Driesen+Kern GmbH

DKP1010 & DKP102X Series

Differential & Barometric Pressure Transmitters

Manual



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Introduction **3**
1 General Information **4**
1.1 Product Description 4
2 Installation **5**
2.1 Mounting the Transmitter 5
2.2 Assembling the Radiation Protector 5
2.3 Electrical Installation 6
2.3.1 Voltage Supply and Analog Outputs (Three-Wire) 6
2.3.2 Voltage Supply and Analog Output (Two-Wire) 7
2.4 Connecting Absolute Pressure (DKP102X) 8
2.5 Connecting Differential Pressure (DKP1010) 8
2.6 Calculating Air Velocity and Volumetric Flow Rate 8
2.7 Connecting Thermocouples 9
2.8 Connecting Temperature Sensors 9
2.9 Connecting a Humidity/Temperature Sensor 9
3 LCD **10**
4 Digital Interfaces **11**
4.1 RS485 Interface 11
4.1.1 Interface Specifications – General 12
4.1.2 Interface – Command Syntax 12
4.1.3 Interface – Changing the RS485 Address 13
4.2 RS232 Interface 14
4.3 USB Interface 15
5 Configuration **16**
5.1 Command Set 16
5.2 Live Readings 17
5.3 Output Configuration 17
6 Calibration **18**
6.1 On-site Calibration (Adjustment) 18
6.2 Restore Factory Calibration 18
7 Alarm Function **19**
7.1 Threshold Exceedance with Hysteresis 20
7.2 Setting Up the Alarm 21
8 Important Notes on Humidity Measurements **22**
8.1 Stable Environmental Conditions 22
8.2 Limitations of Use 22
8.2.1 Chemicals 22
8.2.2 High Humidity 22
8.2.3 High Temperature & High Humidity 23
8.2.4 Low Humidity 23
9 Maintenance **23**
9.1 Differential Pressure Transmitter Zero Point Calibration 23

Introduction

In this manual you will find information about how to set up and use the pressure transducer series DKP1010 and DKP102X (including models DKP1020, DKP1021, DKP1023 and DKP1026).

If there are any problems with the instruments, please try to solve them with the help of this manual first.

If you can't find a solution to your problem in this manual or if the transmitter is defective, please do not hesitate to contact Driesen + Kern GmbH or your distributor.

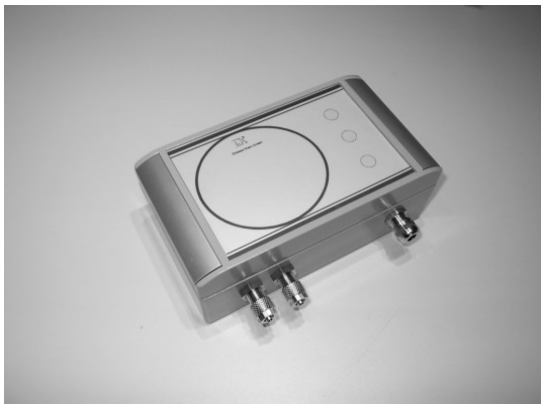
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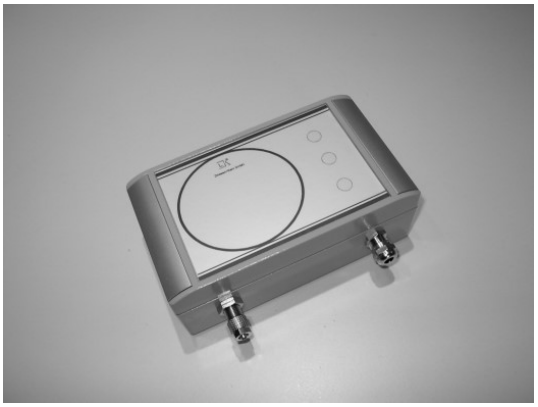
1 General Information

1.1 Product Description

DKP1010 Differential Pressure Transmitter



DKP1020 Barometric Pressure Transmitter



Both transmitter models are available in two- and three-wire technology. Two-wire models feature measurement output through a current loop which is why these models have only one analog output and not the same options for the output as the three-wire models.

The transmitters are based on a modular design and can be customised according to your requirements.

The following options are available:

DKP1010:

- Measurement range selection
- Output configuration
- Alarm function with selectable thresholds
- External PSU for 230V power outlets (cable directly fed into housing), optionally with detachable plug
- Backlit LCD
- Thermocouple connector (ISA socket)
- PT1000 connector
- Humidity/Temperature sensor (heated version for high humidity applications on request)
- Root extraction for air velocity or volumetric flow calculation
- Atmospheric density correction based on the measured temperature
- Additional interface (RS232 or RS485) besides the USB interface

DKP102X:

- Measurement range selection
- Output configuration
- Alarm function with selectable thresholds
- Extrnal PSU for 203V power outlets (cable directly fed into housing), optionally with detachable plug
- Backlit LCD
- Humidity/Temperature sensor (heated version for high humidity applications on request)
- Additional interface (RS232 or RS485) besides the USB interface

Refer to the respective data sheets of DKP1010 and DKP102X for more detailed information about all modules and options.

2 Installation

2.1 Mounting the Transmitter

The pressure transducers DKP1010 and DKP102X are high-precision devices and should be handled carefully, regardless. It is not recommended to install the transmitter next to sources of heat or radiation. It should be mounted vertically on a vibration-free wall, i. e. with the pressure ports (+) and (-) facing down to the floor.

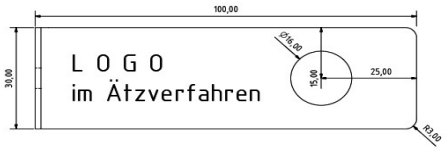


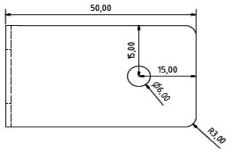
Remove the small protective covers to the left and right of the transmitter housing.

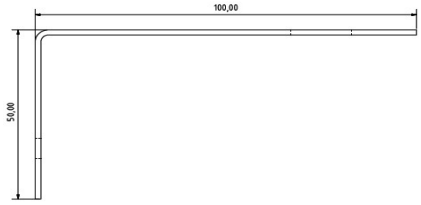
Underneath the covers, locate the two holes and the two Phillips on each side. Loosen the screws in order to open the housing cover.

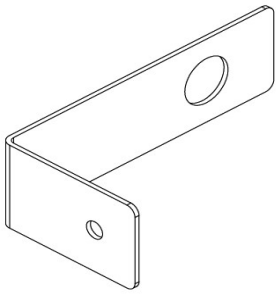
Use the two spare holes on each side to fix the transmitter to the wall, tighten the four screws holding the housing cover and reattach the protective covers.

2.2 Assembling the Radiation Protector









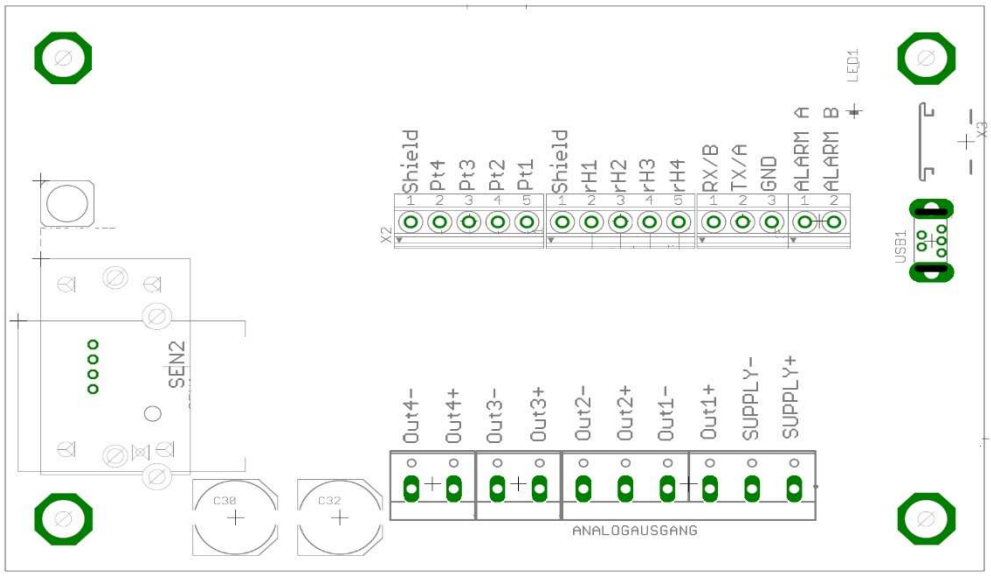


Apply the wall mount to the respective wall. Carefully insert the humidity and temperature probe through the hole in the wall mount into the radiation protector and tighten the cable gland.

2.3 Electrical Installation

Open the housing cover as described in chapter 2.1. Before connecting analog outputs please make sure to verify whether your model is in two- or three-wire technology. This reduces the risk of damaging the transmitter during installation. You can find this piece of information on the type label on the housing.

2.3.1 Voltage Supply and Analog Outputs (Three-Wire)



Voltage Supply:

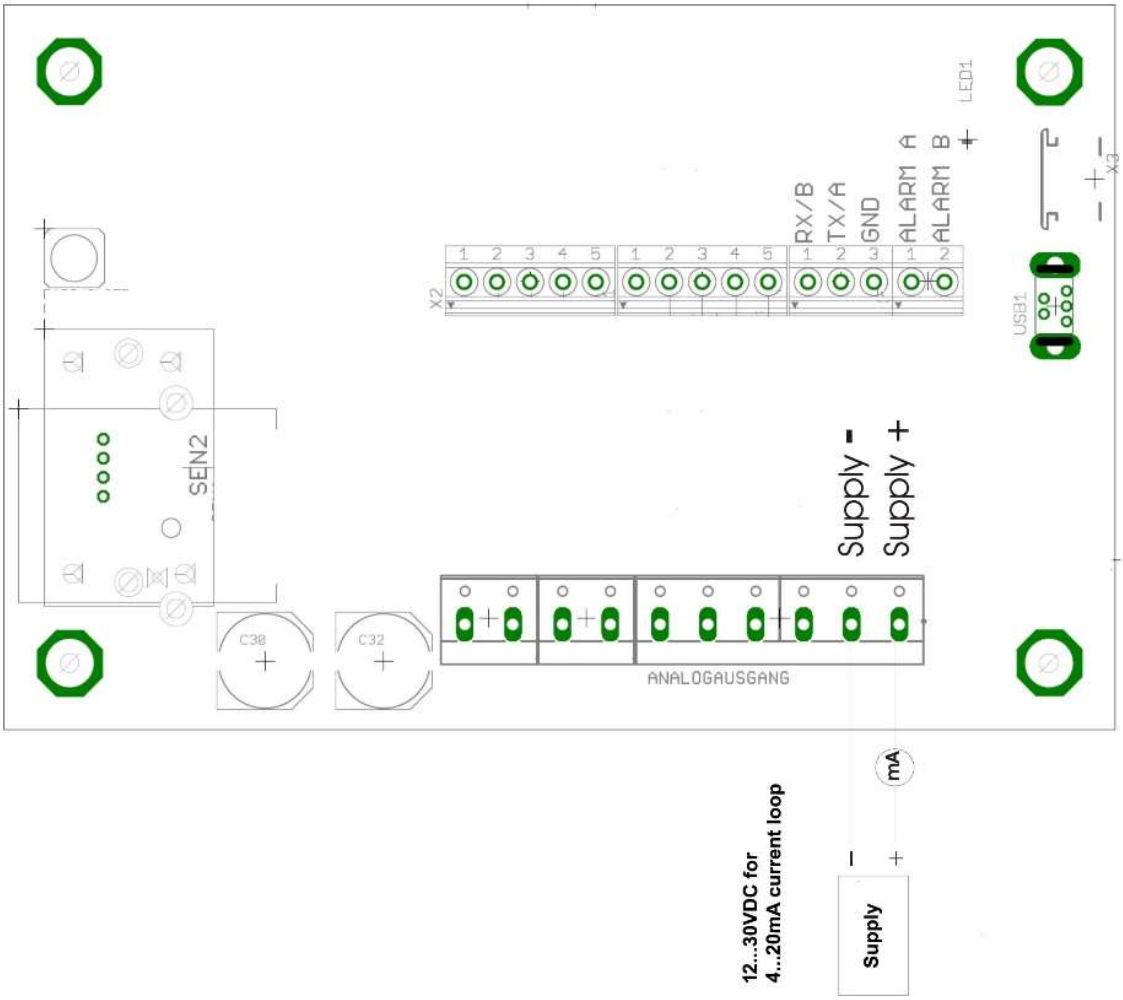
If your transmitter came with a DC power connector and an external PSU you can just plug it in.
Otherwise, an external supply voltage of **12...30VDC** (direct voltage!) needs to be connected to the corresponding pins (“SUPPLY“).

Analog Outputs:

The transmitter can be made to have up to four analog outputs. Output and signal (0...10V or 4...20mA) assignment/allocation is specified on the type label.

Make sure to connect the output signals correctly signed to other devices (e. g. PLCs, data loggers, DVMs etc.).

2.3.2 Voltage Supply and Analog Output (Two-Wire)



Voltage Supply Through the Analog Output:

This model comes with only one current loop analog output (4...20 mA) which means power needs to be supplied to the output. Configuration is specified on the type label.

2.4 Connecting Absolute Pressure (DKP102X)

With the barometric pressure transmitters DP102X, the outside fittings are internally connected to the pressure sensor. No other connection is necessary, but may also be established through another tubing when remote measurements (e. g. in another room or within a climate chamber) need to be performed.

2.5 Connecting Differential Pressure (DKP1010)

Differential pressure transmitter DKP1010-A works based on a flow measurement principle. This is very accurate for low pressure readings and has an excellent zero-point stability. On the other hand, however, the length and diameter of the tubing have to be taken into consideration. We highly recommend tubes with a minimum inside diameter of 6 mm.The following table shows effects of tube lengths on measurement accuracy.

Differential Pressure [Pa]	Tube Length [m]				
	0.5	1.0	2.0	4.0	10.0
0	-0.5 %	-1.0 %	-2.0 %	-4.0 %	-10.0 %
20	-0.3 %	-0.7 %	-1.4 %	-2.7 %	-6.8 %

Other versions of the DKP1010 (for B-E, see data sheet) use a piezo-resistive pressure sensor element. In this case, the pressure needs to be applied to the pressure ports with correct polarity. Positive pressure is the “+“ input, negative pressure is the “-“ input.

2.6 Calculating Air Velocity and Volumetric Flow Rate

If the option was purchased, the DKP1010 can calculate air velocity as well as volumetric flow rate and provide the results at the analog output. The following formula is used for the conversion:

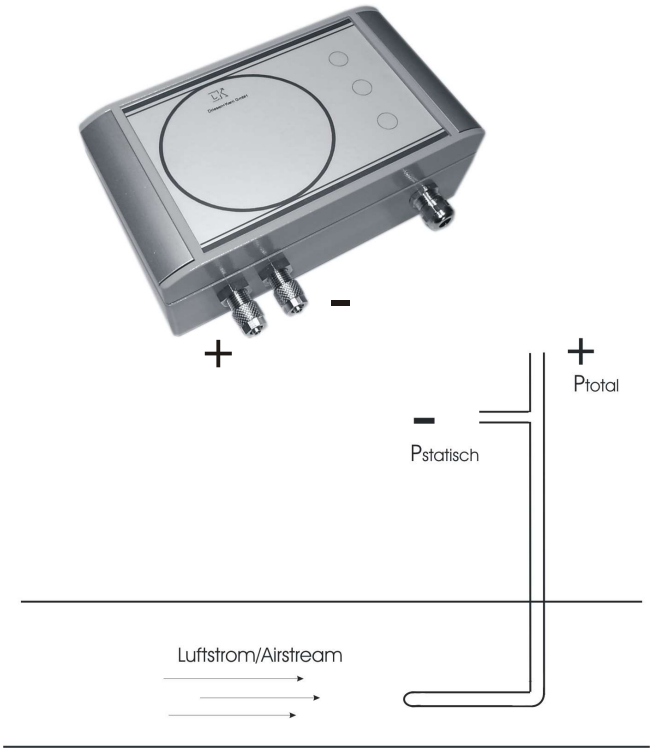
$$V = \sqrt{\frac{2 * DeltaP}{\rho}} * A$$

ρ = Atmospheric density, A = Area, DeltaP = Differential Pressure

Connect the Pitot tube as shown on the right.

If temperatur compensation is required, it will be included in the calculation of the atmospheric density.

A specific Pitot tube with attached thermocouple type “K“ can be connected to an mini ISA slot of DKP1010s which were equipped with a thermocouple input.



2.7 Connecting Thermocouples

Thermocouples type “K“ can be connected to the DKP1010 if the option has been purchased.

The mini-ISA socket for the thermocouple is located between the pressure ports and the electrical connectors.

With the additional analog output assigned to the thermocouple the type label shows the measurement range and the corresponding output signal.

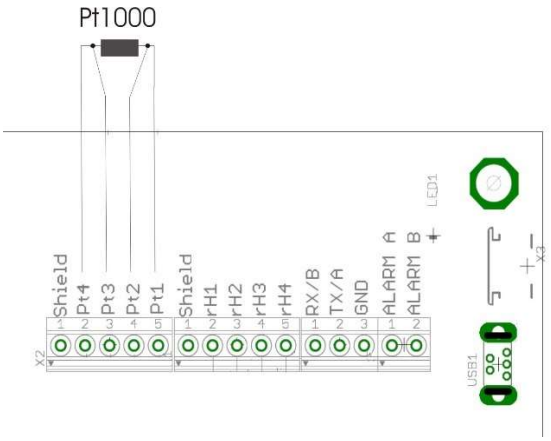


2.8 Connecting Temperature Sensors

Another purchasable option is for connection with an external temperature sensor. In this case the transmitter comes with an input for a PT1000 four-wire temperature sensor. See the pin allocation on the right. For two- or three-wire elements the unused pins need to be bridged, e. g. with an adapter.

If you have simultaneously purchased an external temperature sensor along with the transmitter, it will be connected ex works.

With the additional analog output assigned to an external temperature sensor the type label shows the measurement range and the corresponding output signal.



2.9 Connecting a Humidity/Temperature Sensor

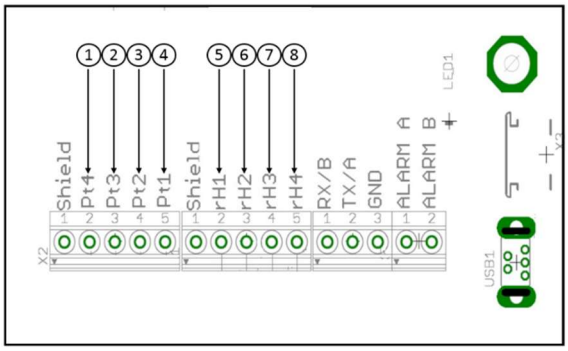
DKP1021 and DKP1023 always come with an additional combined humidity and temperature sensor.

Wire assignment is as follows:

1.	Brown	5.	Green
2.	Orange	6.	Yellow
3.	Blue	7.	Black
4.	White	8.	Red

When ordering a DKP1010 with the same option, the wire assignment is also the same.

The type label shows the configuration of the analog output of the temperature and relative humidity, the respective measurement ranges and output signals.



3 LCD

An LCD is optionally available for the transmitter. It shows the same readings which are being provided at the analog outputs at the same time.

It also shows occurring alarms or errors. The corresponding icons appear at the top of the screen.



Icons:

← ↑ ↓ → All arrows flashing simultaneously = Sensor error

Bell icon = Alarm currently active

Computer icon = Calculations are being made.

Battery icon = Power supply established (flashes if supply too low)

4 Digital Interfaces

The transmitters can additionally be equipped with a digital interface – either with RS232 or RS485.

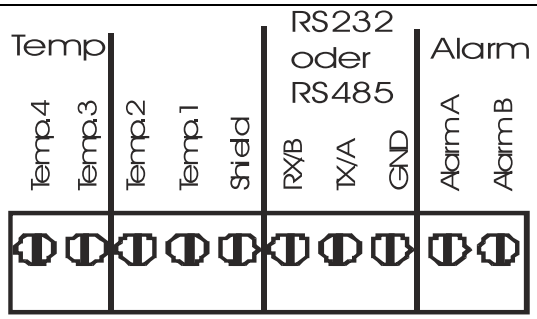
Assignment:

RS232

Rx/B	Red
Tx/A	Brown
GND	Black

RS485

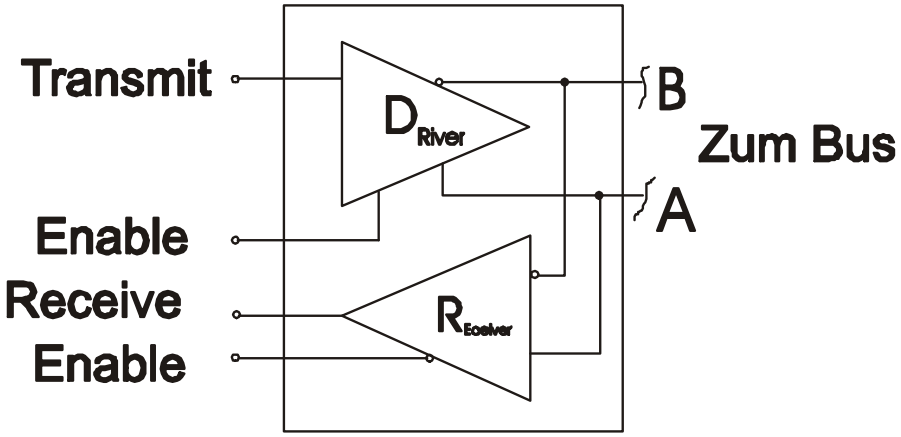
Rx/B	Red
Tx/A	Brown
GND	NC



4.1 RS485 Interface

By default, the DKP10XX comes with a USB port (refer to chapter 4.3) which can be used for configuration. Optionally, an electrically isolated RS485 or RS232 interface can be implemented.

Typical Layout of RS485:



Thanks to the RS485 interface at least 56 transmitters of the same model plus one master can be connected without additional electronics assembly.

Bus Specification:

- Standard RS485, two-wire half-duplex
- -7V to +10V Common-Mode Input Voltage

4.1.1 Interface Specifications – General

Transmission Specifications	
Baud rate	9600
Data bits	8
Parity	none
Stop bits	1
Encoding	1 byte per character
Probe echo	off

4.1.2 Interface – Command Syntax

Refer to chapter 5.1 for a list of commands.

Command syntax for the digital interfaces includes the command consisting of several ASCII characters as well as a carriage return as terminator. The RS485 interface requires a prefix and an address before the command. Address and command are separated by a space (ASCII code 32dez or 0x20hex). There is no checksum function. The address consists of several ASCII characters in plain text, too (ranging from 0...255). Upon delivery the address is 0 by default.

Command Syntax: *PREFIX ADDRESS* 0x20 *COMMAND* CR

The prefix is optional and is used for synchronization on the bus. It is comprised of 3 bytes and looks as follows:

?#: = ASCII Code 0x3Fhex 0x23hex 0x3Ahex

The address has to trail the prefix immediately and without a space.

Codes are:

[SPACE] = ASCII Code 32dez / 0x20hex

[CR] = ASCII Code 13dez / 0x0dhex

[TAB] = ASCII Code 09dez / 0x09hex

Syntax of the sensor response is as follows:
Sensor reading [SPACE]°C[TAB]**Sensor reading** [SPACE]%[CR]
(This represents a configuration with disabled pressure sensor)

Sensor reading **always has a constant length** of **8 characters** including 3 integer places, 3 decimal places and a decimal separator. Algebraic sign (only –) is shown if necessary. Free places are filled with space characters.
A negative value is represented by a minus sign, however this minus sign is not necessarily the first character.
Example: the 8 characters for the value -0.3 would be represented by [SPACE][SPACE]-0.300, making the first two characters spaces insted of more zeros following the minus sign.

Example: Non-recurring data transmission of sensor readings at address "0":

Command: 0[SPACE]Meter[CR]
Response: T : 23.159 °C [TAB]rH: 34.240 % [TAB][CR]

4.1.3 Interface – Changing the RS485 Address

Command: 0[SPACE]commconfig[CR]
Response:
Transmitter responds:
Set basic communication mode for host communication.[CR][LF]
(1)..RS485 addressable (2)..RS232 none addressable ? >

Transmitter is waiting for input:
Enter 1[CR] for RS485 mode.

Transmitter responds:
RS485 address (0) ? >

Transmitter is waiting for input:
Enter digit between 0...255 and send: 12[CR]

Transmitter responds:
Send startup info via RS485 on booting?[CR][LF]
(1)..no (2)..yes ? >

Transmitter is waiting for input:
Enter 1 (disabled/hidden) or 2 (enabled/shown):
2[CR]

Transmitter responds:
Echo disabled![CR][LF]
Wait for RESET System to activate the new settings: 1

Caution: Entering values deviating from the valid range causes the transmitter to respond with:

[CR][LF]…out of range![CR][LF]>

Repeat with a valid input.

Caution: Entering values which are not numerary causes the transmitter to respond with:

[CR][LF]…incorrect![CR][LF]>

Repeat with a valid input.

After 5 seconds the device resets itself and shows the startupinfo (if enabled). It is now ready for use with the new address 12.

If startup info upon POR (power on reset/switching on) is enabled, the transmitter performs an internal systems check and outputs certain parameters through the RS485 interface. This includes the current RS485 address. The startup info screen looks like this:

```
RESET vector!
-MultiSensorPlatform-Transducer DKP10XX series H.V. 4.1
S.V. 4.0.162 build Nov 27 2014 14:10:36 compiler 640 748
(c) Driesen+Kern GmbH Bad Bramstedt Germany
www.driesen-kern.com
SerialNumber: K-10010100222
input range1:    0…1000 Pa    --> output range1:      0 -  10000 mV


RS485 address:  12
```

Current RS485 address, in this case 12.

Changing the address on a windows computer requires a terminal application, such as PuTTY, and an RS485 to RS232 converter. The latter can be purchased from Driesen+Kern GmbH.

Do not use config during RS485 operation. It is meant for one-time parametrization of the transmitter with a terminal program.

4.2 RS232 Interface

By default, all DKP10XX models come with a USB port (refer to chapter 4.3) which can be used for configuration. Optionally, an RS485 or RS232 interface can be implemented which can be used for custom communication. Refer to chapter 5.1 for the available commands.

4.3 USB Interface

The USB interface is used for configuring the transmitter and also for communicating with it. Install the VCP USB driver before connecting a transmitter. You can download the zipped file (VCP_WindowsUSBDriver.zip) from the Driesen + Kern website:

Website: www.driesen-kern.com/updates/
Download link: www.driesen-kern.de/downloads/VCP_WindowsUSBDriver.zip

Select one of the following options after unpacking the ZIP file:

64 bit Computer: CP210xVCPInstaller_x64.exe
32 bit Computer: CP210xVCPInstaller_x86.exe

Run the appropriate file and follow the instructions. After installation was successful, connect the transmitter to the computer with a micro USB cable (type B). Upon connection a virtual COM port is being created. Locate the corresponding port address in Control Panel > Device Manager > Ports (COM & LPT).

Run a terminal programm and enter the port address of the virtual COM port.
Transmission specifications:

Baud rate:	9600
Data bits:	8
Parity:	none
Stop bits:	1
Data flow control:	none

5 Configuration

5.1 Command Set

A command includes the data string in ASCII and a carriage return at the end.

Command Syntax: *COMMAND* CR

The following commands are supported by the DKP1010 and DKP102X models.

Command	Description
COMMCONFIG	Sets communication mode, RS485 or RS232, and address.
ECHO	Enables/disables commands being shown on screen. This option should be enabled when working with a terminal application.
INFO	Non-recurring transmission of device info (including firmware version).
METER	Non-recurring transmission of measured variables (e. g. pressure and temperature).
METER ALL	Non-recurring transmission of measured and calculated variables
METERMODE	Periodic transmission of measured variables every 2 seconds (e. g. pressure and temperature).
METERMODE ALL	Periodic transmission of measured and calculated variables every 2 seconds.
S	Quits Meter Mode
USCAL	On-site user calibration of sensors
CONFIG	Assigns measured variables to analog outputs and allows scaling.
REFACUSCAL	Factory reset.
SETALARM	Define alarm thresholds.

Commands are not case-sensitive.

5.2 Live Readings

METER <cr>:	Transmitter sends current measured values once. Note that only measured variables are being transmitted which have been assigned to an analog output.
METER ALL <cr>:	Transmitter sends current measured as well as calculated variables once.
METERMODE <cr>	Transmitter continuously sends current measured values. Note that only measured variables are being transmitted which have been assigned to an anlog output.
METERMODE ALL <cr>:	Transmitter continuously sends current measured as well as calculated variables.

5.3 Output Configuration

CONFIG <cr> Use config to select a measured variable to be assigned to an analog output and also define the limits of the electrical output signal as shown below.

config
Transmitter configuration for 0..1/5/10 V outputs
OutputChannel (1) or (2) ? >1 Define limits of electrical output 1
Minimum [mV](0.. 12000) ? >**0** Maximum [mV](0.. 12000) ? >**10000**
Choose output signal on output 1
(0)..nothing, no output [-----]
(1)..AirTemperature ['C]
(2)..diff.Pressure [Pa]
(3)..AirVelocity [m/s]
(4)..Flowrate [m3/h]
(5)..Flowrate [l/s]
? >4 Define physical limits of Flowrate on output 1
Minimum [m3/h] (0.. 100000) ? >**0**
Maximum [m3/h] (0.. 100000) ? >**1000**
Setup additional parameters for Flowrate:
Type of area on duct:
(1)..circle (2)..rectangle ? >**1**
Diameter [mm] (300) ? >**300**
barometric pressure [hPa] (1013.25) ? >**1013.25**
configuration change successfully finished.
You can use following formular to calculate the physical parameter [m3/h]from the Transmitters output [mV]
[m3/h] = 0.000 + 1.000 * x [mV]

After these steps the DKP10XX is now programmed and shows its configuration on screen.

6 Calibration

6.1 On-site Calibration (Adjustment)

The transmitter's measured variables can be adjusted with an on-site calibration.

A calibration is to be performed by trained personnel only!

A calibration is to be performed with reliable, accurate and safe testing equipment only!

Make sure to follow the procedure explained in chapter 9 and only confirm calibration points after readings have stabilised.

Procedure:

USCAL <cr>
Transmitter input sensor user calibration:
Choose sensor channel:
(1)..AirTemperature [°C]
(2)..diff.Pressure [Pa]
? >**1**
Choose the calibration points for AirTemperature [°C]
(1).. Offset calibration on one point
(2).. Offset & span calibration on two points
? >**2**
2 points sensor calibration on input channel 1
Apply stable reference condition to sensor.
Then type in reference value after sensor has reached stable condition.
point 0: (press spacebar to enter ref. value!) -20.20 °C
Reference value [°C] on point 0: ? **>-20**
point 1: (press spacebar to enter ref. value!) 79.80 °C
Reference value [°C] on point 1: ? >**80**
...sensor user calibration successful

6.2 Restore Factory Calibration

Restoring the factory calibration needs to be done for each channel individually.

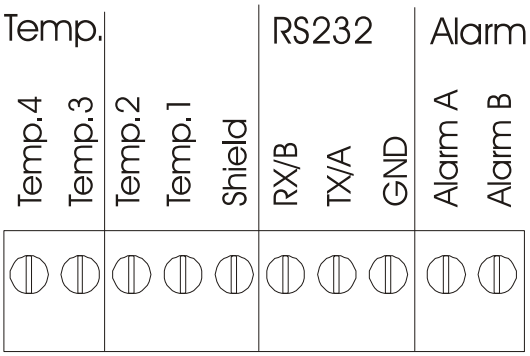
REFACUSCAL<cr>
Transmitter input sensor reset to factory calibration:
(1)..Yes (2)..Cancel ? >**1**
(1)..Cancel (2)..ReallyYes ? >**2**
(1)..AirTemperature [0C]
(2)..diff.Pressure [Pa]

7 Alarm Function

The DKP1010/102X transmitters can optionally be delivered with an alarm function. Please specifiy alarm thresholds, alarm mode and hysteresis during your purchase (refer to chapter 5.1 for more).

Alternatively, you can select the switching values yourself.

The switching contact's capability is more than sufficient for voltages up to 60V and currents up to 1A.
The contacts are located on top of the PCB and are labelled Alarm A and Alarm B. Always connect the higher potential to Alarm A and the lower potential to Alarm B.



7.1 Threshold Exceedance with Hysteresis

All transmitter channels can be enabled/disabled for triggering an alarm. Alarm conditions can be set for eacht channel individually and can be based on AND or OR conditions. Only channels assigned to analog outputs can be configured for the alarm function.

Logically, an alarm always means the closing of the switch. Using the following alarm modes you can build a two-level controller with Hysteresis (https://en.wikipedia.org/wiki/Hysteresis).

Two thresholds, Hysteresis and the alarm mode can be configured for each available channel individually. The settings are saved to the nonvolatile memory of the transmitter.

Alarm-Mode 0:

No alarm active on selected channel.



Alarm-Mode 1:

Two alarm areas are active on selected channel. If sensor reading is higher than (Threshold1 ± Hysteresis) and lower than (Threshold2 ± Hysteresis) the alarm is inactive. Otherwise there is an alarm.



Alarm-Mode 2:

Only one alarm area active on selected channel. If sensor reading is higher than (Threshold1 ± Hysteresis) and lower than (Threshold2 ± Hysteresis) the alarm is active. Otherwise there is no alarm.



7.2 Setting Up the Alarm

The following command allows you to set up and enable an alarm.

Setalarm <cr>
You can set alarm values for the two output channels. These values are threshold1, threshold2 and a hysteresis. You can link both channels with logical AND / OR to get the final alarm value.
Alarm value TRUE means close alarm-switch on motherboard.

Setup alarm parameters for:
(1)..Differential Pressure [Pa]
(2)..Flowrate [m³/h]
(3)..other
? >2
Alarm mode for Flowrate [m³/h]:
(1).. deactivated
No alarm calculation on this output channel.
(2).. ONE ALARM-ON Area
Alarm is true, if actual transducer value is greater threshold1 and smaller threshold2.
(3).. TWO ALARM-ON Areas
Alarm is true, if actual transducer value is smaller threshold1 or greater threshold2.
? >2
Threshold1 [m3/h] (0.. 10000) ? >5000
Threshold2 [m3/h] (0.. 10000) ? >7000
Hysteresis [m3/h] ? >50
Logical channel alarm linkage of output ch1 and output ch2:

(1).. OR linkage
If alarm on outputch1 **OR** on outputch2 true, then close alarm switch.
(2).. AND linkage
If alarm on outputch1 **AND** on outputch2 true, then close alarm switch.
? >1 Configuration change successfully finished

8 Important Notes on Humidity Measurements

8.1 Stable Environmental Conditions

When measuring humidity and calibrating humidity measuring instruments the temperature balance between the sensor and the ambient air is of special importance. A small temperature difference of only ±1°C at ambient conditions of 20°C and 50%RH can cause a measuring error of ±3%RH. At 90%RH ambient humidity the error increases to ±5.4%RH.

8.2 Limitations of Use

Several factors can influence measurements of relative humidity. The following information is supposed to help you prolong the life of your sensor and increase measurement accuracy. In case of doubt, please don't hesitate to contact us for further assistance.

8.2.1 Chemicals

The transmitters feature a capacitive humidity sensor with **CMOSens** technology. Together with some other protective measures this makes the sensor quite resistant against contamination.

However, chemicals, especially cleaning agents, solvents and acids, can affect the measurement and even destroy the sensor.
Please note that in some cases these hazards may appear only at high temperatures or develop a harmful concentration only after long-term gas release.

If and how measurements can be achieved with filters or bypasses in these cases needs to be assessed in the individual case.

8.2.2 High Humidity

In high humidity operating conditions a change in temperature of only a few degrees can cause condensation on the sensor. While the sensor may be subjected to temporary condensation it may not be subjected to regular and/or permanent condensation which causes corrosion within the sensor and on the pcb tracks.
The following measures should help prevent harmful operating conditions:

1. Use a transmitter with a heated sensor head (DKP1026).
2. Remove sensor filter in order to improve drying.
3. Install a bypass with controllable conditions. If necessary, use a conversion to absolute humidity or dew point.
4. Install a baffle plate or immersion pipe in order to prevent the sensor from wetting.

With condensation occurring occasionally, the sensor will work properly after the condensate has dried. If the condensate is contaminated with hazardous substances (e. g. acidifiers, solvents) sensor life may decrease and an irreversible drift in measurements may occur.

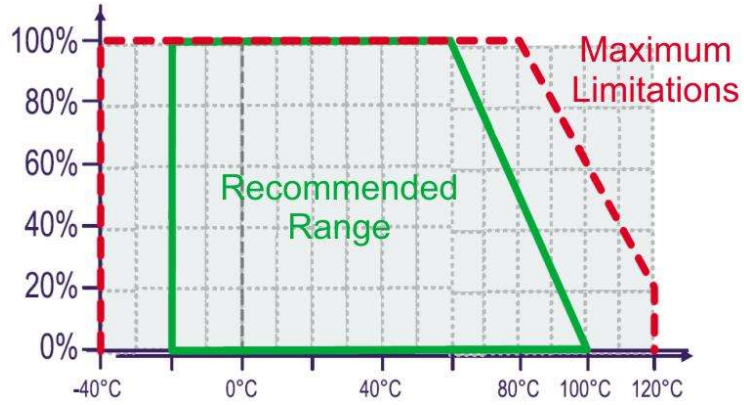
Special transmitter DKP1026 can be used in high humidity applications. It has a built-in sensor heater which prevents the sensor from condensation. In addition, it helps the sensor dry faster.

Since the heater capacity is limited the sensor should still not be used in permanent water vapour or atomized spray. Use a baffle plate or immersion pipe to mitigate the conditions.

Because the probe head of the DKP1026 is heated, both the combined humidity/temperature sensor and the additional temperature probe need to be installed in the same place. The heater automatically starts up when the risk of condensation occurs.

The additional temperature probe needs to measure the correct temperature for the DKP1026 to successfully calculate relative humidity from the measured variables dew point and temperature.

8.2.3 High Temperature & High Humidity



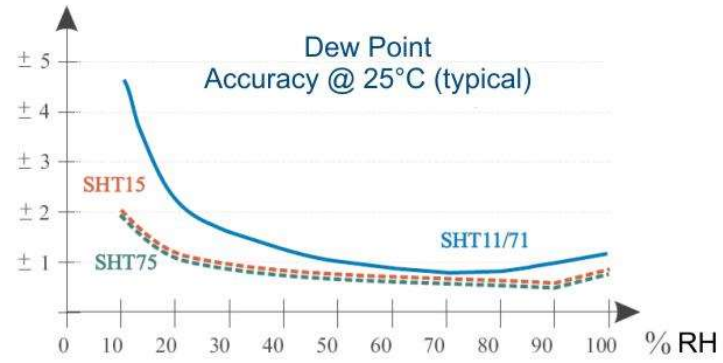
The transmitter can be used within the range of 0...100%RH with the above mentioned restrictions.
Temperature operating range is limited by the electronics, the sensor itself and its materials.
In addition, the sensor may not be used when high temperature and high humidity occur **at the same time**.
Refer to the figure on the left for more details.

Operation outside of the recommended range can increase the humidity signal of up to 3%. Afterwards the sensor will return to its previous calibration.
Do not use the transmitter outside of the maximum admissible limitations.

8.2.4 Low Humidity

In low humidity (close to 0%RH) the sensor is a little less accurate than at usual humidity levels.
Also, the relative error (in relation to the actual reading) increases drastically in low humidity environments.

Example:
Suppose you are measuring at 50%RH. Sensor uncertainty is ±1.8%RH.
This means that the relative error is 1.8/50=3.6%.
Now, suppose you are measuring at 5%RH. Sensor uncertainty is about ±2.5%RH. This means that the relative error is 50%.



In conclusion, dew point calculation at low humidity will be very inaccurate. As seen in the graph on the left.

We recommend establishing a bypass when measuring at very low humidity levels with a humidity transmitter.

9 Maintenance

9.1 Differential Pressure Transmitter Zero Point Calibration

ATTENTION:

Only perform a zero point calibration with the differential pressure transmitter DKP1010!
A zero point calibration of the barometric pressure transmitter DKP102X will cause a permanent distortion of the entire barometric pressure measurement!

Make sure that no pressure is connected to the pressure ports of the DKP1010. (Bridge the ports or disconnect all tubes.)

Locate a small button and an LED on top of the PCB inside of the transmitter. Refer to chapter for 2.1 for information on how to open the housing.
The LED shows the status of the calibration. Pushing and holding the button for ca. 2 seconds starts the calibration process. The LED will be on for a while and start flashing periodically.
Once the LED starts flashing you can let go of the button.
Calibration procedure is successfull once the LED stops flashing.
Analog output should show a signal of 0V or 0 / mA.

For a thorough calibration and maintenance of your transmitter we recommend returning the device to our calibration laboratory annually.

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