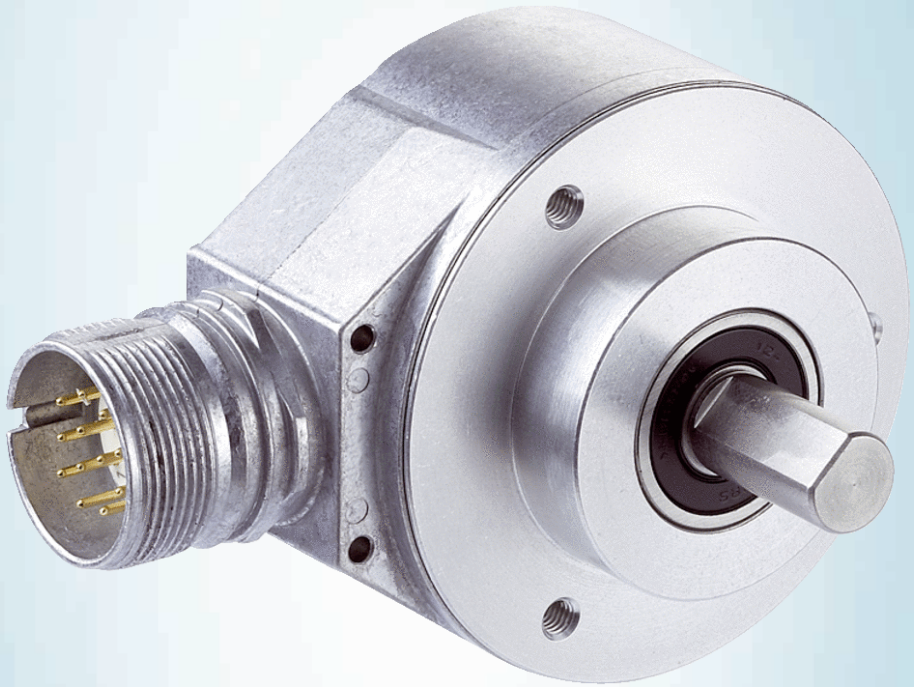
Data sheet



# AFM60E-S4TA004096

## AFS/AFM60 SSI

**ABSOLUTE ENCODERS**

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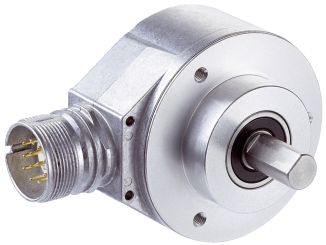


Illustration may differ

## Ordering information

| Type | part no. |
|---|---|
| AFM60E-S4TA004096 | 1073804 |

Other models and accessories ➜ www.sick.com/AFS_AFM60_SSI

## Detailed technical data

### Safety-related parameters

| | |
|---|---|
| **$MTTF_D$ (mean time to dangerous failure)** | 250 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

| | |
|---|---|
| **Number of steps per revolution (max. resolution)** | 4,096 (12 bit) |
| **Number of revolutions** | 4,096 (12 bit) |
| **Max. resolution (number of steps per revolution x number of revolutions)** | 12 bit x 12 bit (4,096 x 4,096) |
| **Error limits G** | 0.2° [1] |
| **Repeatability standard deviation $\sigma_r$** | 0.002° [2] |

[1] In accordance with DIN ISO 1319-1, position of the upper and lower error limit depends on the installation situation, specified value refers to a symmetrical position, i.e. deviation in upper and lower direction is the same.
[2] In accordance with DIN ISO 55350-13; 68.3% of the measured values are inside the specified area.

### Interfaces

| | |
|---|---|
| **Communication interface** | SSI |
| **Communication Interface detail** | SSI + incremental / TTL |
| **Initialization time** | 50 ms [1] |
| **Position forming time** | < 1 µs |
| **Code type** | Gray |
| **Code sequence parameter adjustable** | CW/CCW (V/R) parameter adjustable |
| **Clock frequency** | ≤ 1 MHz [2] |
| **Set (electronic adjustment)** | H-active (L = 0 - 3 V, H = 4,0 - $U_s$ V) |
| **CW/CCW (counting sequence when turning)** | L-active (L = 0 - 1,5 V, H = 2,0 - Us V) |

[1] Valid positional data can be read once this time has elapsed.
[2] Minimum, LOW level (Clock +): 250 ns.

| | |
|---|---|
| **Pulses per revolution** | 1/4 of number of SSI steps per revolution |
| **Output frequency** | ≤ 300 kHz |
| **Load current** | ≤ 30 mA |

[1] Valid positional data can be read once this time has elapsed.
[2] Minimum, LOW level (Clock +): 250 ns.

## Electronics

| | |
|---|---|
| **Connection type** | Male connector, M23, 12-pin, radial |
| **Supply voltage** | 4.5 ... 32 V |
| **Power consumption** | ≤ 0.7 W (without load) |
| **Reverse polarity protection** | ✓ |

## Mechanics

| | |
|---|---|
| **Mechanical design** | Solid shaft, face mount flange |
| **Shaft diameter** | 10 mm |
| **Shaft length** | 19 mm |
| **Characteristics of the shaft** | With flat |
| **Weight** | 0.3 kg [1] |
| **Shaft material** | Stainless steel |
| **Flange material** | Aluminum |
| **Housing material** | Aluminum die cast |
| **Start up torque** | < 0.5 Ncm (+20 °C) |
| **Operating torque** | < 0.3 Ncm (+20 °C) |
| **Permissible shaft loading** | 80 N (radial)<br>40 N (axial) |
| **Operating speed** | ≤ 9,000 $min^{-1}$ [2] |
| **Moment of inertia of the rotor** | 6.2 $gcm^2$ |
| **Bearing lifetime** | 3.0 x 10^9 revolutions |
| **Angular acceleration** | ≤ 500,000 $rad/s^2$ |

[1] Based on devices with male connector.
[2] 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 [1] |
| **Enclosure rating** | IP65, shaft side (IEC 60529)<br>IP67, housing side (IEC 60529) [2] |
| **Permissible relative humidity** | 90 % (Condensation not permitted) |
| **Operating temperature range** | 0 °C ... +85 °C |
| **Storage temperature range** | –40 °C ... +100 °C, without package |
| **Resistance to shocks** | 50 g, 6 ms (EN 60068-2-27) |
| **Resistance to vibration** | 20 g, 10 Hz ... 2,000 Hz (EN 60068-2-6) |

[1] EMC according to the standards quoted is achieved if shielded cables are used.
[2] For devices with male connector: with mounted mating connector.

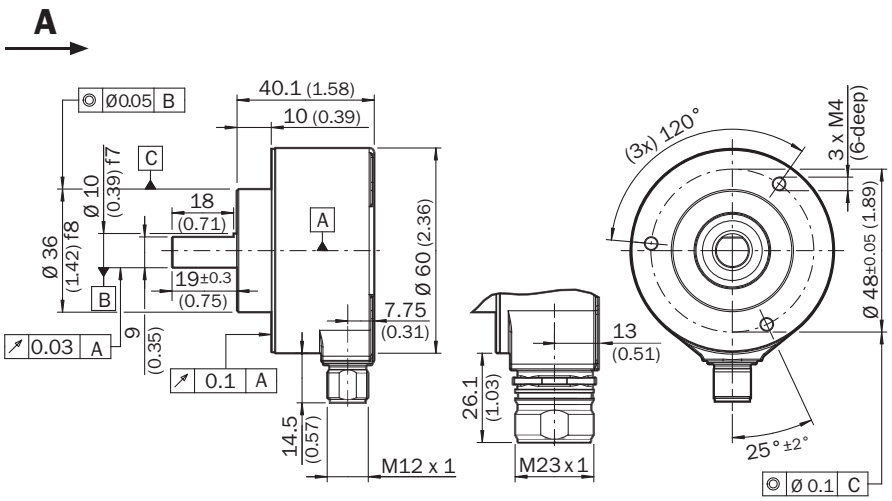
## Certificates

| | |
|---|---|
| **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)** | ✓ |

## Classifications

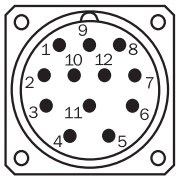
| | |
|---|---|
| **ECLASS 5.0** | 27270502 |
| **ECLASS 5.1.4** | 27270502 |
| **ECLASS 6.0** | 27270590 |
| **ECLASS 6.2** | 27270590 |
| **ECLASS 7.0** | 27270502 |
| **ECLASS 8.0** | 27270502 |
| **ECLASS 8.1** | 27270502 |
| **ECLASS 9.0** | 27270502 |
| **ECLASS 10.0** | 27270502 |
| **ECLASS 11.0** | 27270502 |
| **ECLASS 12.0** | 27270502 |
| **ETIM 5.0** | EC001486 |
| **ETIM 6.0** | EC001486 |
| **ETIM 7.0** | EC001486 |
| **ETIM 8.0** | EC001486 |
| **UNSPSC 16.0901** | 41112113 |

## Dimensional drawing



Dimensions in mm (inch)

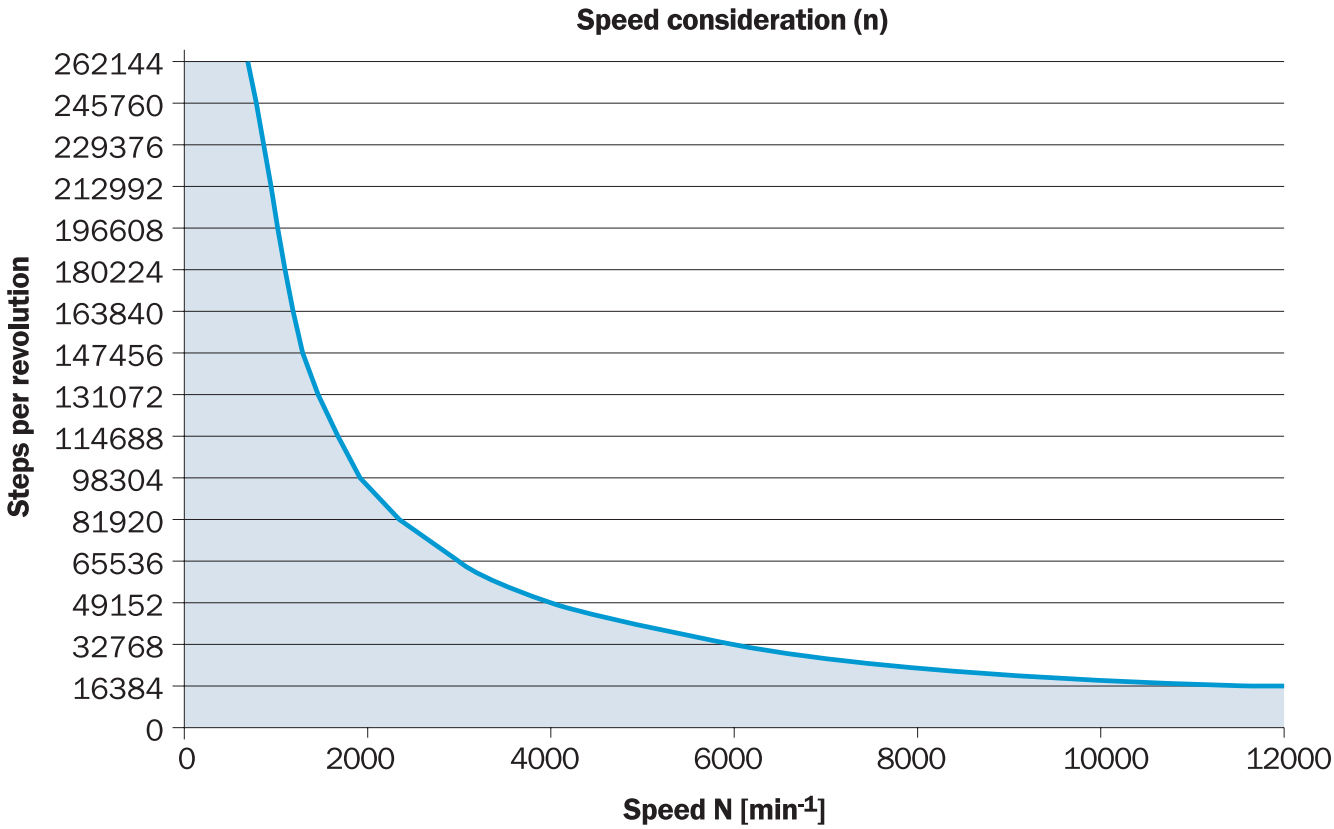
## Anschlussbelegung M23 male connector, 12-pin and cable, 12-wire, SSI/Gray + incremental




view of M23 male device connector on encoder

| PIN | Wire colors (cable connection) | SignalSin/Cos | Explanation |
|---|---|---|---|
| 1 | Red | $U_S$ | Operating voltage |
| 2 | Blue | GND | Ground connection |
| 3 | Yellow | Clock + | Interface signals |
| 4 | White | Data + | Interface signals |
| 5 | Orange | SET | Electronic adjustment |
| 6 | Brown | Data - | Interface signals |
| 7 | Violet | Clock - | Interface signals |
| 8 | Black | $\overline{B}$ | Signal wire |
| 9 | Orange-black | CW/CCW (V/R) | Sequence in direction of rotation |
| 10 | Green | $\overline{A}$ | Signal wire |
| 11 | Gray | A | Signal wire |
| 12 | Pink | B | Signal wire |
| – | – | Shielding | Shielding connected to housing on encoder side. Connected to ground on control side. |

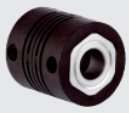
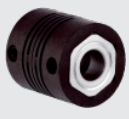
## Diagrams

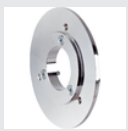



The maximum speed is also dependent on the shaft type.

## Recommended accessories

Other models and accessories ➜ www.sick.com/AFS_AFM60_SSI

| | 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 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:** 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:** 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:** 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:** 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:** 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 | KUP-1010-S | 2056408 |
| | • **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 | KUP-1010-W | 5319914 |

| | Brief description | Type | part no. |
|---|---|---|---|
| | driving shaft 40°, left viewed on driving shaft 60°, material: spring steel 1.0600 nickel plated, zinc die cast hubs | | |
| | • **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:** 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:** 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 |
| Mounting systems | | | |
| | • **Description:** Servo clamps, large, for servo flange (clamps, eccentric fastener), 3 pcs, without mounting material<br>• **Items supplied:** Without mounting hardware | BEF-WK-SF | 2029166 |
|  | • **Description:** Flange adapter, adaptation of face mount flange with 36 mm centering hub to 100 mm servo flange with 60 mm centering hub, aluminum<br>• **Material:** Aluminum<br>• **Details:** Aluminum | BEF-FA-036-100 | 2029161 |

| | Brief description | Type | part no. |
|---|---|---|---|
| connectors and cables | | | |
|  | • **Description:** HIPERFACE®, shielded, SSI, Incremental<br>• **Connection type head A:** Female connector, M23, 12-pin, angled, A-coded<br>• **Signal type:** HIPERFACE®, SSI, Incremental<br>• **Connection systems:** Solder connection | DOS-2312-W01 | 2072580 |
| | • **Description:** HIPERFACE®, shielded, SSI, Incremental<br>• **Connection type head A:** Female connector, M23, 12-pin, straight, A-coded<br>• **Signal type:** HIPERFACE®, SSI, Incremental<br>• **Connection systems:** Solder connection | DOS-2312-G02 | 2077057 |
| | • **Description:** HIPERFACE®, shielded, SSI, Incremental<br>• **Connection type head A:** Female connector, M23, 12-pin, straight, A-coded<br>• **Signal type:** HIPERFACE®, SSI, Incremental<br>• **Connection systems:** Solder connection | DOS-2312-G | 6027538 |
| | • **Connection type head A:** Female connector, M23, 12-pin, straight<br>• **Connection type head B:** Flying leads<br>• **Cable:** 3 m, 12-wire<br>• **Description:** Shielded<br>• **Application:** Drag chain operation, Zones with chemicals, Zones with oils and lubricants | DOL-2312-G03MMD2 | 2062300 |
| | • **Connection type head A:** Female connector, M23, 12-pin, straight<br>• **Connection type head B:** Flying leads<br>• **Cable:** 5 m, 12-wire<br>• **Description:** Shielded<br>• **Application:** Drag chain operation, Zones with chemicals, Zones with oils and lubricants | DOL-2312-G05MMD2 | 2062301 |
| | • **Connection type head A:** Female connector, M23, 12-pin, straight<br>• **Connection type head B:** Flying leads<br>• **Cable:** 1.5 m, 12-wire<br>• **Description:** Unshielded<br>• **Application:** Drag chain operation, Zones with chemicals, Zones with oils and lubricants | DOL-2312-G1M5MD2 | 2062284 |
| | • **Connection type head A:** Female connector, M23, 12-pin, straight<br>• **Connection type head B:** Flying leads<br>• **Cable:** 10 m, 12-wire<br>• **Description:** Shielded<br>• **Application:** Drag chain operation, Zones with chemicals, Zones with oils and lubricants | DOL-2312-G10MMD2 | 2062302 |
| | • **Connection type head A:** Female connector, M23, 12-pin, straight<br>• **Connection type head B:** Flying leads<br>• **Cable:** 20 m, 12-wire<br>• **Description:** Shielded<br>• **Application:** Drag chain operation, Zones with chemicals, Zones with oils and lubricants | DOL-2312-G20MMD2 | 2062303 |
| | • **Connection type head A:** Female connector, M23, 12-pin, straight<br>• **Connection type head B:** Flying leads<br>• **Cable:** 30 m, 12-wire<br>• **Description:** Shielded<br>• **Application:** Drag chain operation, Zones with chemicals, Zones with oils and lubricants | DOL-2312-G30MMD2 | 2062304 |
| | • **Description:** HIPERFACE®, shielded, SSI, Incremental<br>• **Connection type head A:** Female connector, M23, 9-pin, straight, A-coded<br>• **Signal type:** HIPERFACE®, SSI, Incremental<br>• **Connection systems:** Solder connection | DOS-2309-G | 6028533 |

# SICK AT A GLANCE

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