

ENX EASY INT

Encoders

Product Information



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Table of Contents

1	Technical Data	4
1.1	Absolute Maximum Rating	4
1.2	General Data	4
1.3	Incremental Interface	4
1.4	Absolute Interface	5
1.5	Commutation Interface	5
1.6	Angle Measurement	6
1.7	Angle Alignment	7
1.8	Mechanical Data	7
1.9	Dimensional Drawings	8
2	Absolute Encoder	10
2.1	SSI Mode	10
2.2	BiSS-C Mode	10
3	Definitions	11
4	Typical Measurement Results	13
4.1	Angle Error per Turn, calibrated	13
4.2	Temperature Dependence	15
4.3	Resolution Dependence	15
5	Pin Assignment	17
5.1	ENX 8 EASY INT & ENX 8 EASY INT COMM	17
5.2	ENX 8 EASY INT Absolute & ENX 8 EASY INT Absolute COMM	18
5.3	ENX 13...22 EASY INT COMM	19
5.4	ENX 13...22 EASY INT Absolute	21
5.5	ENX 16...22 EASY INT Absolute COMM	23
5.6	ENX 13...22 COMM	24
6	Output Circuitry	26
7	Accessories	28

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ENX EASY INT Encoders – Product Information



The ultra compact maxon EASY encoders use an interpolated Hall sensor angle measurement system to generate angle information of up to 4096 steps per turn. Electively or in combination available are incremental square wave signals, absolute angular values (SSI or BISS-C), and/or commutation signals.

The encoders are available for diameter-compliant mounting on motors of the ECX series with outside diameters of 8, 13, 16, 19, and 22 mm:

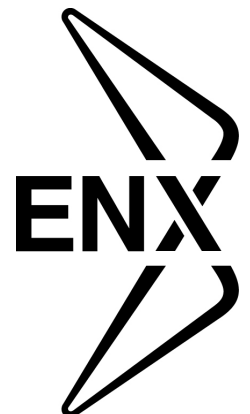
- ENX 8...22 EASY INT – incremental encoder with differential output signals
- ENX 8...22 EASY INT COMM – incremental encoder with commutation signals
- ENX 8...22 EASY INT Absolute – absolute encoder
- ENX 8...22 EASY INT Absolute COMM – absolute encoder with commutation signals
- ENX 13...22 COMM – commutation signals, only

Depending on the model, as connection cables available are flat ribbon cables or single strands. The models with single strands are protected against reverse polarity.

Pin-out for all versions is compatible to most maxon motor 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	+6.0	V
Voltage at signal output (V_{signal})		-0.3	+6.0	V
Supply current (I_{dd})		-30	+220	mA
Signal output current (I_{signal})	A,B,I; no supply voltage	-100	+100	mA
	DATA; no supply voltage	-10	+10	
ESD voltage (V_{esd}), all pins	HBM 100 pF, 1.5 k Ω	\varnothing 8	2	kV
	EN 61000-4-2	\varnothing 13...22	>2	
Operating temperature (T_{amb}) *1		-40	+100	°C
Storage temperature (T_{store}) *1		-40	+100	°C
Humidity (condensation not permitted)	\varnothing 8	20	80	%rH
	\varnothing 13...22 *1	20	100	

Annotation *1 The included connectors are designed for a temperature range of -40...+105 °C and a humidity of 20...80%rH.

1.2 General Data

Parameter	Conditions	Min	Typ	Max	Unit
Supply voltage (V_{CC})		+4.5	5	+5.5	V
Supply current (I_{dd})	Output pulse frequency <100 kHz, load resistor \geq 100 k Ω	\varnothing 8	19		mA
		\varnothing 13...22	22		

1.3 Incremental Interface

Parameter	Conditions	Min	Typ	Max	Unit
Number of channels	ChA, ChB, ChI		3		—
Counts per turn (N) (factory-configurable)	1...128, 256, 512, 1024	\varnothing 8	1	256	cpt
	1...1024	\varnothing 13...22	1	256	
Pulse frequency (f_{pulse})	\varnothing 8		0.5		MHz
	\varnothing 13...22		4		
Signal output current (I_{signal})	With Line Receiver EIA-422	-20		+20	mA
Signal voltage high (V_{high})	I_{signal} <20 mA, relative to V_{CC}	$V_{CC}-0.5$ V			V
Signal voltage low (V_{low})	I_{signal} <20 mA			0.5	V
Transition time (t_{trans})	Rise time/fall time ChA/B/I @ load resistor 100 Ω , $C_{load} \leq$ 200 pF		10	25	ns

1.4 Absolute Interface

Parameter	Conditions	Min	Typ	Max	Unit
Steps per turn (N)	SSI/BiSS mode 12 bit		4096		steps
Signal output current (I_{signal})	DATA output SSI/BiSS interface			20	mA
Signal voltage high (V_{high})	DATA output: $I_{\text{signal}} < 20$ mA, relative to V_{CC}	$V_{\text{CC}} - 1$ V			V
Signal voltage low (V_{low})	DATA output: $I_{\text{signal}} < 20$ mA			0.5	V
Transition time (t_{trans})	DATA output: Rise time/fall time, $C_{\text{load}} = 50$ pF			60	ns
System Clock (f_{sys})		0.8	1.0	1.2	MHz
CLK Signal Frequency (f_{clk})	SSI mode	0.04		4	MHz
	BiSS mode	0.6		10	
Timeout (t_{out})	SSI mode	Ø 8	16		µs
		Ø13...22	20		
	BiSS mode	Ø 8	2		
		Ø13...22	1.5* ($1/f_{\text{clk}}$) + 3.75 µs		
Minimum input level CLK HIGH (V_{high})	SSI/BiSS mode	2			V
Maximum input level CLK LOW (V_{low})	SSI/BiSS mode			0.8	V
Input resistance CLK (R_{input})	Ø 8		6.7		kΩ
	Ø13...22		12		

1.5 Commutation Interface

Parameter	Conditions	Min	Typ	Max	Unit
Number of channels	H1, H2, H3		3		–
Pulse frequency (f_{pulse})	Maximum output pulse frequency		53		kHz
Signal output current (I_{signal})		–20		+20	mA
Signal voltage high (V_{high})	$I_{\text{signal}} < 20$ mA, relative to V_{CC}	$V_{\text{CC}} - 0.5$ V			V
Signal voltage low (V_{low})	$I_{\text{signal}} < 20$ mA			0.5	V
Transition time (t_{trans})	Rise time/fall time ChA/B/I without load		10	25	ns

1.6 Angle Measurement

Conditions All values at $T = 25^{\circ}\text{C}$, $n = 10000 \text{ rpm}$, $V_{\text{CC}} = 5 \text{ V}$ unless otherwise specified.

Definitions See →page 11.

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		CW		
Counting direction of absolute signals (Dir)	Motor shaft movement for increasing angle values as seen from the shaft end		CW		
State length (L_{state}) and index pulse width (L_{index}), synchronized with ChA/B), incremental	$N=1 \dots 128, 256, 512 \text{ cpt}$	45	90	135	$^{\circ}\text{e}$
	$N=1024 \text{ cpt}$	30	90	160	
	$N=500, 1000 \text{ cpt}$ and other non-binary number of impulses *2	30	90	250	
Minimum state duration (t_{state}), incremental	$f_{\text{pulse}} \leq 0.5 \text{ MHz}$	$\varnothing 8$	500		ns
	$f_{\text{pulse}} \leq 2.0 \text{ MHz}$	$\varnothing 13 \dots 22$	125		
	$f_{\text{pulse}} > 2.0 \text{ MHz}$	$\varnothing 13 \dots 22$	62.5		
Integral Nonlinearity (INL)	All number of impulses		<1	2	$^{\circ}\text{m}$
Differential Nonlinearity (DNL)	$N=1 \dots 128, 256, 512 \text{ cpt}$		0.3	0.5	LSB
	$N=1024 \text{ cpt}$		0.6	0.9	
	$N=500, 1000 \text{ cpt}$ and other non-binary number of impulses *2			2	
Repeatability (Jitter), incremental	$N=512 \text{ cpt}$	$\varnothing 8$	<2		LSB
		$\varnothing 13 \dots 22$	0.5		
	$N=1024 \text{ cpt}$	$\varnothing 8$	<4		
		$\varnothing 13 \dots 22$	1		
Repeatability (Jitter)	All number of impulses	$\varnothing 8$	<0.35		$^{\circ}\text{m}$
		$\varnothing 13 \dots 22$	0.1		
Repeatability (Jitter), absolute	SSI/BiSS mode 12 bit	$\varnothing 8$	<4 *3		LSB
		$\varnothing 13 \dots 22$	1 *3		
Phase delay A to B (Phase θ), incremental	$N=1 \dots 512 \text{ cpt}$	45	90	135	$^{\circ}\text{e}$
	$N=513 \dots 1024 \text{ cpt}$	15	90	165	
Angle hysteresis (Hyst)	$N=1 \dots 1024 \text{ cpt}$	$\varnothing 8$	0.35		$^{\circ}\text{m}$
		$\varnothing 13 \dots 22$	0.17		
Bandwidth of analog signal path	Typical equivalent bandwidth of single pole low-pass filter		16		kHz
Delay of digital signal path	Typical latency of digital signal processing		2		μs

Annotations *2 With non-binary number of impulses (ENX 13...22 EASY INT only), individual states are systematically omitted from the maximum possible number of states per turn. Thereby, the associated initial impulses are being extended and thus deteriorate the resolution-dependent characteristics.

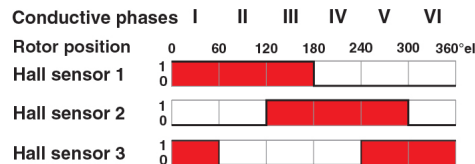
*3 When reading the absolute angle at the same position, six standard deviations of the resulting sequence of values can approach 1, respectively 4 LSB.

1.7 Angle Alignment

The angle value “zero” of the absolute encoder, the index of the incremental encoder, as well as the rising edge of the communication signal H1 are factory-programmed to the commutation angle “zero” of the used EC (BLCD) motor (→Figure 2).

- When assembled onto a motor with several pole pairs (n), the absolute encoders will show the angle value “zero” and the incremental encoders the index **once per mechanical turn**.
- Due to its multiple sets of pole pairs, the **motor** will show this commutation angle **n times per mechanical turn**.

Signal Sequence of Hall Sensors



Supplied Motor Voltage (Phase to Phase)

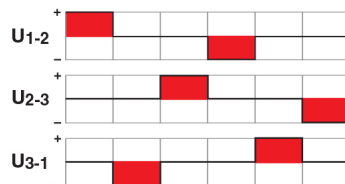


Figure 2 Block Commutation of EC (BLDC) Motors – Definition of Phases

1.8 Mechanical Data

Parameter	Conditions	Value	Unit
Dimensions (dimensional drawings → as of page 8)	ENX 8 EASY INT	Ø8	mm
	ENX 13 EASY INT ENX 13 COMM	Ø13	
	ENX 16 EASY INT ENX 16 COMM	Ø16	
	ENX 19 EASY INT ENX 19 COMM	Ø19	
	ENX 22 EASY INT ENX 22 COMM	Ø22	
Moment of inertia (Jt)	motor shaft Ø1...8 mm	0.01...0.7	g cm ²
Standard cable length (Lc)	ENX 8 EASY INT	300	mm
	ENX 13 EASY INT ENX 13 COMM ENX 16 EASY INT ENX 16 COMM ENX 19 EASY INT ENX 19 COMM ENX 22 EASY INT ENX 22 COMM	200 / 500	

1.9 Dimensional Drawings

For details → section “1.8 Mechanical Data”.

1.9.1 ENX 8 EASY INT

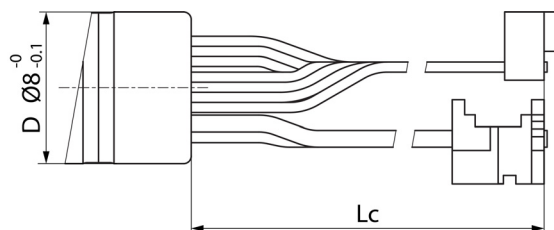


Figure 3 ENX 8 EASY INT – Dimensional Drawing [mm]

1.9.2 ENX 13...22 EASY INT COMM

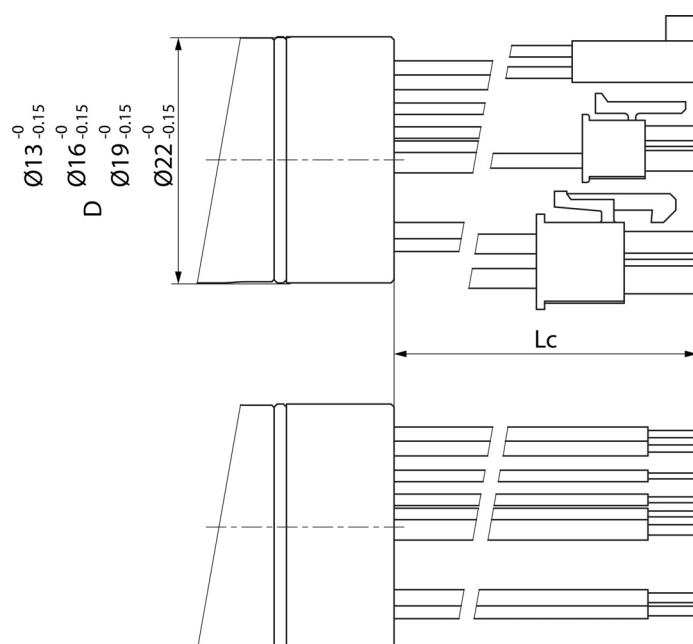


Figure 4 ENX 13...22 EASY INT COMM – Dimensional Drawing [mm]

1.9.3 ENX 13...22 EASY INT Absolute COMM

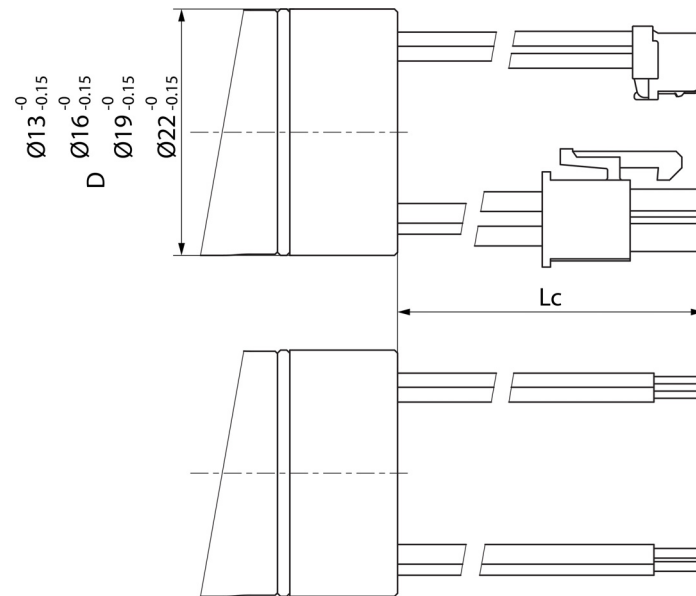


Figure 5 ENX 13...22 EASY INT Absolute COMM – Dimensional Drawing [mm]

1.9.4 ENX 13...22 COMM

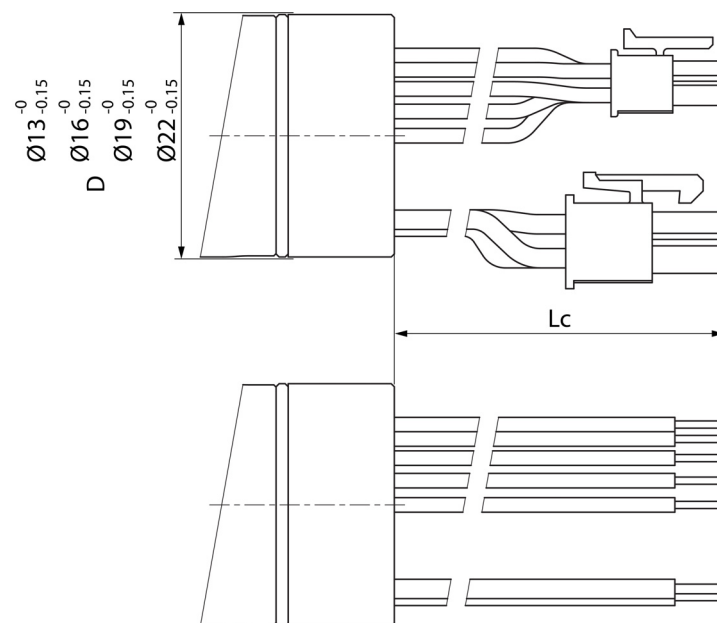


Figure 6 ENX 13...22 COMM – Dimensional Drawing [mm]

2 Absolute Encoder

The «ENX EASY INT» absolute encoders provide the functionality of a single-turn absolute encoder. Two interface protocol variants are factory-configurable; SSI and BiSS-C.

2.1 SSI Mode

- The wait time after reading of last bit must be larger than Timeout (t_{out}).
- Protocol: 13 bit data, MSB first, last bit always zero, gray coded
- A complete reading cycle at maximum clock rate can be calculated using the following formula:

$$13 \cdot \frac{1}{4MHz} + t_{out}$$

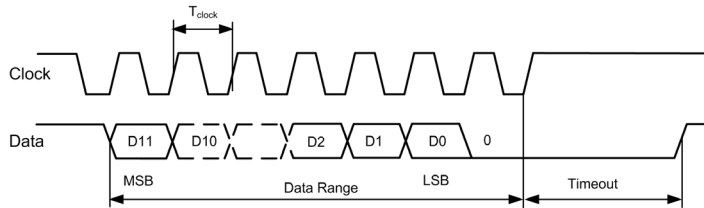


Figure 7 Timing of EASY INT Absolute in SSI Mode

2.2 BiSS-C Mode

- The wait time after reading of last bit must be larger than Timeout (t_{out}).
- Protocol: 3 bit start sequence {Ack, Start, CDS} fixed values, 12 bit data (MSB first), 2 bits Error/Warning, 6 bit CRC (polynomial: 0b1000011, inverted mode).
- A complete reading cycle at maximum clock rate takes at least as follows:

ENX 8 EASY INT

$$23 \cdot \frac{1}{10MHz} + t_{out}$$

ENX 13...22 EASY INT

$$23 \cdot \frac{1}{10MHz} + \left(1.5 \cdot \frac{1}{10MHz} + t_{out}\right)$$

- The interface is BiSS-C-compatible. For more information to the BiSS-C interface specification → <http://biss-interface.com/> (section "Downloads").
In the simplest configuration, the controller is the master and ENX 16 EASY Absolute the only slave.

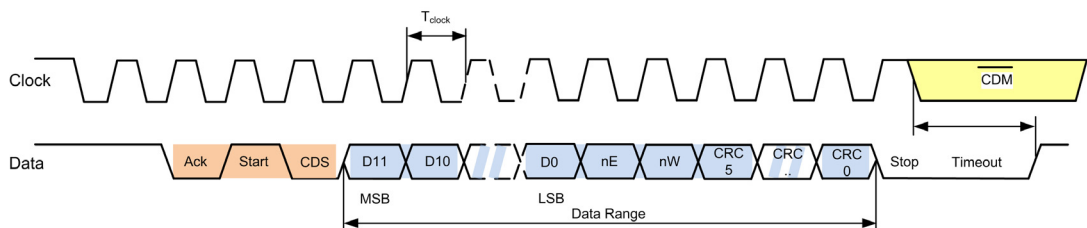


Figure 8 Timing of EASY INT Absolute in BiSS-C Mode

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 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]	<p>Six standard deviations of Angle Error per turn (at each position, over a given number of turns).</p> <p>Jitter [°m] is typically independent of the resolution and defines the maximum useful positioning repeatability.</p> <p>Jitter [LSB] is resolution-dependent. At given Jitter [°m], the value is roughly proportional to resolution.</p>	
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.	

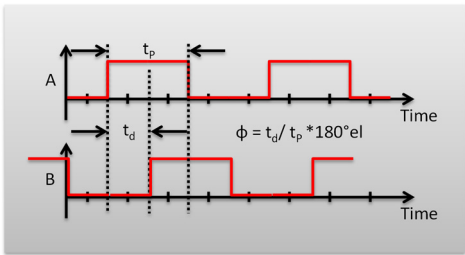
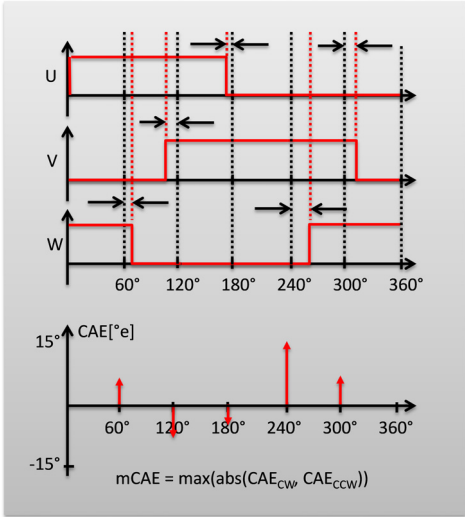
Metric	Definition	Illustration
Phase delay θ [°e]	Time difference of rising edge A to B relative to duration of positive level of A.	 <p>Timing diagram showing two square waves A and B. Wave A is the reference. Wave B is delayed by t_d. The period of A is t_p. The phase delay is calculated as $\phi = t_d / t_p * 180^\circ \text{el}$.</p>
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.	 <p>Diagram showing three commutation signals U, V, and W over 360°. Below it, a graph of CAE [°e] vs angle, showing peaks at 60°, 120°, 180°, 240°, and 300°. The formula $mCAE = \max(\text{abs}(CAE_{CW}), \text{abs}(CAE_{CCW}))$ is shown.</p>

Table 1

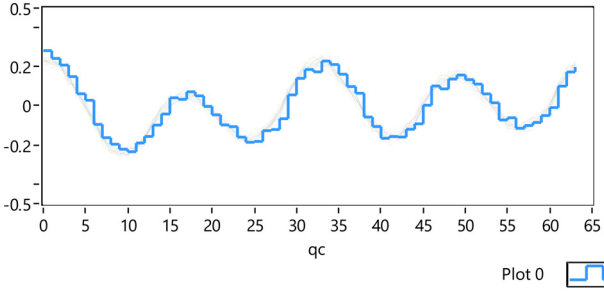
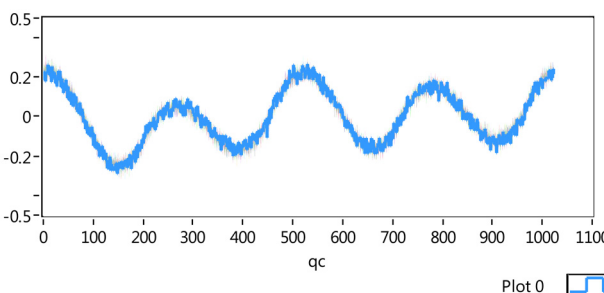
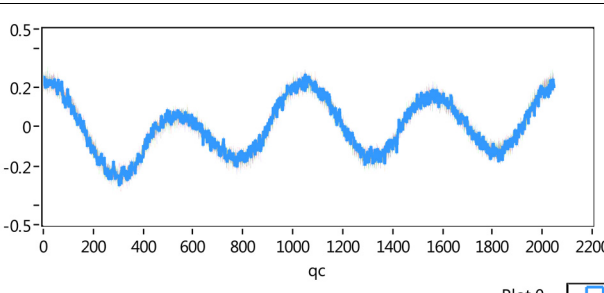
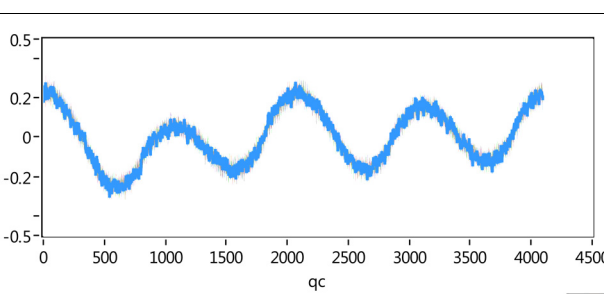
Definitions

4 Typical Measurement Results

4.1 Angle Error per Turn, calibrated

The average angle error [$^{\circ}$ m] and the repeatability (Jitter) [$^{\circ}$ m] are independent of the chosen resolution. The metrics given in LSB are resolution-dependent.

Below graphs show angle error measurements of an ENX 13 EASY INT, configured as incremental encoder in various resolutions and as absolute encoder with maximum resolution under following conditions: Measurement of 25 turns at $V_{CC}=5$ V, $n=10000$ rpm, $T=25^{\circ}\text{C}$.

Resolution	Graph	Analysis	
16 cpt		INL Jitter DNL Min State Max State	0.5°m 0.1°m = 0.02 LSB 0.03 LSB 0.97 LSB = 87°e 1.02 LSB = 92°e
256 cpt		INL Jitter DNL Min State Max State	0.5°m 0.1°m = 0.25 LSB 0.12 LSB 0.9 LSB = 81°e 1.1 LSB = 99°e
512 cpt		INL Jitter DNL Min State Max State	0.5°m 0.1°m = 0.5 LSB 0.3 LSB 0.85 LSB = 76°e 1.3 LSB = 117°e
1024 cpt		INL Jitter DNL Min State Max State	0.5°m 0.1°m = 1 LSB 0.5 LSB 0.8 LSB = 72°e 1.5 LSB = 135°e

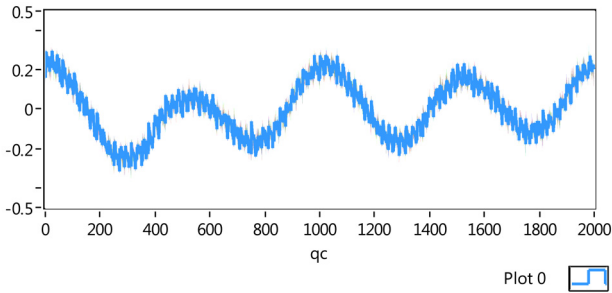
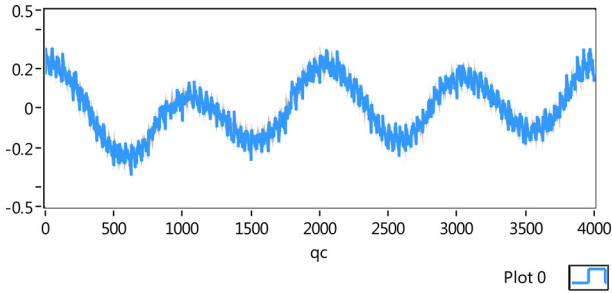
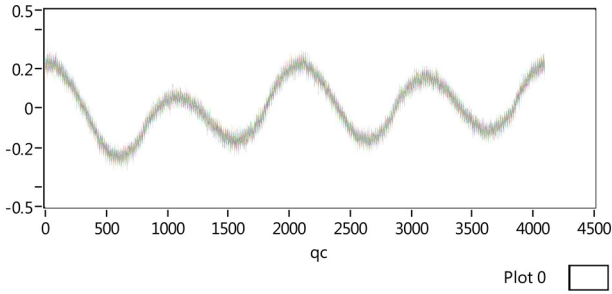
Resolution	Graph	Analysis	
500 cpt (non-binary)		INL Jitter DNL Min State Max State	0.5°m $0.1^{\circ}\text{m} = 0.5 \text{ LSB}$ 0.75 LSB $0.85 \text{ LSB} = 76^{\circ}\text{e}$ $1.75 \text{ LSB} = 175^{\circ}\text{e}$
1000 cpt (non-binary)		INL Jitter DNL Min State Max State	0.5°m $0.1^{\circ}\text{m} = 1 \text{ LSB}$ 1.5 LSB $0.75 \text{ LSB} = 67^{\circ}\text{e}$ $2.5 \text{ LSB} = 225^{\circ}\text{e}$
12 bit (Absolute)		INL Jitter	0.5°m $0.1^{\circ}\text{m} = 1 \text{ LSB}$

Table 2 Typical Measurement Results

4.2 Temperature Dependence

Basically, INL, DNL, and State are temperature-independent. Due to thermal noise, Jitter increases, respectively repeatability decreases with rising temperature.

Figure 9 shows the temperature dependence of eight different ENX 13 EASY INT samples under the following conditions: $V_{CC}=5$ V, 10'000 rpm, 1 k Ω load, 1024 cpt.

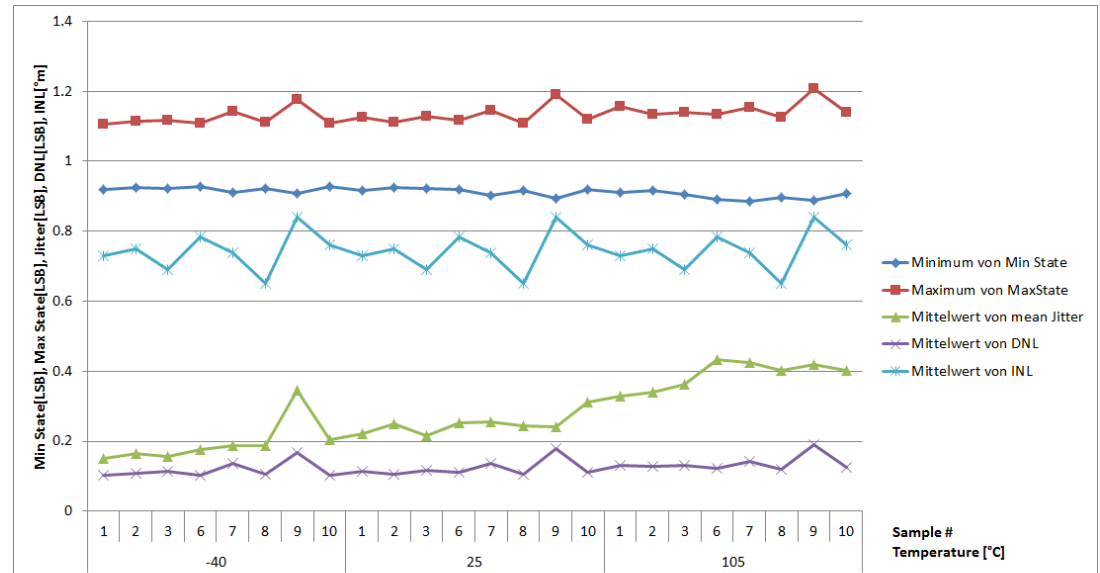


Figure 9 Temperature Dependence

4.3 Resolution Dependence

INL and Jitter [°m] are independent of resolution (→Table 2). Resolution-dependent metrics deteriorate with increased resolution, particularly with non-binary resolutions (→Figure 11)

Figure 10 shows the resolution dependence of eight different ENX 13 EASY INT samples under following conditions: $V_{CC}=5$ V, 10'000 rpm, 1 k Ω load, 25°C, binary resolution

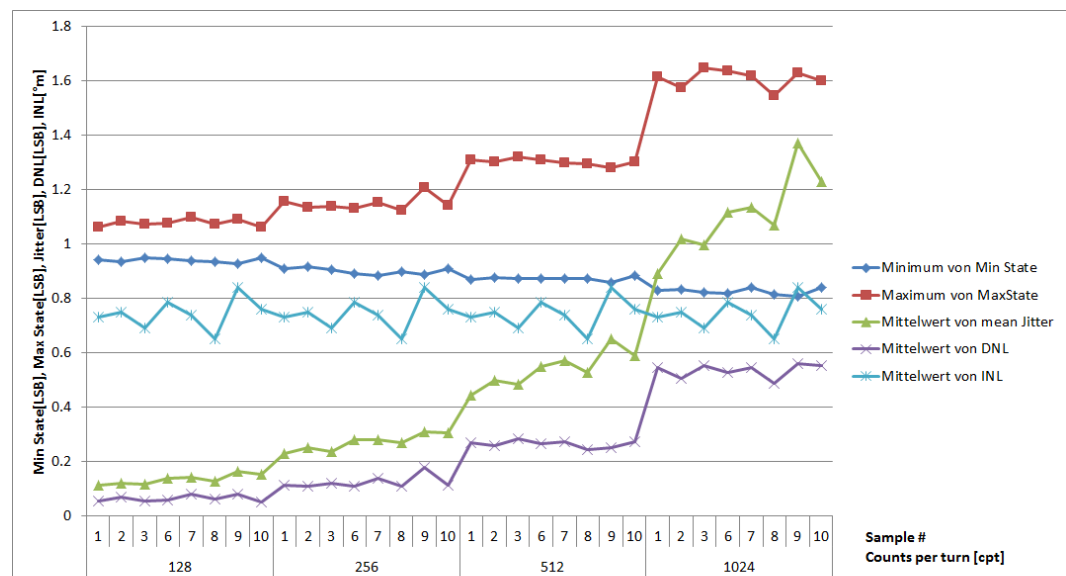


Figure 10 Resolution Dependence (binary Resolutions)

Figure 11 shows the resolution dependence of eight different ENX 13 EASY INT samples under following conditions: $V_{cc}=5\text{ V}$, 10'000 rpm, 1 k Ω load, 25°C, non-binary resolution

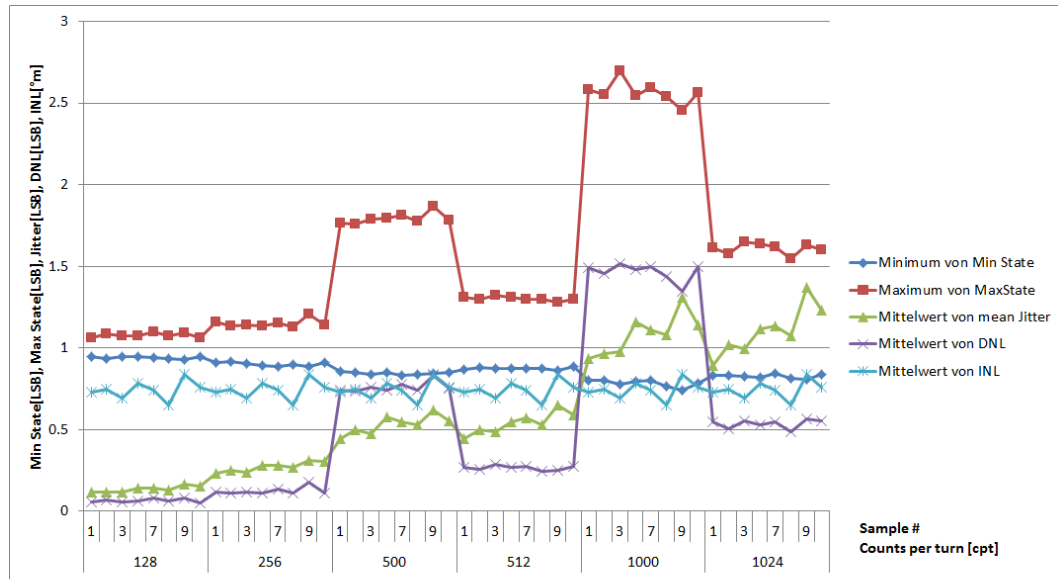


Figure 11 Resolution Dependence (Comparison binary/non-binary Resolutions)

5 Pin Assignment



Maximum permitted Supply Voltage

- Make sure that supply power is within stated range.
- Supply voltages exceeding the stated range will destroy the unit.
- Connect the unit only when supply voltage is switched off ($V_{cc}=0$).

5.1 ENX 8 EASY INT & ENX 8 EASY INT COMM

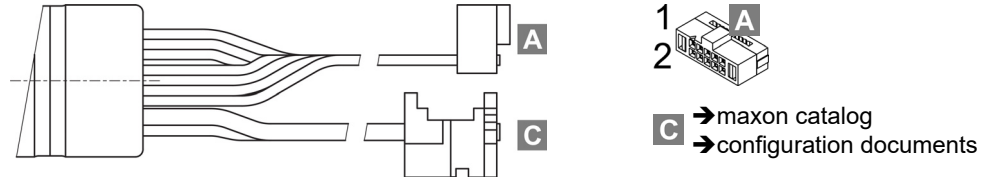


Figure 12 ENX 8 EASY INT (COMM) – Cable Plugs

Pin	Color	Signal		Description
		ENX 8 EASY INT	ENX 8 EASY INT COMM	
A1	marked	do not connect	do not connect	—
A2	gray	V_{cc}	V_{cc}	Power supply voltage
A3	gray	GND	GND	Ground
A4	gray	do not connect	do not connect	—
A5	gray	ChA/	H1	Channel A complement / Hall sensor 1
A6	gray	ChA	ChA	Channel A
A7	gray	ChB/	H2	Channel B complement / Hall sensor 2
A8	gray	ChB	ChB	Channel B
A9	gray	ChI/	H3	Channel I (Index) complement / Hall sensor 3
A10	gray	ChI	ChI	Channel I (Index)

Table 3 ENX 8 EASY INT (COMM) – Pin Assignment



Externally applied voltages at pins A1 and A4 can destroy the device.

Cable Plug ENX 8 EASY INT / ENX 8 EASY INT COMM		
A	Connector	IDC socket, pitch 1.27 mm, 5 x 2 poles
	Mating plug	Pin header, pitch 1.27 mm, 5 x 2 poles, pin length 3.05 mm/0.12 inch (e.g. Samtec FTSH series)
C	→ maxon catalog or configurations documents	

Table 4 ENX 8 EASY INT (COMM) – Specifications Cable Plugs

5.2 ENX 8 EASY INT Absolute & ENX 8 EASY INT Absolute COMM

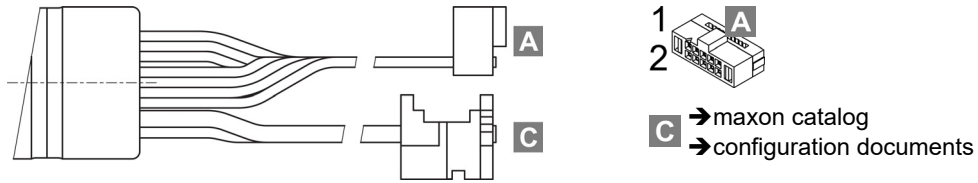


Figure 13 ENX 8 EASY INT Absolute (COMM) – Cable Plugs

Pin	Color	Signal		Description
		ENX 8 EASY INT Absolute	ENX 8 EASY INT Absolute COMM	
A1	marked	SSI/BiSS DATA	do not connect	Absolute encoder Data
A2	gray	V _{CC}	V _{CC}	Power supply voltage
A3	gray	GND	GND	Ground
A4	gray	SSI/BiSS CLK	do not connect	Absolute encoder Clock
A5	gray	do not connect	H1	Hall sensor 1
A6	gray	do not connect	ChA	—
A7	gray	do not connect	H2	Hall sensor 2
A8	gray	do not connect	ChB	—
A9	gray	do not connect	H3	Hall sensor 3
A10	gray	do not connect	ChI	—

Table 5 ENX 8 EASY INT Absolute (COMM) – Pin Assignment



Externally applied voltages at pins A1 and A4 can destroy the device.

Cable Plug ENX 8 EASY INT Absolute / ENX 8 EASY INT Absolute COMM		
A	Connector	IDC socket, pitch 1.27 mm, 5 x 2 poles
	Mating plug	Pin header, pitch 1.27 mm, 5 x 2 poles, pin length 3.05 mm/0.12 inch (e.g. Samtec FTSH series)
C	→ maxon catalog or configurations documents	

Table 6 ENX 8 EASY INT Absolute (COMM) – Specifications Cable Plugs

5.3 ENX 13...22 EASY INT COMM


Versions available:

- Encoder with plug / Hall sensors without plug / Motor without plug
- Encoder with plug / Hall sensors with plug / Motor with plug (→Figure 14)

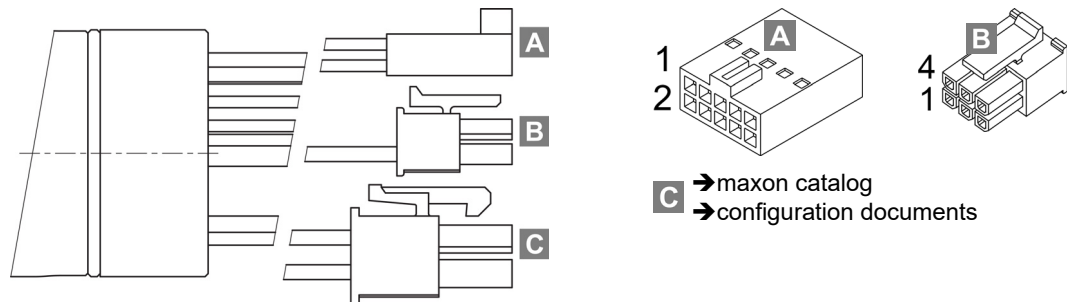


Figure 14 ENX 13...22 EASY INT COMM – Cable Plugs

Pin	Color	Signal	Description
A1	—	not connected	—
A2	black	V _{CC}	Power supply voltage
A3	brown	GND	Ground
A4	—	not connected	—
A5	red	ChA/	Channel A complement
A6	orange	ChA	Channel A
A7	yellow	ChB/	Channel B complement
A8	green	ChB	Channel B
A9	blue	ChI/	Channel I (index) complement
A10	violet	ChI	Channel I (Index)

Pin	Color	Signal	Description
B1	yellow	H1	Hall sensor 1
B2	brown	H2	Hall sensor 2
B3	gray	H3	Hall sensor 3
B4	—	not connected	—
B5	—	not connected	—
B6	—	not connected	—

Table 7 ENX 13...22 EASY INT COMM – Pin Assignment

Continued on next page.

Cable Plugs ENX 13...22 EASY INT COMM		
A	Connector	Crimp contact housing, pitch 2.54 mm, 5 x 2 poles
	Mating plug	Pin header, pitch 2.54 mm, 5 x 2 poles (EN 60603-13/DIN 41651)
B	Connector	Molex Micro-Fit 3.0, 6 poles (430-25-0600)
	Mating plug	Molex Micro-Fit 3.0, 6 poles (430-45-0612)
C	➔ maxon catalog or configurations documents	

Table 8 ENX 13...22 EASY INT COMM – Specifications Cable Plugs

5.4 ENX 13...22 EASY INT Absolute



Versions available:

- Absolute encoder without plug / Motor without plug
- Absolute encoder with plug / Motor with plug (→Figure 15)
- Absolute encoder and motor with pins (→Figure 16)

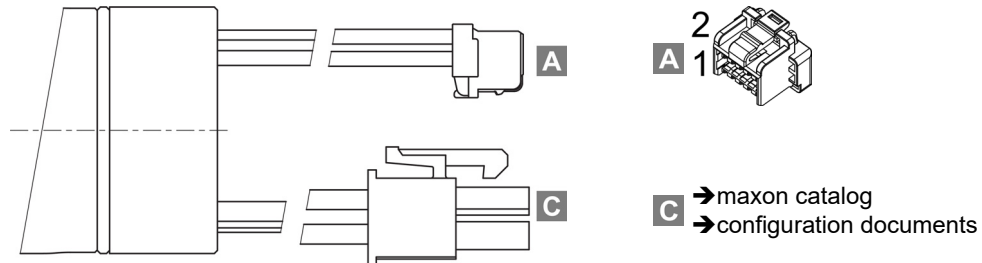


Figure 15 ENX 13...22 EASY INT Absolute – Cable Plugs

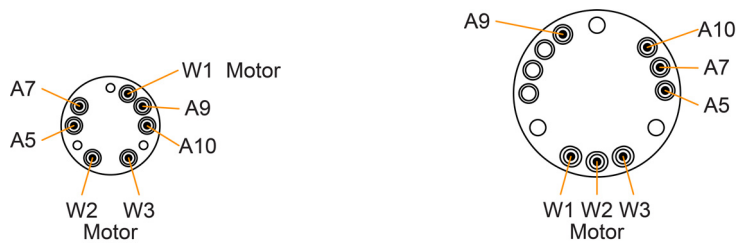


Figure 16 ENX 13 (left) / 16...22 (right) EASY INT Absolute – Pins

Pin	Color	Signal	Description
A1	—	not connected	—
A2	—	not connected	—
A3	—	not connected	—
A4	—	not connected	—
A5	yellow	SSI/BiSS CLK	Absolute encoder Clock
A6	—	not connected	—
A7	green	SSI/BiSS DATA	Absolute encoder Data
A8	—	not connected	—
A9	brown	GND	Ground
A10	black	V _{CC}	Power supply voltage

Table 9 ENX 13...22 EASY INT Absolute – Pin Assignment

Continued on next page.

Cable Plugs ENX 13...22 EASY INT Absolute		
A	Connector	Molex CLIK-Mate, pitch 1.5 mm, 5 x 2 poles (503149 series)
	Mating plug	Molex CLIK-Mate, pitch 1.5 mm, 5 x 2 poles (503154 series)
C	➔ maxon catalog or configurations documents	

Table 10 ENX 13...22 EASY INT Absolute – Specifications Cable Plugs

5.5 ENX 16...22 EASY INT Absolute COMM



Versions available:

- Absolute encoder, Hall sensors, and motor with pins (→Figure 17)

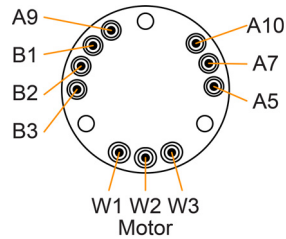


Figure 17 ENX 16...22 EASY INT Absolute COMM – Pins

Pin	Color	Signal	Description
A5	—	SSI/BiSS CLK	Absolute encoder Clock
A7	—	SSI/BiSS DATA	Absolute encoder Data
A9	—	GND	Ground
A10	—	V _{cc}	Power supply voltage
B1	—	H1	Hall sensor 1
B2	—	H2	Hall sensor 2
B3	—	H3	Hall sensor 3

Table 11 ENX 16...22 EASY INT Absolute COMM – Pin Assignment

5.6 ENX 13...22 COMM



Versions available:

- Hall sensors without plug / Motor without plug
- Hall sensors without plug / Motor without plug / NTC without plug
- Hall sensors with plug / Motor with plug (→Figure 18)
- Hall sensors with plug / Motor with plug / NTC with plug (→Figure 19)
- Hall sensors, motor, and NTC with pins (→Figure 20)

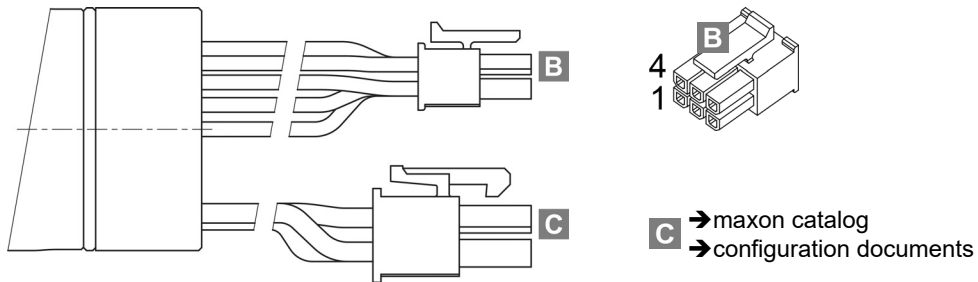


Figure 18 ENX 13...22 COMM – Cable Plugs

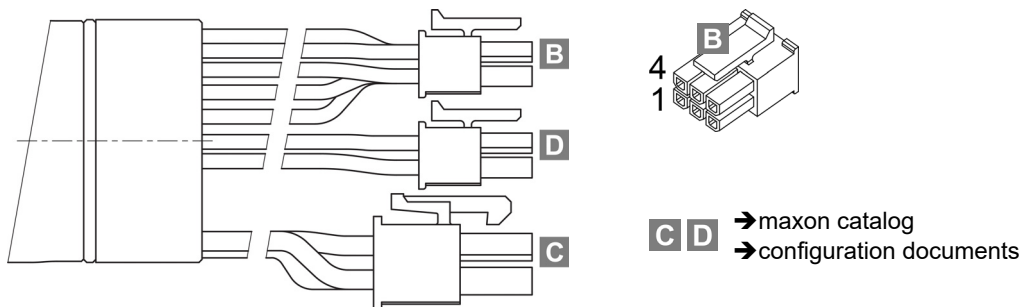


Figure 19 ENX 13...22 COMM (thermistor version) – Cable Plugs

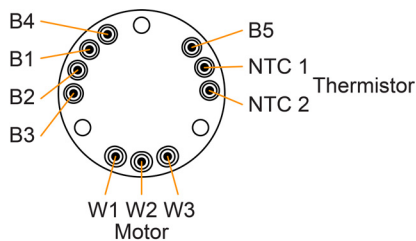


Figure 20 ENX 13...22 COMM – Pins

Continued on next page.

Pin	Color	Signal	Description
B1	yellow	H1	Hall sensor 1
B2	brown	H2	Hall sensor 2
B3	gray	H3	Hall sensor 3
B4	blue	GND	Ground
B5	orange	V _{Hall}	Hall sensor supply voltage
B6	—	not connected	—

Table 12 ENX 13...22 COMM – Pin Assignment

Cable Plugs ENX 13...22 COMM		
B	Connector	Molex Micro-Fit 3.0, 6 poles (430-25-0600)
	Mating plug	Molex Micro-Fit 3.0, 6 poles (430-45-0612)
C	→ maxon catalog or configurations documents	
D		

Table 13 ENX 13...22 COMM – Specifications Cable Plugs

6 Output Circuitry

The following figures show the conceptual output schematics of the different encoders including ESD protection circuitry.

6.1 ENX 8 EASY INT

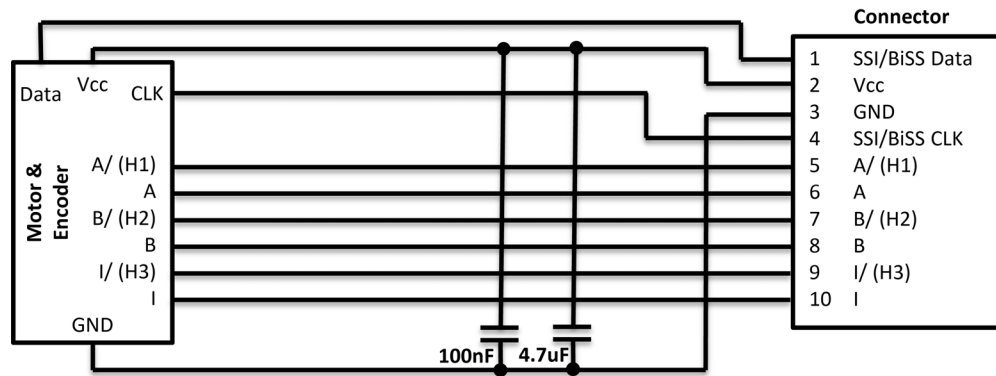


Figure 21 ENX 8 EASY INT – Output Circuitry

6.2 ENX 13...22 EASY INT COMM

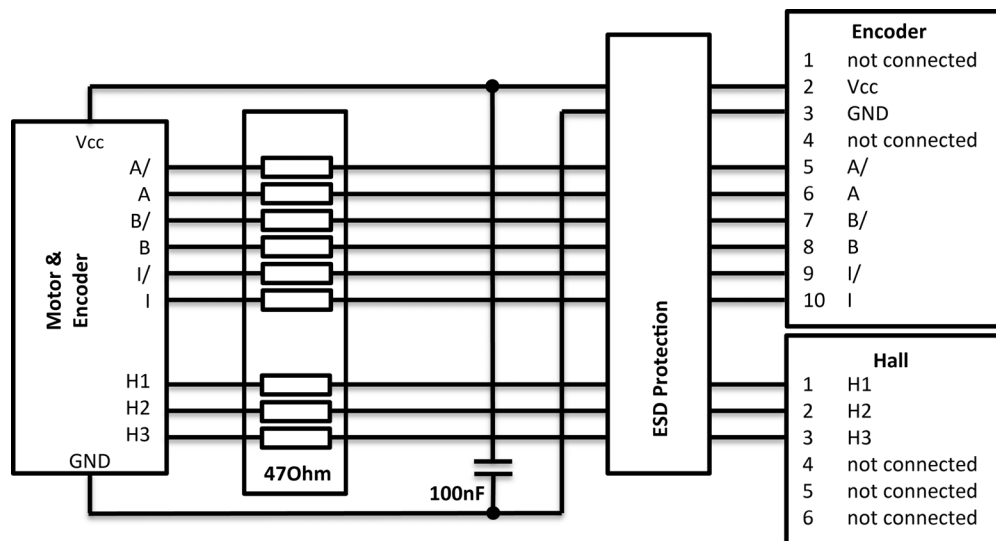


Figure 22 ENX 13...22 EASY INT COMM – Output Circuitry

6.3 ENX 13...22 EASY INT Absolute

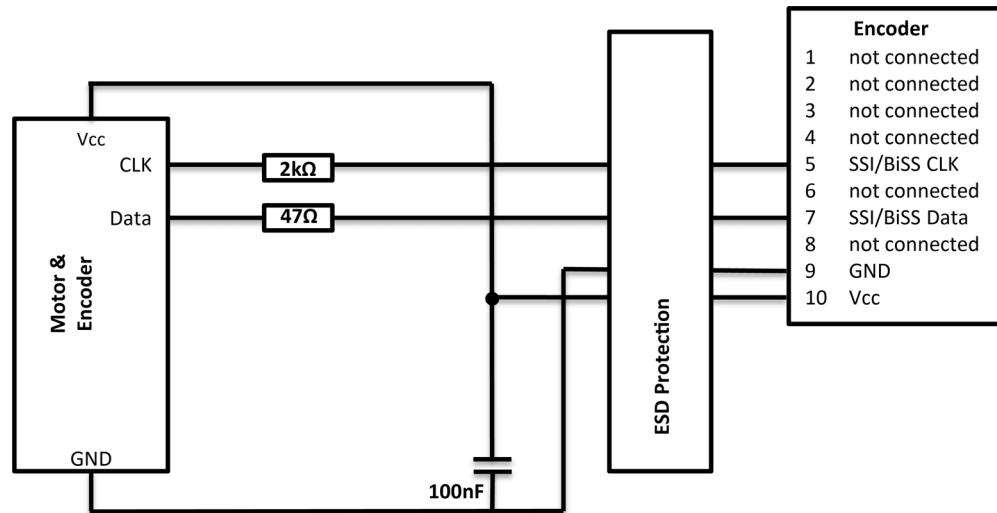


Figure 23 ENX 13...22 EASY INT Absolute – Output Circuitry

6.4 ENX 13...22 EASY INT Absolute COMM

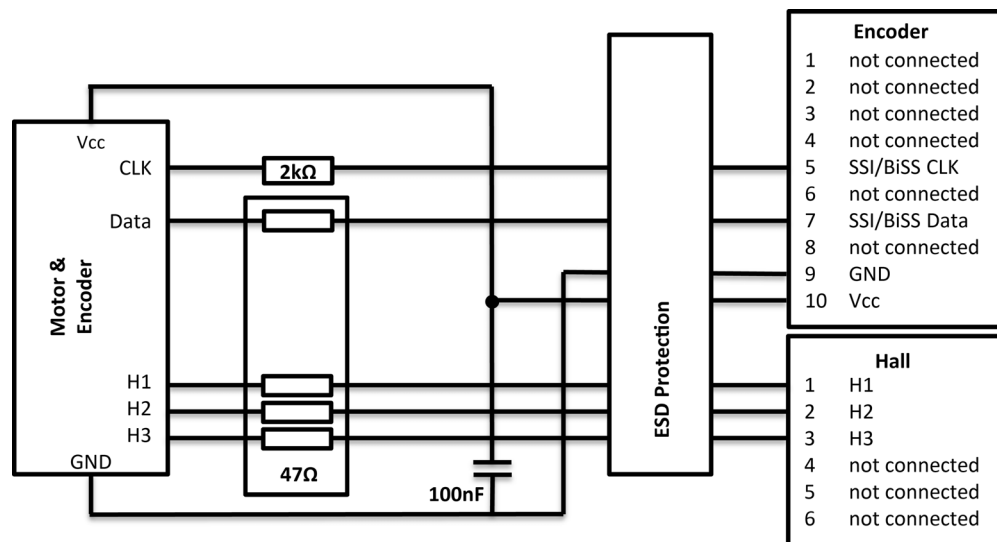


Figure 24 ENX 13...22 EASY INT Absolute COMM – Output Circuitry

6.5 ENX 13...22 COMM

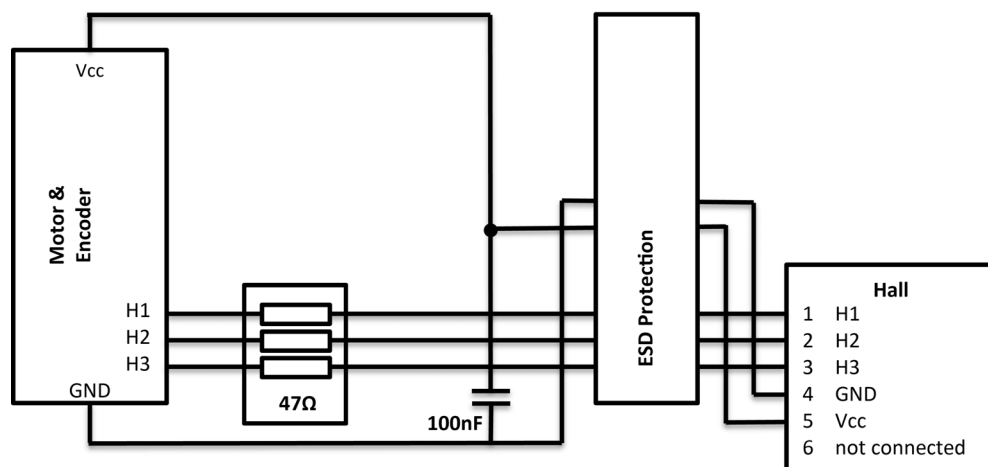


Figure 25 ENX 13...22 COMM – Output Circuitry

7 Accessories

Order number	Description	
498157	Adapter Micromotor	To connect the ENX 8 EASY INT to a maxon controller
For further details → maxon catalog		

Table 14 Suitable Accessories

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