



**Absolute encoders  
AFS/AFM60 SSI**

AFM60E-S4AK004096

**Model Name** > **AFM60E-S4AK004096**  
**Part No.** > **1037654**



**At a glance**

- High-resolution absolute encoders with up to 30 bits (AFM60) or up to 18 bits (AFS60)
- Face mount flange, servo flange, blind or through hollow shaft
- SSI, SSI + Incremental or SSI + Sin/Cos interface
- Programmable resolution and offset (dependent on type)
- Connection system: M12, M23 connector or cable outlet
- Enclosure rating: IP 67 (housing), IP 65 (shaft)
- Operating temperature: -30 °C to +100 °C (depends on type)

**Your benefits**

- Programmability of the encoders means less storage, greater machine availability and easy installation
- Precise positioning due to high resolutions
- Large selection of mechanical interfaces and electrical contacting possibilities: Suitable for all applications
- Suitable for applications with limited space requirements (extremely short installation depth of 30 mm)
- Very good rotation accuracy due to increased bearing distance
- One programming tool and software with automatic encoder detection for AFS60/AFM60/DFS60



**Performance**

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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:	± 0.2 °
Repeatability (Ta not constant):	0.002 °
Measuring step deviation:	± 0.2 °
Measuring step:	0.09 ° 360 ° / number of steps
Initialization time:	50 ms <sup>1)</sup>

<sup>1)</sup> Valid positional data can be read once this time has elapsed

**Mechanical data**

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Mechanical interface:	Solid shaft with flat, Face mount flange
Shaft diameter:	10 mm

Start up torque:	0.5 Ncm (+20 °C)
Operating torque:	0.3 Ncm (+20 °C)
Permissible Load capacity of shaft:	40 N (axial), 80 N (radial)
Maximum operating speed:	9,000 /min <sup>1)</sup>
Moment of inertia of the rotor:	6.2 gcm <sup>2</sup>
Bearing lifetime:	3.0 x 10 <sup>9</sup> revolutions
Max. angular acceleration:	500,000 rad/s <sup>2</sup>

<sup>1)</sup> Self warming of 3.3 K per 1000 revolutions/min when applying note working temperature range

## Electrical data

Power consumption:	0.5 W (without load)
Operating voltage range:	4.5 V DC ... 32 V DC
MTTFd: mean time to dangerous failure:	250 a (EN ISO 13849-1) <sup>1)</sup>
Connection type:	Cable, 8-wire, universal, 1.5 m <sup>2)</sup>
Code type:	Gray
Code sequence:	CW/CCW, parameter adjustable
Reverse polarity protection:	1

<sup>1)</sup> 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. <sup>2)</sup> The universal cable outlet is positioned in such a way, that it is possible to lay the cable in a radial or axial direction without kinking it

## Interfaces

Electrical interface:	SSI/Gray
Interface signals:	Clock +, Clock -, Data +, Data- <sup>1)</sup>
Clock frequency:	1 MHz
SET (electronic adjustment):	H-active (L ≡ 0 - 1,5 V, H ≡ 2,0 - Us V)
CW/CCW (counting sequence when turning):	L-active (L ≡ 0 - 1,5 V, H ≡ 2,0 - Us V)

<sup>1)</sup>

## Ambient data

EMC:	(according to EN 61000-6-2 and EN 61000-6-3) <sup>1)</sup>
Enclosure rating:	IP 65 (according to IEC 60529), shaft side, IP 67 (according to IEC 60529), housing side
Permissible relative humidity:	90 % (condensation of the optical scanning not permitted)
Working temperature range:	0 °C ... +85 °C
Storage temperature range:	-40 °C ... +100 °C, without package
Resistance to shocks:	50 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)

<sup>1)</sup>



# Drehzahlbetrachtung



The maximum speed is also dependent on the shaft type.

# Signalausgänge

SSI data format singleturn

SSI 1-18 Position Bits  
 • LSB: Least significant bit  
 • MSB: Most significant bit

SSI 19-23 Error Bits  
 • ERR000: Future message about speed. If this failure occurs during the position holding procedure it will be indicated by the ERR000 bit.  
 • ERR001: Light source monitoring failure.  
 • ERR002: Concentricity of the disc or tracking system. During the determination of the position, an error has occurred since the last SSI transmission. The error bit will be cleared 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  
 SSI 1-12 Position Bits multiturn  
 SSI 13-16 Position Bits singleturn  
 SSI 17-23 Error Bits

27 Bits  
 SSI 1-12 Position Bits multiturn  
 SSI 13-27 Position Bits singleturn  
 SSI 28-30 Error Bits

Error Bits  
 • ERR000: Future message about speed. If this failure occurs during the position holding procedure it will be indicated by the ERR000 bit.  
 • ERR001: Light source monitoring failure.  
 • ERR002: Concentricity of the disc or tracking system. During the determination of the position, an error has occurred since the last SSI transmission. The error bit will be cleared 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.

# Interfaces

Electrical Interfaces sine 0.5 V<sub>pp</sub>

Power supply: 5 V<sub>DC</sub> ± 5%  
 Signal: 0.5 V<sub>pp</sub> sine 0.5 V<sub>pp</sub>

Signal before differential generation at load 120 Ω at U<sub>i</sub> = 5 V  
 Signal diagram for clockwise rotation of the shaft looking in direction "A" (clock)

Reference signals Sin, Cos, Cos, Sin Signal before differential generation at load 120 Ω. Signal offset: 0 V<sub>DC</sub> ± 0.5% 20 V ± 0.5%

Signal after differential generation at load 120 Ω at U<sub>i</sub> = 5 V  
 Signal diagram for clockwise rotation of the shaft looking in direction "A" (clock)

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

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