the manufacturer.

7. PROFIBUS® PA

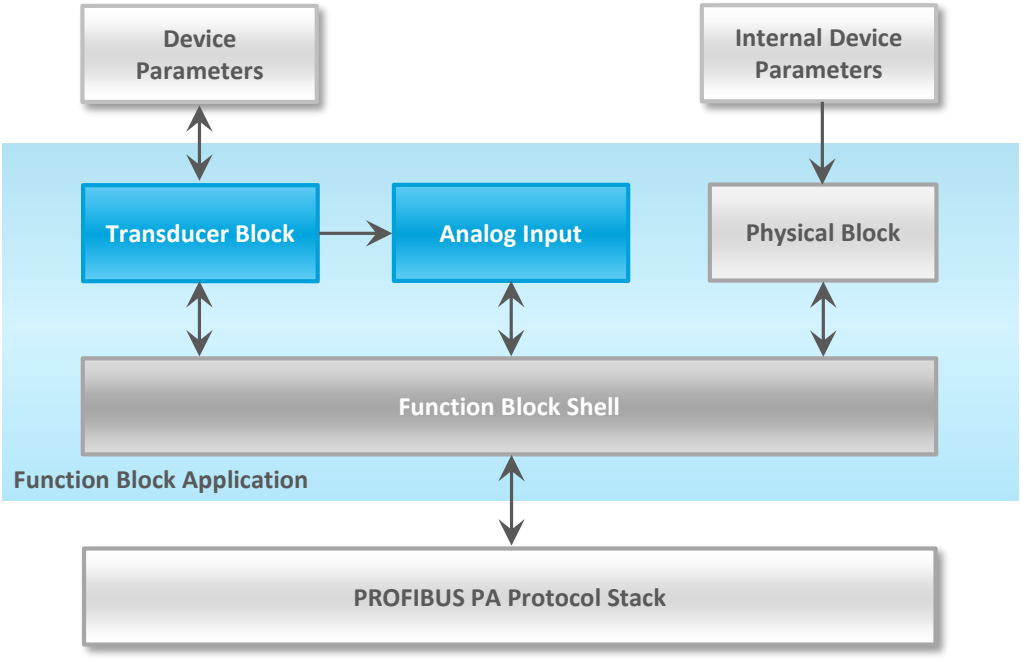
7.1 PA INTERFACE

The Series 4000-PROFIBUS PA is developed as a PROFIBUS® Slave device. A slave device is a addressable peripheral device which reads process information and delivers output information to the Master device in the PROFIBUS® system. The Series 4000 is developed for Profibus PA Profile V3.02 and is backwards compatible with Profile version V3.01.

The Series 4000 supports 2 communication layers:

- **DP-V0**: **Cyclic exchange** of process data and exchanging diagnosis functions between master and slaves.
- **DP-V1**: **Acyclic data exchange** and alarm handling between master and slaves for diagnosis, control, monitoring and alarm handling of the slaves in parallel with cyclic data traffic.

The PROFIBUS® PA network is standardized using a block models. The different block types are explained below.



Block Type	Description
Function Block	Control system behavior like for example: Analog Input, Analog Output, Discrete Input, Discrete Output and Totalizer.
Transducer Block	Converting mapping between process data and Function Blocks. The Transducer Block is used to perform preprocessing and calibration parameters of device data according to specific device settings. At least one Transducer Block has to be available for a PROFIBUS® PA field device.
Physical Block	Describes the specific data identifying the individual physical device properties such as the device name, manufacturer, and serial number.

Physical Block Parameters (Slot 0)

In the table below the Physical Block parameters.

Index	Name	Type	Description
16	BLOCK_OBJECT	Record	Block object
	Reserved	Unsigned8	0
	Block_Object	Unsigned8	0x01, physical block
	Parent_Class	Unsigned8	0x01, Transmitter
	Class	Unsigned8	250, not used
	Dev_Rev	Unsigned16	1
	Dev_Rev_Comp	Unsigned16	1
	DD_Revision	Unsigned16	0
	Profile	OctetString(2)	MSB: 0x40 -> Number of the PROFIBUS PA profiles within PI Profile Class 64 LSB: 0x02 -> Class B
	Profile_Revision	Unsigned16	0x302: PA Prfile Revision 3.02
	Execution_Time	Unsigned8	0
	Number_of_Parameters	Unsigned16	29, number of parameters
	Address_of_View_1	Unsigned16	0x00F8, View_1 has an index 248
	Number_of_Views	Unsigned8	1, only one View_1 in Device
17	ST_REV	Unsigned16	ST_REV shall be incremented at least by one if at least one static parameter in the corresponding block has been modified
18	TAG_DESC	OctetString(32)	
19	STRATEGY	Unsigned16	
20	ALERT_KEY	Unsigned8	
21	TARGET_MODE	Unsigned8	Target mode
22	MODE_BLK	Record	
	Actual_mode	Unsigned8	Actual mode
	Permitted_mode	Unsigned8	Permitted mode
	Normal_mode	Unsigned8	Normal mode
23	ALARM_SUM	Record	
	Current	OctetString(2)	Current alarm
	Unacknowledged	OctetString(2)	Unacknowledged alarm
	Unreported	OctetString(2)	Unreported alarm
	Disabled	OctetString(2)	Disabled alarm
24	SOFTWARE_REVISION	VisibleString(16)	Revision-number of the software of the field device
25	HARDWARE_REVISION	VisibleString(16)	Revision-number of the hardware of the field device
26	DEVICE_MAN_ID	Unsigned16	Identification code of the manufacturer of the field device
27	DEVICE_ID	VisibleString(16)	Manufacturer specific identification of the device
28	DEVICE_SER_NUM	VisibleString(16)	Serial number of the field device
29	DIAGNOSIS	OctetString(4)	Detailed information of the device, bitwize coded. More than one message possible at once.
30	DIAGNOSIS_EXT	OctetString(6)	Additional manufacturer-specific information of the device, bitwize coded. More than one message possible at once.
31	DIAGNOSIS_MASK	OctetString(4)	Definition of supported DIAGNOSIS information-bits (0: not supported, 1: supported)
32	DIAGNOSIS_MASK_EXT	OctetString(6)	Definition of supported DIAGNOSIS_EXTENSION information-bits (0: not supported, 1: supported)
33	DEVICE_CERTIFICATION	VisibleString(32)	Certifications of the field device, e.g. EX certification

34	WRITE_LOCKING	Unsigned16	Software write protection
35	FACTORY_RESET	Unsigned16	Parameter for the device resetting
36	DESCRIPTOR	OctetString(32)	
37	DEVICE_MESSAGE	OctetString(32)	
38	DEVICE_INSTAL_DATE	OctetString(16)	
39	NULL_PARAM		Optional parameter LOCAL_OP_ENA isn't implemented
40	IDENT_NUMBER_SELECT		
41	NULL_PARAM		Optional parameter HW_WRITE_PROTECTION isn't implemented
42	FEATURE	Record	Indicates optional features implemented in the device and the status of these features which indicates if the feature is supported or not supported.
	Supported	OctetString(4)	Supported features
	Enabled	OctetString(4)	Enabled features
43	COND_STATUS_DIAG	Unsigned8	Indicates the mode of a device that can be configured for status and diagnostic behavior
44	DIAG_EVENT_SWITCH	Record	Indicates / controls the reaction of the device on device specific diagnostic events if FEATURE.Enabled.Condensed_Status = 1
	Diag_Status_Link	Unsigned8-Array(48)	Array of switches for device specific diagnostic events. Mapping to diagnosis bit and status code
	Slot	Unsigned8	Slot of the continuation of Diag_Event_Switches. Points to the next Diag_Event_Switch structure
	Index	Unsigned8	Index (absolute) of the continuation of Diag_Event_Switches. Points to the next Diag_Event_Switch structure.

Transducer Block Parameters (Slot 5)

In the table below the Transducer Block is shown with the specific Device Configuration parameters. Index parameters 25, 27, 43, 44, 45, 53 and 54 can only be configured when transmitter is set to **Out of Service** (OOS). The transducer block can be set to Out of Service in index number 21. After configuring the transducer block, index number 21 must be set to **AUTO**.

Index	Name	Type	Description
16	BLOCK_OBJECT	Record	Block object
	Reserved	Unsigned8	0
	Block_Object	Unsigned8	0x03, transducer block
	Parent_Class	Unsigned8	244, manufacture specific
	Class	Unsigned8	250, not used
	Dev_Rev	Unsigned16	1
	Dev_Rev_Comp	Unsigned16	1
	DD_Revision	Unsigned16	0
	Profile	OctetString(2)	MSB: 0x40 -> Number of the PROFIBUS PA profiles within PI Profile Class 64 LSB: 0x02 -> Class B
	Profile_Revision	Unsigned16	0x302: PA Profile Revision 3.02
	Execution_Time	Unsigned8	0
	Number_of_Parameters	Unsigned16	52, number of parameters
	Address_of_View_1	Unsigned16	0x05F8, View_1 has an index 248
	Number_of_Views	Unsigned8	1, one View_1

17	ST_REV	Unsigned16	ST_REV shall be incremented at least by one if at least one static parameter in the corresponding block has been modified
18	TAG_DESC	OctetString(32)	
19	STRATEGY	Unsigned16	
20	ALERT_KEY	Unsigned8	
21	TARGET_MODE	Unsigned8	Target mode
22	MODE_BLK	Record	
	Actual_mode	Unsigned8	Actual mode
	Permitted_mode	Unsigned8	Permitted mode
	Normal_mode	Unsigned8	Normal mode
23	ALARM_SUM	Record	
	Current	OctetString(2)	Current alarm
	Unacknowledged	OctetString(2)	Unacknowledged alarm
	Unreported	OctetString(2)	Unreported alarm
	Disabled	OctetString(2)	Disabled alarm
24	PRIMARY_VALUE	Record	Primary value and status (Pressure)
	Value	Float	Primary value
	Status	Unsigned8	Primary status
25	PV_UNIT	Unsigned16	Primary value unit (Pressure engineering units)
26	SECONDARY_VALUE	Record	Secondary value and status (Process Temperature)
	Value	Float	Secondary value
	Status	Unsigned8	Secondary status
27	SV_UNIT	Unsigned16	Secondary value unit (Temperature units)
28	TERTIARY_VALUE	Record	Tertiary value and status (Ambient Temperature)
	Value	Float	Tertiary value
	Status	Unsigned8	Tertiary status
29	TV_UNIT	Unsigned16	Tertiary value init (Temperature units)
30	QUATERNARY_VALUE	Record	Quaternary value and status (Pressure)
	Value	Float	Quaternary value
	Status	Unsigned8	Quaternary status
31	QV_UNIT	Unsigned16	Quaternary value unit (Pressure engineering units)
32	INTERNAL_MAN_ID	Unsigned16	INTERNAL device manufacture ID
33	INTERNAL_DEV_TYPE	Unsigned16	INTERNAL device type
34	INTERNAL_DEV_ID	Unsigned32	INTERNAL device ID
35	INTERNAL_DEV_REV	Unsigned8	INTERNAL device revision
36	INTERNAL_SW_REV	Unsigned8	INTERNAL device software revision
37	INTERNAL_HW_REV	Unsigned8	INTERNAL device hardware revision
38	INTERNAL_TAG_DESC_DATE	Record	INTERNAL TAG, Descriptor and Date record
	Tag	VisibleString(8)	INTERNAL tag
	Descriptor	VisibleString(16)	INTERNAL descriptor
	Day	Unsigned8	Day
	Month	Unsigned8	Month
	Year	Unsigned8	Year
39	INTERNAL_CMD_MAJOR_REV	Unsigned8	INTERNAL command major revision
40	INTERNAL_MESSAGE	VisibleString(32)	INTERNAL message
41	SIMULATION_VALUE	Record	Simulation value and status
	Value	Float	Simulation value
	Status	Unsigned8	Simulation status
42	COMM_STATE	Unsigned8	INTERNAL communication status
43	PV LRV	Float	Transducer Lower Range Value (Zero)
44	PV URV	Float	Transducer Upper Range Value (Span)
45	PV DAMPING VALUE	Float	PV damping value in seconds
46	RESERVED	Float	

47	RESERVED	Float	
48	RESERVED	Float	
49	RESERVED	Float	
50	RESERVED	Float	
51	RESERVED	Float	
52	RESERVED	Float	
53	PV MOUNT CORRECTION	Unsigned16	(0: reset, 1: correct mounting effect with measured pressure)
54	DEVICE SETTINGS	Unsigned16	Bitmapped structure Bit 0 = Reverse Output Bit 1 = Secondary display reading Bit 2-3 = Backlight Bit 4-6 = Language Bit 7-10 = Primary display reading Bit 11-15 = Reserved
55	RESERVED	Unsigned16	
56	RESERVED	Unsigned16	
57	RESERVED	Unsigned16	
58	RESERVED	Unsigned16	
59	RESERVED	Unsigned16	
60	RESERVED	Unsigned16	
61	RESERVED	Unsigned32	
62	RESERVED	Unsigned32	
63	RESERVED	Unsigned32	
64	RESERVED	Unsigned32	
65	RESERVED	Unsigned32	
66	RESERVED	OctetString(32)	
67	RESERVED	OctetString(32)	

Analog Input Block Parameters (Slot 1 - 4)

In the table below the Analog Input Block parameters.

Index	Name	Type	Description
16	BLOCK_OBJECT	Record	Block object
	Reserved	Unsigned8	0
	Block_Object	Unsigned8	0x02, function block
	Parent_Class	Unsigned8	0x01, input
	Class	Unsigned8	0x01, analog input
	Dev_Rev	Unsigned16	1
	Dev_Rev_Comp	Unsigned16	1
	DD_Revision	Unsigned16	0
	Profile	OctetString(2)	MSB: 0x40 -> Number of the PROFIBUS PA profiles within PI Profile Class 64 LSB: 0x02 -> Class B
	Profile_Revision	Unsigned16	0x302: PA Prfile Revision 3.02
	Execution_Time	Unsigned8	0
	Number of Parameters	Unsigned16	45, number of parameters
	Address_of_View_1	Unsigned16	(0x01F8,0x02F8, 0x03F8, 0x04F8 for different AI blocks) View_1 has an index 248
	Number_of_Views	Unsigned8	1, only one View_1 in Device
17	ST_REV	Unsigned16	ST_REV shall be incremented at least by one if at least one static parameter in the corresponding block has been modified
18	TAG_DESC	OctetString(32)	

19	STRATEGY	Unsigned16	
20	ALERT_KEY	Unsigned8	
21	TARGET_MODE	Unsigned8	Target mode
22	MODE_BLK	Record	
	Actual_mode	Unsigned8	Actual mode
	Permitted_mode	Unsigned8	Permitted mode
	Normal_mode	Unsigned8	Normal mode
23	ALARM_SUM	Record	
	Current	OctetString(2)	Current alarm
	Unacknowledged	OctetString(2)	Unacknowledged alarm
	Unreported	OctetString(2)	Unreported alarm
	Disabled	OctetString(2)	Disabled alarm
24	BATCH	Record	Batch structure
	Batch_ID	Unsigned32	Identifies a certain batch to allow assignment of equipment-related information (e.g. faults, alarms ...) to the batch
	Rup	Unsigned16	No. of Recipe Unit Procedure or of Unit
	Operation	Unsigned16	No. of Recipe Operation
	Phase	Unsigned16	No. of Recipe Phase
25	NULL_PARAM	--	
26	OUT	Record	Output of the AI block
	Value	Float	Output value
	Status	Unsigned8	Output status
27	PV_SCALE	Array	Conversion of the Process Variable into percent using the high and low scale values
	PV_SCALE.EU_at_100%	Float	Element 0 of the array: value at EU of 100%
	PV_SCALE.EU_at_0%	Float	Element 1 of the array: value at EU of 0%
28	OUT_SCALE	Record	Scale of the Process Variable
	EU_at_100%	Float	
	EU_at_0%	Float	
	Units_Index	Unsigned16	
	Decimal_Point	Unsigned8	
29	LIN_TYPE	Unsigned8	Type of linearization
30	CHANNEL	Unsigned16	Reference to the active Transducer Block which provides the measurement value to the Function Block
31	NULL_PARAM	--	
32	PV_FTIME	Float	Filter time of the Process Variable
33	FSAFE_TYPE	Unsigned8	Defines the reaction of the device, if a fault is detected
34	FSAFE_VALUE	Float	Default value for the OUT parameter, if a sensor or sensor electronic fault is detected. The unit of this parameter is the same like the OUT one
35	ALARM_HYS	Float	Hysteresis
36	NULL_PARAM	--	
37	HI_HI_LIM	Float	Value for upper limit of alarms
38	NULL_PARAM	--	
39	HI_LIM	Float	Value for upper limit of warnings
40	NULL_PARAM	--	
41	LO_LIM	Float	Value for lower limit of warnings
42	NULL_PARAM	--	
43	LO_LO_LIM	Float	Value for lower limit of alarms
44	NULL_PARAM	--	
45	NULL_PARAM	--	
46	HI_HI_ALM	Record	

	Unacknowledged	Unsigned8	State of the upper limit of alarms.
	Alarm_State	Unsigned8	
	Time_Stamp	TimeValue	
	Subcode	Unsigned16	
	Value	Float	
47	HI_ALM	Record	State of the upper limit of warnings
	Unacknowledged	Unsigned8	
	Alarm_State	Unsigned8	
	Time_Stamp	TimeValue	
	Subcode	Unsigned16	
	Value	Float	
48	LO_ALM	Record	State of the lower limit of warnings
	Unacknowledged	Unsigned8	
	Alarm_State	Unsigned8	
	Time_Stamp	TimeValue	
	Subcode	Unsigned16	
	Value	Float	
49	LO_LO_ALM	Record	State of the lower limit of alarms
	Unacknowledged	Unsigned8	
	Alarm_State	Unsigned8	
	Time_Stamp	TimeValue	
	Subcode	Unsigned16	
	Value	Float	
50	SIMULATE	Record	For commissioning and test purposes the input value from the Transducer Block into the Analog Input Function Block AI-FB can be modified. That means that the Transducer and AI-FB will be disconnected
	Simulate_Status	Unsigned8	
	Simulate_Value	Float	
	Simulate_Enable	Unsigned8	
51	OUT_UNIT_TEXT	OctetString(16)	

7.2 IDENT NUMBER

Profibus devices have unique ID numbers. An ID allows devices connected to the bus to be identified. The Ident Number of the Series 4000-Profibus PA is: 0FAB (hex). The Ident Number is also stored in the GSD File.

7.3 GSD FILES

GSD (General Station Description) Files are needed to configure a profibus network. GSD files containing general information and device-specific capabilities about the transmitter. The PLC or a configuration tool reads the device identification, adjustable parameters, data type and the limiting values of the transmitter from this GSD file. The GSD file is usable for all Profibus master that are compatible to the standard and configured for the floating point standard **IEEE754**.
The GSD files are available at: **www.klay.nl** under section downloads.

7.4 ENGINEERING UNITS

The following engineering units are supported by the Series 4000 Profibus PA.

Index	Unit	Description
1001	° C	Celsius
1002	° F	Fahrenheit

Additional units can be configured in the Analog Input Block. This is explained step by step by an example:

- The Span is set to 100.0 ° C in program point P102. (0 till 100.0 ° C)
- In the Analog Input Block index value 27 is automatically filled with calibrated span of 100.0 ° C.
- In the Analog Input Block index value 28 must be filled in for scaling from ° C to ° F:
- **OUT_SCALE** = 212.0 (100.0 °C = 212 ° F)
- **EU_at_100%** = 212.0 and **EU_at_0%** = 0
- **Units_Index** = 1002 (Corresponding Engineering unit for ° F)
- **Decimal_Point** = 1
- The converted output is available on index value 26 (OUT) in the Analog Input Block.

When the Engineering Unit is changed on the transmitter with Programming point P104 or P109, the conversion in the Analog Input Block will be invalid and must re-calculated and configured as described above. The same applies when the SPAN is changed.

Configuring the transmitter local and remote simultaneously will cause transmission errors and must be prevented.

7.5 PROFIBUS ADDRESS

The Series 4000-PROFIBUS PA is standard configured at address **126** (Unconfigured Device). This address is used for configuration and commissioning purpose only. The address can be changed with Program point P103 or a Profibus Master device (Only Class 2).

7.6 ROTATABLE DISPLAY

The display of the Series TT-4000 is fully rotatable. To rotate the display, place a small screw driver into the recess on top of the display. Turn it by hand by moving the screw driver into the desired direction, use the other hand to guide this movement to avoid any damages. The display can be turned both left and right.

8. SPECIFICATIONS

Manufacturer	Klay Instruments B.V.
Instrument	TT-4000
Output	PA 3.02
Power Supply	Standard: 12 – 36 Vdc
Accuracy	0.1 ° C.
Ambient Temperature Standard	-20 °C to 70 °C (-4 °F to 158 °F)
Damping	0,00 seconds to 25,00 seconds Standard: 0,00 seconds.
Protection Grade	IP66
Material Housing "Wetted" parts	AISI 304 (Optional AISI 316) AISI 316 L (Other materials on request)

9. PRECAUTIONS AND WARNINGS

- **Check if the specifications of the transmitter meet the needs of the process conditions**
- **WELDING INFORMATION:**
  When using the Series TT-4000 with weld-on nipple, the welding information on page 6 must be followed exactly. This is very important to prevent distortion of the weld-on nipples. It also prevents the screw thread from being deformed.
- **Prevent any damaging of the transmitter.**
- **As soon as the wiring is brought inside through the cable gland and connected to the terminal board, make sure the cable gland is tightly fixed, so that moisture cannot enter into the electronic housing.**
- **Avoid high pressure water-jets pointed at the venting.**
- **If the ambient conditions are very wet, we advise to use a venting through the cable. A special vented cable can be connected on request. (The normal venting will be removed) In that case the transmitter is IP68.**
- **The covers ① and ③must be fully engaged, so that moisture cannot ingress into the electronic housing.**
- **WARRANTY: 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 4000. Warranty will be given, to be decided by the manufacturer. Transmitter must be shipped prepaid to the factory on manufacturers authorization.
- **NOTE: 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.**