



Operating Manual

Ultrasonic double sheet detection with 2 switching outputs

- dbk+4/3CFF/M18 E+S
- dbk+4/WK/3CFF/M18 E+S
- dbk+4/M12/3CFF/M18 E+S
- dbk+5/3CFF/M18 E+S

Product Description

The function of the double sheet detection is to detect two or more sheets or other flat materials lying one on top of the other. The sensor system consists of a transmitter and a receiver complete with integrated evaluation electronics.

A high-frequency ultrasonic transmitter beams from the underside against the sheet material. The emitted ultrasonic pulse excites the sheet material into vibrations. The effect of these vibrations is for a very small sonic wave on the other side of the sheet to spread. This wave is received by the ultrasonic receiver located there. In the case of sheet one on top of the other (double sheet), the receiver detects the difference in signal and sets its outputs accordingly.

Product description

- Assured detection of single, double and multiple sheet.
- Scanning of the most varied of materials – from thin Washi through to wafers.
- Double sheet and missing sheet output as push-pull switching outputs.
- Scanning of sheet material weights from 20 g/m^2 to $1,200 \text{ g/m}^2$; films, thin sheet metals and finest corrugated cards possible.
- Vertical mounting to the sheet running through is permitted.

- Three control inputs allow for an external setting of sensitivity for the material to be scanned.
- Changes to sensitivity classes under ongoing operations can be undertaken.
- Additional Teach-in mode e.g. for scanning wafers glued with a water film.
- Optional trigger operation mode e.g. for applications in the shingled stream.
- Parameterization via LinkControl
- 0.5 ms response time until a double or missing sheet in the trigger mode is detected.

IO-Link

The dbk+ sensors are IO-Link-capable in accordance with IO-Link specification V1.1 and support Smart Sensor Profile like »Digital Measuring Sensor«. The sensors can be monitored and parameterized via IO-Link. Detailed information on parameterization via IO-Link, the IODD, and the IO-Link accompanying document for the sensor can be found at

www.microsonic.de/en/dbk+

Safety Notes

- Read the operating manual prior to start-up.
- Connection, installation and adjustment works should be carried out by expert personnel only.
- No safety component in accordance with the EU Machine Directive, use in the area of personal and machine protection not permitted

Proper Use

The dbk+ ultrasonic sensors are used for non-contact double-sheet detection.

Mounting

- Mount the transmitter and receiver as shown in Fig. 2, maintaining the specified installation distance between them. The distance between the transmitter and receiver can be adjusted to suit local conditions within the specified ranges. The dbk+ can be fitted at any position.
- Connect the transmitter to the receiver using the M8 connector.
- Connect the 7-wire control line of the receiver as shown in Fig. 1.

Notes

- The coaxiality of transmitter and receiver must be $\leq 0.5 \text{ mm}$.
- Transmitter and receiver are not to be inclined to each other in excess of 2° .
- Vertical mounting to the sheet is recommended for papers and thin films (Fig. 2a).
- In case of vertical mounting to the sheet, the spacing between transmitter and/or receiver and the sheet running through is not to be under 7 mm .
- In case of thin sheet metals or thicker plastic films (e.g. credit cards), the dbk+ is to be mounted at a 27° inclination to sheet normal (Fig. 2b).
- Thick papers and paperboard responsible for faulty switching in case of vertical mounting can often be scanned at a 27° to 45° mounting angle to sheet normal. Measuring corrugated card obliquely to the waves makes it possible for even fine corrugated cardboards (G- and F-wave) to be scanned (Fig. 2c).
- Other materials may make a special fitting position necessary. Do contact microsonic when you work with these special materials.
- The max. torque of the nuts is 15 Nm for the M18 and 8 Nm for the M12 sleeves respectively.
- The drill hole must be $\geq 12 \text{ mm}$ given that the transmitter is recess-mounted or a sheet feed is envisaged between transmitter and receiver. The recommendation is for a 18 mm diameter (see Fig. 2).
- The line between transmitter and receiver is not to be bridged with an external potential.

	colour
+U _B	brown
-U _B	blue
Missing sheet D2	white
Double sheet D1	black
Control input C1	violet
Control input C2	pink
Control input C3/Com	grey

Fig. 1: Colour coding of the control line

Note

- Via IO-Link and LinkControl, the functions assigned to D1 and D2 can be changed.

Start-up

- Select the »Standard« sensitivity class by placing all the 3 control inputs onto logic 0 (see Fig. 5 and Fig. 4) or leave them unconnected.
- Switch on the dbk+ voltage supply.
- The Alignment Assistance can be used to optimize the alignment or adjustment of the distance, see »Alignment Assistance«.

Check the function with a test sheet:

- Hold a single test sheet within the working range between transmitter and receiver.

The LED must light up green for »Single sheet detected«. Should the LED light up red, then check on the dbk+ fitting dimension and the selected test sheet.

- Hold a double test sheet within the working range between transmitter and receiver.

The LED must light up red for »Double sheet detected«.

- Remove all the sheets between transmitter and receiver.

The LED must flash red for »Missing sheet detected«.

Note

You can use a material of a high sheet weight as the test sheet or the test sheet itself obtainable as an accessory with the »dbk test sheet« article name. This test sheet works as critical material at the ambient temperature in the »Standard« sensitivity class and can be used to examine the correct adjustment and function.

Factory setting

The dbk+ are delivered with the following factory settings:

- Free-run mode with 3 sensitivity classes and Teach-in
- Missing sheet output on NCC
- Double sheet output on NCC
- 20, 40 and 50 mm spacing

Condition	LED 1	LED 2	
single sheet	green	green	static on
single sheet overmodulation	green	orange	static on
double sheet	red	red	static on
missing sheet	red	red	flashing
Teach-in activated	green	green	flashing alternately
Teach-in dismissed	red	red	flashing alternately

Fig. 3: LED displays

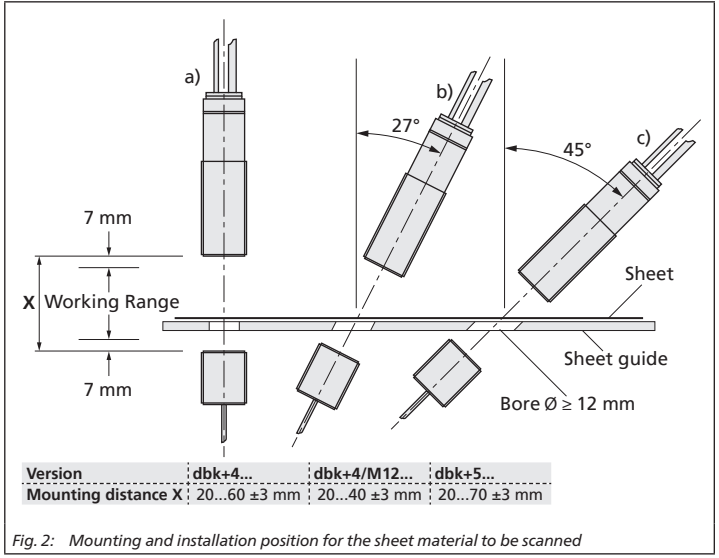
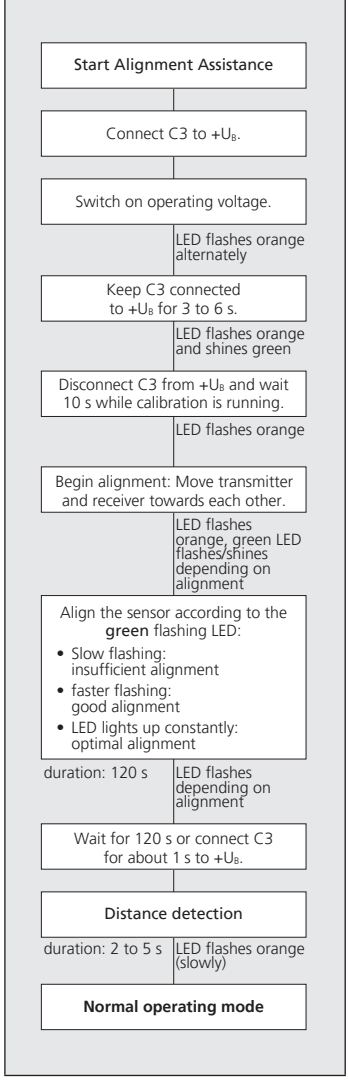


Fig. 2: Mounting and installation position for the sheet material to be scanned

Alignment Assistance

The Alignment Assistance is designed to simplify alignment between the receiver and transmitter during installation and to automatically measure the selected installation distance between them.

To use the Alignment Assistance, follow the steps in the following diagram:



Operation in the free-run mode

The dbk+ operates in free-run mode by default, performing measurements cyclically. The sensitivity classes »Standard«, »Thick«, »Thin« and »Teach-in Mode« are available, as shown in Fig. 4.

	C1	C2	C3
Standard	0	0	0
Thick	0	1	0
Thin	1	0	0
Teach-in-Mode	1	1	0
Teach-in active	1	1	1

Fig. 4: Free-run mode: selection of the sensitivity class and Teach-in

Notes

- If C3 is set to logical 1 when the supply voltage is switched on, the sensor starts the Alignment Assistance, see »Alignment Assistance«.
- If measurements should be taken in the shingled stream, then an external trigger signal can individually trigger each measurement. To this end, the trigger mode can be parameterized with the help of the LCA-2 LinkControl adapter available as an accessory and the LinkControl software.

Input level

The voltage levels present at inputs C1 to C3 are converted to the corresponding logic states »0« and »1« depending on the selected input type (pnp/npn), see Fig. 5.

Logical State	Voltage Level	
	pnp	npn
0	-U _B	+U _B
1	+U _B	-U _B

Fig. 5: Voltage level of the logic states at the control inputs

Sensitivity classes

If the dbk+ control inputs are not connected or are set to logical 0, the »Standard« sensitivity class is selected, in which scanning of the grammage range from typically 50 g/m² to 800 g/m² is possible.

- The 3 control inputs allow the sensitivity classes to be pre-selected in keeping with the Fig. 4 table.
- The »Thin« setting is to be selected for extremely thin materials, such as bible printing paper, with weight per unit areas of under 50 g/m².

■ The »Thick« setting is available for sheet metals, thick plastic films, paperboard and finest corrugated card.

■ Teach-in mode provides a sensitivity class that can be freely programmed.

■ Changes between sensitivity classes can be undertaken under on-going operations.

■ Pre-selecting an over-low sensitivity class can result – even with a single sheet – in a double sheet signal appearing. In such an instance, the next-higher sensitivity class is to be pre-selected.

■ Pre-selecting an over-high sensitivity class results – given a single sheet – in the double-sheet detection indicating overmodulation at the LEDs: one LED lights up green and the other orange (green + red blend). In such an instance, the next-lower sensitivity class is to be pre-selected.

Note

■ With IO-Link and LinkControl, all four sensitivity classes (»Standard«, »Thick«, »Thin« and »Teach-in Mode«) can be programmed for new material properties.

Teach-in

The Teach-in mode is also available for materials glued to each other across their full extent (e.g. two wafers bonded with a water film, a spline on a paper web) and special materials which cannot be scanned with one of the 3 sensitivity classes.

→ Select the Teach-in mode (C1 and C2 on logic 1) in keeping with the table in Fig. 4.

■ A Teach-in via the control input can also be performed when synchronization is activated.

This is the way to Teach-in a material:
→ Place a single sheet of the material in the working range of the double sheet detection.

→ Place the C3 control input on logic 1 for a minimum of 3 seconds. Materials with inhomogeneities must be moved during the Teach-in phase so that dbk+ can detect them.

Success with a Teach-in operation is shown by a green LED. In instances of where no material Teach-in was possible, LED flashes red. Then repeat the operation.

→ On finishing the Teach-in operation, either place the C3 control input on logic 0 or leave it unconnected.

The material can now be scanned.

Operation in the Trigger mode

If LinkControl was used to parameterize the trigger mode, then the external trigger signal is to be placed on the C2 control input.

Available in the trigger mode are sensitivity classes »Standard«, »Thin« and the Teach-in mode in keeping with the Fig. 6 table.

In the edge-controlled trigger setting (see Fig. 8), the double sheet detection takes a measurement with every edge from 0 to 1. The finding is then stored until the next trigger edge.

	C1	C2	C3
Standard	0	Trigger	0
Thin	0	Trigger	1
Teach-in-Mode	1	Trigger	0
Teach-in active	1	Trigger	1

Fig. 6: Trigger mode: selection of the sensitivity class and Teach-in mode

In the level-controlled trigger mode, dbk+ keeps on taking measurements for as long as the trigger signal is on hand. With dbk+ deactivated (C2 control input to logic 0), the reading of the last measurement at the switching outputs is frozen (see Fig. 9).

Synchronisation

If several dbk+ sensors are operated in a confined space, they may interfere with each other. To avoid this, the dbk+ sensors can be synchronised with each other.

→ To do this, connect all control inputs C3 to each other.

→ Set the operating mode to synchronisation mode.

Parameterization via LinkControl

The dbk+ can be extensively parameterized under LinkControl. Here you need the optionally available LinkControl adapter LCA-2 and the LinkControl software for Windows®.

Operation via LinkControl

→ Install the LinkControl software onto your PC.

Connect the LinkControl adapter to your PC with the USB cable.

→ Connect dbk+ to the LCA-2 in keeping with the Fig. 7 table. For this, use the adapter cable in the LCA-2 case.

→ Connect the voltage supply cable to the LCA-2 on the other side of the T-connector.

→ Start the LinkControl software and follow the instructions on the screen.

	Colour dbk+	Colour adapter cable	Pin
+U _B	brown	brown	1
-U _B	blue	blue	3
C3/Com	grey	grey	5

Fig. 7: Connecting dbk+ to the LCA-2

The following settings can be undertaken:

- Numeric input of the spacing between transmitter and receiver
- The switching outputs can be freely configured. The functions »single sheet«, »overmodulation«, »missing sheet« and »double sheet« can be set, as well as NOC or NCC.
- Operating mode
Free-run mode with 3 pre-defined sensitivity classes and additional Teach-in mode or Free-run mode with 4 independent Teach-in classes or trigger mode with 2 pre-defined sensitivity classes and additional Teach-in mode or Edge- or level-controlled trigger mode

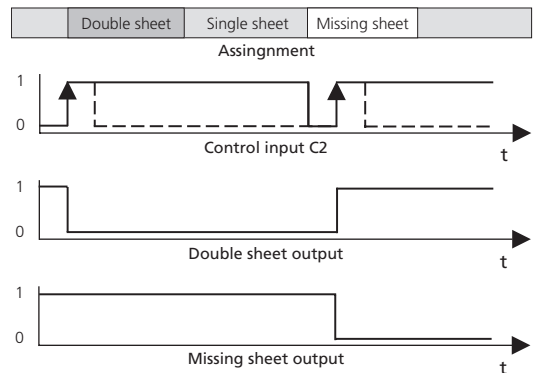


Fig. 8: Trigger mode edge-controlled

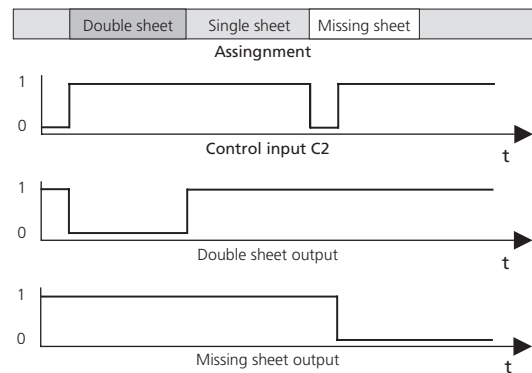


Fig. 9: Trigger mode level-controlled

■ Switching logic of the Teach-in input

■ Teach-in procedures

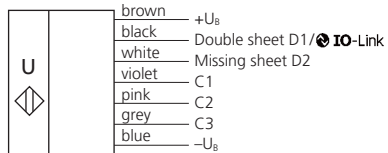
■ and much more

Also available is a diagrammatic representation of the readings.

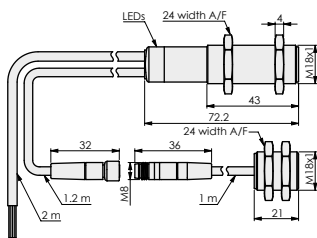
Maintenance

The dbk+ is maintenance-free. If there are heavy deposits of dirt, we recommend cleaning the sensor surfaces on the transmitter and receiver. To do this, apply some isopropanol to a cotton cloth and wipe the surface with it. Make sure that the cleaner does not remain on the surface for too long; wipe the transducer surfaces dry quickly.

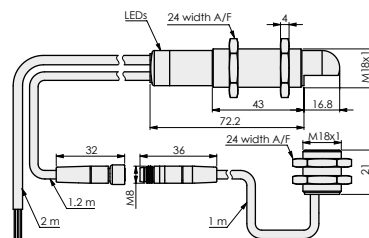
Technical data



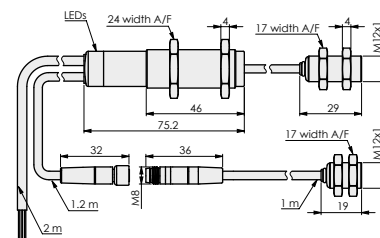
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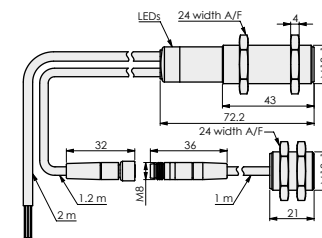
dbk+4/WK/3CFF/M18 E+S



dbk+4/M12/3CFF/M18 E+S



dbk+5/3CFF/M18 E+S



Spacing transmitter-receiver	20 to 60 mm	20 to 60 mm	20 to 40 mm	30 to 70 mm
Optimum spacing transmitter-receiver	40 mm ± 3 mm	40 mm ± 3 mm	20 mm ± 3 mm	50 mm ± 3 mm
Blind zone (in front of transmitter and receiver)	7 mm	7 mm	5 mm	7 mm
Permissible angular deviation	±45° from the perpendicular of the sheet	±45° from the perpendicular of the sheet	±45° from the perpendicular of the sheet	±45° from the perpendicular of the sheet
Ultrasonic frequency	400 kHz	400 kHz	500 kHz	200 kHz
Working range	papers with grammages of < 20 g/m ² to 1,200 g/m ² ; Washi, metal-laminated sheets and films up to 0.4 mm thickness, self-adhesive films, sheet metals up to 0.3 mm thickness, finest corrugated cardboard, wafer, printed circuit boards	papers with grammages of < 20 g/m ² to 1,200 g/m ² ; Washi, metal-laminated sheets and films up to 0.4 mm thickness, self-adhesive films, sheet metals up to 0.3 mm thickness, finest corrugated cardboard, wafer, printed circuit boards	papers with grammages of < 20 g/m ² to 1,200 g/m ² ; Washi, metal-laminated sheets and films up to 0.4 mm thickness, self-adhesive films, sheet metals up to 0.3 mm thickness, printed circuit boards	papers with grammages of 100 g/m ² to 2,000 g/m ² ; plastic sheets and films up to 5 mm thickness self-adhesive films, sheetmetals up to 2 mm, corrugated cardboard, wafer, printed circuit boards
Operating voltage U_B	18 to 30 V DC, reverse polarity protection (Class 2)	18 to 30 V DC, reverse polarity protection (Class 2)	18 to 30 V DC, reverse polarity protection (Class 2)	18 to 30 V DC, reverse polarity protection (Class 2)
Voltage ripple	±10 %	±10 %	±10 %	±10 %
No-load current consumption	≤50 mA	≤50 mA	≤50 mA	≤50 mA
Type of connection	2 m PUR cable, 7 x 0.14 mm ²	2 m PUR cable, 7 x 0.14 mm ²	2 m PUR cable, 7 x 0.14 mm ²	2 m PUR cable, 7 x 0.14 mm ²
Transmitter-receiver connection	at receiver: PUR, 1.2 m; at transmitter: 1 m, PUR; both with M8 connector	at receiver: PUR, 1.2 m; at transmitter: 1 m, PUR; both with M8 connector	at receiver: PUR, 1.2 m; at transmitter: 1 m, PUR; both with M8 connector connection cable to external ultrasonic transducer: PVC, 1,2 m	at receiver: PUR, 1.2 m; at transmitter: 1 m, PUR; both with M8 connector
IO-Link Controls	V1.1	V1.1	V1.1	V1.1
Scope of settings	3 Control inputs: C1 to C3	3 Control inputs: C1 to C3	3 Control inputs: C1 to C3	3 Control inputs: C1 to C3
Synchronisation	Teach-in, LinkControl, IO-Link	Teach-in, LinkControl, IO-Link	Teach-in, LinkControl, IO-Link	Teach-in, LinkControl, IO-Link
Response time Trigger-Mode ¹⁾	<500 µs	<500 µs	<500 µs	<500 µs
Response time Free-Run-Mode ¹⁾	2.5 ms	2.5 ms	2.5 ms	5.5 ms
Indicators	green: working/single sheet red: double sheet, red flashing: missing sheet orange/green: overmodulation	green: working/single sheet red: double sheet, red flashing: missing sheet orange/green: overmodulation	green: working/single sheet red: double sheet, red flashing: missing sheet orange/green: overmodulation	green: working/single sheet red: double sheet, red flashing: missing sheet orange/green: overmodulation
Housing	brass sleeve, nickel-plated; plastic parts: PBT, PA; cable: PUR; ultrasonic transducer: polyurethane, epoxy resin with glass content	brass sleeve, nickel-plated; plastic parts: PBT, PA; cable: PUR; ultrasonic transducer: polyurethane, epoxy resin with glass content	brass sleeve, nickel-plated; plastic parts: PBT, PA; cable: PUR; ultrasonic transducer: polyurethane, epoxy resin with glass content	brass sleeve, nickel-plated; plastic parts: PBT, PA; cable: PUR; ultrasonic transducer: polyurethane, epoxy resin with glass content
Max. tightening torque of nuts	M18, 15 Nm	M18, 15 Nm	M18, 15 Nm; M12, 8 Nm	M18, 15 Nm
Class of protection to EN 60529	IP 65	IP 65	IP 65	IP 65
Operating temperature	+5 to +60 °C	+5 to +60 °C	+5 to +60 °C	+5 to +60 °C
Storage temperature	-40 to +85 °C	-40 to +85 °C	-40 to +85 °C	-40 to +85 °C
Weight	130 g	130 g	160 g	130 g
Norm conformity	EN 60947-5-2	EN 60947-5-2	EN 60947-5-2	EN 60947-5-2
Order no.	dbk+4/3CFF/M18 E+S	dbk+4/WK/3CFF/M18 E+S	dbk+4/M12/3CFF/M18 E+S	dbk+5/3CFF/M18 E+S
Double sheet output	push-pull, +U _B -1 V, -U _B +1 V, I _{max} = 100 mA, short circuit proof, switchable NOC/NCC	push-pull, +U _B -1 V, -U _B +1 V, I _{max} = 100 mA, short circuit proof, switchable NOC/NCC	push-pull, +U _B -3 V, -U _B +3 V, I _{max} = 100 mA, short circuit proof, switchable NOC/NCC	push-pull, +U _B -1 V, -U _B +1 V, I _{max} = 100 mA, short circuit proof, switchable NOC/NCC
Missing sheet output	push-pull, +U _B -1 V, -U _B +1 V, I _{max} = 100 mA, short circuit proof, switchable NOC/NCC	push-pull, +U _B -1 V, -U _B +1 V, I _{max} = 100 mA, short circuit proof, switchable NOC/NCC	push-pull, +U _B -3 V, -U _B +3 V, I _{max} = 100 mA, short circuit proof, switchable NOC/NCC	push-pull, +U _B -1 V, -U _B +1 V, I _{max} = 100 mA, short circuit proof, switchable NOC/NCC
U_E at control inputs C1-C3	> 3/4 U _B ; logical 1	> 3/4 U _B ; logical 1	> 3/4 U _B ; logical 1	> 3/4 U _B ; logical 1
Time delay before availability	< 1/4 U _B or control input open: logical 0 <300 ms	< 1/4 U _B or control input open: logical 0 <300 ms	< 1/4 U _B or control input open: logical 0 <300 ms	< 1/4 U _B or control input open: logical 0 <300 ms

¹⁾ Can be programmed via LinkControl