Data sheet



# DFS60I-S4WC01800

## DFS60

INCREMENTAL ENCODERS

SICK
Sensor Intelligence.

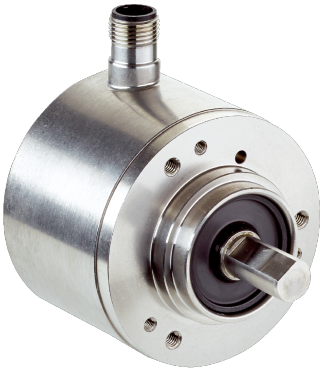


Illustration may differ

## Ordering information

| Type | part no. |
|---|---|
| DFS60I-S4WC01800 | 1087638 |

Other models and accessories ➜ www.sick.com/DFS60

## Detailed technical data

### Safety-related parameters

| | |
|---|---|
| **$MTTF_D$ (mean time to dangerous failure)** | 300 years (EN ISO 13849-1) [1] |

[1] This product is a standard product and does not constitute a safety component as defined in the Machinery Directive. Calculation based on nominal load of components, average ambient temperature 40 °C, frequency of use 8760 h/a. All electronic failures are considered hazardous. For more information, see document no. 8015532.

### Performance

| | |
|---|---|
| **Pulses per revolution** | 1,800 [1] |
| **Measuring step** | 90°, electric/pulses per revolution |
| **Measuring step deviation at non binary number of lines** | ± 0.008° |
| **Error limits** | ± 0.03° |

[1] See maximum revolution range.

### Interfaces

| | |
|---|---|
| **Communication interface** | Incremental |
| **Communication Interface detail** | HTL / Push pull |
| **Number of signal channels** | 6-channel |
| **0-set function via hardware pin** | ✓ |
| **0-SET function** | H-active, L ≡ 0 - 3 V, H ≡ 4.0 - Us V [1] |
| **Initialization time** | 30 ms |
| **Output frequency** | ≤ 820 kHz |
| **Load current** | ≤ 30 mA |
| **Operating current** | 40 mA (without load) |
| **Power consumption** | ≤ 0.7 W (without load) |

[1] Only with devices with M12 connector in connection with electrical interfaces M, V and W.

| | |
|---|---|
| **Load resistance** | ≥ 120 Ω |

[1] Only with devices with M12 connector in connection with electrical interfaces M, V and W.

## Electronics

| | |
|---|---|
| **Connection type** | Male connector, M12, 12-pin, radial |
| **Supply voltage** | 4.5 ... 32 V |
| **Reference signal, number** | 1 |
| **Reference signal, position** | 90°, electric, logically gated with A and B |
| **Reverse polarity protection** | ✓ |
| **Short-circuit protection of the outputs** | ✓ [1] |

[1] Short-circuit opposite to another channel, US or GND permissable for maximum 30 s.

## Mechanics

| | |
|---|---|
| **Mechanical design** | Solid shaft, face mount flange |
| **Shaft diameter** | 10 mmWith flat |
| **Shaft length** | 19 mm |
| **Weight** | + 0.5 kg |
| **Shaft material** | Stainless steel V2A |
| **Flange material** | Stainless steel V2A |
| **Housing material** | Stainless steel V2A |
| **Start up torque** | 1 Ncm (+20 °C) |
| **Operating torque** | 0.5 Ncm (+20 °C) |
| **Permissible shaft loading** | 80 N (radial)<br>40 N (axial) |
| **Operating speed** | ≤ 9,000 $min^{-1}$ [1] |
| **Moment of inertia of the rotor** | 6.2 $gcm^2$ |
| **Bearing lifetime** | 3.6 x 10^10 revolutions |
| **Angular acceleration** | ≤ 500,000 $rad/s^2$ |

[1] Allow for self-heating of 3.3 K per 1,000 rpm when designing the operating temperature range.

## Ambient data

| | |
|---|---|
| **EMC** | According to EN 61000-6-2 and EN 61000-6-3 |
| **Enclosure rating** | IP67, housing side (IEC 60529) [1]<br>IP67, shaft side (IEC 60529) |
| **Permissible relative humidity** | 90 % (Condensation not permitted) |
| **Operating temperature range** | –40 °C ... +100 °C [2]<br>–30 °C ... +100 °C [3] |
| **Storage temperature range** | –40 °C ... +100 °C, without package |
| **Resistance to shocks** | 100 g, 6 ms (EN 60068-2-27) |
| **Resistance to vibration** | 10 g, 10 Hz ... 2,000 Hz (EN 60068-2-6) |

[1] With mating connector fitted.
[2] Stationary position of the cable.
[3] Flexible position of the cable.

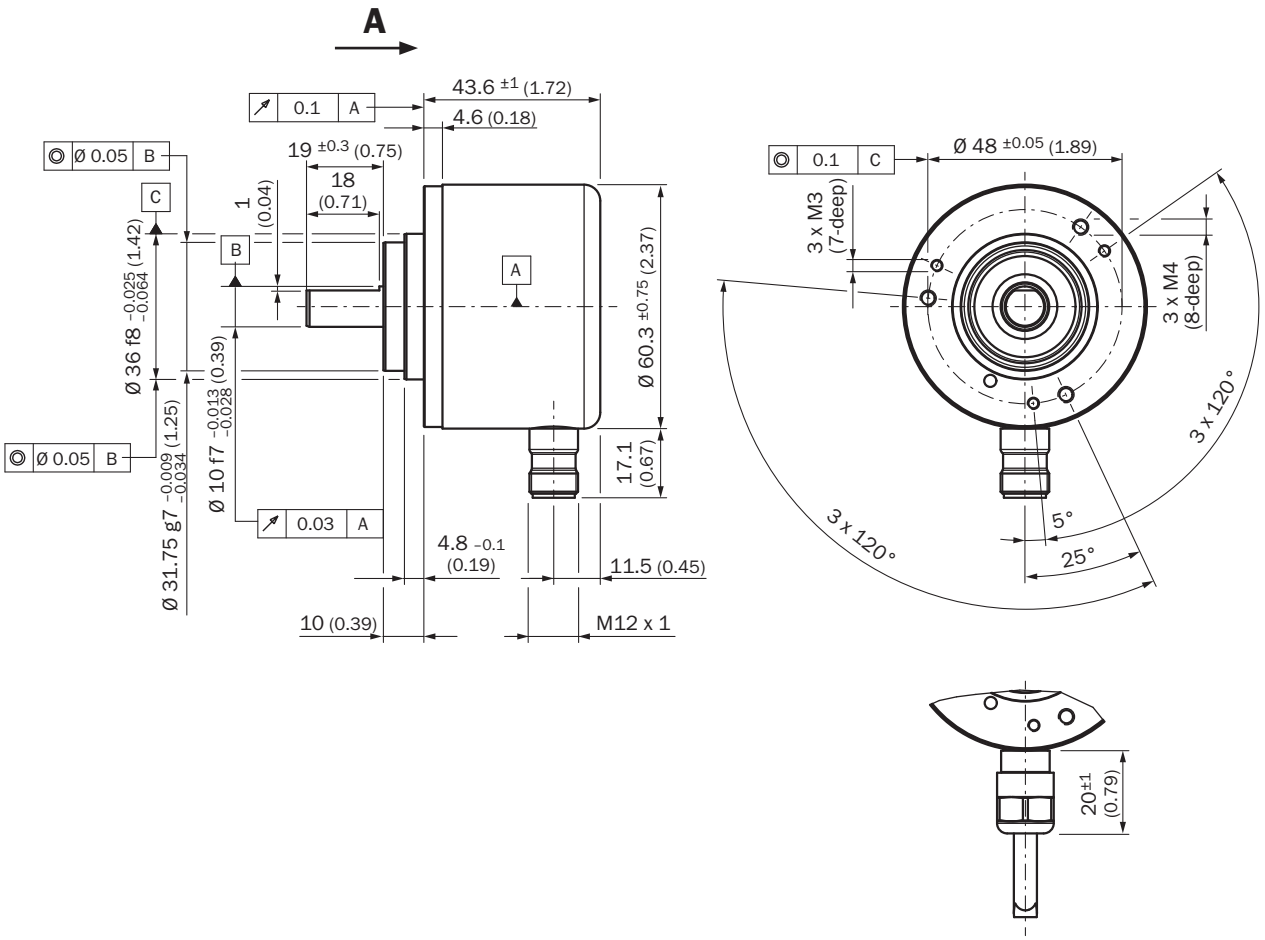
## Classifications

| | |
|---|---|
| **ECLASS 5.0** | 27270501 |
| **ECLASS 5.1.4** | 27270501 |
| **ECLASS 6.0** | 27270590 |
| **ECLASS 6.2** | 27270590 |
| **ECLASS 7.0** | 27270501 |
| **ECLASS 8.0** | 27270501 |
| **ECLASS 8.1** | 27270501 |
| **ECLASS 9.0** | 27270501 |
| **ECLASS 10.0** | 27270501 |
| **ECLASS 11.0** | 27270501 |
| **ECLASS 12.0** | 27270501 |
| **ETIM 5.0** | EC001486 |
| **ETIM 6.0** | EC001486 |
| **ETIM 7.0** | EC001486 |
| **ETIM 8.0** | EC001486 |
| **UNSPSC 16.0901** | 41112113 |

## Certificates

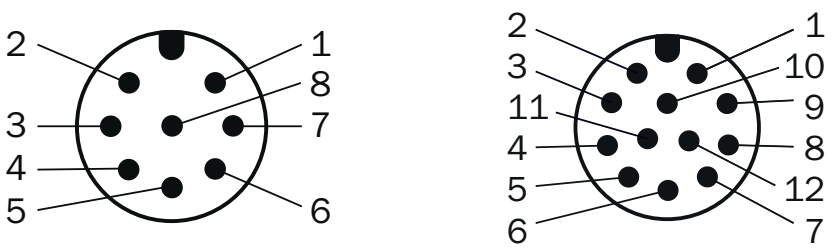
| | |
|---|---|
| **EU declaration of conformity** | ✓ |
| **UK declaration of conformity** | ✓ |
| **ACMA declaration of conformity** | ✓ |
| **Moroccan declaration of conformity** | ✓ |
| **China-RoHS** | ✓ |
| **cULus certificate** | ✓ |
| **Information according to Art. 3 of Data Act (Regulation EU 2023/2854)** | ✓ |

## Dimensional drawing




Dimensions in mm (inch)

## PIN assignment

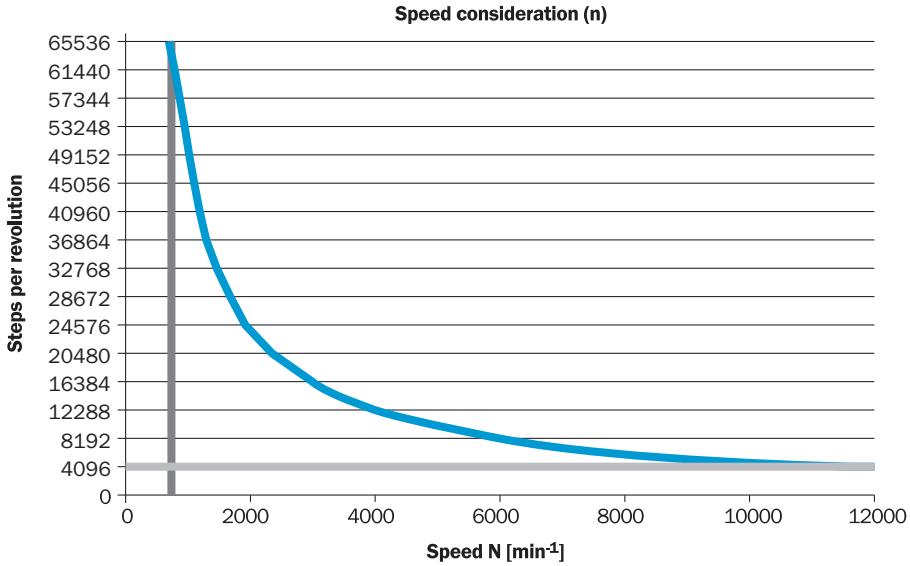



view of M12 male device connector on encoder

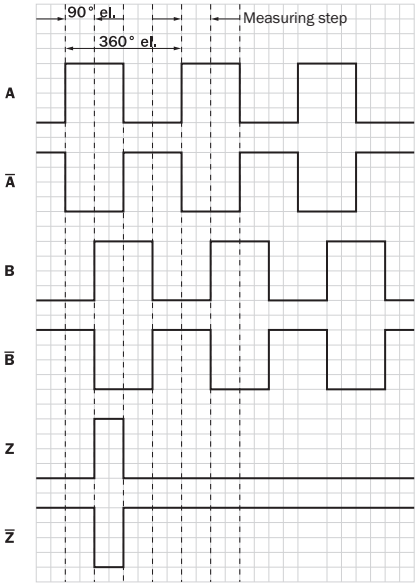
| Male connector M12, 8-pin | Connector M12, 12-pin | Wire colors (cable connection) | TTL/HTL signal | Sin/Cos 1.0 $V_{PP}$ | Explanation |
|---|---|---|---|---|---|
| 1 | 7 | Brown | $\overline{A}$ | COS- | Signal wire |
| 2 | 6 | White | A | COS+ | Signal wire |
| 3 | 9 | Black | $\overline{B}$ | SIN- | Signal wire |
| 4 | 8 | Pink | B | SIN+ | Signal wire |

| Male connector M12, 8-pin | Connector M12, 12-pin | Wire colors (cable connection) | TTL/HTL signal | Sin/Cos 1.0 $V_{PP}$ | Explanation |
|---|---|---|---|---|---|
| 5 | 4 | Yellow | $\overline{Z}$ | $\overline{Z}$ | Signal wire |
| 6 | 11 | Purple | Z | Z | Signal wire |
| 7 | 12 | Blue | GND | GND | Ground connection |
| 8 | 5 | Red | $+U_S$ | $+U_S$ | Supply voltage |
| - | 2 | - | N.c. | N.c. | Not assigned |
| - | 3 | - | N.c. | N.c. | Not assigned |
| - | 1 | - | N.c. | N.c. | Not assigned |
| - | 10 [1)] | - | 0-SET [1)] | N.c. | Set zero pulse1) |
| Screen | Screen | Screen | Screen | Screen | Screen connected to housing on encoder side. Connected to ground on control side. |

## maximum revolution range



## signal outputs




CW with view on the encoder shaft in direction “A”, compare dimensional drawing.

| Supply voltage | Output |
|---|---|
| 4,5 V ... 5,5 V | TTL |
| 10 V ... 32 V | TTL |
| 10 V ... 32 V | HTL |

## Recommended accessories

Other models and accessories ➜ www.sick.com/DFS60

| | Brief description | Type | part no. |
|---|---|---|---|
| shaft adaptation | | | |
|  | • **Product segment:** Shaft adaptation<br>• **Product:** Shaft couplings<br>• **Description:** Bellows coupling, shaft diameter 6 mm / 10 mm, maximum shaft offset: radial ± 0.25 mm, axial ± 0.4 mm, angular +/- 4°; max. speed 10,000 rpm, –30 °C to +120 °C, max. torque 120 Ncm; material: stainless steel bellows, aluminum hub | KUP-0610-B | 5312982 |
|  | • **Product segment:** Shaft adaptation<br>• **Product:** Shaft couplings<br>• **Description:** Double loop coupling, shaft diameter 6 mm / 10 mm, max. shaft offset: radially +/- 2,5 mm, axially +/-3 mm, angle +/- 10 degrees;max. speed 3.000 rpm, –30 to +80 degrees Celsius, torsional spring stiffness of 25 Nm/rad | KUP-0610-D | 5326697 |
|  | • **Product segment:** Shaft adaptation<br>• **Product:** Shaft couplings<br>• **Description:** Spring washer coupling, shaft diameter 6 mm / 10 mm, Maximum shaft offset: radial +/- 0.3 mm, axial +/- 0.4 mm, angular +/- 2.5°; max. speed 12,000 rpm, –10° to +80 °C, max. torque 60 Ncm; material: aluminum flange, glass fiber-reinforced polyamide membrane and hardened steel coupling pin | KUP-0610-F | 5312985 |
|  | • **Product segment:** Shaft adaptation<br>• **Product:** Shaft couplings<br>• **Description:** Bar coupling, shaft diameter 6 mm / 10 mm, max. shaft offset: radial ± 0,3 mm, axial ± 0,3 mm, angular ± 3°; max. speed 10.000 rpm, –10° to +80 °C, max. torque: 80 Ncm, material: fiber-glass reinforced polyamide, aluminum hub | KUP-0610-S | 2056407 |
|  | • **Product segment:** Shaft adaptation<br>• **Product:** Shaft couplings<br>• **Description:** Claw coupling, shaft diameter 6 mm / 10 mm, damping element 80 shore blue, maximum shaft offset: radial ± 0.22 mm, axial ± 1 mm angular ± 1.3°, max. speed 19,000 rpm, angle of twist max. 10°, –30 °C to +80 °C, max. torque 800 Ncm, tightening torque of screws: ISO 4029 150 Ncm, material: aluminum flange, damping element: polyurethane | KUP-0610-J | 2127056 |
|  | • **Product segment:** Shaft adaptation<br>• **Product:** Shaft couplings<br>• **Description:** Double loop coupling, shaft diameter 10 mm / 12 mm, Maximum shaft offset: radial +/- 2.5 mm, axial +/- 3 mm, angular +/- 10°; max. speed 3,000 rpm, –30° to +80 °C, max. torque 1.5 Nm; material: polyurethane, galvanized steel flange | KUP-1012-D | 5326702 |
|  | • **Product segment:** Shaft adaptation<br>• **Product:** Shaft couplings<br>• **Description:** 10 mm / 12 mm; maximum shaft offset: radial +/- 0.25 mm, axial +/- 0.4 mm, angular +/- 4°; max. revolutions 10,000 rpm, –30° to +120 °C, max. torque 120 Ncm; material: stainless steel bellows, aluminum clamping hubs | KUP-1012-B | 5312984 |
|  | • **Product segment:** Shaft adaptation<br>• **Product:** Shaft couplings<br>• **Description:** Spring coupling, shaft diameter 10 mm / 10 mm, maximum shaft offset: radial ± 1.5 mm, axial ± 1.0 mm, angular ± 5°, max. speed 3,000 rpm, –30° to +120 °Celsius, nominal torque 150 Ncm, rotational angle at half nominal torque, direction of rotation right viewed on driving shaft 40°, left viewed on driving shaft 60°, material: spring steel 1.0600 nickel plated, zinc die cast hubs | KUP-1010-W | 5319914 |
|  | • **Product segment:** Shaft adaptation<br>• **Product:** Shaft couplings | KUP-1010-S | 2056408 |

| | Brief description | Type | part no. |
|---|---|---|---|
| | • **Description:** Bar coupling, shaft diameter 10 mm / 10 mm; maximum shaft offset: radial ± 0.3 mm, axial ± 0.2 mm, angular ± 3°; speed 10,000 rpm, –10° to +80° Celsius, max. torque 80 Ncm; material: glass fiber-reinforced polyamide, aluminum hub | | |
|  | • **Product segment:** Shaft adaptation<br>• **Product:** Shaft couplings<br>• **Description:** Spring washer coupling, shaft diameter 10 mm / 10 mm, maximum shaft offset, radial ± 0.3 mm, axial ± 0.4 mm, angle ± 2.5°, torsion spring stiffness 30 Nm/rad; material: aluminum flange, glass-fiber reinforced polyamide membrane and hardened steel coupling pin | KUP-1010-F | 5312986 |
|  | • **Product segment:** Shaft adaptation<br>• **Product:** Shaft couplings<br>• **Description:** Double loop coupling, shaft diameter 10 mm / 10 mm, Maximum shaft offset: radial +/- 2.5 mm, axial +/- 3 mm, angular +/- 10°; max. speed 3,000 rpm, –30° to +80 °C, max. torque 1.5 Nm; material: polyurethane, galvanized steel flange | KUP-1010-D | 5326703 |
|  | • **Product segment:** Shaft adaptation<br>• **Product:** Shaft couplings<br>• **Description:** Bellows coupling, shaft diameter 10 mm/10 mm; maximum shaft offset: radial +/- 0.25 mm, axial +/- 0.4 mm, angular +/- 4°; max. revolutions 10,000 rpm, –30° to +120 °C, max. torque 120 Ncm; material: stainless steel bellows, aluminum clamping hubs | KUP-1010-B | 5312983 |
|  | • **Product segment:** Shaft adaptation<br>• **Product:** Shaft couplings<br>• **Description:** Bar coupling, shaft diameter 8 mm / 10 mm, max. shaft offset: radial ± 0,3 mm, axial ± 0,3 mm, angular ± 3°; max. speed 10.000 rpm, –10° to +80 °C, max. torque: 80 Ncm, material: fiber-glass reinforced polyamide, aluminum hub | KUP-0810-S | 5314178 |
|  | • **Product segment:** Shaft adaptation<br>• **Product:** Shaft couplings<br>• **Description:** Double loop coupling, shaft diameter 8 mm / 10 mm, max. shaft offset: radially +/- 0,25 mm, axially +/-0,4 mm, angle +/- 4 degrees;max. speed 10.000 rpm, –30 to +120 degrees Celsius, torsional spring stiffness of 150 Nm/rad | KUP-0810-D | 5326704 |
|  | • **Product segment:** Shaft adaptation<br>• **Product:** Shaft couplings<br>• **Description:** Claw coupling, shaft diameter 8 mm / 10 mm, damping element 80 shore blue, maximum shaft offset: radial ± 0.22 mm, axial ± 1 mm angular ± 1.3°, max. speed 19,000 rpm, angle of twist max. 10°, –30 °C to +80 °C, max. torque 800 Ncm, tightening torque of screws: ISO 4029 150 Ncm, material: aluminum flange, damping element: polyurethane | KUP-0810-J | 2128267 |
|  | • **Product segment:** Shaft adaptation<br>• **Product:** Shaft couplings<br>• **Description:** Claw coupling, shaft diameter 10 mm / 10 mm, damping element 80 shore blue, maximum shaft offset: radial ± 0.22 mm, axial ± 1 mm angular ± 1.3°, max. speed 19,000 rpm, angle of twist max. 10°, –30 °C to +80 °C, max. torque 800 Ncm, tightening torque of screws: ISO 4029 150 Ncm, material: aluminum flange, damping element: polyurethane | KUP-1010-J | 2127054 |
|  | • **Product segment:** Shaft adaptation<br>• **Product:** Shaft couplings<br>• **Description:** Claw coupling, shaft diameter 10 mm / 12 mm, damping element 80 shore blue, maximum shaft offset: radial ± 0.22 mm, axial ± 1 mm angular ± 1.3°, max. speed 19,000 rpm, angle of twist max. 10°, –30 °C to +80 °C, max. torque 800 Ncm, tightening torque of screws: ISO 4029 150 Ncm, material: aluminum flange, damping element: polyurethane | KUP-1012-J | 2128265 |

| | Brief description | Type | part no. |
|---|---|---|---|
| Mounting systems | | | |
|  | • **Description:** Bearing block for servo and face mount flange encoder. The heavy-duty bearing block is used to absorb very large radial and axial shaft loads. Particularly when using belt pulleys, chain sprockets, friction wheels. Operating speed max. 4,000 rpm^-1, axial shaft load 150 N, radial shaft load 250 N, bearing service life 3.6 x 10^9 revolutions | BEF-FA-LB1210 | 2044591 |
|  | • **Description:** Flange adapter, adaptation of face mount flange with 36 mm centering hub to 58 mm square mounting plate with shock absorbers, aluminum<br>• **Material:** Aluminum<br>• **Details:** Aluminum | BEF-FA-036-060RSA | 2029163 |
|  | • **Description:** Mounting angle spring-loaded, for flange with centerring collar 36 mm, working temperature range –40° ... +120°C<br>• **Material:** Aluminum<br>• **Details:** Aluminum | BEF-WF36F | 4084775 |
|  | • **Description:** Mounting bracket for encoder with spigot 36 mm for face mount flange<br>• **Items supplied:** Mounting kit included | BEF-WF-36 | 2029164 |

| | Brief description | Type | part no. |
|---|---|---|---|
| measuring wheels and measuring wheel mechanics | | | |
|  | • **Product segment:** Measuring wheels and measuring wheel mechanics<br>• **Product family:** Measuring wheels<br>• **Description:** Aluminium measuring wheel with O-ring (NBR70) for 10 mm solid shaft, circumference 200 mm | BEF-MR010020R | 2055224 |
|  | • **Product segment:** Measuring wheels and measuring wheel mechanics<br>• **Product family:** Measuring wheels<br>• **Description:** Aluminium measuring wheel with O-ring (NBR70) for 10 mm solid shaft, circumference 300 mm | BEF-MR010030R | 2049278 |
|  | • **Product segment:** Measuring wheels and measuring wheel mechanics<br>• **Product family:** Measuring wheels<br>• **Description:** Measuring wheel with O-ring (NBR70) for 10 mm solid shaft, circumference 500 mm | BEF-MR010050R | 2055227 |
|  | • **Product segment:** Measuring wheels and measuring wheel mechanics<br>• **Product family:** Measuring wheels<br>• **Description:** Aluminum measuring wheel with cross-knurled surface for 10 mm solid shaft, circumference 200 mm | BEF-MR10200AK | 4084737 |
|  | • **Product segment:** Measuring wheels and measuring wheel mechanics<br>• **Product family:** Measuring wheels<br>• **Description:** Aluminum measuring wheel with smooth polyurethane surface for 10 mm solid shaft, circumference 200 mm | BEF-MR10200AP | 4084738 |
|  | • **Product segment:** Measuring wheels and measuring wheel mechanics<br>• **Product family:** Measuring wheels<br>• **Description:** Aluminum measuring wheel with ridged polyurethane surface for 10 mm solid shaft, circumference 200 mm | BEF-MR10200APG | 4084740 |
| | • **Product segment:** Measuring wheels and measuring wheel mechanics<br>• **Product family:** Measuring wheels | BEF-MR10200APN | 4084739 |

| | Brief description | Type | part no. |
|---|---|---|---|
| | • **Description:** Aluminum measuring wheel with studded polyurethane surface for 10 mm solid shaft, circumference 200 mm | | |
|  | • **Product segment:** Measuring wheels and measuring wheel mechanics<br>• **Product family:** Measuring wheels<br>• **Description:** Aluminum measuring wheel with cross-knurled surface for 10 mm solid shaft, circumference 500 mm | BEF-MR10500AK | 4084733 |
|  | • **Product segment:** Measuring wheels and measuring wheel mechanics<br>• **Product family:** Measuring wheels<br>• **Description:** Aluminum measuring wheel with smooth polyurethane surface for 10 mm solid shaft, circumference 500 mm | BEF-MR10500AP | 4084734 |
|  | • **Product segment:** Measuring wheels and measuring wheel mechanics<br>• **Product family:** Measuring wheels<br>• **Description:** Aluminum measuring wheel with ridged polyurethane surface for 10 mm solid shaft, circumference 500 mm | BEF-MR10500APG | 4084736 |
|  | • **Product segment:** Measuring wheels and measuring wheel mechanics<br>• **Product family:** Measuring wheels<br>• **Description:** Aluminum measuring wheel with studded polyurethane surface for 10 mm solid shaft, circumference 500 mm | BEF-MR10500APN | 4084735 |
|  | • **Product segment:** Measuring wheels and measuring wheel mechanics<br>• **Product family:** Measuring wheel mechanics<br>• **Description:** SICK modular measuring wheel system for face mount flange encoder with S4 mechanical design (10 mm x 19 mm solid shaft), e.g., DFS60-S4: with O-ring measuring wheel, circumference 200 mm<br>• **Suitable for:** Face mount flange encoder DFS60, DBS60, AFM60, AFS60, mechanical design S4 (solid shaft 10 mm x 19 mm) | BEF-MRS-10-U | 2085714 |

| | Brief description | Type | part no. |
|---|---|---|---|
| connectors and cables | | | |
|  | • **Connection type head A:** Male connector, M12, 8-pin, straight, A-coded<br>• **Description:** Shielded<br>• **Connection systems:** Screw-type terminals<br>• **Permitted cross-section:** ≤ 0.5 mm²<br>• **Application:** Hygienic and washdown zones | YM12ES8-0050S5586A | 2097337 |
|  | • **Connection type head A:** Female connector, M12, 8-pin, straight, A-coded<br>• **Description:** Shielded<br>• **Connection systems:** Screw-type terminals<br>• **Permitted cross-section:** 0.25 mm² ... 0.5 mm²<br>• **Application:** Hygienic and washdown zones | YF12ES8-0050S5586A | 2097334 |
|  | • **Connection type head A:** Female connector, M12, 12-pin, straight, A-coded<br>• **Connection type head B:** Flying leads<br>• **Signal type:** SSI<br>• **Cable:** 2 m, 12-wire, PUR, halogen-free<br>• **Description:** SSI, shielded<br>• **Note:** Drag chain use | DOL-1212-G02MAC1 | 6053273 |
|  | • **Connection type head A:** Female connector, M12, 12-pin, straight, A-coded<br>• **Connection type head B:** Flying leads<br>• **Signal type:** SSI<br>• **Cable:** 5 m, 12-wire, PUR, halogen-free<br>• **Description:** SSI, shielded<br>• **Note:** Drag chain use | DOL-1212-G05MAC1 | 6053274 |
|  | • **Connection type head A:** Female connector, M12, 12-pin, straight, A-coded<br>• **Connection type head B:** Flying leads<br>• **Signal type:** SSI<br>• **Cable:** 10 m, 12-wire, PUR, halogen-free<br>• **Description:** SSI, shielded<br>• **Note:** Drag chain use | DOL-1212-G10MAC1 | 6053275 |
|  | • **Connection type head A:** Female connector, M12, 12-pin, straight, A-coded<br>• **Connection type head B:** Flying leads<br>• **Signal type:** SSI<br>• **Cable:** 20 m, 12-wire, PUR, halogen-free<br>• **Description:** SSI, shielded<br>• **Note:** Drag chain use | DOL-1212-G20MAC1 | 6053276 |
|  | • **Connection type head A:** Female connector, M12, 12-pin, angled, A-coded<br>• **Connection type head B:** Flying leads<br>• **Signal type:** SSI<br>• **Cable:** 2 m, 12-wire, PUR, halogen-free<br>• **Description:** SSI, shielded | DOL-1212-W02MAC1 | 6039824 |
|  | • **Connection type head A:** Female connector, M12, 12-pin, angled, A-coded<br>• **Connection type head B:** Flying leads<br>• **Signal type:** SSI<br>• **Cable:** 5 m, 12-wire, PUR, halogen-free<br>• **Description:** SSI, shielded<br>• **Note:** Drag chain use | DOL-1212-W05MAC1 | 6039825 |
|  | • **Connection type head A:** Female connector, M12, 12-pin, angled, A-coded<br>• **Connection type head B:** Flying leads<br>• **Signal type:** SSI<br>• **Cable:** 10 m, 12-wire, PUR, halogen-free<br>• **Description:** SSI, shielded<br>• **Note:** Drag chain use | DOL-1212-W10MAC1 | 6039826 |
|  | • **Connection type head A:** Female connector, M12, 12-pin, angled, A-coded<br>• **Connection type head B:** Flying leads<br>• **Signal type:** SSI<br>• **Cable:** 20 m, 12-wire, PUR, halogen-free<br>• **Description:** SSI, shielded<br>• **Note:** Drag chain use | DOL-1212-W20MAC1 | 6039827 |

# SICK AT A GLANCE

SICK is one of the leading manufacturers of intelligent sensors and sensor solutions for industrial applications. A unique range of products and services creates the perfect basis for controlling processes securely and efficiently, protecting individuals from accidents and preventing damage to the environment.

We have extensive experience in a wide range of industries and understand their processes and requirements. With intelligent sensors, we can deliver exactly what our customers need. In application centers in Europe, Asia and North America, system solutions are tested and optimized in accordance with customer specifications. All this makes us a reliable supplier and development partner.

Comprehensive services complete our offering: SICK LifeTime Services provide support throughout the machine life cycle and ensure safety and productivity.

**For us, that is “Sensor Intelligence.”**

# WORLDWIDE PRESENCE:

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