DMU330 — Ultrasonic sensors with analog and switching output

en 01-2017/02 50135826

M30

250 … 3500 mm
350 … 6000 mm

12 - 30 V DC
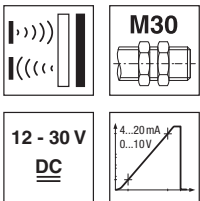
4…20 mA
0…10 V

- Function largely independent of surface properties, ideal for detection of liquids, bulk materials, transparent media, …
- Small dead zone at long scanning range
- 1 analog output 0 … 10V or 4 … 20mA
- 1 switching output (PNP or NPN)
- NO/NC function reversible
- **NEW** – Both outputs can easily be taught using a button
- **NEW** – Stable plastic design
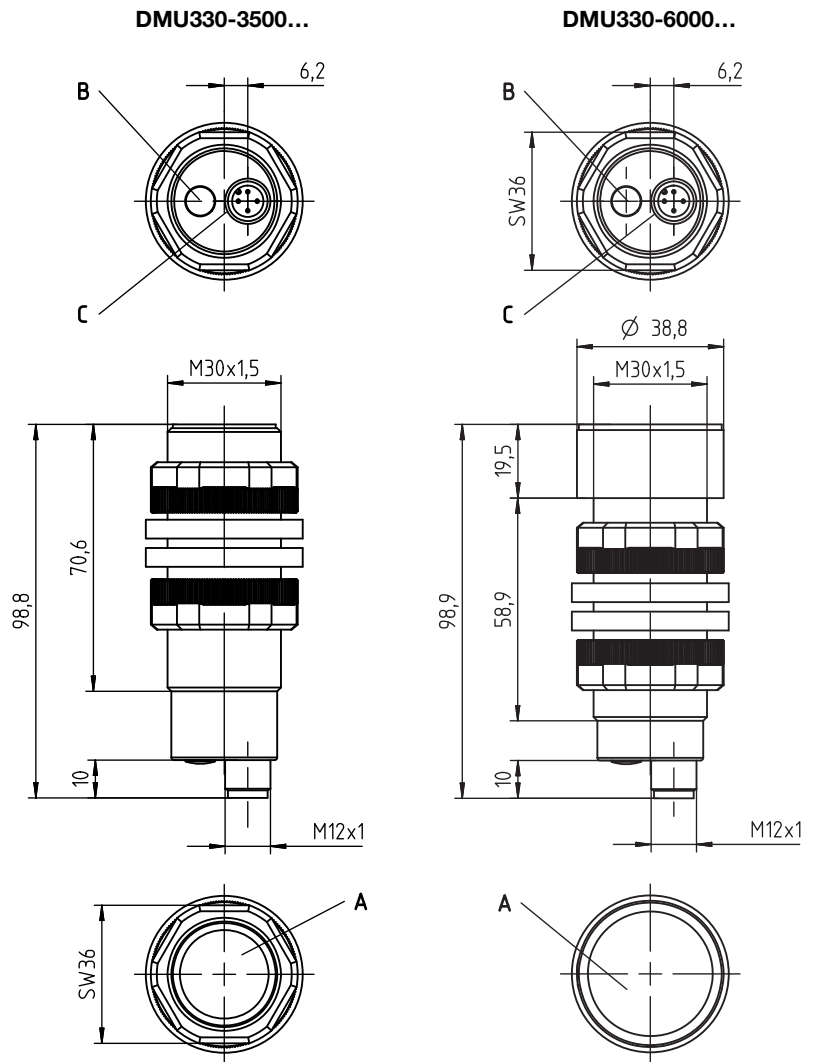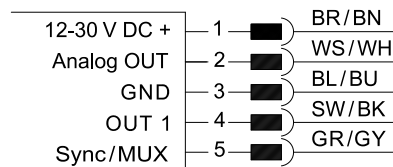- **NEW** – Temperature-compensated scanning range

CE c UL us LISTED IP 67

IEC 60947… IEC 60947…
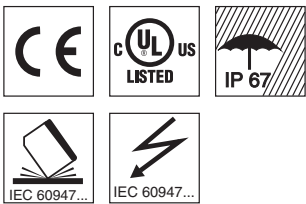
Accessories:

(available separately)

- Mounting systems
- Cables with M12 connector (KD …)

We reserve the right to make changes • PAL_DMU330_3500_6000_en_50135826.fm

Dimensioned drawing

DMU330-3500…

6,2
M30x1,5
98,8
70,6
10
M12x1
SW36

DMU330-6000…

6,2
SW36
Ø 38,8
M30x1,5
98,9
19,5
58,9
10
M12x1

A Active sensor surface
B Teach-in button
C Indicator diodes

Electrical connection

12-30 V DC +	1	BR/BN
Analog OUT	2	WS/WH
GND	3	BL/BU
OUT 1	4	SW/BK
Sync/MUX	5	GR/GY

DMU330-3500…-M12 - 01
DMU330-6000…-M12 - 01

Technical data

Ultrasonic specifications	DMU330-3500.3/…-M12	DMU330-6000.3/…-M12
Scanning range [1]	250 … 3500 mm [2]	350 … 6000 mm [3]
Adjustment range	250 … 3500 mm	350 … 6000 mm
Ultrasonic frequency	112 kHz	75 kHz
Typ. opening angle	± 7°	± 9°
Resolution	5 mm	6 mm
Direction of beam	Axial	Axial
Reproducibility	± 0.5 % [1] [4]	± 0.5 % [1] [4]
Switching hysteresis	1 % [4]	1 % [4]
Analog output accuracy	1 % [4]	1 % [4]
Temperature drift [5]	Analog output: ≤ 5 %, Switching output: ≤ 8 %	Analog output: ≤ 5 %, Switching output: ≤ 8 %

Timing		
Switching frequency	2 Hz	1 Hz
Response time	250 ms	500 ms
Readiness delay	≤ 900 ms (analog output), ≤ 500 ms (switching output)	≤ 900 ms (analog output), ≤ 500 ms (switching output)

Electrical data

Operating voltage U_B [6]	12 … 30V DC (incl. ± 5 % residual ripple)
Residual ripple	± 5 % of U_B
Open-circuit current	≤ 50 mA

Analog output

Analog output	…/…C…	1 analog output 4 … 20 mA
	…/…V…	1 analog output 0 … 10 V
Load resistance		Current output: $R_L ≤ 500 Ω$, Voltage output: $R_L ≥ 2 kΩ$
Characteristic curve adjustment		1-point teach: teach in button 2 … 7 s, 2-point teach: teach in button 7 … 12 s, Characteristic curve inversion: teach in button > 12 s
Analog output error signal		Distance too small: approx. 3.8 mA, Distance too large: approx. 11 V / approx. 21 mA

Switching output

Switching output / Function	…/4…	1 PNP transistor switching output OUT 1 (pin 4): NO contact preset
	…/2…	1 NPN transistor switching output OUT 1 (pin 4): NO contact preset
Output current		Max. 100 mA
Switching range adjustment		1-point teach: teach-in button 2 … 7 s, 2-point teach: teach-in button 7 … 12 s
Changeover NO/NC		Teach-in button > 12 s

Indicators

Yellow LED	OUT1: object detected
Blue LED	Analog OUT: object detected
Yellow/green or blue/green LED flashing	Teach-in / teaching error
Green LED	Object within the scanning range

Mechanical data

Housing	Plastic (PBT)
Active surface	Epoxy resin, glass fiber reinforced
Weight	140 g / 170 g
Ultrasonic transducer	Piezoceramic [7]
Connection type	M12 connector, 5-pin
Fitting position	Any

Environmental data

Ambient temp. (operation/storage)	-20° … +70°C/-20° … +70°C
Protective circuit [8]	1, 2, 3
VDE protection class	III
Degree of protection	IP 67
Standards applied	EN 60947-5-2
Certifications	UL 508, CSA C22.2 No.14-13 [6] [9]

1) At 20°C
2) Target: 200 mm x 200 mm plate
3) Target: 400 mm x 400 mm plate
4) From end value
5) Over the temperature range -20°C … +70°C
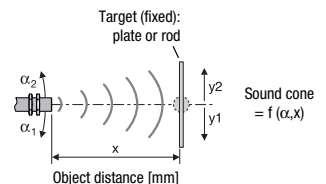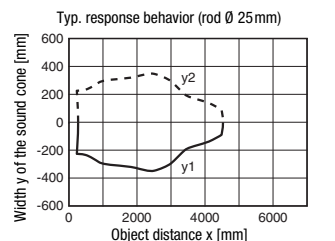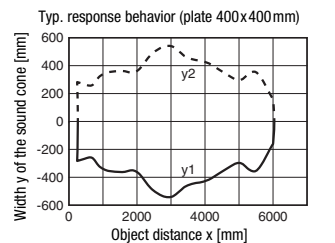6) For UL applications: use is permitted exclusively in Class 2 circuits according to NEC
7) The ceramic material of the ultrasonic transducer contains lead zirconium titanate (PZT)
8) 1=short-circuit and overload protection, 2=polarity reversal protection, 3=wire break and inductive protection
9) These proximity switches shall be used with UL Listed Cable assemblies rated 30V, 0.5A min, in the field installation, or equivalent (categories: CYJV/CYJV7 or PVVA/PVVA7)

Diagrams

DMU330-3500.3/…-M12

Typ. response behavior (plate 200 x 200 mm)

Typ. response behavior (rod Ø 25 mm)

DMU330-6000.3/…-M12

Typ. response behavior (plate 400 x 400 mm)

Typ. response behavior (rod Ø 25 mm)

Target (fixed): plate or rod

Sound cone = f (α,x)

Object distance [mm]
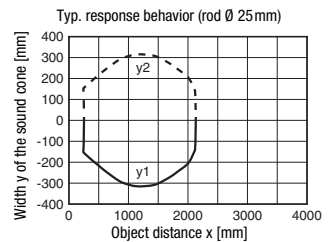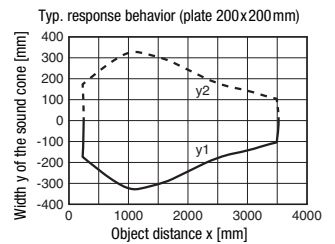
Notes

Observe intended use!

↳ This product is not a safety sensor and is not intended as personnel protection.
↳ The product may only be put into operation by competent persons.
↳ Only use the product in accordance with its intended use.

Part number code

DMU330-3500.3/4VK-M12

Operating principle

HTU	Ultrasonic sensor, scanning principle, with background suppression
DMU	Ultrasonic sensor, distance measurement
RKU	Ultrasonic sensor, retro-reflective ultrasonic sensor

Series

| 330 | 330 series, cylindrical short M30 design |

Scanning range in mm

| 3500 | 250 … 3500 |
| 6000 | 350 … 6000 |

Equipment

| .3 | Teach button on the sensor |

Pin assignment of connector pin 4 / black cable wire (OUT1)

4	PNP output, NO contact preset
P	PNP output, NC contact preset
2	NPN output, NO contact preset
N	NPN output, NC contact preset

Pin assignment of connector pin 2 / white cable wire (Analog OUT/OUT2)

4	PNP output, NO contact preset
P	PNP output, NC contact preset
2	NPN output, NO contact preset
N	NPN output, NC contact preset
C	Analog output 4 … 20 mA
V	Analog output 0 … 10 V

Pin assignment of connector pin 5 / gray cable wire (Sync / MUX)

| K | Synchronization/multiplex input |

Connection technology

| M12 | M12 connector, 5-pin |

Order guide

The sensors listed here are preferred types; current information at **www.leuze.com**.

	Designation	Part no.
Scanning range / switching output / analog output / teach-in		
250 … 3500 mm / PNP / current output 4 … 20 mA / teach button	DMU330-3500.3/4CK-M12	50136114
250 … 3500 mm / PNP / voltage output 0 … 10 V / teach button	DMU330-3500.3/4VK-M12	50136112
250 … 3500 mm / NPN / current output 4 … 20 mA / teach button	DMU330-3500.3/2CK-M12	50136115
250 … 3500 mm / NPN / voltage output 0 … 10 V / teach button	DMU330-3500.3/2VK-M12	50136113
350 … 6000 mm / PNP / current output 4 … 20 mA / teach button	DMU330-6000.3/4CK-M12	50136117

Device functions and indicators – switching output

The sensor has a button for setting switching output **OUT1** and analog output **Analog OUT**. Use the **teach button** to perform the 1-point teach, the 2-point window-teach and to changeover the switching function (NO contact/NC contact). Device status and switching states for **OUT1** are indicated as follows by means of a **yellow LED**:

Switching output OUT1

1-point teach (1 switching point)	
Switching behavior NO contact	**Switching behavior NC contact**

2-point window-teach (2 switching points)	
Switching behavior NO contact	**Switching behavior NC contact**
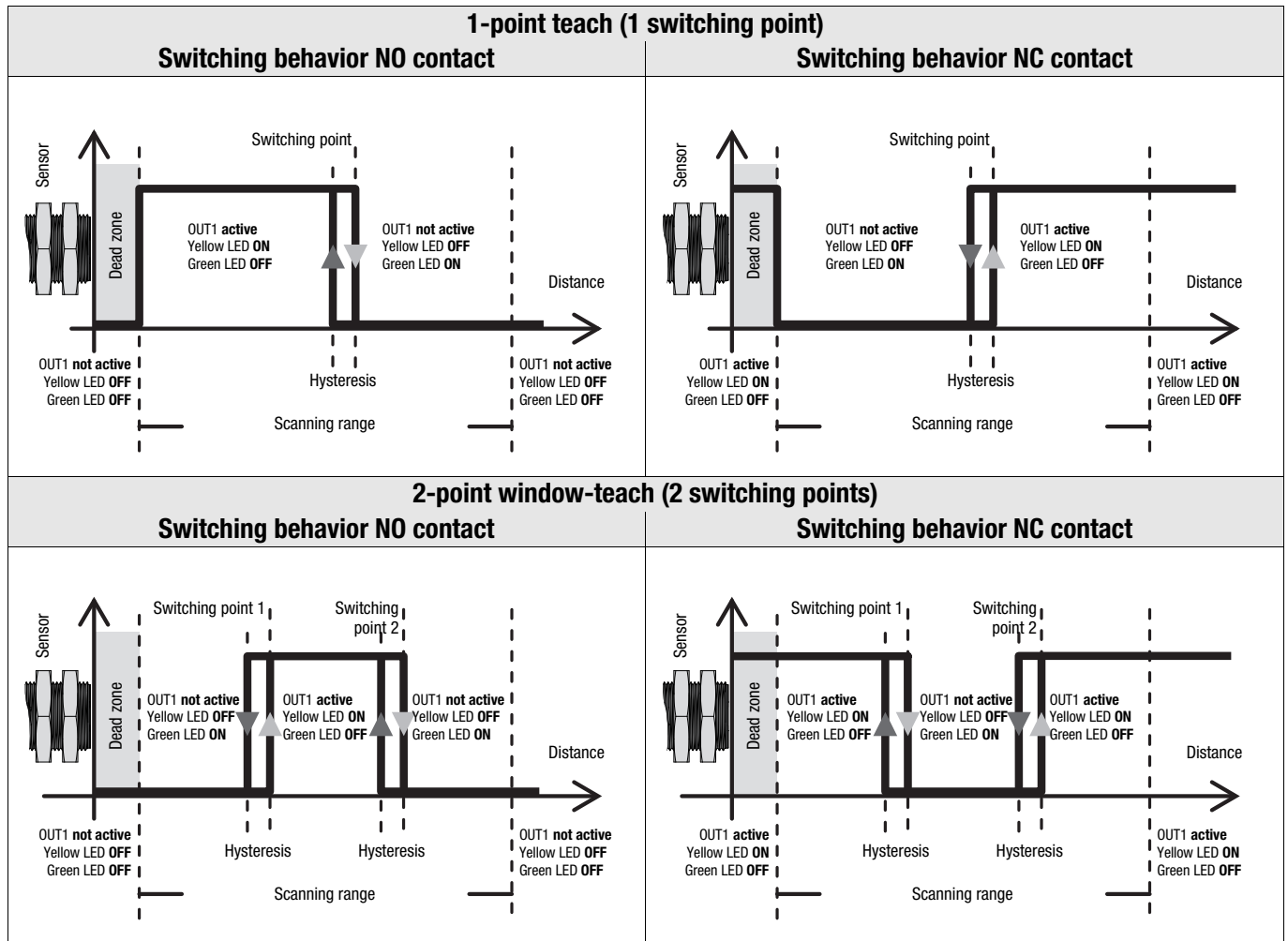
> ○ **Note!**
> ⫇ The switching behavior is not defined in the dead zone.

Switching behavior with 2-point window-teach as a function of the switching function

Switching function configured as	First taught object distance	Second taught object distance	Output switching behavior
NO (normally open)	Close	Far	
	Far	Close	
NC (normally closed)	Close	Far	
	Far	Close	

DMU330	Ultrasonic sensors with analog and switching output

Adjusting the switching points via the teach button

The switching point of the sensor is set to 3500 mm or 6000 mm (static 1-point teach) on delivery.

By means of a simple operating procedure, the switching point for the output OUT1 can be individually taught to an arbitrary distance within the scanning range with 1-point teach (static) or 2-point window-teach (static).

Moreover, the output function can be switched from NO contact (NO - normally open) to NC contact (NC - normally closed).

Selecting the output that is to be taught: OUT1 or Analog OUT

1. Press the **teach button** for **≥ 2s** to **activate teach mode**. The **yellow LED (OUT 1) flashes** at 1 Hz.
   While in this state, **output OUT 1** can be taught.
2. To teach **output Analog OUT**, **briefly** press the **teach button** again. The **blue LED (Analog OUT)** now flashes at 1 Hz.
   While in this state, **output Analog OUT** can be taught.
3. Briefly press the teach button again to toggle between outputs **OUT 1** and **Analog OUT** in this state. The flashing LED indicates which output is ready for teaching:
   yellow LED flashing = OUT 1 ready for teaching,
   blue LED flashing = Analog OUT ready for teaching.

Teaching output OUT 1

First activate the previously described teach mode for output OUT 1.

1-point teach (static)	2-point window-teach (static) [1]
1. Place object at desired switching distance.	**1.** First, **place** object at desired switching distance for **switching point 1**.
2. To adjust the output **OUT1**, **press** the **teach button** for **2 … 7s** until the **yellow LED flashes** at **3 Hz**.	**2.** To adjust the output **OUT1**, **press** the **teach button** for **7 … 12s** until the **yellow and green LEDs flash alternately at 3 Hz**.
3. Release the **teach button** to complete the teach event. The current object distance has been taught as the new switching point.	**3. Release the button**. The sensor remains in teach mode and the LEDs continue to flash.
4. Error-free teach: **LED** states and switching behavior according to the diagram shown above. **Faulty teach** (object may be too close or too far away – please note scanning range)**:** **green and yellow LEDs flash at 8 Hz** until an error-free teach event is performed. The affected output is inactive as long as there is a teaching error.	**4.** Then, **place** the object at the desired switching distance for **switching point 2**. **Note**: The **minimum distance between the switching points** is as follows: scanning range of 3500 mm:**350 mm** scanning range of 6000 mm:**600 mm**
	5. Briefly press the **teach button** again to complete the teach event. The switching window was taught in.
	6. Error-free teach: LED states and switching behavior according to the diagram shown above. **Faulty teach** (object may be too close or too far away – please note scanning range)**:** **green and yellow LEDs flash at 8 Hz** until an error-free teach event is performed.

1) See table "Switching behavior with 2-point window-teach as a function of the switching function"

Adjusting the switching function (NC/NO) via the teach button

The switching function of the sensor is preset as follows on delivery:

- **OUT 1: NO contact**

The output function can be switched from NO contact (NO - normally open) to NC contact (NC - normally closed) and vice versa. If the switching function is changed, the switching output is changed to the opposite state (toggled).

First activate the previously described teach mode for output OUT 1.

Changeover of the switching function
1. To change the switching function of output **OUT 1**, **press** the **teach button** for **longer than 12s**. The current state of output **OUT 1** is frozen during the adjustment process.
2. The **green and yellow LEDs flash alternately at 3Hz**. If the **yellow LED** is **ON** afterwards, output **OUT 1** functions as a **normally open contact (NO)**. If the **yellow LED** is **OFF** afterwards, output **OUT 1** functions as a **normally closed contact (NC)**.

Device functions – analog output

In measurement operation, the **blue LED** displays the behavior of analog output **Analog OUT**.

Analog output Analog OUT
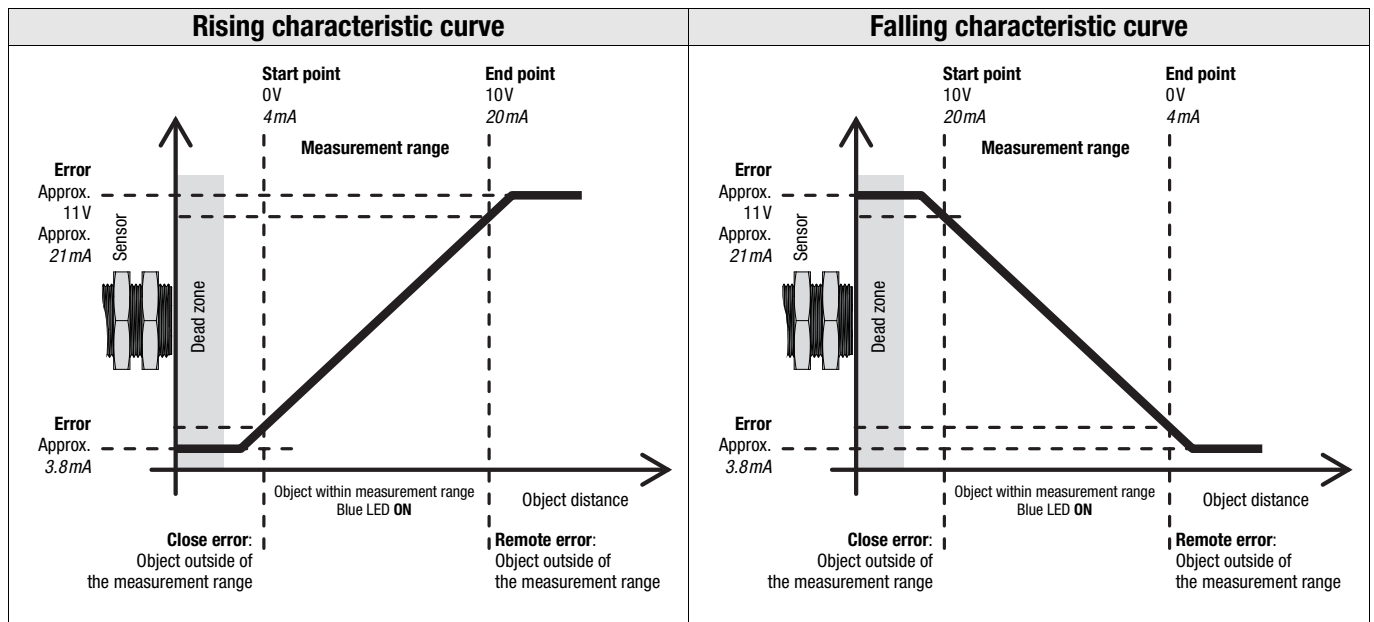
> **Note!**
> When setting the analog output (teach) via the teach button, one **rising characteristic curve** is always taught; with 2-point teach, independent of the selected object distances near/far. The characteristic output curve can be inverted, however.

Adjusting the analog output via the teach button

On delivery, the characteristic output curve of the sensor is set as a rising characteristic curve with spread over the entire scanning range: 4 … 20 mA or 0 … 10 V corresponds to an object distance of 250 … 3500 mm or 350 … 6000 mm, respectively.

The analog output can be set by means of 1-point teach or 2-point teach.

> **Note!**
> When setting the analog output (teach) via the teach input, one **rising characteristic curve** is always taught; with 2-point teach, independent of the selected object distances near/far. The characteristic output curve can be inverted, however.

Selecting the output that is to be taught: OUT1 or Analog OUT

1. Press the **teach button** for **≥ 2s** to **activate teach mode**. The **yellow LED (OUT 1) flashes** at 1 Hz.
   While in this state, **output OUT 1** can be taught.
2. To teach **output Analog OUT**, **briefly** press the **teach button** again. The **blue LED (Analog OUT)** now flashes at 1 Hz.
   While in this state, **output Analog OUT** can be taught.
3. Briefly press the teach button again to toggle between outputs **OUT 1** and **Analog OUT** in this state. The flashing LED indicates which output is ready for teaching:
   yellow LED flashing = OUT 1 ready for teaching,
   blue LED flashing = Analog OUT ready for teaching.

1-point teach of the analog output
First activate the previously described teach mode for output Analog OUT.

By selecting an object distance within the scanning range, the characteristic curve of the analog output can be adjusted.

If an object is located outside of the taught measurement range, an error signal is output. A different analog signal is output here by the sensor for the errors "distance too close: object outside of the measurement range" and "distance too far: object outside of the measurement range".

1-point teach - rising characteristic curve
1. Place object at desired distance for the end point of the measurement range.   **Note**: The **minimum object distance for the end of the measurement range** is as follows: scanning range of 3500 mm:**600 mm**   scanning range of 6000 mm:**950 mm**
2. To adjust analog output **Analog OUT**, **press** the **teach button** for **2 … 7 s**   until the **blue and green LEDs flash simultaneously at 3 Hz.**
3. Release the button. The characteristic curve with plot rising from the start of the range (50 mm or 150 mm) to the set object distance was taught in.
4. Error-free teach: LED states acc. to "Technical data" -> "Indicators".   **Faulty teach: green and blue LEDs flash at 8 Hz** until an error-free teach is performed.

2-point teach of the analog output
First activate the previously described teach mode for output Analog OUT.

By selecting 2 object distances within the scanning range, the characteristic curve of the analog output can be adjusted.

If an object is located outside of the taught measurement range, an error signal is output. A different analog signal is output here by the sensor for the errors "distance too close: object outside of the measurement range" and "distance too far: object outside of the measurement range".

2-point teach - rising characteristic curve
1. Position the object at the first desired distance (near or far).
2. To adjust analog output **Analog OUT**, **press** the **teach button** for **7 … 12 s** until the **blue and green LEDs flash alternately at 3 Hz.**
3. Release the button. The sensor remains in teach mode and the LEDs continue to flash.
4. Then **position** the object at the second desired distance (far or near).   **Note**: the **minimum object distance between the start and end point of the measurement range**   for a scanning range of 3500 mm is:**350 mm**   for a scanning range of 6000 mm is:**600 mm**
5. Briefly press the **teach button** again to complete the teach event.   The characteristic curve with rising plot from the near to the far object distance was taught in.
6. Error-free teach: LED states acc. to "Technical data" -> "Indicators".   **Faulty teach: green and blue LEDs flash at 8 Hz** until an error-free teach is performed.

Inverting the analog output (falling/rising characteristic curve)
First activate the previously described teach mode for output Analog OUT.

The characteristic curve of the analog output can be inverted, e.g., if a falling characteristic output curve is desired.

Inverting the characteristic curve
1. To invert the characteristic curve of the analog output **Analog OUT**, **press** the **teach button** for **> 12 s** until the **blue and green LEDs flash alternately**.
2. Release the button. The characteristic curve plot was inverted.   The **blue LED** indicates the current setting of the analog output: **ON** = **rising** characteristic curve   **OFF** = **falling** characteristic curve

Synchronization of multiple DMU330 ultrasonic sensors

If adjacent ultrasonic sensors receive the signals of other sensors, so-called crosstalk occurs, which leads to faulty measurement results. Through temporal synchronization of the adjacent sensors, this can be avoided. Via the **Sync/MUX** input, the DMU330 ultrasonic sensors can be synchronized in 2 different ways:
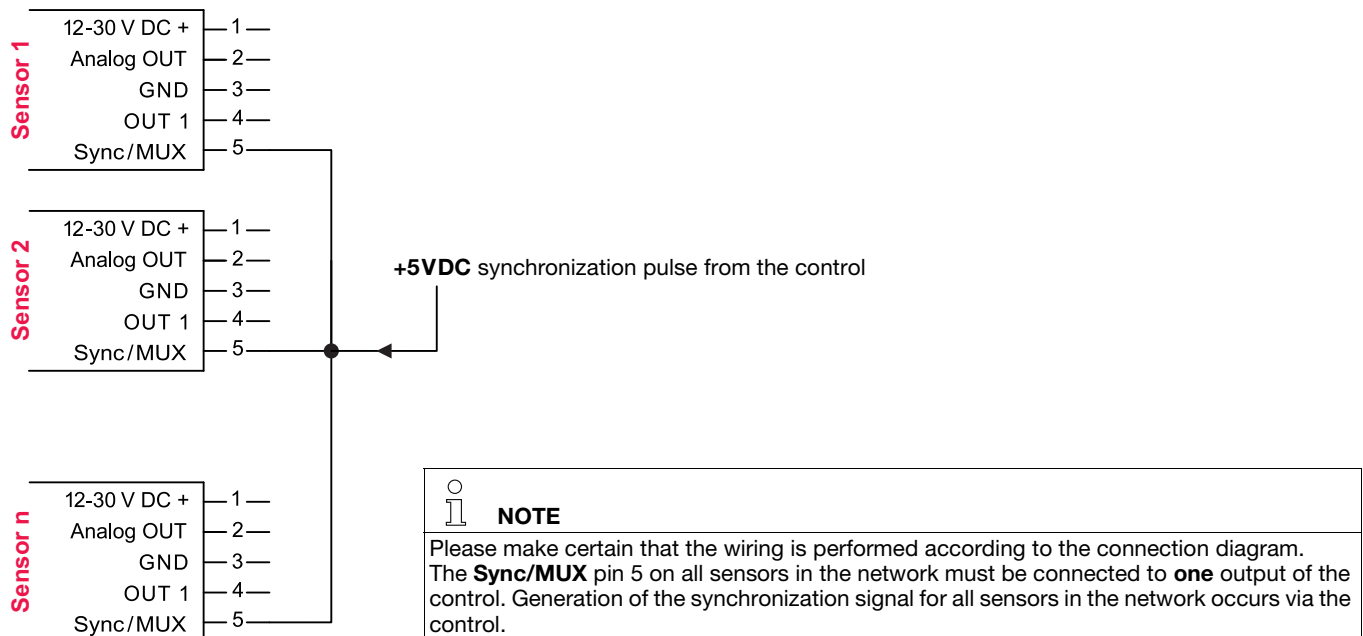
Synchronous operation

In this operating mode the mutual interference of adjacent sensors can be avoided; a minimum mounting distance between the sensors is to be maintained, however:

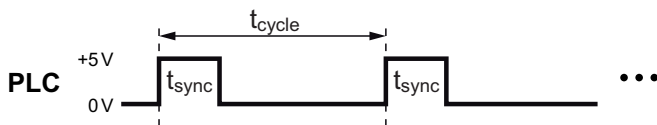| Working distance	Minimum mounting distance
< 1,500 mm	100 mm
≥ 1500 mm	50 mm

Sensors of the same type are wired together in a network according to the following diagram. A synchronization pulse from the control activates synchronous operation.

The devices work in synchronous operation with a **simultaneous transmission pulse**. The response time of the individual sensors in the network corresponds approximately to that of a single sensor.

Synchronous operation wiring schematic

Sensor 1
12-30 V DC + — 1 —
Analog OUT — 2 —
GND — 3 —
OUT 1 — 4 —
Sync/MUX — 5 —

Sensor 2
12-30 V DC + — 1 —
Analog OUT — 2 —
GND — 3 —
OUT 1 — 4 —
Sync/MUX — 5 —

+5VDC synchronization pulse from the control

Sensor n
12-30 V DC + — 1 —
Analog OUT — 2 —
GND — 3 —
OUT 1 — 4 —
Sync/MUX — 5 —

> **NOTE**
> Please make certain that the wiring is performed according to the connection diagram. The **Sync/MUX** pin 5 on all sensors in the network must be connected to **one** output of the control. Generation of the synchronization signal for all sensors in the network occurs via the control.

Timing diagram for synchronous operation

Scanning range	Sync impulse duration t_{sync}	Cycle time t_{cycle}
250 … 3500 mm	0.5 … 5 ms	35 ms
350 … 6000 mm	0.5 … 1 ms	60 ms

Multiplex operation

In this operating mode the mutual interference of adjacent sensors can be reliably avoided. For this purpose, each sensor is wired with a separate output of the control.

The devices operate in multiplex operation with a **cyclically time-delayed transmission pulse** and are switched to a passive state outside of the active phase.

Multiplex operation wiring schematic
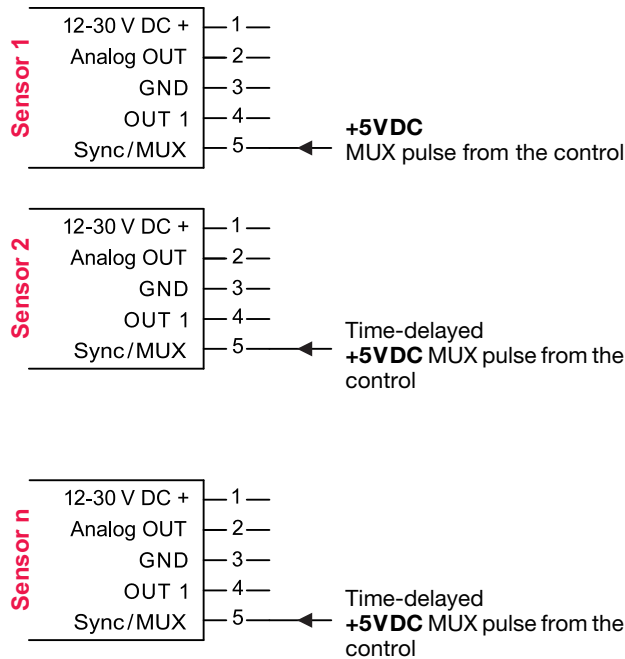
Sensor 1

12-30 V DC +	1 —
Analog OUT	2 —
GND	3 —
OUT 1	4 —
Sync / MUX	5 — ←

+5VDC MUX pulse from the control

Sensor 2

12-30 V DC +	1 —
Analog OUT	2 —
GND	3 —
OUT 1	4 —
Sync / MUX	5 — ←

Time-delayed **+5VDC** MUX pulse from the control

Sensor n

12-30 V DC +	1 —
Analog OUT	2 —
GND	3 —
OUT 1	4 —
Sync / MUX	5 — ←

Time-delayed **+5VDC** MUX pulse from the control

NOTE

Please make certain that the wiring is performed according to the connection diagram.

The **Sync/MUX** pin 5 of each sensor must be connected with a separate output of the control.
The control generates the time-delayed multiplex signals for all sensors.

Timing diagram for multiplex operation

Sensor 1 t_{resp} t_{resp}

Sensor 2 t_{resp} t_{resp}

Sensor 3 t_{resp} t_{resp}
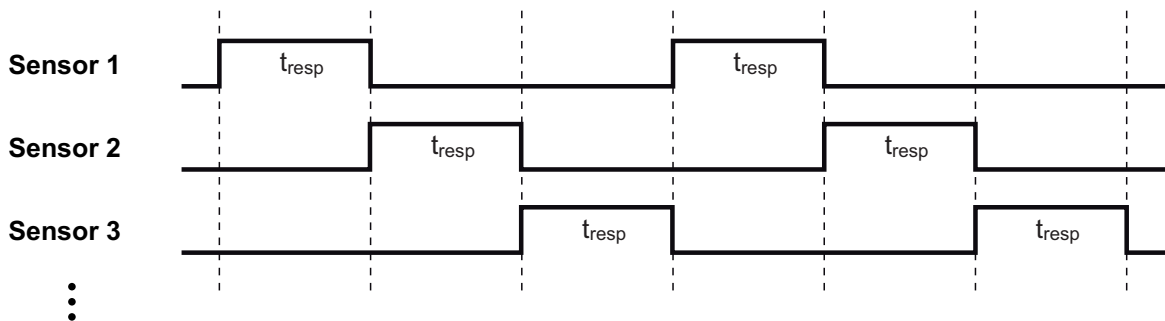
Scanning range	Response time of the switching/analog output t_{resp}
250 … 3500 mm	250 ms
350 … 6000 mm	500 ms

Resetting to factory settings

The sensor can be reset to the factory setting (1 switching point at 3500 mm or 6000 mm, rising characteristic curve with spread over the entire scanning range).

Resetting to factory settings
1. When switching on the supply voltage (during power-on), press the **teach button** for **> 5s**.
2. Release the button. The **green, yellow and blue LEDs** flash **alternately and very quickly** for a brief time.   The sensor was reset to the factory setting: **switching output**: 1 switching point at 3500 mm or 6000 mm (1-point teach, static),   **analog output**: 4 … 20 mA or 0 … 10 V corresponds to an object distance of 250 … 3500 mm or 350 … 6000 mm, respectively.