Evaluation unit
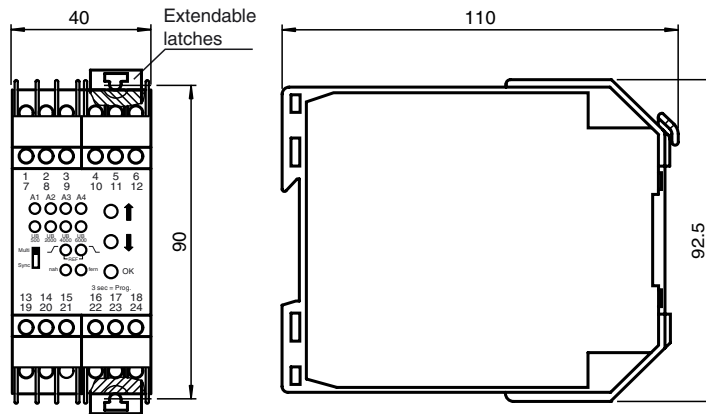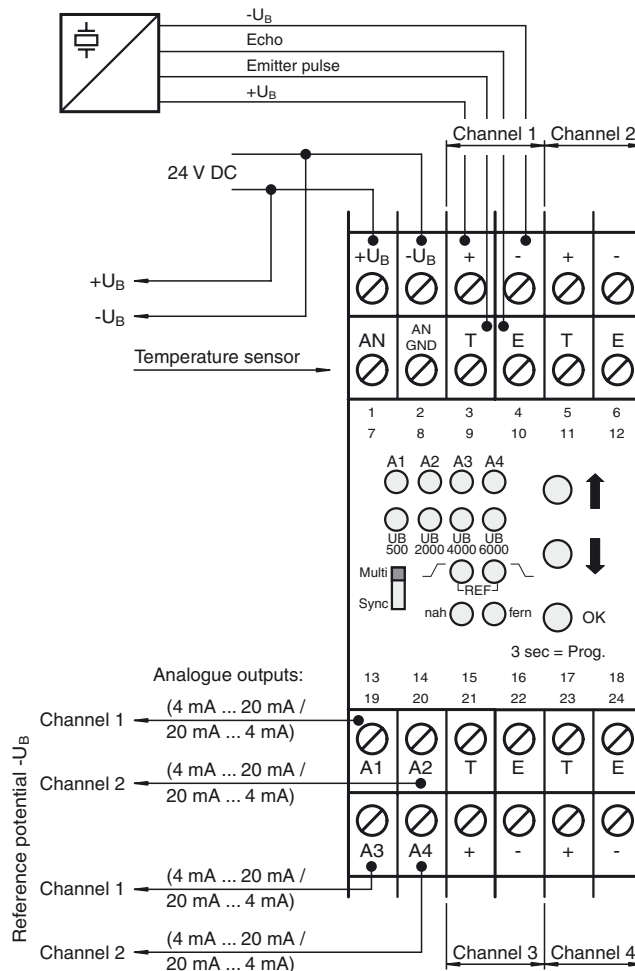# UH3-KHD2-4I

Features

- External evaluation for ultrasonic sensors UB...-H1, -H2 and -H3
- Modular concept: Installation of sensor on-site and evaluation in the control cabinet
- Simultaneous operation of 1 to 4 ultrasonic sensors with ranges from 60 mm to 6 m (up to 15 m when operated as a through beam barrier)
- Freely selectable measuring window
- Multiplex operation - no mutual interaction, operation is possible in a very confined space
- Synchronous operation
- Temperature compensation
- Reference measurement for highest accuracy
- 4 analogue outputs 4 mA ... 20 mA (rising/falling slope can be set)

Dimensions

$C \epsilon$

Electrical connection

Pepperl+Fuchs Group • Tel.: Germany +49 621 776-0 • USA +1 330 4253555 • Singapore +65 67799091 • Internet http://www.pepperl-fuchs.com

Technial Data

Ordering code

Description

General specifications

Operating modes	with switch-over: multiplex operation - consecutive activation of the channels synchronous operation - activation of the channels simultaneously
Measuring frequency	dependent on the operating mode, number and longest range of the active sensors (see page multiplex/synchronous operation

Indicators/operating means

LED green	sensor type / channel active (4 items) current slope: increasing / decreasing / REF (2 items) measuring window limits near / far (2 items)
LED yellow	channel number A1 ... A4 / object in operating range (4 items)

Electrical specifications

Operating voltage U_B	20 ... 30 V DC , ripple 10 %$_{SS}$
No-load supply current I_0	≤ 50 mA (without sensors)

Input

Input type	for 4 sensors for each of 4 connections $+U_B$/$-U_B$/clock (T)/echo (E) short-circuit proof with reverse-polarity protection attachable sensors:UB500/2000/4000/6000-...-H3 or -H1/-H2

Output

Output type	4 analogue outputs A1 ... A4, 4 ... 20 mA rising/falling ramp
Repeat accuracy	multiplex operation: ± 1 mm synchronous operation: ± 3 mm

Ambient conditions

Ambient temperature	-20 ... 70 °C (253 ... 343 K)
Storage temperature	-40 ... 85 °C (233 ... 358 K)

Mechanical specifications

Protection degree	IP20
Connection	terminal housing, suitable for 35 mm standard rail plug-in screw terminal 1.5 mm^2
Mass	230 g

The UH3-KHD2-4I is an evaluation device for ultrasonic sensors with external interface electronics. Up to four sensors of type UB...-H3 or sensor pairs UB...-H1/-H2 can be connected to the device.

The evaluation unit issues the transmission pulses (cycle) for each sensor channel, then records the echo signal and forms a current value proportional to the echo time (4 mA ... 20 mA). An analogue output is associated with each channel.
An evaluation window and a rising or falling current ramp can be selected in the detection section for each output. If the distance determined is within the programmed measuring window, the output of the associated channel will deliver a value between 4 mA and 20 mA. The yellow LED associated with the channel will be lit.
Sensors with a variety of detection ranges can be deployed on the four evaluation channels. One of the channels can be programmed as a reference measurement for a temperature compensation.

Note:
The maximum cable-length between evaluation unit and sensor must not exceed 20 m!

Notes

Initial operation/connection of the sensors

The sensors are connected to the channels in accordance with the terminal diagram. **Caution:** Please refer also to the electrical connection on the sensors data sheet.
It is recommended to connect the operating power U_B first. The sensor cable must not exceed a length of 20 m. The number of connected sensors is limited by the performance of the external 24 V DC power supply of the evaluation unit.
Channels equipped with sensors may also be disabled via programming (program step 2).

Selecting the operating mode

The slide switch Multi/Sync toggles the multiplex and synchronous operating modes.

Multiplex mode: The connected sensors are controlled consecutively, briefly and in a cyclic manner. The evaluation unit always processes the signals of a single sensor.
This operating mode should be selected if the sensors are installed in a restricted space or are arranged opposite each other. Multiplex mode prevents mutual interference.
The measuring repeat rate is based on the number of activated sensors multiplied by the repeat time of the sensor with the longest range.
The repeat times are:

UB 500:	approx. 30 ms
UB 2000:	approx. 40 ms
UB 4000:	approx. 50 ms
UB 6000:	approx. 65 ms

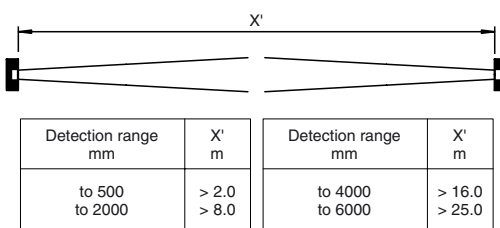**Synchronous mode:** This operating mode guarantees a shorter response time than multiplex mode.
All activated channels receive transmit pulses simultaneously. Each channel evaluates the time between the transmit pulse and the first echo. Later echoes could be signals from a neighbouring sensor in the case of sensors with similar ranges (longer distance). They are not evaluated.

The lateral safety distance required to avoid mutual interference in neighbouring sensors can be determined with the following table, provided smooth objects at a right angle to the axis of the ultrasonic bursts are to be detected. The indicated values are intended as a guideline. The values increase in the event of unfavorable alignment of the objects and should then be determined experimentally.
The repeat time of the sensor with the greatest range determines the measuring repeat rate of the evaluation unit.

Detection range mm	X m	Detection range mm	X m
to 500	> 0.3	to 4000	> 2.0
to 2000	> 1.0	to 6000	> 2.5
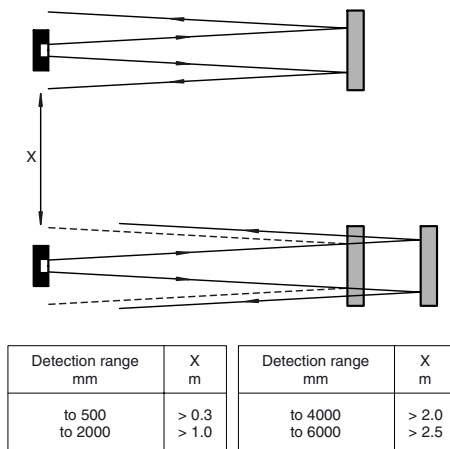
The distance "X" must be observed if two sensors of the same range are installed opposite one another.

Detection range mm	X' m	Detection range mm	X' m
to 500	> 2.0	to 4000	> 16.0
to 2000	> 8.0	to 6000	> 25.0

Programming mode

Programming is performed with three keys: ▲ (up),
▼ (down) and OK. Starting the programming mode: Press OK key for 3 seconds.

Step 1: Select channel

One of the yellow LEDs in the upper row will be flashing to indicate the channel to be programmed, A1 to A4. Use ▲ (up) or ▼ (down) to select a different channel if required and confirm your choice with OK (yellow LED lit).

Step 2: Select UB range/(disable channel)

After the first OK, one of the green LEDs in the second row will be flashing. It indicates the range. Use ▲ (up) or ▼ (down) to make a selection (500/2000/4000/6000) so that the display corresponds to the range of the connected sensor. Confirm this setting with OK.

Disable channel: In step 2, ▲ (up) or ▼ (down) can also be used to start the "disable" function (all four green LEDs flashing). If this is confirmed with OK, the selected channel will be removed from the measuring cycle. The programming mode will be aborted and normal operation started.

Step 3: Select output characteristic/(REF)

After confirming the range, the program switches to the third LED row. The output behaviour is checked or set here. Use the ▲ (up) or ▼ (down) keys to select either the rising analogue ramp (╱ : 4 mA ... 20 mA) or falling ramp (╲ : 20 mA ... 4 mA). Confirm your choice with the OK key.
REF: The third option is REF (both LEDs). If this is confirmed with the OK key, the sensor on the selected channel must be aligned with a reference object. Normal operation will start immediately.
If the start does not take place, the sensor will not detect a reference object.

Steps 4 and 5: Setting the measuring window

These steps set a measuring window (minimum width: 5 cm) within the detection range of the selected sensor. The analogue value changes in a linear manner from 4 mA ... 20 mA (or 20 mA ... 4 mA) in dependence upon the measured distance.
First, set the near window limit.

Step 4: Setting/teaching the near window limit

The near window limit must be outside the sensor's unusable area. The unusable areas for the usable UB sensors are indicated

on the data sheets:

UB 500:	60 mm
UB 2000:	200 mm
UB 4000:	500 mm
UB 6000:	800 mm

After pressing OK in step 3, the lower left LED "near" will be flashing initially. The near limit can now be set to a greater distance with ▲ (up) or to a shorter distance with ▼ (down).

If the near limit comes within 5 cm (minimum window width) of the far limit, the far limit will be changed accordingly. The far limit will be moved outward 5 cm ahead of the near limit until the maximum range has been reached.
Use the OK key to confirm the lower limit. The display and program will move to the right LED "far" and the appropriate program section.

TEACH-IN: Press ▲ (up) and ▼ (down) simultaneously to store a distance determined by a target positioned in the sound cone as a near limit. If the sensor does not detect a reflector, the window will be set to the 5 cm within the maximum range. The program will then switch to the "far limit" (LED "far") option.

Step 5: Setting/teaching the far window limit

(LED "far"): The distance is changed with the ▲ (up) key toward the maximum range and the ▼ (down) key toward the sensor or near limit as when previously setting the near window limit.
Exception: The far limit cannot affect the near limit.

TEACH-IN: Pressing ▲ (up) and ▼ (down) simultaneously will also store the distance to a target as a measuring window limit in this case. If the sensor does not detect an echo (no reflector), the window will be extended to the maximum range.
If the object is closer than the near limit, the measuring window will be set to a width of 5 cm from the near limit. The near limit will remain unchanged.
Confirm the setting with OK.
After the TEACH-IN, the programming mode will end automatically and normal operation will be started.
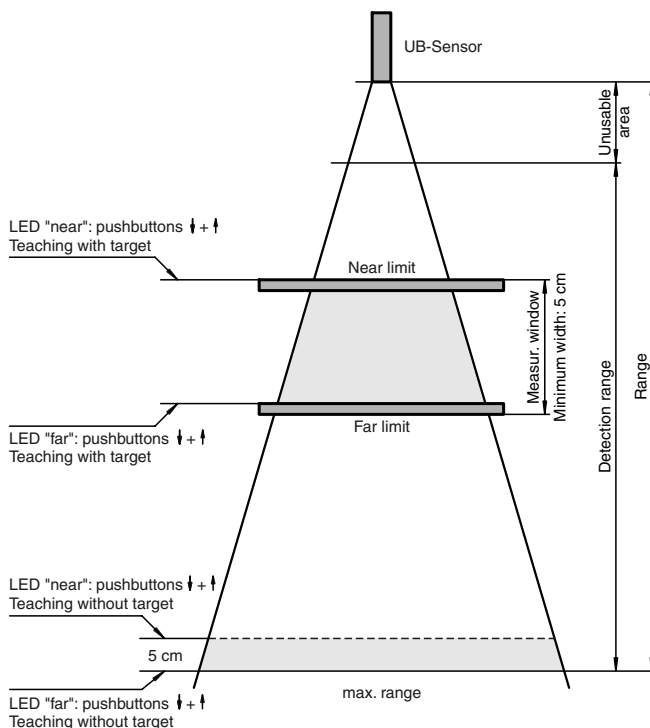
General information on programming mode

The channels must be programmed individually and consecutively.
The selected options will not be permanently stored for the given channel until the fifth programming step has been completed.
Correction option: In the event of an incorrectly chosen option, the programming mode can be aborted by not pressing any keys for 20 s. The previous settings for the selected channel (output ramp, measuring window limits) will be restored.

Display mode

To check the selected settings, use ▲ (up) or ▼ (down) during normal operation to start the display. The settings will remain unchanged.

Yellow LEDs:	Channel number A1 to A4: Object in measuring window
Upper row green LEDs:	Type of connected sensor/channel active
Green LEDs ╱ / ╲ /REF:	Rising/falling ramp of output current/reference measurement

Back to normal operation: Press ▲ (up) and ▼ (down) keys simultaneously or do not press any key for 20 seconds.

Temperature compensation/reference measurement (REF)

The properties of the air as a transmission medium affect the velocity of sound. Especially fluctuations of the air temperature have a noticeable effect on the evaluation. Two types of compensation are possible to ensure the highest measuring accuracy:

Connection of an external temperature probe: The evaluation unit calculates using the following basic data: 4 mA = -20 °C and 20 mA = +70 °C. The Pepperl+Fuchs KFD2-UT-Ex1 universal temperature measuring transducer fulfills these requirements. It is simple to parameterise via an RS 232 interface, or can be supplied preconfigured if desired. A Pt100 is preferable as a temperature probe; a thermocouple (Type B, E, J, K, L, N, R, S, T) can also be connected. The transformer must be externally supplied with 24 V DC and connected to contacts 7 and 8 (GND).

Reference measurement (REF): In program section 3, the option REF can be specified for the selected channel. The connected UB sensor must be working against a fixed target. All deviations of the echo time resulting from changes in the ambient conditions of the reference measurement distance will be applied to the other channels and their measured values adjusted accordingly. The reference channel does not provide analogue output. If another channel has already been selected as the reference channel, the REF function will be disabled for that channel and the normal measuring function activated. The start of the reference function of a channel must take place at the same temperature at which the measuring window limits were programmed for the other channels. If this was done at other temperatures, they should be readjusted.

Interesting deployment options

Increased coverage: Multiple UB sensors of the same range can work together if a larger area is to be monitored. Connect the transmission pulse inputs (BK/2) of all sensors to one another externally and connect them to the transmission pulse output (T) of a channel. The echo outputs (WH/4) of all sensors must also be connected to one another externally and then connected to the same evaluation channel of the echo input (E, see terminal diagram A).

All interconnected sensors thus simultaneously transmit ultrasonic pulses. Due to the inclusive OR circuit, the evaluation unit does not distinguish which sensor delivered the first echo. The time between the transmission pulse for all sensors on a channel and this first echo is used by the electronics to determine the distance to the detected object.

The number of connected sensors is limited by the performance of the external 24 V DC power supply of the evaluation unit.

The current consumption of an evaluation system is the sum of the following values:

1. The no-load current consumption of the unit (max. 50 mA) and current consumption of the temperature probe (if connected: max. 20 mA)

2. The total no-load current consumption of all connected US sensors; (for the sake of simplicity, calculate 30 mA max. for each sensor),

3. The maximum output current of the evaluation unit: 80 A (4 channels x 20 mA)

Example: In the terminal diagram, three UB sensors are connected to a single evaluation channel. If one sensor is working on each of the three other channels, the total no-load current (for 6 sensors) is 180 mA. The power supply must have a capacity of around 310 mA (50 mA + 6 x 30 mA + 80 mA), not including a temperature probe.
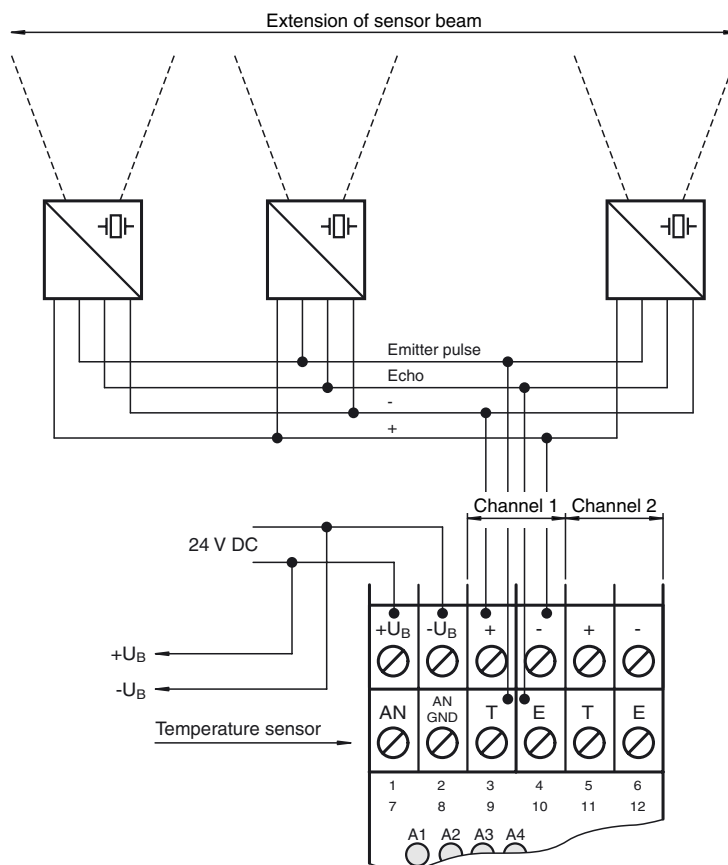
UB sensor with multiple measuring ranges:

A UB sensor connected to any evaluation channel can work with up to four independent measuring ranges by making use of the three other channels. Select synchronous mode and connect the echo output (WH/4) of the sensor to the echo signal inputs (E) of the other channels. For four measuring ranges, use the entire evaluation unit.
Program each used channel to the same range (that of the connected sensor) in programming step 2. The measuring ranges can then be set or taught consecutively for the channels.
Perform the TEACH-IN in programming steps 4 and 5 by placing a target in the sound cone at the desired distances and pressing the ▲ (up) and ▼ (down) keys simultaneously. Program the near measuring range limit (step 4) and the far measuring range limit for each channel.
The sequence and spatial relationship of the measuring ranges to one another can be freely selected.

-U_B
Echo
Emitter pulse
+U_B

Channel 1 | Channel 2

24 V DC

+U_B

-U_B

Temperature sensor

+U_B	-U_B	+	-	+	-
AN	AN GND	T	E	T	E
1	2	3	4	5	6
7	8	9	10	11	12

A1 A2 A3 A4

UB UB UB UB
500 2000 4000 6000

Multi
Sync

REF

nah   fern   OK

3 sec = Prog.

Analogue outputs:

13	14	15	16	17	18
19	20	21	22	23	24

Channel 1 — (4 mA ... 20 mA/ 20 mA ... 4 mA)

| A1 | A2 | T | E | T | E |

Channel 2 — (4 mA ... 20 mA/ 20 mA ... 4 mA)

| A3 | A4 | + | - | + | - |

Channel 1 — (4 mA ... 20 mA/ 20 mA ... 4 mA)

Channel 2 — (4 mA ... 20 mA/ 20 mA ... 4 mA)

Channel 3 | Channel 4

Reference potential -U_B