


ONLINE DATA SHEET
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# Absolute encoders
# AFS/AFM60 SSI

AFS60E-TEAC004096

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# Absolute encoders
# AFS/AFM60 SSI

| | |
|---|---|
| **Model Name** | **> AFS60E-TEAC004096** |
| **Part No.** | **> 1038055** |



**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

| | |
|---|---|
| Max. number of steps per revolution: | 4,096 |
| Max. number of revolutions: | 1 |
| Resolution power: | 4,096 x 1 |
| Error limits: | ± 0.3 ° |
| Repeatability (Ta not constant): | 0.002 ° |
| Measuring step deviation: | ± 0.2 ° |
| Measuring step: | 0.09 ° 360 °/number of steps |
| Initialization time: | 50 ms [1)] |

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

## Mechanical data

| | |
|---|---|
| Mechanical interface: | Through hollow shaft |
| Shaft diameter: | 12 mm |
| Mass: | 0.2 kg |


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| | |
|---|---|
| Start up torque: | 0.8 Ncm (20 °C) |
| Operating torque: | 0.6 Ncm (20 °C) |
| Maximum operating speed: | 9,000 /min [1] |
| Moment of inertia of the rotor: | 40 gcm² |
| Bearing lifetime: | 3.0 x 10^9 revolutions |
| Max. angular acceleration: | 500,000 rad/s² |
| Permissible movement axial static/dynamic: | ± 0.5 mm, ± 0.2 mm |
| Permissible movement radial static/dynamic: | ± 0.3 mm, ± 0.1 mm |
| Type of mounting shaft: | Through hollow shaft |

[1] 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) [1] |
| Connection type: | Male connector M12, 8-pin, radial |
| Code type: | Gray |
| Code sequence: | CW/CCW, parameter adjustable |
| Reverse polarity protection: | 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.

## Interfaces

| | |
|---|---|
| Electrical interface: | SSI/Gray |
| Interface signals: | Clock +, Clock -, Data +, Data- |
| Clock frequency: | 1 MHz [1] |
| 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) |

[1]

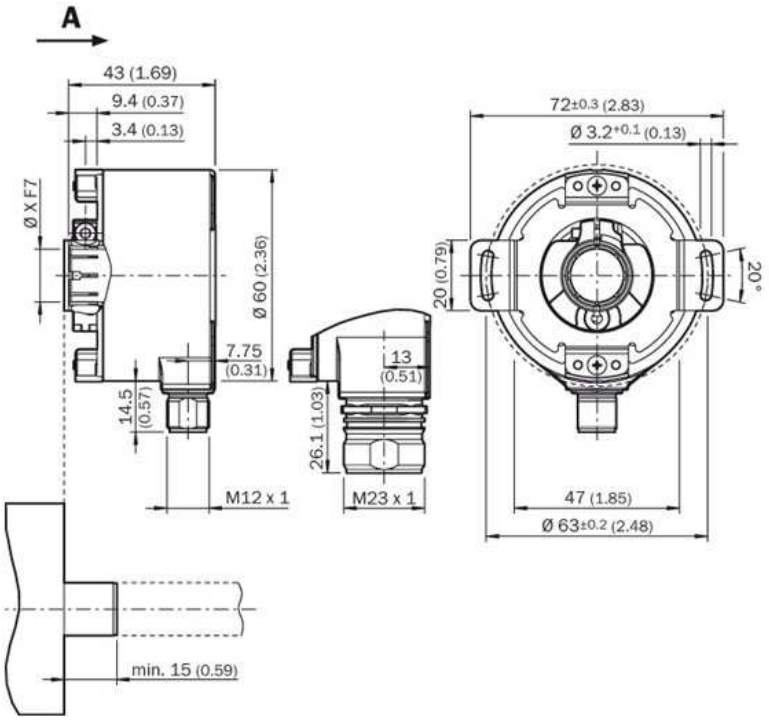
## Ambient data

| | |
|---|---|
| EMC: | (according to EN 61000-6-2 and EN 61000-6-3) [1] |
| Enclosure rating: | IP 65 (according to IEC 60529), housing side, IP 65 (according to IEC 60529), shaft side [2] |
| 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) |

[1] [2] With mating connector fitted


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## Dimensional drawing




|1| Cable diameter = 5,6 mm
+/- 2 mmBending radius = 30 mm

## PIN assignment

| Pin | Color wires | Signal SSI | Explanation |
|---|---|---|---|
| 1 | Brown | Data– | Interface signals |
| 2 | White | Data+ | Interface signals |
| 3 | Black | CW/$\overline{CCW}$ | Counting sequence when turning |
| 4 | Pink | SET | Electronic adjustment |
| 5 | Yellow | Clock+ | Interface signals |
| 6 | Lilac | Clock– | Interface signals |
| 7 | Blue | GND | Ground connection |
| 8 | Red | $+U_s$ | Supply voltage |
| | | Screen | Screen on the encoder side connected to the housing. On the control side connected to earth. |


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## Signalausgänge

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.**

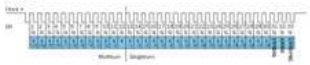
The provided error bits don't have to be used by the PLC compulsorily.

**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.

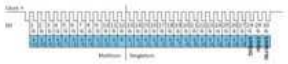
SSI data format multiturn

**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.

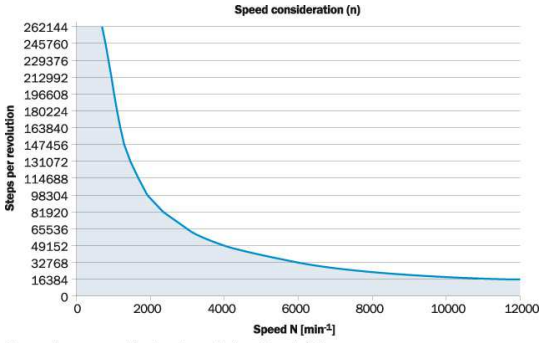
**The evaluation of the error bits has to be realized in the PLC.**

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

**Example**

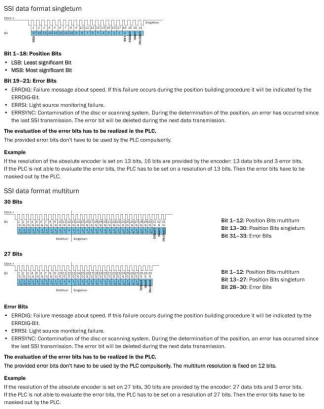
If the resolution of the absolute encoder is set on 27 bits, 30 bits are provided by the encoder: 27 data bits and 3 error bits.
If the PLC is not able to evaluate the error bits, the PLC has to be set on a resolution of 27 bits. Then the error bits have to be masked out by the PLC.

## Drehzahlbetrachtung




The maximum speed is also dependent on the shaft type.

## Signalausgänge



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.

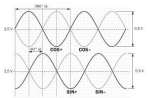
## Interfaces

**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 $U_p$ = 5 V

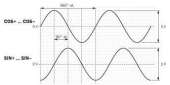
**Signal diagram for clockwise rotation of the shaft looking in direction "A" (shaft)**



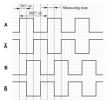

| Interface signals Sin, SIN, Cos, COS | Signal before differential generation at load 120 Ω | Signal offset |
|---|---|---|
| Analog differential | 0.5 $V_{pp}$ ± 20 % | 2.5 V ± 10 % |

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

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




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





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