ENX 6 OPT
ENX 8 OPT

Encoders

Product Information

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ENX OPT Encoders – Product Information

Figure 1 ENX 6 OPT (left) / ENX 8 OPT (right)

The ultra compact maxon OPT encoders use an optically reflective angle measurement system to generate incremental quadrature output signals. They offer three channels (A, B, I) with a fixed resolution of 128 impulses per turn given by the optical disc.

With their supply voltage range of 3 to 6 V and very low power requirements, the encoders are superbly suitable for mobile and battery-powered applications.

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})		3	6	V
Voltage at signal output (V_{signal})		3	6	V
Operating temperature (T_{amb})		–20	+85	°C
Storage temperature (T_{store})		–20	+85	°C
Humidity	Condensation not permitted	20	85	%rH

Table 1 Absolute Maximum Rating

1.2 General Data

Parameter	Conditions	Min	Typ	Max	Unit
Supply voltage (V_{cc})		+3		+6	V
Supply current (I_{dd})	V_{cc} = 5 V, outputs unloaded		4		mA

Table 2 General Data

1.3 Incremental Interface

Parameter	Conditions	Min	Typ	Max	Unit
Number of channels	ChA, ChB, ChI		3		–
Counts per turn (N)			128		cpt
Pulse frequency (f_{pulse})	Maximum output pulse frequency		1		MHz
Signal output current (I_{signal})	V_{cc} = 5 V		5		mA
Signal voltage high (V_{high})	I_{signal} <5 mA, relative to V_{cc}	V_{cc}–0.5 V			V
Signal voltage low (V_{low})	I_{signal} <5 mA			0.5	V
Transition time (t_{trans})	Rise time/fall time ChA/B/I without load		100		ns

Table 3 Incremental Interface

1.4 Angle Measurement

Conditions *All values at T = 25°C, n = 10000 rpm, V_{cc} = 5 V unless otherwise specified.*

Definitions *See ➔page 6.*

Parameter	Conditions	Min	Typ	Max	Unit
Counting direction of incremental signals (Dir)	Motor shaft movement for signal phase alignment “A leads B” as seen from the shaft end		CCW		
State length (L_{state}) and index pulse width (L_{index} synchronized with ChA/B), incremental signals	N=128 cpt	45	90	135	°e
Minimum state duration (t_{state})			1		µs
Integral Nonlinearity (INL), incremental signals			1	3.5	°m
Differential Nonlinearity (DNL)	N=128 cpt		0.25	0.5	LSB
Repeatability (Jitter), incremental signals	N=128 cpt		<0.05		LSB
Repeatability (Jitter)			<0.035		°m
Phase delay A to B (Phase θ), incremental signals		60	90	120	°e
Angle hysteresis (Hyst)			0.01		°m

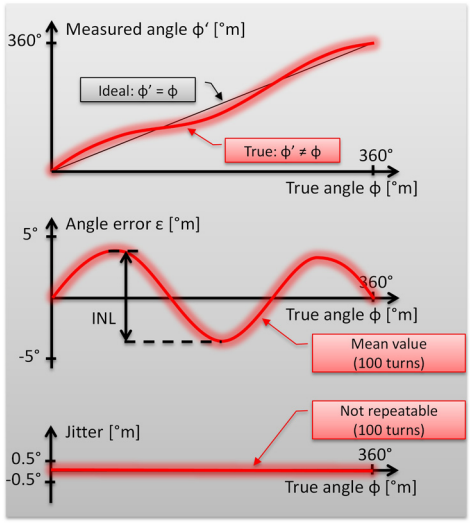
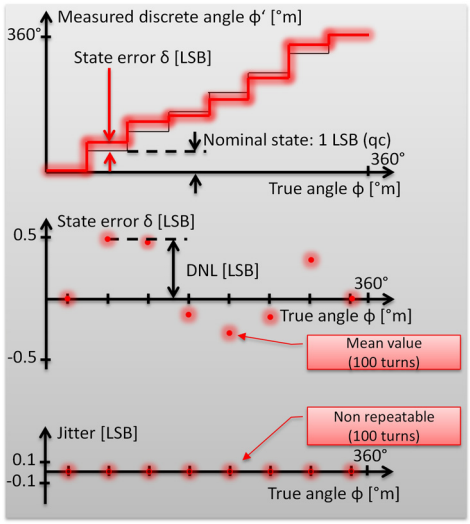
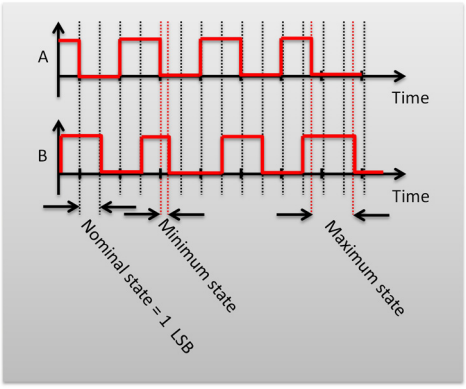
Table 4 Angle Measurement

1.5 Mechanical Data

Parameter	Conditions	Value	Unit
Dimensions (D x L), without flange (➔Figure 4)	ENX 6 OPT	Ø6.0 x 6.1	mm
	ENX 8 OPT	Ø8.0 x 5.8	
Moment of inertia (Jt)	motor shaft Ø1 mm	0.0015	g cm²
Standard cable length (Lc)	ENX 6 OPT	80	mm
	ENX 8 OPT	80	

Table 5 Mechanical Data

2 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 at each position, over a given 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 (at each position, over a given number of turns). **Jitter [°m]** is typically independent of the 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 [°e]	Minimum measured state length within a number of turns relative to pulse length.	
Maximum State Length [°e]	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.	

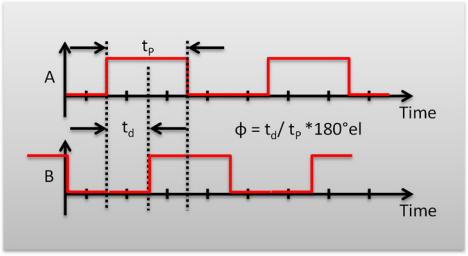
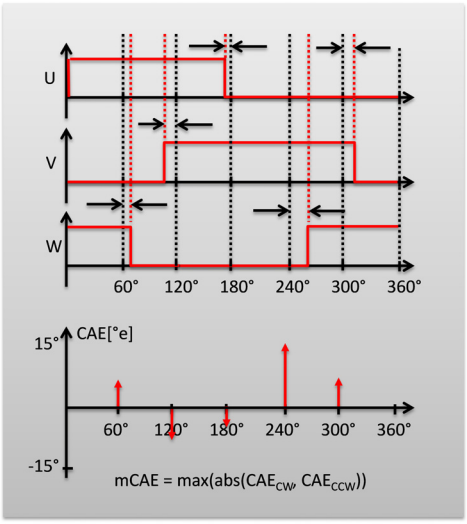
Metric	Definition	Illustration
Phase delay θ [°e]	Time difference of rising edge A to B relative to duration of positive level of A.	
Maximum commutation angle error (maxCAE) [°e]	Minimum positive or negative deviation of the individual switching points of the commutation signals (reference signals), determined over a certain number of turns.	

Table 6 Definitions

3 Typical Measurement Results

3.1 Angle Error per Turn

Below graphs show angle error measurements of two different OPT encoders with permissible characteristic values under following conditions: Measurement of 25 turns at V_{cc}=5 V, n=10000 rpm, T=25°C.

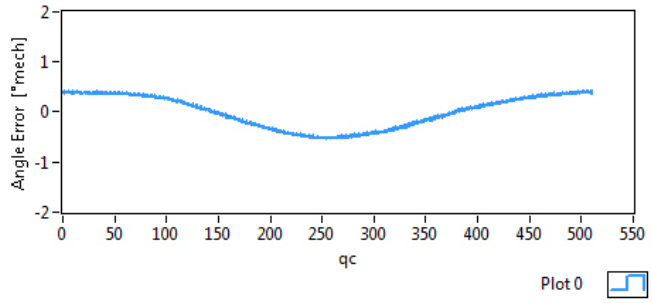
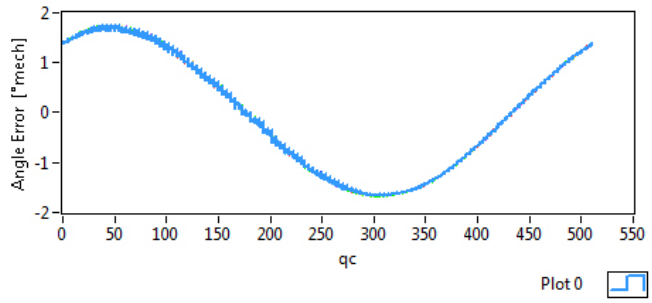
	Graph	Analysis	
Typ		INL Jitter DNL Min State Max State	1°m 0.02°m = 0.03 LSB 0.1 LSB 0.9 LSB = 81°e 1.1 LSB = 99°e
Max		INL Jitter DNL Min State Max State	3.4°m 0.03°m = 0.04 LSB 0.35 LSB 0.65 LSB = 60°e 1.2 LSB = 110°e

Table 7 Typical Measurement Results

3.2 Temperature Dependence

The encoder's characteristics are largely temperature-independent.

Figure 2 shows the temperature dependence of ten OPT encoder samples under following conditions: V_{cc}=5 V, 10'000 rpm, 128 cpt

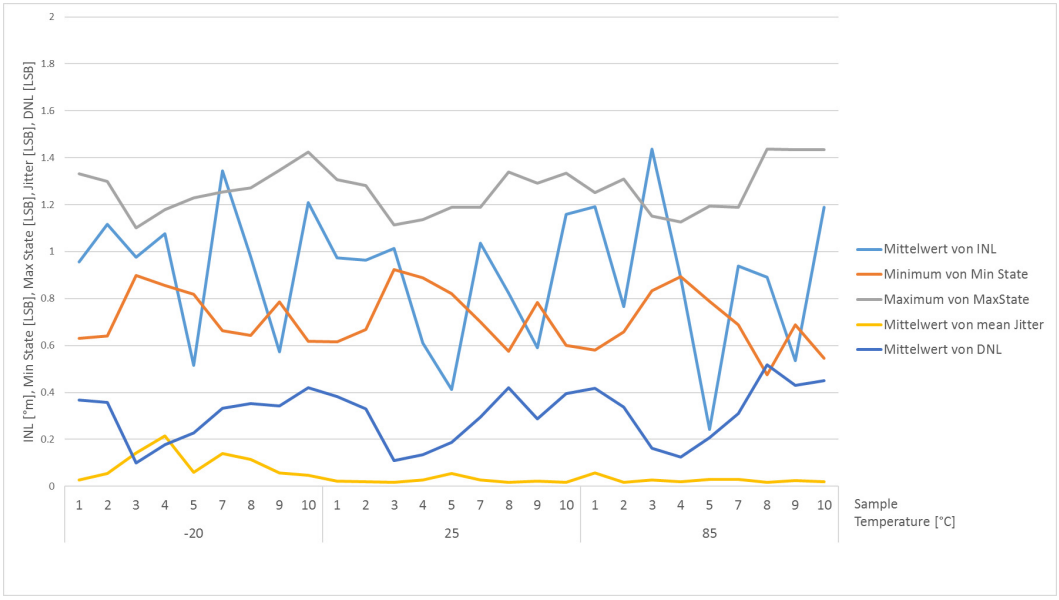


Figure 2 Temperature Dependence

3.3 Oscilloscope Plots

Figure 3 shows the incremental signals A, B, I recorded in rotational direction CW at V_{cc}=5 V, 10'000 rpm, T=25°C.

Signals: C1 = ChA; C2 = ChB; C3 = ChI; 20 us/div; 5 V/div

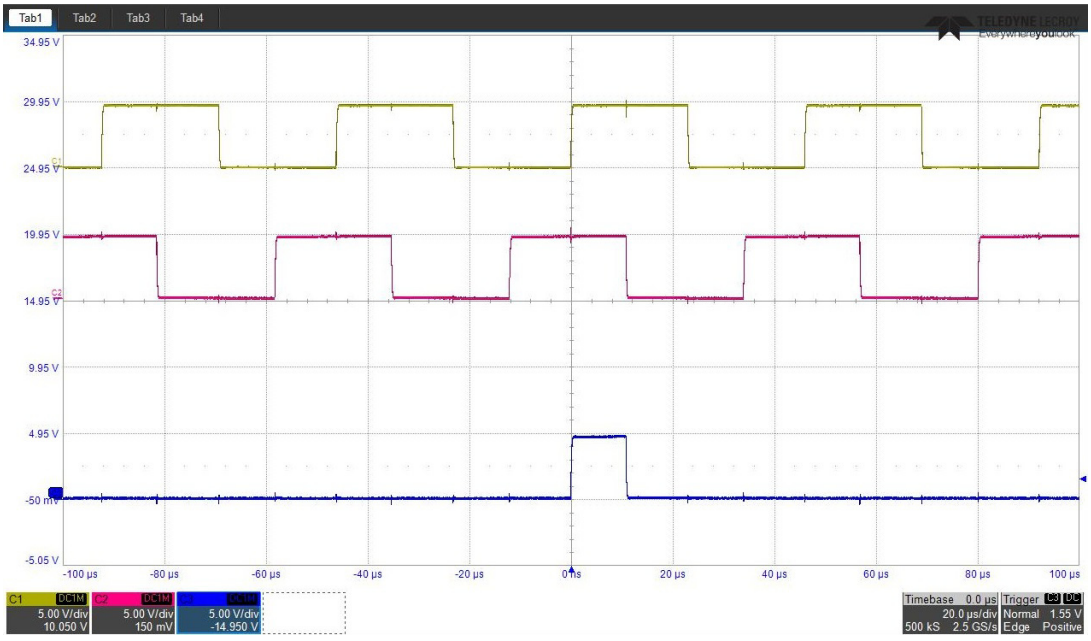


Figure 3 Oscilloscope plot

4 Dimensional Drawings

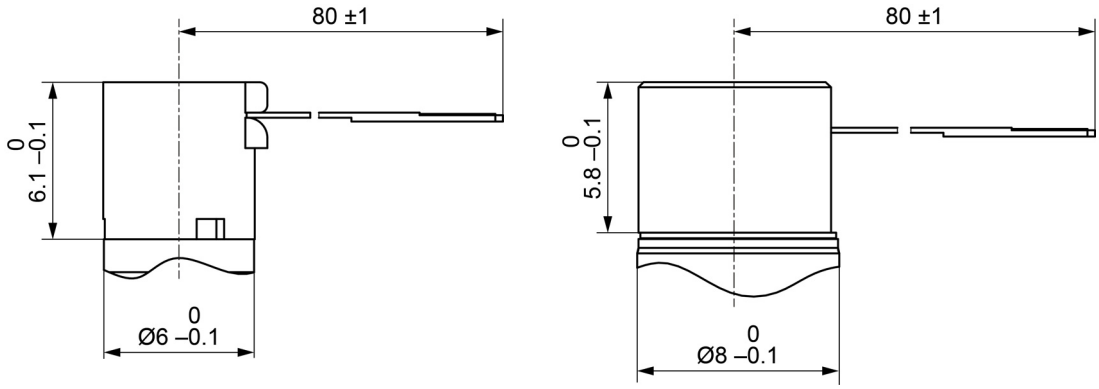


Figure 4 Dimensional Drawings [mm] – ENX 6 OPT (left) / ENX 8 OPT (right)

5 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).*

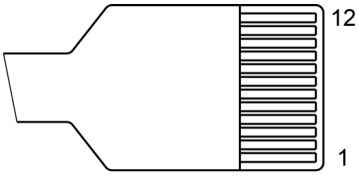


Figure 5 Connector

Pin	ENX OPT & DC motor	ENX OPT & EC-Motor	Description
1	Motor +	Winding W1	Motor connections
2	Motor −	Winding W2	
3	not connected	Winding W3	
4	GND	GND	Ground
5	V_{cc}	V_{cc}	Power supply voltage
6	ChA	ChA	Channel A
7	ChB	ChB	Channel B
8	ChI	ChI	Channel I (Index)
9	not connected	not connected	–
10	not connected	not connected	–
11	not connected	not connected	–
12	not connected	not connected	–

Table 8 Connector – Pin Assignment

Specifications		
ENX 6 OPT ENX 8 OPT	Mating plug	FFC/FPC connector; for example… • Molex (52745-1297) • Tyco (1-1734839-2)

Table 9 Connector – Specifications

6 Output Circuitry

Figure 6 shows the conceptual output schematic.

Figure 6 Output Circuitry – ENX OPT

In general, a high-impedance network (CMOS input, for example) is recommended.

Pull-up and/or pull-down resistors are permitted but not necessary. However, if they are used, they must be dimensioned that the current per channel is limited to <5 mA.

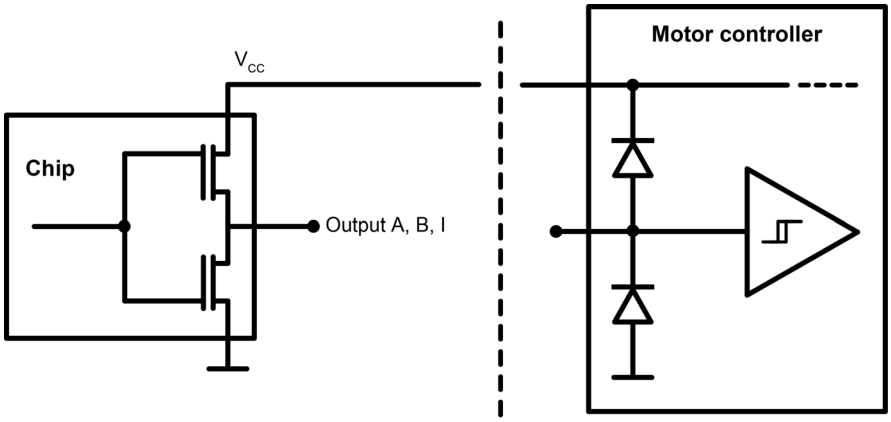


Figure 7 Output Circuitry

Supply Voltage
The supply voltage of the load network must not exceed the supply voltage of the encoder.

7 Accessories

Order number	Description	
498157	Adapter	To connect the ENX 6/8 OPT to a maxon controller. With integrated Line Driver RS422 and selectable encoder supply V_{ENC} = 3.3V (from V_{CC} via linear regulators) or V_{ENC} = V_{CC} = 5V
For further details ➔maxon catalog		

Table 10 Suitable Accessories

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