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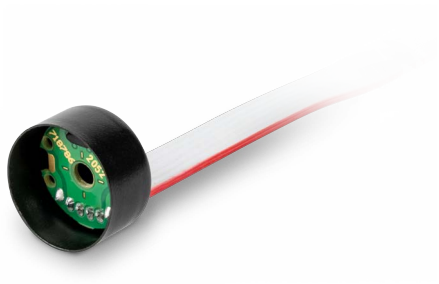
ENX GAMA

Product Information



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ENX GAMA Encoders – Product Information

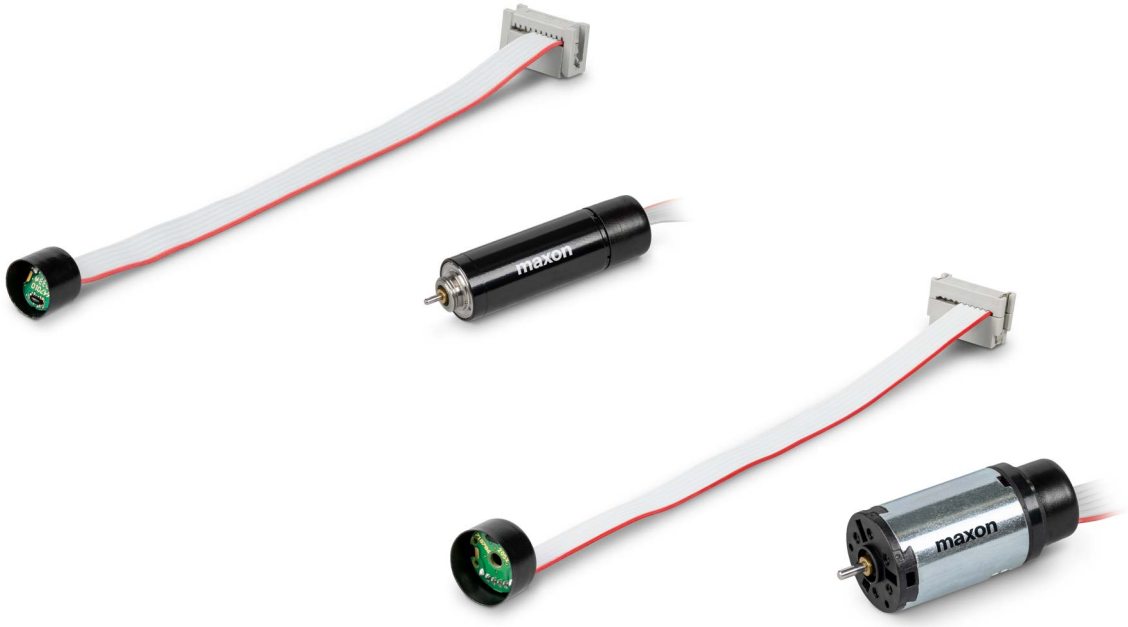


Figure 1 Top: ENX 10 GAMA alone and assembled on RE 10
Bottom: ENX 13 GAMA alone and assembled on DC-max 16

The compact maxon ENX GAMA Encoders use magnetoresistive sensors (AMR sensor) to generate incremental square wave signals. The resolution is 12 impulses (ENX 10 GAMA) or 16 impulses (ENX 13 GAMA). Available are two channels (A and B, single-ended).

The axially arranged connection cable is designed as a single cable system and integrates the two motor cables on the attached DC motor. The ENX GAMA Encoders can be combined with various DC motors from the maxon product range. They feature ESD protection and are available with various cable lengths and different connectors.

The ENX GAMA Encoders are radiation-resistant. They can be utilized in environments exposed to ionizing radiation and are resistant to a radiation dose (TID) of up to 500 krad(SiO_2).

Note
The listed data are for informational purposes only. The values or specifications given are intended as an indicator and may differ from the effective performance.

1 TECHNICAL DATA

1.1 Absolute Maximum Rating

Parameter	Conditions	Min	Max	Unit
Supply voltage (V_{cc})		–0.5	+9.0	V
Voltage at signal output (V_{signal})		–0.5	V_{cc}–0.1 V	V
ESD voltage (V_{ESD})	all pins		>8	kV
Operating temperature (T_{amb})		–20	+105	°C
Storage temperature (T_{store})		–20	+105	°C
Humidity	condensation not permitted	20	85	%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})			9.5		mA

1.3 Incremental Interface (single-ended)

Parameter	Conditions	Min	Typ	Max	Unit
Number of channels	ChA, ChB		2		–
Counts per turn (N)	ENX 10 GAMA		12		cpt
	ENX 13 GAMA		16		
Pulse frequency (f_{pulse})	Maximum output pulse frequency		24		kHz
Signal output current (I_{signal})				+10	mA
Transition time (t_{trans})	Rise time/fall time ChA/ChB without load, R_{DIFF} = 1'000 Ω, CD = 50 pF		3		µs

1.4 Angle Measurement

Conditions *All values at T = 25°C, n = 5'000 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		CW		—
Integral Nonlinearity (INL)	ENX 10 GAMA: N = 12 cpt ENX 13 GAMA: N = 16 cpt		3 2	6 5	°m
Differential Nonlinearity (DNL) [a]	ENX 10 GAMA: N = 12 cpt ENX 13 GAMA: N = 16 cpt		0.2 0.15	0.5 0.5	LSB
Repeatability (Jitter), incremental signals			0.01	0.1	LSB
Phase delay A to B (Phase θ), incremental	ENX 10 GAMA: N = 12 cpt ENX 13 GAMA: N = 16 cpt	70 80		110 100	°e
Duty cycle per channel		40		60	%

[a] *Measurement results from laboratory characterization.*

1.5 Dimensional Drawings

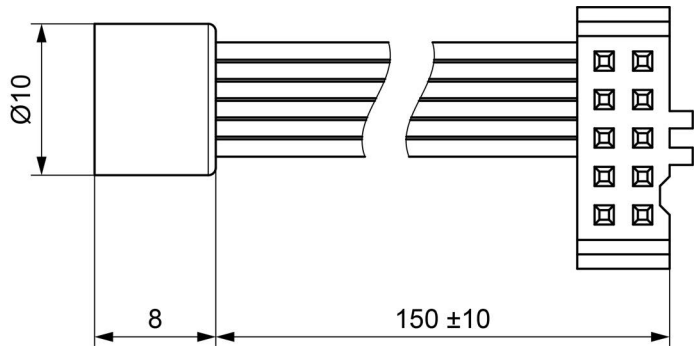


Figure 2 ENX 10 GAMA – Dimensional drawing [mm]

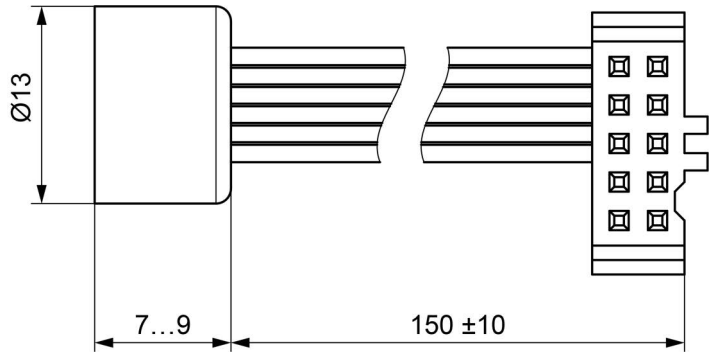
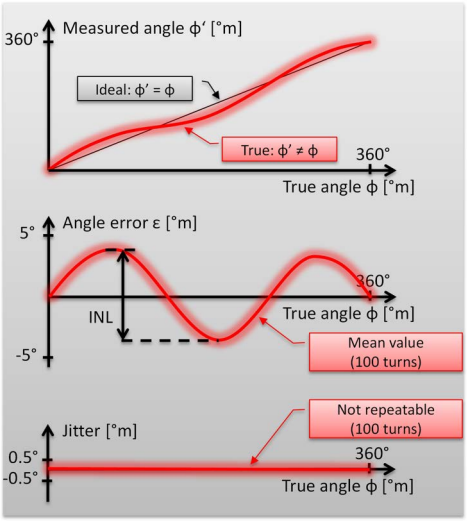
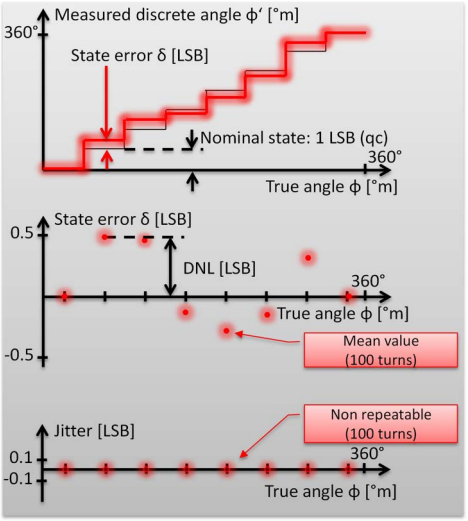
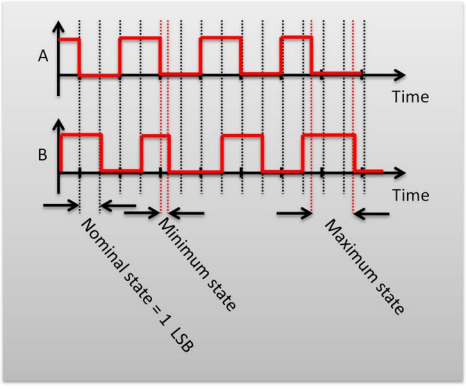


Figure 3 ENX 13 GAMA – Dimensional drawing [mm]

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.	

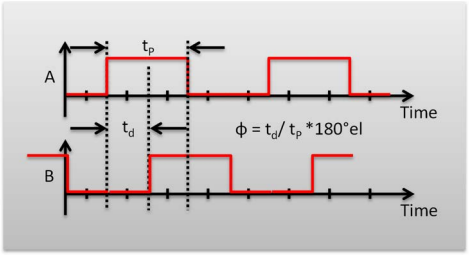
Metric	Definition	Illustration
Phase delay θ [°e]	Time difference of rising edge A to B relative to duration of positive level of A.	
Duty cycle [%]	Ratio of the state duration of the positive level to the pulse length.	

Table 1 Definitions

3 ADDITIONAL INFORMATION

3.1 Compliance to Regulations

Parameter	Description
Electrostatic discharge immunity (DIN EN 61000-4-2)	Direct discharge on input/output pins– ±8 kV.
Mean Time Between Failure (MTBF)	(MIL-HDBK-217F, Ground Benign GB, 25°C, In accordance with circuit diagram and nominal power) • ENX 10 GAMA: 28'694'120 hrs • ENX 13 GAMA: 66'915'425 hrs

Table 2 Compliance to regulations

3.2 Radiation Resistance

A special feature of the ENX GAMA Encoders is their radiation-resistant. They can be utilized in environments exposed to ionizing radiation and are resistant to a radiation dose (TID) of up to 500 krad(SiO_2).

The radiation resistance was determined based on type measurements and by means of «Total Ionizing Dose (TID) Tests». These tests were performed at a Cobalt-Co60 radiation source and at an applied dose rate of up to 18 krad(SiO_2)/h.

3.3 Preconditions for operation

Preconditions for trouble-free operation

- *The encoder already reacts to small and medium magnetic fields. For best performance, no magnetic fields must be present in the encoder's immediate vicinity.*
- *The supply voltage (V_{cc}) must be within the specified range.*

4 PIN ASSIGNMENT

Maximum permitted Supply Voltage
- *Supply voltages exceeding the stated range will destroy the unit.*
- *Connect the unit only when the supply voltage is switched off (V_{CC}=0).*

Load capacity of connection cables
- *The maximum permissible continuous current of the cable and plug is 1.2 A (at an ambient temperature of 25 °C).*
- *The connection cable has no strain relief and must not be subject to excessive tensile forces.*

Figure 4 Cable Plug 6pole

Pin	Signal	Description
1	Motor (+M)	Motor +
2	V_{CC}	Power supply voltage
3	Ch A	Channel A
4	Ch B	Channel B
5	GND	Ground
6	Motor (−M)	Motor −

Table 3 Cable Plug 6pole – Pin Assignment

Specifications	
Connector	IDC socket, pitch 2.54 mm, 3 x 2 poles
Mating plug	Pin header, pitch 2.54 mm, 3 x 2 poles (EN 60603-13/DIN 41651)

Table 4 Cable Plug 6pole – Specifications

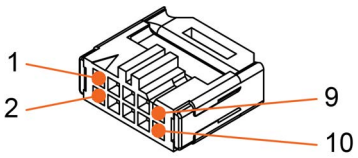


Figure 5 Cable Plug 10pole

Pin	Signal	Description
1	Motor (+M)	Motor +
2	V_{CC}	Power supply voltage
3	Ch A	Channel A
4	Ch B	Channel B
5	GND	Ground
6	Motor (−M)	Motor −
7	–	not connected
8	–	not connected
9	–	not connected
10	–	not connected

Table 5 Cable Plug 10pole – Pin Assignment

Specifications	
Connector	IDC socket, 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)

Table 6 Cable Plug 10pole – Specifications

5 OUTPUT CIRCUITRY

In general, a high impedance network with cable lengths <1 m is recommended (signals are single-ended).

The encoder can be loaded with up to 10 mA per channel (@5 V, R = 500 Ω). The integrated push-pull circuit generates TTL compatible output signals.

Pull-up/pull-down resistors are permitted but not mandatory. If they are used, it must be ensured that the current per channel is limited to <10 mA.

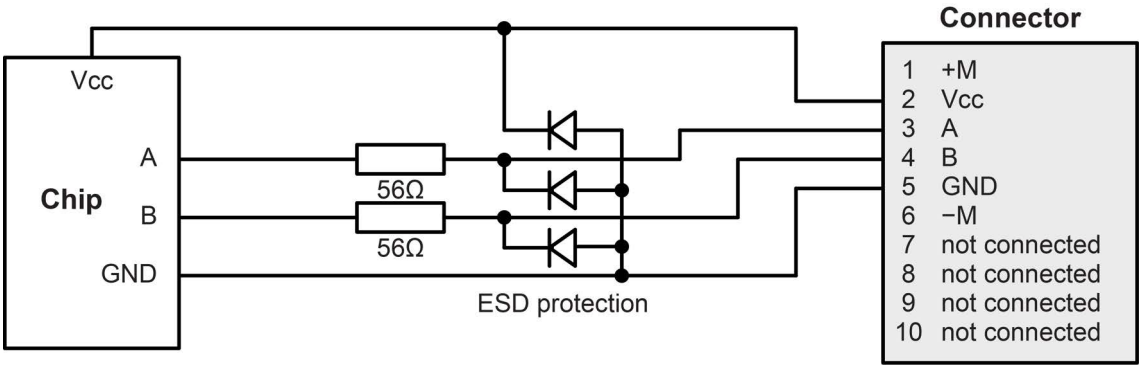


Figure 6 Signal output with line matching with 56 Ohm and ESD protection circuitry

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