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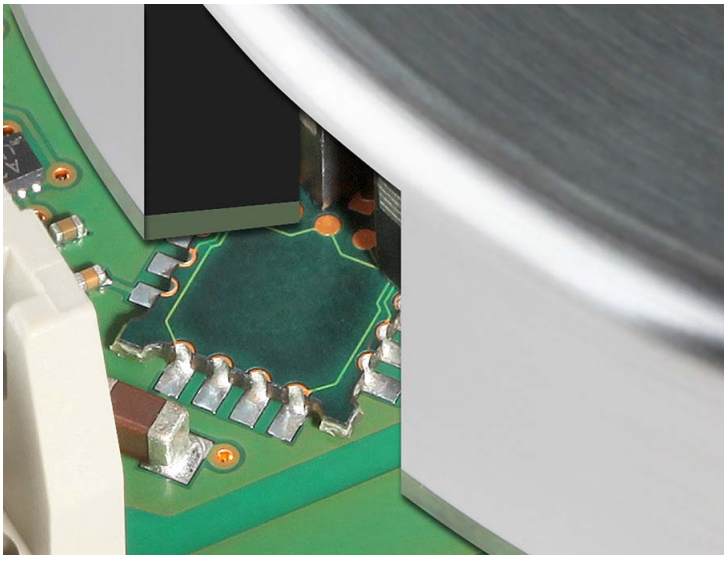
MILE Encoder for EC 60 flat

Product Information



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TRADEMARKS AND BRAND NAMES

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MILE Encoder for EC 60 flat – Product Information

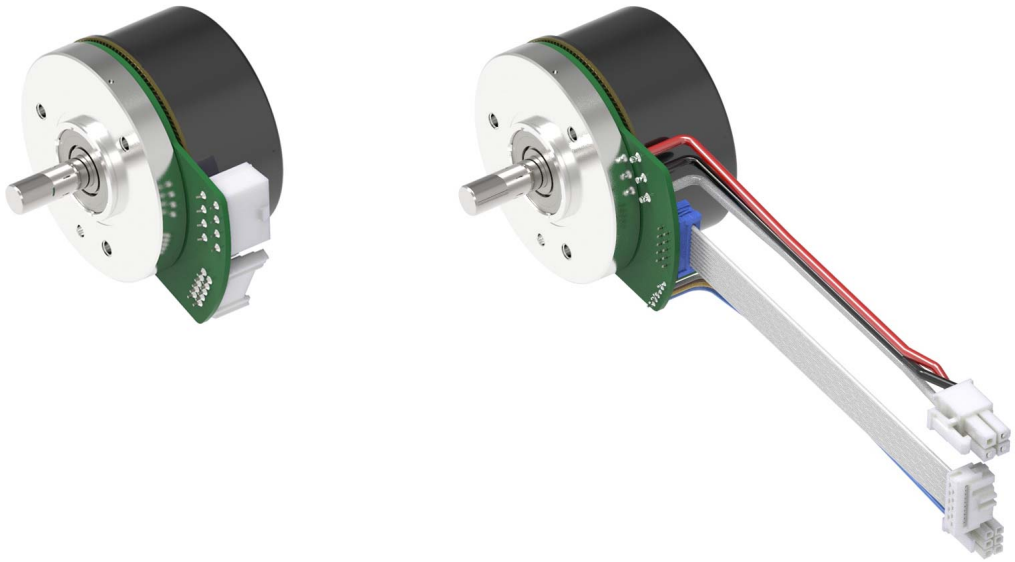


Figure 1 EC 60 flat with MILE-Encoder (633399, 645106)

The MILE encoder uses an inductive angle measurement system to generate incremental quadrature output signals. Two channels (A, B) with differential electrical signals are available. Four resolutions are factory-programmable: 512, 1024, 2048, and 4096 impulses per turn.

The encoder is designed for highest robustness in industrial applications. It can be operated in the open environment of an EC flat motor and is equipped with additional ESD protection circuitry. Due to the robustness of the MILE technology in terms of magnetic interference it was possible to integrate the encoder into the flat motor with minimal change of dimensions with respect to a motor without encoder.

Pin-out is compatible to most maxon controllers with encoder interface.

Note

The listed data are for informational purposes only. None of the stated values or information may be used as an indicator of guaranteed performance.

1 TECHNICAL DATA

1.1 Absolute Maximum Rating

Parameter	Conditions	Min.	Max.	Unit
Supply voltage (V_{cc})		–0.3	6	V
Voltage at signal output (V_{signal})		–0.3	V_{cc}+0.3	V
Signal output current (I_{signal})		–4	+4	mA
ESD voltage (V_{esd}), all pins	EN 61000-4-2		>2	kV
Storage temperature (T_{store})		–40	+105	°C
Operation temperature (T_{amb})		–40	+100	°C
Humidity	Condensation not permitted	20	80	%rH

1.2 Electrical Data

Parameter	Conditions	Min.	Typ.	Max.	Unit
Supply voltage (V_{cc})		4.5	5.0	5.5	V
Supply current (I_{dd})	Output pulse frequency <100 kHz, load resistor ≥10 kΩ		15		mA
Signal output current (I_{signal})		–4		+4	mA
Signal voltage high (V_{high})	I_{signal} ≤4 mA, V_{cc} =5 V	4.5	5		V
Signal voltage low (V_{low})	I_{signal} ≤4 mA, V_{cc} =5 V		0.2	0.5	V
Transition time (t_{trans})	Rise time/fall time ChA/B @ load resistor 1 kΩ, C_{load} 25 pF		20		ns

1.3 Angle Measurement

All values at T = 25°C, n = 1000 rpm, unless otherwise specified.
➔“Definitions” on page 7

Parameter	Conditions	Min.	Typ.	Max.	Unit
Number of channels	ChA, ChB		2		–
Pulse frequency (f_{pulse})				1000	kHz
Resolution (N)	Full period of A, B	512	1024	4096	cpt
State length (L_{state})	N≤1024 cpt	45	90	135 *1	°el
	N=2048 cpt	36	90	—	
	N=4096 cpt	36	90	—	
Integral Nonlinearity (INL)	N≤4096 cpt		0.25	0.9	°m
Repeatability of angle error (Jitter)	N=512 cpt		0.06	0.4	LSB
	N=1024 cpt		0.12	0.8	
	N=2048 cpt		0.25	1.6	
	N=4096 cpt		0.5	3.2	
Differential Nonlinearity (DNL)	N=512 cpt		0.3	0.8	LSB
	N=1024 cpt		0.35	0.9	
	N=2048 cpt		0.4	1.0	
	N=4096 cpt		0.45	1.1	

Parameter	Conditions	Min.	Typ.	Max.	Unit
Angle hysteresis (Hyst)	All resolutions		1		LSB

**1 Typical value for maximum state length*

1.4 Hall Sensor

Parameter	Conditions	Min.	Typ.	Max.	Unit
Supply voltage (V_{cc} Hall)	With ESD protection diode	4.5	5.0	18	V
Supply current (I_{Vcc})	Output “High”, i.e. minimum current into output Q	0.5	3	6	mA
Signal output current (I_{signal})	Limits minimum external pull-up			12	mA
Signal output voltage (V_{signal})	Output Q = “High”		V_{cc}	V_{cc}+0.3	V
	Output Q = “Low”	0	0.2	0.4	V
ESD voltage (V_{esd}), all pins	EN 61000-4-2			>2	kV
Storage temperature (T_{store})		–40		+125	°C
Operation temperature (T_{amb})		–40		+115	°C

1.5 Mechanical Data

Parameter	Conditions	Value	Unit
Dimensions (➔Figure 2)	D x H	Ø60.0 x 39	mm
	Lateral projection PCB (W x H)	—	
Moment of inertia of pole wheel		13	g cm²
Standard cable length		300 ±10	mm

1.6 Dimensional Drawing

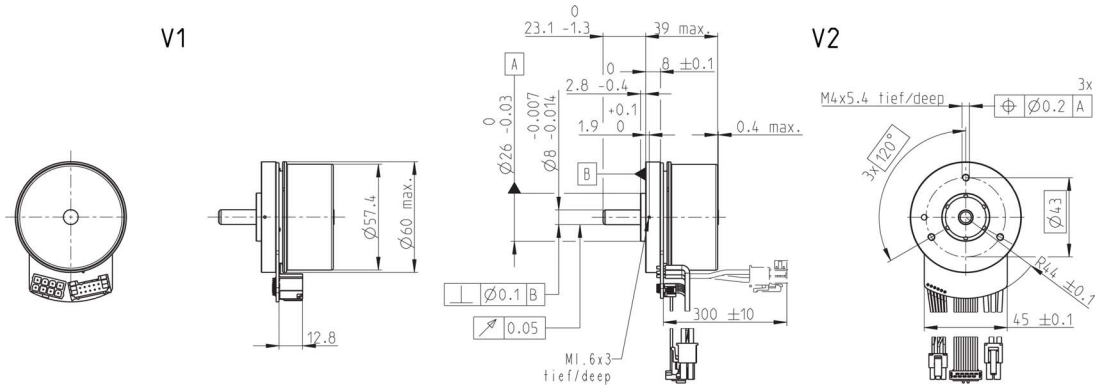


Figure 2 Dimensional Drawing [mm]

2 PROTECTION AND ROBUSTNESS

- Outputs for Hall sensor and encoder (line driver) are protected by ESD protection diodes designed for an ESD level of at least 2 kV according to EN 61000-4-2.
- In addition, outputs for Hall sensor and encoder (line driver) are protected by series resistances of 47 Ohm or 56 Ohm, respectively.
- The encoder by virtue of its inductive operating principle is immune to magnetic interference, dust, and dirt.

3 DEFINITIONS

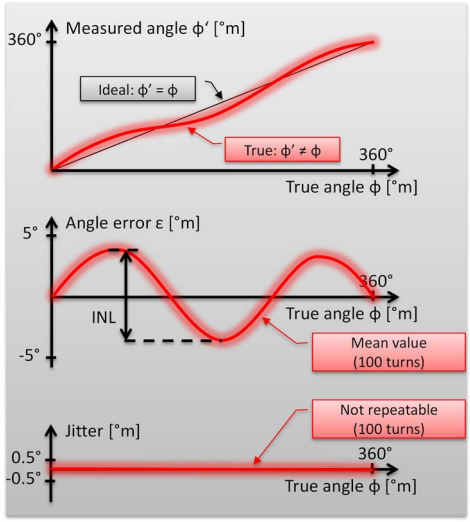
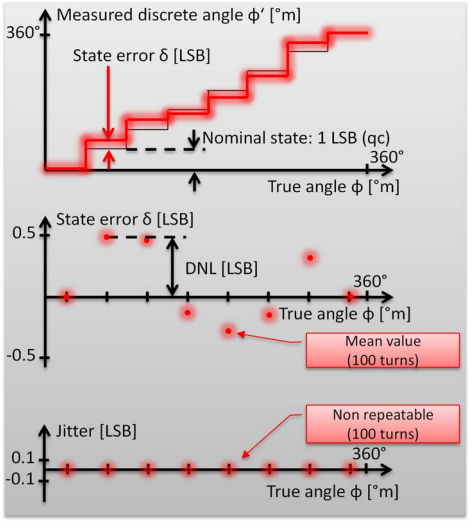
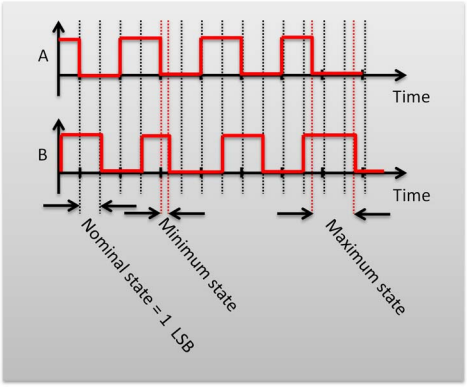
Metric	Definition	Illustration
Angle Error [°m]	Difference of measured and true angular shaft position at each position.	
Average Angle Error [°m]	Average of Angle Error over a number of turns.	
Integral Nonlinearity (INL) [°m]	Peak-to-peak value of Average Angle Error.	
Jitter (Repeatability) [°m] or [LSB]	Six standard deviations of Angle Error per turn (over one turn, at a given number of turns). **Jitter [°m]** is typically independent of resolution and defines the maximum useful positioning repeatability. **Jitter [LSB]** is resolution-dependent. At given Jitter [°m], the value is roughly proportional to resolution.	
Least Significant Bit (LSB)	Minimum measurable difference between two angle values at given resolution (= quadcount, = State).	
State Error [LSB]	Difference between actual state length and average state length.	
Average State Error [LSB]	Average of State Error over a number of turns for each state of a turn.	
Differential Nonlinearity [DNL]	Maximum positive or negative Average State Error.	
Minimum State Length [°el]	Minimum measured state length within a number of turns relative to pulse length.	
Maximum State Length [°el]	Maximum measured state length within a number of turns relative to pulse length.	
Minimum State Duration [ns]	By chip limited minimum time separation between two A/B transitions.	

Table 1 Definitions

4 PIN ASSIGNMENT

Maximum permitted Supply Voltage
- *Make sure that supply power is within stated range.*
- *Supply voltages exceeding the stated range, or wrong polarity will destroy the unit.*
- *Connect the unit only when supply voltage is switched off (V_{CC}=0).*

4.1 Encoder

Figure 3 Encoder Connector

V1	V2	Signal	Description
A1	A1	–	not connected
A2	A2	V_{CC}	Power supply voltage
A3	A3	GND	Ground
A4	A4	–	not connected
A5	A5	ChA/	Channel A complement
A6	A6	ChA	Channel A
A7	A7	ChB/	Channel B complement
A8	A8	ChB	Channel B
A9	A9	internal signal	do not connect
A10	A10	internal signal	do not connect

Table 2 Encoder Connector – Pin Assignment

Specifications			
V1	**A**	Connector	Pin header, pitch 2.54 mm, 5 x 2 poles (DIN 41651/EN 60603-13)
		Mating plug	IDC socket, pitch 2.54 mm, 5 x 2 poles
V2	**A**	Connector	IDC socket, pitch 2.54 mm, 5 x 2 poles (DIN 41651/EN 60603-13)
		Mating plug	Pin header, pitch 2.54 mm, 5 x 2 poles

Table 3 Encoder Connector – Specifications

4.2 Motor/Hall Sensor

The MILE on EC 60 flat PCB comprises three digital Hall sensors for commutation. For specifications ➔chapter “1.4 Hall Sensor” on page 5, for output interface ➔Figure 5.

Figure 4 Motor/Hall Sensor Connector

V1	V2	Signal	Description
B1	B1	Hall sensor 1	Hall sensor 1 output
B2	B2	Hall sensor 2	Hall sensor 2 output
B3	B5	V_{cc}, Hall	Hall sensor supply voltage
B4	C3	Motor winding 3	Winding 3
B5	B3	Hall sensor 3	Hall sensor 3 output
B6	B4	GND	Hall Sensor ground
B7	C1	Motor winding 1	Winding 1
B8	C2	Motor winding 2	Winding 3

Table 4 Motor/Hall Sensor Connector – Pin Assignment

Specifications			
V1	**B**	Connector	Molex Mini-Fit Plus, pitch 4.2 mm, 8 poles (46015-0806)
		Mating plug	Crimp housing, pitch 4.2 mm, 8 poles
V2	**B**	Connector	Molex Micro-Fit 3.0, pitch 3 mm, 6 poles (43025-0600)
		Mating plug	Crimp housing, pitch 3 mm, 6 poles
	C	Connector	Molex Micro-Fit Jr., pitch 4.2 mm, 4 poles (39-01-2040)
		Mating plug	Crimp housing, pitch 4.2 mm, 4 poles

Table 5 Motor/Hall Sensor Connector – Specifications

5 OUTPUT CIRCUITRY

5.1 Hall Sensor

The Hall sensor output signals are equipped with ESD protection .

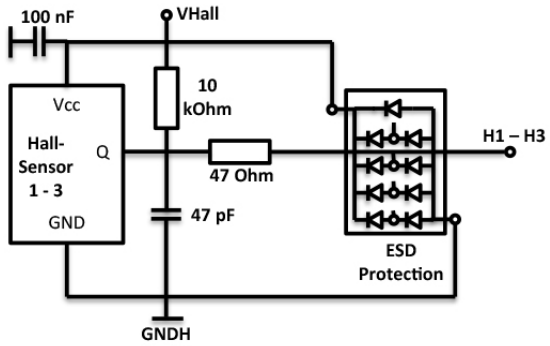


Figure 5 Hall Sensor – Output Circuitry

5.2 Encoder

The encoder output signals are equipped with ESD protection diodes.

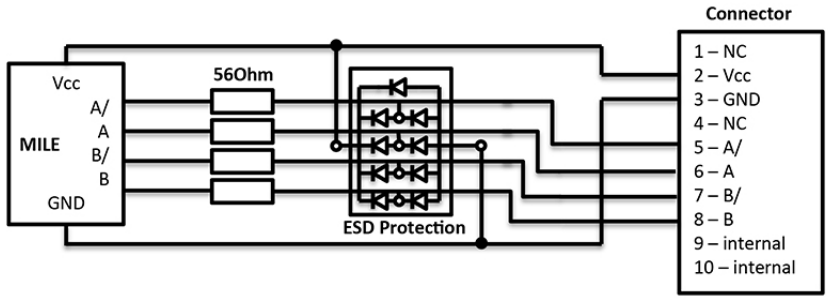


Figure 6 Encoder – Output Circuitry

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