AFM60B-S4AA004096

AFS/AFM60 SSI

ABSOLUTE ENCODERS

SICK
Sensor Intelligence.
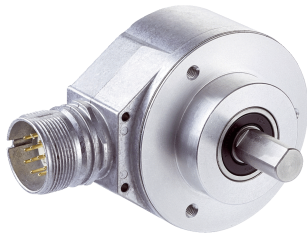
Illustration may differ

Ordering information

Type	Part no.
AFM60B-S4AA004096	1037777

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

Detailed technical data

Performance

Max. number of steps per revolution	4,096
Max. number of revolutions	4,096
Resolution power	4,096 x 4,096
Resolution	12 bit x 12 bit
Error limits	± 0.05°
Repeat accuracy	0.002°
Initialization time	50 ms [1]
Position forming time	< 1 µs

[1] Valid positional data can be read once this time has elapsed.

Interfaces

SSI, SSI + Incremental, SSI + Sin/Cos

Electrical interface	SSI/Gray
Code type	Gray
Code sequence parameter adjustable	CW/CCW parameter adjustable
Measuring step	0.01°
Interface signals	Clock +, Clock -, Data +, Data-
Clock frequency	2 MHz [1]
Set (electronic adjustment)	H-active (L = 0 - 3 V, H = 4,0 - Us V)
CW/CCW (counting sequence when turning)	L-active (L = 0 - 1,5 V, H = 2,0 - Us V)
Measuring step deviation (Range of pulses per revolution)	
< 8,192	± 0.01°

[1] Minimum, LOW level (Clock +): 500 ns.

Electrical data

Connection type	Connector M23, 12-pin, radial

[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.

Power consumption	0.5 W (without load)
Operating voltage range	4.5 V DC ... 32 V DC
Reverse polarity protection	✓
MTTFd: mean time to dangerous failure	250 years (EN ISO 13849-1) [1]

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Mechanical data

Mechanical interface	Solid shaft, Face mount flange
Shaft diameter	10 mm x 19 mm
Shaft length	19 mm
Weight	0.3 kg
Start up torque	0.5 Ncm (+20 °C)
Operating torque	0.3 Ncm (+20 °C)
Permissible movement axial static/dynamic	± 0.2 mm
Permissible Load capacity of shaft	80 N / radial 40 N / axial
Moment of inertia of the rotor	6.2 gcm²
Bearing lifetime	3.0 x 10^9 revolutions
Max. angular acceleration	≤ 500,000 rad/s²

Ambient data

EMC	According to EN 61000-6-2 and EN 61000-6-3 [1]
Enclosure rating	IP 65, shaft side (according to IEC 60529) [2] IP 67, housing side (according to IEC 60529)
Permissible relative humidity	90 % (condensation of the optical scanning not permitted)
Working temperature range	−40 °C ... +100 °C
Storage temperature range	−40 °C ... +100 °C, without package
Resistance to shocks	70 g, 6 ms (according to EN 60068-2-27)
Resistance to vibration	30 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] With mating connector fitted.

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
ETIM 5.0	EC001486
ETIM 6.0	EC001486

UNSPSC 16.0901	41112113

Dimensional drawing (Dimensions in mm (inch))

Face mount flange, radial connector outlet M12 and M23

General tolerances as per ISO 2768-mk
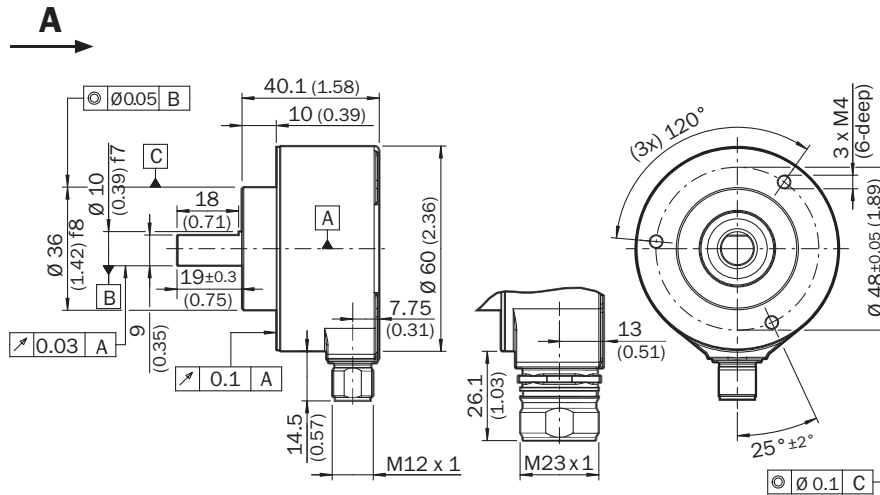
PIN assignment

View of the M23 male connector plug-in face
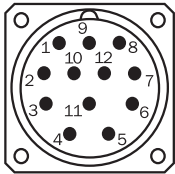
Connector M23, 12-pin
SSI/Gray

| Pin	Signal	Explanation
1	GND	Ground connection
2	Data+	Interface signals
3	Clock+	Interface signals
4	N. C.	Not connected
5	N. C.	Not connected
6	N. C.	Not connected
7	N. C.	Not connected
8	U_s	Supply voltage
9	SET	Electronic adjustment
10	Data–	Interface signals
11	Clock–	Interface signals
12	CW/$\overline{CCW}$	Counting sequence when turning
	Screen	Screen on the encoder side connected to the housing. On the control side connected to earth.

Connector M23, 12-pin and cable outlet, cable 12-core
SSI/Gray + Incremental

Pin	Color wires	Signal	Explanation
1	Red	+U_s	Supply voltage
2	Blue	GND	Ground connection
3	Yellow	Clock+	Interface signal
4	White	Data+	Interface signal
5	Orange	SET	Electronic adjustment
6	Brown	Data–	Interface signal
7	Violet	Clock–	Interface signal
8	Black	$\overline{B}$	Signal line
9	Orange/black	CW/$\overline{CCW}$	Counting sequence when turning
10	Green	$\overline{A}$	Signal line
11	Gray	A	Signal line
12	Pink	B	Signal line
		Screen	Screen on the encoder side connected to the housing. On the control side connected to earth.

Connector M23, 12-pin and cable outlet, cable 12-core
SSI/Gray + Sin/Cos

| Pin	Color wires	Signal	Explanation
1	Red	+U_s	Supply voltage
2	Blue	GND	Ground connection
3	Yellow	Clock+	Interface signal
4	White	Data+	Interface signal
5	Orange	SET	Electronic adjustment
6	Brown	Data–	Interface signal
7	Violet	Clock–	Interface signal
8	Black	Sin–	Signal line
9	Orange/black	CW/$\overline{CCW}$	Counting sequence when turning
10	Green	Cos–	Signal line
11	Gray	Cos+	Signal line
12	Pink	Sin+	Signal line
		Screen	Screen on the encoder side connected to the housing. On the control side connected to earth.

Maximum revolution range
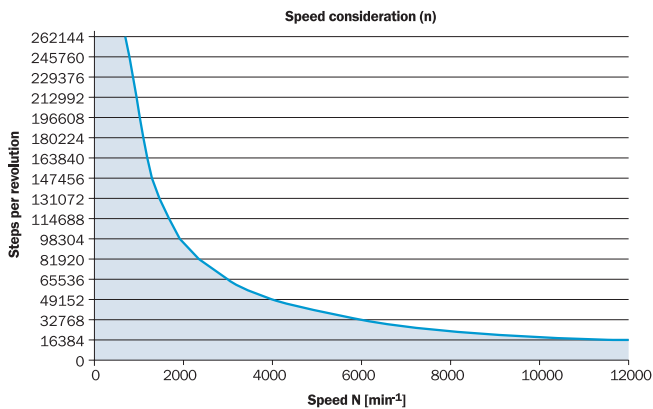
The maximum speed is also dependent on the shaft type.

Signal outputs

SSI data format singleturn
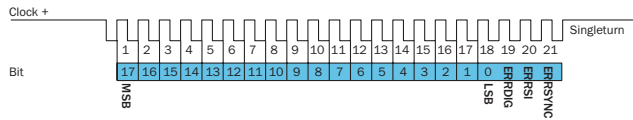
Bit 1–18: Position Bits

- 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.
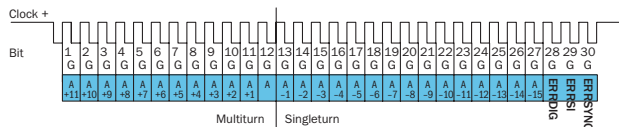
SSI data format multiturn

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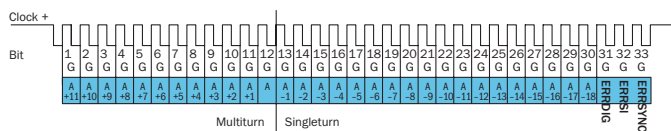
Bit 1–12: Position Bits multiturn
Bit 13–30: Position Bits singleturn
Bit 31–33: Error Bits

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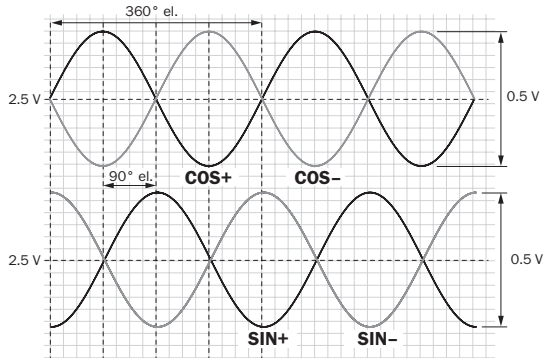
Interface signals Sin, $\overline{Sin}$, Cos, $\overline{Cos}$	Signal before differential generation at load 120 Ω	Signal offset
Analog differential	0.5 V$_{pp}$ ± 20 %	2.5 V ± 10 %

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)
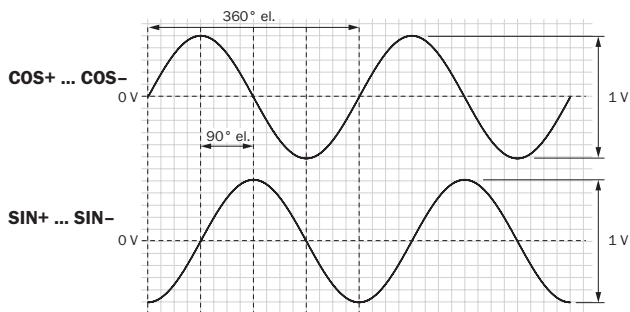
Electrical interfaces HTL/TTL
Incremental pulse diagram for clockwise rotation of the shaft looking in direction "A", see dimensional drawing
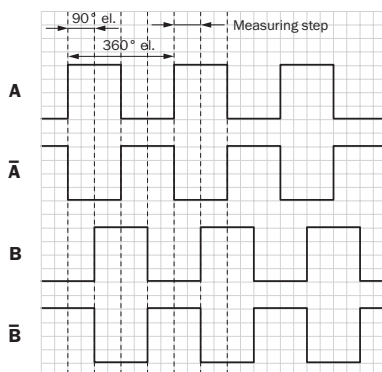
Recommended accessories

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

	Brief description	Type	Part no.
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° to +120 °C, max. torque 120 Ncm; material: stainless steel bellows, aluminum hub	KUP-0610-B	5312982
	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

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."

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