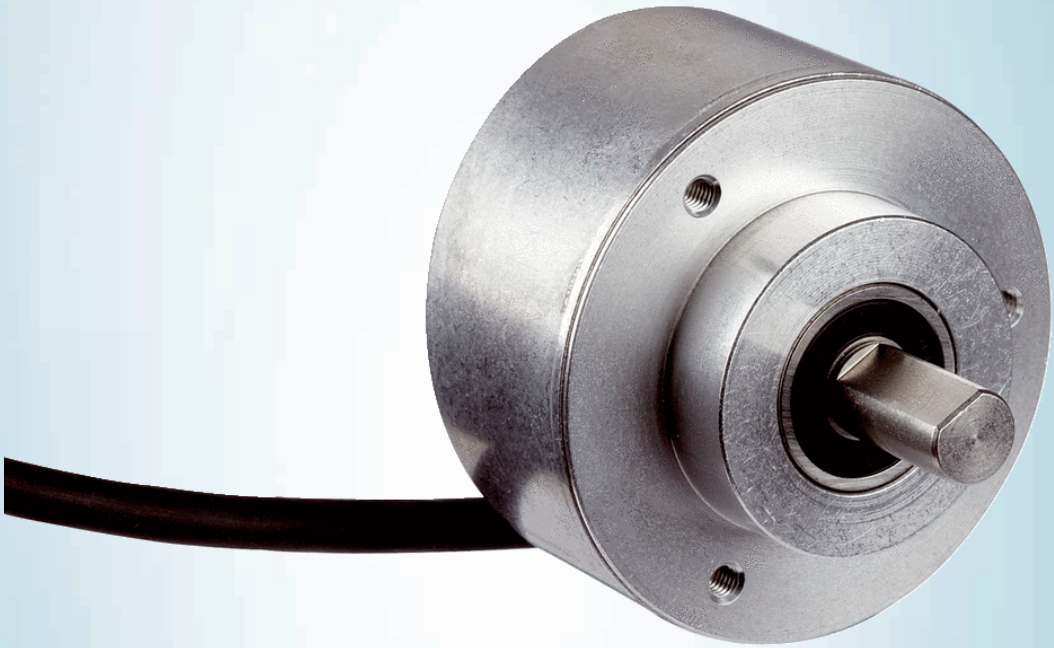
Product data sheet



# AFM60A-S4AL065536

## AFS/AFM60 SSI

**ABSOLUTE ENCODERS**

SICK
Sensor Intelligence.

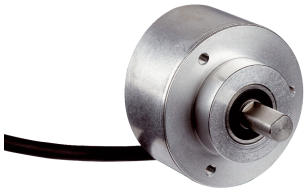


Illustration may differ

## Ordering information

| Type | Part no. |
|---|---|
| AFM60A-S4AL065536 | 1038173 |

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

## Detailed technical data

### Performance

| | |
|---|---|
| **Max. resolution (number of steps per revolution x number of revolutions)** | 16 bit x 12 bit (65,536 x 4,096) |
| **Error limits G** | 0.03° [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 |
| **Initialization time** | 50 ms [1] |
| **Position forming time** | < 1 µs |
| **SSI** | |
| Code type | Gray |
| Code sequence parameter adjustable | CW/CCW (V/R) parameter adjustable |
| Clock frequency | ≤ 2 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) |
| **Sin/Cos** | |
| Load resistance | ≥ 120 Ω |

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

### Electrical data

| | |
|---|---|
| **Connection type** | Cable, 8-wire, universal, 3 m [1] |
| **Supply voltage** | 4.5 ... 32 V DC |
| **Power consumption** | ≤ 0.7 W (without load) |
| **Reverse polarity protection** | ✓ |

[1] The universal cable connection is positioned so that it is possible to lay it without bends in a radial or axial direction.
[2] 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.

| | |
|---|---|
| **MTTFd: mean time to dangerous failure** | 250 years (EN ISO 13849-1) [2] |

[1] The universal cable connection is positioned so that it is possible to lay it without bends in a radial or axial direction.

[2] 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.

## Mechanical data

| | |
|---|---|
| **Mechanical design** | Solid shaft, face mount flange |
| **Shaft diameter** | 10 mm |
| **Shaft length** | 19 mm |
| **Weight** | 0.3 kg [1] |
| **Shaft material** | Stainless steel |
| **Flange material** | Aluminum |
| **Housing material** | Aluminum die cast |
| **Start up torque** | < 0.5 Ncm [2] |
| **Operating torque** | < 0.3 Ncm [2] |
| **Permissible Load capacity of shaft** | 80 N / radial<br>40 N / axial |
| **Moment of inertia of the rotor** | 6.2 gcm² |
| **Bearing lifetime** | 3.0 x 10^9 revolutions |
| **Angular acceleration** | + 500,000 rad/s² |
| **Operating speed** | ≤ 9,000 min$^{-1}$ [3] |

[1] Relates to devices with male connector connection.

[2] At 20 °C.

[3] Allow for self-heating of approx. 3.3 K / 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 (according to IEC 60529)<br>IP67, housing side (according to IEC 60529) [2] |
| **Permissible relative humidity** | 90 % (condensation of the optical scanning not permitted) |
| **Operating temperature range** | –40 °C ... +100 °C [3] |
| **Storage temperature range** | –40 °C ... +100 °C, without package |
| **Resistance to shocks** | 60 g, 6 ms (according to EN 60068-2-27) |
| **Resistance to vibration** | 20 g, 10 Hz ... 2,000 Hz (according to EN 60068-2-6) |

[1] EMC according to the standards quoted is achieved if shielded cables are used.

[2] For devices with connector connection: With mating connector mounted.

[3] Stationary position of the cable.

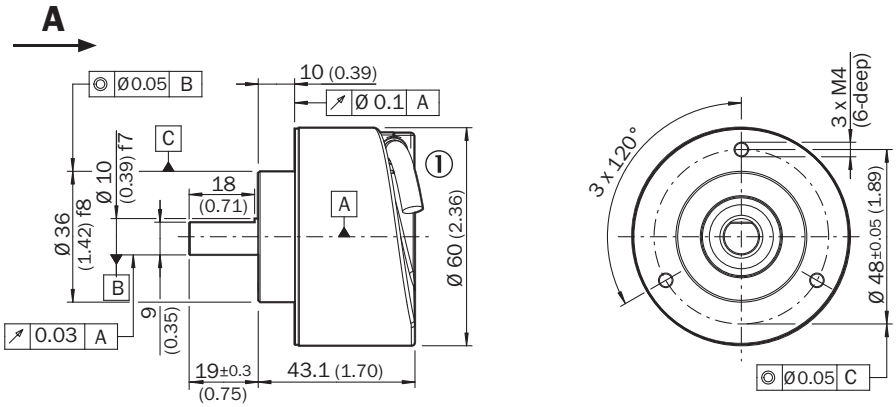
## Classifications

| | |
|---|---|
| **ECl@ss 5.0** | 27270502 |
| **ECl@ss 5.1.4** | 27270502 |
| **ECl@ss 6.0** | 27270590 |
| **ECl@ss 6.2** | 27270590 |
| **ECl@ss 7.0** | 27270502 |

| | |
|---|---|
| **ECl@ss 8.0** | 27270502 |
| **ECl@ss 8.1** | 27270502 |
| **ECl@ss 9.0** | 27270502 |
| **ECl@ss 10.0** | 27270502 |
| **ECl@ss 11.0** | 27270502 |
| **ETIM 5.0** | EC001486 |
| **ETIM 6.0** | EC001486 |
| **ETIM 7.0** | EC001486 |
| **UNSPSC 16.0901** | 41112113 |

## Dimensional drawing (Dimensions in mm (inch))

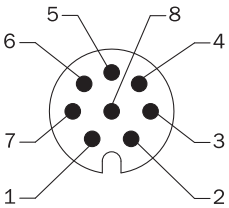
Face mount flange, cable connection




General tolerances according to DIN ISO 2768-mk
① Cable diameter = 5.6 mm +/- 0.2 mm bend radius = 30 mm

## PIN assignment

M12 male connector, 8-pin and cable, 8-wire, SSI/Gray

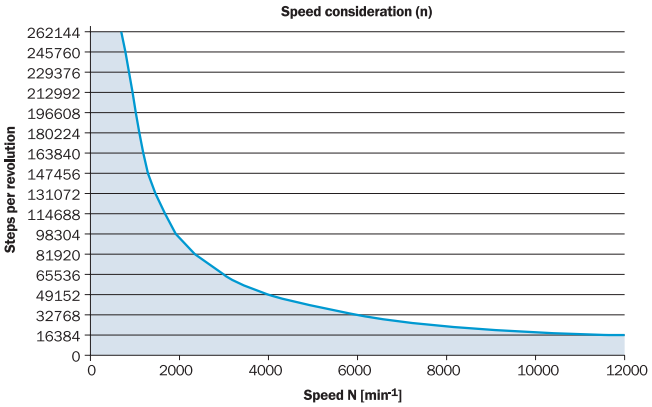



View of M12 male device connector on encoder

| PIN | Wire colors (cable connection) | Signal | Explanation |
|---|---|---|---|
| 1 | Brown | Data - | Interface signals |
| 2 | White | Data + | Interface signals |
| 3 | Black | V/R | Sequence in direction of rotation |
| 4 | Pink | SET | Electronic adjustment<br>Interface signals |
| 5 | Yellow | Clock + | Interface signals |

| PIN | Wire colors (cable connection) | Signal | Explanation |
|---|---|---|---|
| 6 | Purple | Clock - | Interface signals |
| 7 | Blue | GND | Ground connection |
| 8 | Red | $U_S$ | Operating voltage |
| | | Screen | Screen connected to housing on encoder side. Connected to ground on control side. |

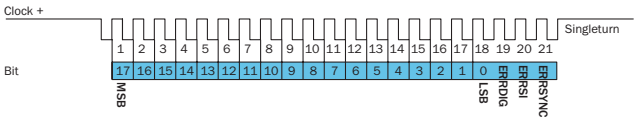
## Maximum revolution range




The maximum speed is also dependent on the shaft type.

## Diagrams

### SSI data format singleturn




**Bit 1–18: Position Bits**

- LSB: Least significant Bit
- MSB: Most significant Bit

**Bit 19–21: Error Bits**

- ERRDIG: Failure message about speed. If this failure occurs during the position building procedure it will be indicated by the ERRDIG-Bit.
- ERRSI: Light source monitoring failure.
- ERRSYNC: Contamination of the disc or scanning system. During the determination of the position, an error has occurred since the last SSI transmission. The error bit will be deleted during the next data transmission.

**The evaluation of the error bits has to be realized in the PLC.**

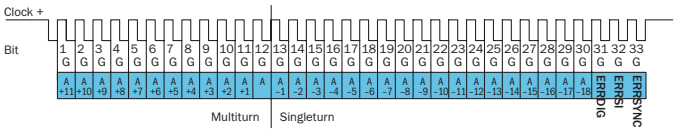
The provided error bits don't have to be used by the PLC compulsorily.

**Example**

If the resolution of the absolute encoder is set on 13 bits, 16 bits are provided by the encoder: 13 data bits and 3 error bits.
If the PLC is not able to evaluate the error bits, the PLC has to be set on a resolution of 13 bits. Then the error bits have to be masked out by the PLC.

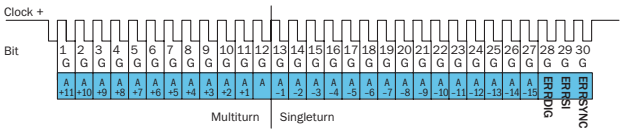
### SSI data format multiturn

**30 Bits**




**Bit 1–12:** Position Bits multiturn
**Bit 13–30:** Position Bits singleturn
**Bit 31–33:** Error Bits

**27 Bits**




**Bit 1–12:** Position Bits multiturn
**Bit 13–27:** Position Bits singleturn
**Bit 28–30:** Error Bits

**Error Bits**

- ERRDIG: Failure message about speed. If this failure occurs during the position building procedure it will be indicated by the ERRDIG-Bit.
- ERRSI: Light source monitoring failure.
- ERRSYNC: Contamination of the disc or scanning system. During the determination of the position, an error has occurred since the last SSI transmission. The error bit will be deleted during the next data transmission.

**The evaluation of the error bits has to be realized in the PLC.**

The provided error bits don't have to be used by the PLC compulsorily. The multiturn resolution is fixed on 12 bits.

**Example**

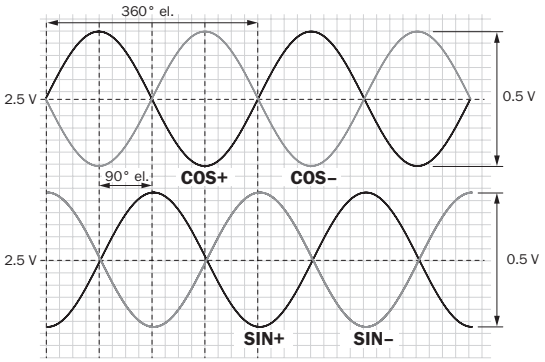
If the resolution of the absolute encoder is set on 27 bits, 30 bits are provided by the encoder: 27 data bits and 3 error bits.
If the PLC is not able to evaluate the error bits, the PLC has to be set on a resolution of 27 bits. Then the error bits have to be masked out by the PLC.

## Electrical interfaces sine 0.5 $V_{pp}$

| Power supply | Output |
|---|---|
| 4.5 ... 5.5 V | Sine 0.5 $V_{pp}$ |

Signal **before** differential generation at load 120 Ω at $U_S$ = 5 V

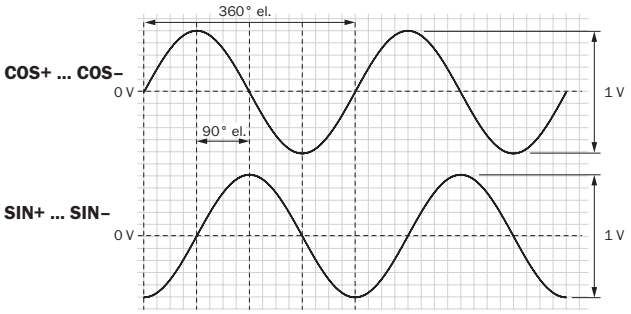
**Signal diagram for clockwise rotation of the shaft looking in direction "A" (shaft)**




| Interface signals Sin, $\overline{\text{Sin}}$, Cos, $\overline{\text{Cos}}$ | Signal before differential generation at load 120 Ω | Signal offset |
|---|---|---|
| Analog differential | 0.5 $V_{pp}$ ± 20 % | 2.5 V ± 10 % |

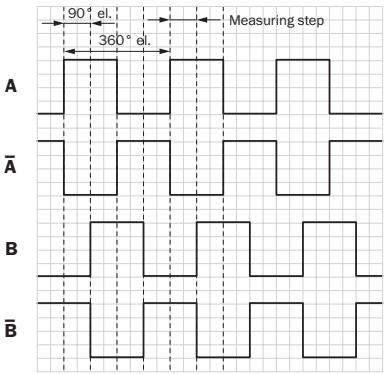
Signal **after** differential generation at load 120 Ω at $U_S$ = 5 V

**Signal diagram for clockwise rotation of the shaft looking in direction "A" (shaft)**




## Electrical interfaces HTL/TTL

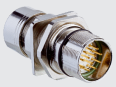
**Incremental pulse diagram for clockwise rotation of the shaft looking in direction "A", see dimensional drawing**



## Recommended accessories

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

| | Brief description | Type | Part no. |
|---|---|---|---|
| Flanges | | | |
|  | Flange adapter, adaptation of face mount flange with 36 mm centering hub to 100 mm servo flange with 60 mm centering hub, aluminum, Aluminum | BEF-FA-036-100 | 2029161 |
| Other mounting accessories | | | |
|  | Servo clamps, large, for servo flanges (clamps, eccentric fastener), 3 pcs., without mounting material, without mounting hardware | BEF-WK-SF | 2029166 |
| Shaft adaptation | | | |
|  | 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 80 Ncm; material: stainless steel bellows, aluminum hub | KUP-0610-B | 5312982 |
|  | 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 |
|  | 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 |
|  | 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 |
|  | 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 |
|  | 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 |
|  | 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 80 Ncm; material: stainless steel bellows, aluminum clamping hubs | KUP-1010-B | 5312983 |
|  | 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 |
|  | 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 |
|  | 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 |
|  | 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-W | 5319914 |
|  | 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 80 Ncm; material: stainless steel bellows, aluminum clamping hubs | KUP-1012-B | 5312984 |

| | Brief description | Type | Part no. |
|---|---|---|---|
|  | 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 |
| Plug connectors and cables | | | |
|  | Head A: male connector, M12, 8-pin, straight, A-coded<br>Head B: -<br>Cable: Incremental, shielded | STE-1208-GA01 | 6044892 |
|  | Head A: male connector, M23, 12-pin, straight<br>Head B: -<br>Cable: HIPERFACE®, SSI, Incremental, RS-422, shielded | STE-2312-G | 6027537 |
|  | Head A: male connector, M23, 12-pin, straight<br>Head B: -<br>Cable: HIPERFACE®, SSI, Incremental, shielded | STE-2312-G01 | 2077273 |
|  | | STE-2312-GX | 6028548 |

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