Operating Instructions

for

Double/Differential Second Portable Thermometer

Model: HND-T105

1. Contents

Manufactured and sold by:

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2. Note

Please read these operating instructions before unpacking and putting the unit into operation. Follow the instructions precisely as described herein.
The devices are only to be used, maintained and serviced by persons familiar with these operating instructions and in accordance with local regulations applying to Health & Safety and prevention of accidents.

When used in machines, the measuring unit should be used only when the machines fulfil the EC-machine guidelines.

3. Instrument Inspection

Instruments are inspected before shipping and sent out in perfect condition.
Should damage to a device be visible, we recommend a thorough inspection of the delivery packaging. In case of damage, please inform your parcel service / forwarding agent immediately, since they are responsible for damages during transit.

Scope of delivery:
The standard delivery includes:
- Double/Differential Second Portable Thermometer, model: HND-T105
- Operating Instructions

4. Regulation Use

Any use of the Double/Differential Second Portable Thermometer, model: HND-T105, which exceeds the manufacturer's specification may invalidate its warranty. Therefore, any resulting damage is not the responsibility of the manufacturer. The user assumes all risk for such usage.

5. Operating Principle

The KOBOLD manual temperature measuring units HND-T105 are highly precise, compact thermometers for PT100 4-wire-probes that can be used universally. The high degree of accuracy of these housings makes them extremely well suited for all calibration tasks. In conjunction with the appropriate temperature probes, precise measurement results over the entire measuring range can be achieved. Various probes are available for a multitude of measuring tasks and special applications. The respective measurement task determines which combination is selected. Naturally, these first-rate KOBOLD-measuring units can display more than just the temperature values. All housings in this series allow for minimum/maximum value memory, hold function, automatic self-shut-off, and zero point/increase entry, for example.

6. Electrical Connection

6.1 Mains Operation

Attention*:* When using a power supply unit, please note that operating voltage has to be 10.5 to 12 V_{DC}. Do not apply overvoltage!! Simple 12V-power supplies often have excessive no-load voltage. We, therefore, recommend using regulated voltage power supplies. Trouble-free operation is guaranteed by our power supply HND-Z002. Prior to connecting the plug power supply with the mains supply make sure that the operating voltage stated at the power supply is identical to the mains voltage.

- Treat device and probes carefully. Use only in accordance with above specification (do not throw, hit against etc.). Protect plugs and sockets from soiling.
- To disconnect sensor plug do not pull at the cable but at the plug.
- When connecting the probe the plug will slide in smoothly if plug is entered correctly.
- **Selection of Output-Mode**: The output can be used as serial interface or as analogue output. This choice has to be done in the configuration menu.

6.2 Battery Operation

The battery has been used up and needs to be replaced, if „bAt“ is shown in lower display.
The device however, will continue operating correctly for a certain time.
The battery has been completely used up, if ´bAt´ is shown in the upper display.
The battery has to be taken out, when storing device above 50 °C.

Hint: We recommend removing the battery if device is not used for a longer period of time!

7. Operation / Configuration / Adjustments

7.1 Safety Instructions

This device has been designed and tested in accordance to the safety regulations for electronic devices.
However, its trouble-free operation and reliability cannot be guaranteed unless the standard safety measures and special safety advises given in this manual will be adhered to when using it.

1. Trouble-free operation and reliability of the device can only be guaranteed if it is not subjected to any other climatic conditions than those stated under 8 Technical Information.
2. By transporting the device from a cold to a warm environment, condensation may result in a failure of the function. In such a case make sure the device temperature has adjusted to the ambient temperature before trying a new start-up.
3. The circuitry has to be designed most carefully if the device should be connected to other devices. Internal connection in third party devices (e.g. connection GND and earth) may result in not-permissible voltages impairing or destroying the device or another device connected.

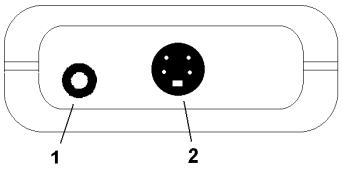
Warning: Operating the device with a defective mains power supply (e.g. short circuit from mains voltage to output voltage) may result in hazardous voltages at the device (e.g. at sensor socket)

4. Whenever there may be a risk whatsoever involved in running it, the device has to be switched off immediately and to be marked accordingly to avoid re-starting. Operator's safety may be a affected if:
   - there is visible damage to the device
   - the device is not working as specified
   - the device has been stored under unsuitable conditions for a longer time

   In case of doubt, please return device to manufacturer for repair or maintenance.

Warning: Do not use this product as safety or emergency stop device, or in any other application where failure of the product could result in personal injury or material damage.
Failure to comply with these instructions could result in death or serious injury and material damage.

7.2 Connections

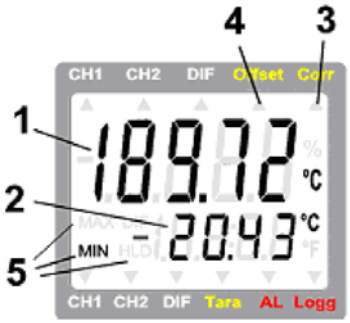


1 **Output:** Operation as interface: Connect to optically isolated interface adapter
(accessory: HND-Z031 / HND-Z032)
Operation as analogue output: Connection via suitable cable.
Attention: The output mode has to be configured and influences battery life!

2. **Probe connection** Pt100 4-wire

3. The **mains socket** is located at the left side of the instrument

7.3 Connections

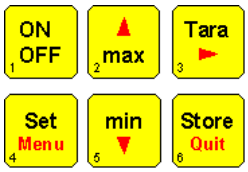


1 = Main Display: Currently measured temperature
2 = Auxiliary Display: Display of min, max or hold values

Special display elements:

3 = Corr-arrow: indicates that correction factor is activated
4 = Offset-arrow: indicates that zero point offset (offset) is activated
5 = Min/Max/Hold: shows if a min., max. or hold value is displayed in the secondary display

7.4 Pushbuttons



key 1: **On/Off key**

key 4: **Set/Menu**
press (Menu) for 2 sec.: configuration will activated

keys 2, 5: **min/max when taking measurements:**
press shortly: min. or max. measuring value will be displayed
press for 2 sec.: the min. or max. value will be deleted
up/down for configuration:
to enter values or change settings

key 6: **Store/Quit**:
- Measurement: Hold current measuring value ('HLD' in display)
- Menu: Acknowledge setting, return to measuring

key 3: no function

7.5 Device Configuration

For configuration of the device press "**Menu**"-key (key 4) for 2 seconds, the first menu will be shown. Choose between the individual values that can be set by pressing the "**Menu**"-key (key 4) again. The individual values are changed by pressing the keys "▲" (key 2) or "▼" (key 5).
Use key "**Quit**" (key 6) to leave configuration and to store settings.

7.5.1 'Unit': Selection of Temperature Unit °C / °F

°C: All temperature values are in degrees Celsius

°F: All temperature values are in degrees Fahrenheit

7.5.2 'Resolution': The Display Resolution

0.1°: Resolution 0.1 °C
0.01°: Resolution 0.01 °C
Auto: Resolution is selected automatically

7.5.3 'Offset': Zero Displacement

-2.50 °C...2.50 °C
respectively
-4.50 °F...4.50 °F
The zero point of the measurement will be displaced by this value to compensate for deviations in the temperature probe or in the measuring device

oFF: Zero displacement inactive (=0.0°)

7.5.4 'Scal': Scale Correction

-2.000...2.000: The scale of the measuring will be changed by this factor to compensate for deviations in the temperature probe or in the measuring device (factor is in %)

oFF: Scale correction factor inactive (=0.000)

7.5.5 'Power.off': Selection of Power-Off Delay

Power-off delay in minutes.

1...120: Device will be automatically switched off as soon as this time has elapsed if no key is pressed/no interface communication takes place

oFF: Power-off function inactive (continuous operation, e.g. mains operation)

7.5.6 'Out': Function of the Output

OFF: No output function, lowest power consumption

SEr: Output is serial interface

dAC: Output is analogue output 0...1 V

7.5.7 'Address': Selection of Base Address when Output = Serial Interface

01, 11, 21, ..., 91: Base address of device for interface communication.

7.5.8 'dAC.0Volt': Output Offset When Output = Analogue Output

-200.0...850.0 °C respectively -328.0...1562.0 °F

Enter desired temperature value at which the analogue output potential should be 0 V

7.5.9 'dAC.1Volt': Output Scale When Output = Analogue Output

-200.0...850.0 °C respectively -328.0...1562.0 °F

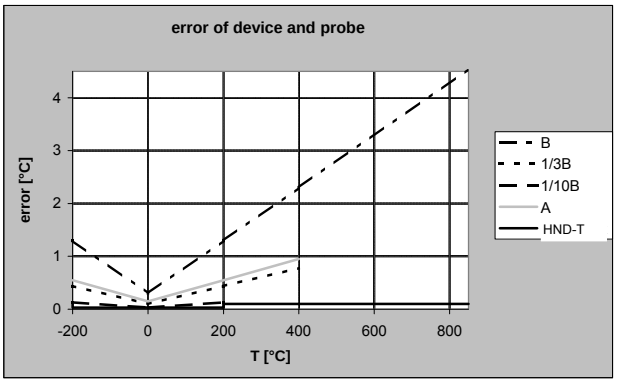
Enter desired temperature value at which the analogue output potential should be 1 V

Hint: The settings will be set to the settings ex works, if key 'Set' and 'Store' are pressed simultaneously for more than 2 seconds.

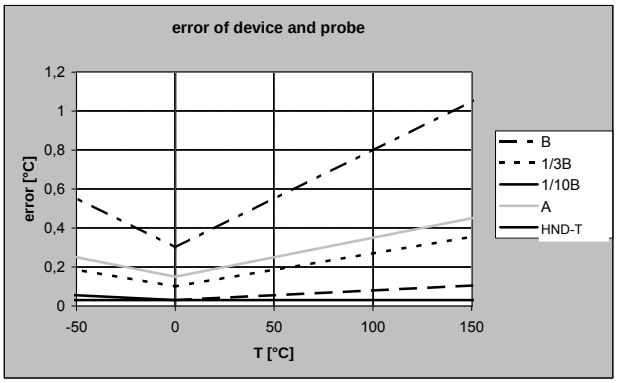
7.6 Some Basics of Precision Temperature Measuring

- **Probe Precision/Device Precision**
  The device is very precise (please refer to technical data). To be able to use this high precision, the connected temperature probe has to be as precise as possible, too. The following precision classes are available as a standard at reasonable prices (Platinum resistor thermometers according to EN60751):

Class	Error ranges
B	**± (0.3 + 0.005 • |temperature|)**
1/3 B (=1/3 DIN)	**± (0.1 + 0.0017 |temperature|)**
1/10 B (=1/10 DIN)	**± (0.03 + 0,0005 • |temperature|)**
A	± (0.15 + 0.002 • |temperature|)



Error over measuring range



Error over range –50...150 °C

For applications demanding higher precision than given by this classes we suggest to adjust the device to the used probe or to get a calibration certificate for the device combined with the probe.
When demanding highest possible precision we suggest the usage of the instrument HND-T205.

Attention: if an adjusted or calibrated probe is replaced, also the adjustment or calibration certificate has to be renewed to maintain the referring overall precision!

Be careful when buying third party temperature probes: Besides the standard EN60751 there are some other obsolete or unusual standards on the market. If such a probe has to be connected, the HND-T205 should be used instead!

4-Wire-Measuring
When using resistance thermometers as the Pt100, a quite large measuring error can be caused by inadequate cables and connections. Using 4wire measuring avoids these kinds of errors mainly caused by unwanted resistances. It is suggested to use suitable probes and extensions only. (For pin assignment please refer to chapter 7.9 Probe pin assignment)

Heat loss caused by probe construction:
Especially when measuring temperatures which deviate very much from the ambient temperature, measuring errors often occur if the heat loss caused by the probe is not considered. When measuring fluids therefore the probe should be emerged sufficiently deep and be stirred continuously. When measuring gases the probe should also emerge as deep as possible in the gas to be measured (e.g. when measuring in channel/pipes) and the gas should flow around the probe at sufficient flow.

Measuring Surface Temperature
If temperature of the surface of an object has to be measured, one should pay attention especially when measuring hot (or very cold) surfaces, that the ambient air cools (or heats) the surface. Additionally the object will be cooled (or heated) by the probe or the probe can have a better heat flow to the ambient temperature as to the objects surface. Therefore specially designed surface probes should be used. The measuring precision depends mainly on he construction of the probe and of the physics of the surface itself. If choosing a probe try to choose one with low mass and heat flow from sensor to handle. Thermally conductive paste can increase the precision in some cases.

Allowable temperature Range of Probes
Pt100 Sensors are defined over a wide temperature range. Depending on probe materials and sort of sensor (e.g. hybrid sensors, wire wound resistors...) the allowable temperature ranges have to be considered. Exceeding the ranges at least causes a wrong measuring, it may even damage the probe permanently! Often it also has to be considered, that the temperature range is just valid for the probe tube, (plastic-) handles can't stand the same high temperatures. Therefore the tube length should be selected long enough, so that temperature keeps low at the handle.

Self Heating
The measuring current of the instrument is just 0.3 mA. Because of this comparably low current practically now self heating effect has to be considered, even at air with low movement the self heating is <= 0.01 °C.

Cooling by Evaporation
When measuring air temperature the probe has to be dry. Otherwise the cold due to the evaporation causes too low measurings.

7.7 Special Functions

7.7.1 Display Resolution

Standard setting: 'Auto', i.e. the device automatically switches over to the optimum resolution between .01° and 0.01°.
If temperatures to be measured are near the switching threshold, a fixed resolution may be better, e.g. for easy recording. In such a case please select the optimum resolution manually.

7.7.2 Zero Displacement ('Offset')

A zero displacement can be carried out for the measured temperature:

temperature displayed = temperature measured - offset

Standard setting: 'off' = 0.0°, i.e. no zero displacement will be carried out. Together with the scale correction (see below) this factor is mainly used to compensate for sensor deviations. Unless the factor is set to 'off', the offset arrow in the display shows an active zero displacement.

7.7.3 Scale Correction ('Scale')

The scale of the measuring can be influenced by this setting (factor is in %):

displayed temperature[°C] = measured temperature[°C] * (1+Scal/100)
respectively displayed temperature[°F] = (measured temperature [°F]-32 °F) * (1+Scal/100) + 32 °F

Standard setting: 'off' =0.000, i.e. temperature is not corrected. Together with the zero displacement (see above) this factor is mainly used to compensate for sensor deviations.
Unless the factor is set to 'off', the Corr arrow in the display shows an active scale correction.

7.7.4 Output

The output can be used as serial interface (for HND-Z031) or as analogue output (0-1V). If none of both is needed, we suggest switching the output off, because battery life then is extended.

7.7.4.1 Interface - Base Address ('Adr.')

By using an electrically isolated interface converter HND-Z031 or HND-Z032 (accessory) the device can be connected to a PC. In order to avoid transmission errors, there are several security checks implemented (e.g. CRC).

The following standard software package is available for data transfer:

BUS-S20M Software for recording measurement data on a computer, for instruments of the HND-series without logger function

Note: The measuring and range values read via interface are always in the selected display unit (°C/°F)!

Supported interface functions:

Code	Name/Function	Code	Name/Function
0	read nominal value	200	read min. display range
3	read system status	201	read max. display range
6	read min. value	202	read unit of display
7	read max. value	204	read decimal point of display
12	read ID-no.	208	read channel count
174	delete min. value	214	read scale correction
175	delete max. value	215	set scale correction
176	read min measuring range	216	read zero displacement
177	read max measuring range	217	set zero displacement
178	read measuring range unit	222	read power-off time
179	read measuring range decimal point	223	set power-off time
180	read measuring type	240	Reset
194	set display unit	254	read program identification
199	read meas. type in display		

7.7.4.2 Analogue Output – Scaling with DAC.0 and DAC.1

With the DAC.0 and DAC.1 values the output can be rapidly scaled to Your efforts.

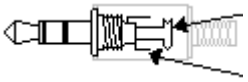
Keep in mind not to connect low-resistive loads to the output, otherwise the output value will be wrong and battery life is decreased. Loads up to ca 10kOhm are uncritical.

If the display exceeds the value set by DAC.1, then the device will apply 1V to the output.

If the display falls below the value set by DAC.0, then the device will apply 0V to the output.

In case of an error (Err.1, Err.2, no sensor, etc.), the device will apply slightly above 1V to the output.

plug wiring:



GND

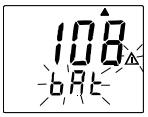
+Uout

Attention!

The 3rd contact has to be left floating!

Only stereo plugs are allowed!

7.8 Fault and System Messages

Display	Meaning	Remedy
	low battery voltage, device will continue to work for a short time	replace battery
	If mains operation: wrong voltage	replace power supply, if fault continues to exist: device damaged
	low battery voltage	replace battery
	If mains operation: wrong voltage	Check/replace power supply, if fault continues to exist: device damaged
No display or weird display Device does not react on keypress	low battery voltage	replace battery
	If mains operation: wrong voltage	Check/replace power supply, if fault continues to exist: device damaged
	system error	Disconnect battery or power supply, wait some time, re-connect
	device defective	return to manufacturer for repair
Err.1	Value exceeding measuring range	Check: Is the value exceeding the measuring range specified? ->temperature too high!
	Wrong probe connected	Check probe
	sensor/cable defective	-> replace
Err.2	Value below display range	Check: Is the value below the measuring range specified? -> temperature too low!
	Wrong probe connected	Check probe
	sensor/cable defective	-> replace
Err.3	Value exceeding display range	-> set resolution to 0.1° or Auto
Err.4	Value below display range	-> set resolution to 0.1° or Auto
Err.7	system error	return to manufacturer for repair

7.9 Probe pin assignment

The device is constructed for the connection of a Pt100 4-wire probe. The connection is being carried out as follows:

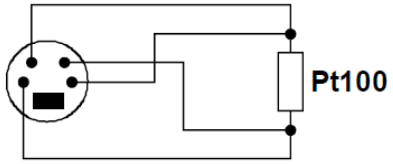
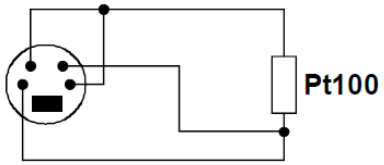
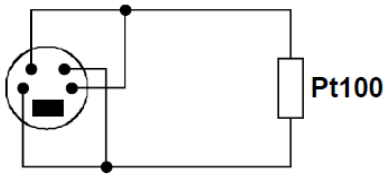


figure shows view upon probe jack pins

It is also possible to connect a 3- or 2-wire probe to the device. Please observe that in consequence of the cable resistance an increased measuring fault will occur. The connection of these probes should be carried out as follows:



3-wire connection



2- wire connection

8. Technical Information

Measurement input:	Pt 100, 4-wire, in accordance with DIN EN 60751
Measuring range:	-199.99...+199.99 °C or -200.0...+850.0 °C (Fahrenheit values accordingly)
Accuracy:	(at nominal temperature 25 °C) ≤ 0.03 °C in the range -199.99...199.99 °C ≤ 0.1°C ±1 digit in the range 200.0...850.0 °C
Resolution:	0.01 °C or 0.1 °C (0.01 °F or 0.1 °F)
Display:	2x 4 ½-digit LCD
Operating temperature:	-25 to +50 °C
Storage temperature:	-25 to +70 °C
Storage humidity:	0 to 95 % rH (non-condensing)
Probe connection:	4-pin shielded Mini-DIN plug
Output:	0-1 V, freely scalable or serial interface (via 3-pin jack, transformer on RS232 or USB optional)
Power supply:	9 V-monobloc battery (included in the scope of delivery), external 10.5 -12 V_{DC} via jack
Current consumption:	approx. 1 mA
Material:	housing made of impact-resistant ABS plastic
Protection:	IP 65, front
Dimensions:	142 x 71 x 26 mm (H x W x D)
Weight:	approx. 155 g

Scope of functions

- Minimum/maximum value memory
- Hold function: »freezing« of the current value
- Automatic-off function: 1...120 min (can be deactivated)
- Zero point and increase entry: zero point and increase correction can be entered digitally

9. Order Codes

Order-no.	Housing design
HND-T105	Pt 100 input, standard

9.1 PT100-measuring probe Class B

Probe type	Temperature/ response time (t_{90})	Order-no.
Immersion probe for liquids and gases, 4-wire Rustproof V4A-tube, plastic handle, approx. 1m 4-pin PVC-cable, strain relief screw connection, 4-pin Mini-DIN plug	-50...+400 °C approx. 10 sec	**HND-TF01**
Immersion probe for liquids and gases, 4-wire Like HND-TF01, but with 1/3 DIN Class B (±0.1°C at 0°C)	-50...+400 °C approx. 10 sec	**HND-TF02**
Immersion probe for liquids and gases, 4-wire Like HND-TF01, but with 1/10 DIN Class B (±0.03°C at 0 °C) and flexible sheath tube, Ø 3 mm	-50...+400 °C approx. 10 sec	**HND-TF03**
Insertion probe for soft, plastic media, 4-wire Techn. data like HND-TF01, but with needle-shaped knife-edge tip	-50...+400 °C approx. 10 sec	**HND-TF04**
Insertion probe for soft, plastic media, 4- wire Like HND-TF04, but with 1/3 DIN Class B (±0.1°C at 0°C)	-50...+400 °C approx. 10 sec	**HND-TF05**
Immersion probe for liquids and gases, 4- wire Rustproof V4A-tube, approx. 1 m 4-pin PVC-cable, 4-pin Mini-DIN-plug	-50...+400 °C approx. 10 sec	**HND-TF06**

9.2 Accessories

Description	Order no.
Plug power supply unit (220/240 V, 50/60 Hz), 10.5 V/10 mA	**HND-Z002**
Protective housing bag, nappa leather, with cut-out for round sensor connection for HND-T105, HND-T205	**HND-Z011**
Protective housing bag, nappa leather, with cut-out for square sensor connection for HND-T110, HND-T120, HND-T125	**HND-Z013**
Protective housing bag, nappa leather, with cut-out for two sensor connections for HND-T115 and HND-T215	**HND-Z014**
Case with recess (275x229x83 mm)	**HND-Z021***
Universal case with egg crate foam (275x229x83 mm)	**HND-Z022***
Large case with recess (394x294x106 mm)	**HND-Z023***
Interface converter on RS232, galvanically isolated	**HND-Z031**
Interface converter on USB, galvanically isolated	**HND-Z032**
Adapter RS232 converter on USB-interface	**HND-Z033**
Windows software for setting, data read out, and printing of the data of housings of the HND-series with logger function	**HND-Z034**
Software for recording measurement data on a computer, for instruments of the HND-series without logger function	**BUS-S20M**
Flat connector type N, free of thermoelectric voltage, for connection of thermocouple element probe HND-TF21/22/23	**HND-Z041**

Additional probe accessories upon request

* Observe instrument dimensions

10. EU Declaration of Conformance

We, KOBOLD Messring GmbH, Hofheim-Ts, Germany, declare under our sole responsibility that the product:

Double/Differential Second Portable Thermometer HND-T105

to which this declaration relates is in conformity with the standards noted below:

EN 61326-1:2013
Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements

EN 50581:2012
Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Also the following EC guidelines are fulfilled:

2014/30/EU Electromagnetic compatibility
2011/65/EU **RoHS** (category 9) industrial monitoring and control instruments, compliant, no CE-marking for the transitional period until 2017

Hofheim, 13. Oct. 2016

H. Peters
General Manager

M. Wenzel
Proxy Holder