

EBx7811xBx-DA-UA

Incremental Sensor Module with optional Reference

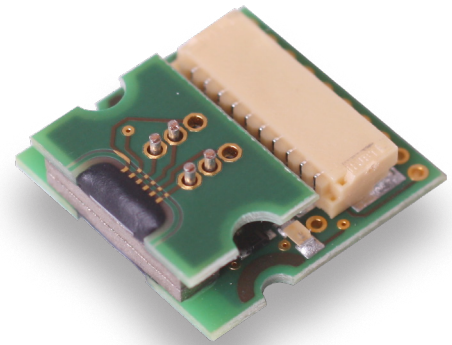
The sensor module EBx7811 contains a GMR (Giant MagnetoResistive) tooth sensor combined with a magnet and a high resolution 9 bit interpolation-IC.

The EBx7811 sensor module with FixPitch layouts are designed for several tooth structures with different pitches. The sensor modules are available for 0.94 mm, 1.0 mm, 1.57 mm, 2.0 mm and 3.0 mm pitches. Additionally there are two types of output signals available (see product overview on page 2 for all sensor modules).

The combination of a suitable tooth structure and the sensor module EBx7811xBx (digital type) delivers two 90 degree phase shifted rectangular-signals A and B (see Fig. 3) with a differential channel. It is possible to configure the resolution up to 400 flanks per pitch.

The combination of a suitable tooth structure and the sensor module EBx7811xDB (analogue type) delivers two 90 degree phase shifted analogue signals sine (A) and cosine (B) (see Fig. 5) with a differential channel.

Different pre-configured sensor modules are available (see table product overview on page 10).



Features

- Modules for different tooth pitch
- Adjustable resolution up to 400 flanks per pitch (digital type)
- Sine/Cosine output 1 V_{SS} (analogue type)
- Full differential output signal
- FixPitch sensor
- Temperature range from -25 °C to +100 °C

Advantages

- Small size
- Adjustable hysteresis (digital type)
- Error detection (amplitude and frequency)

Applications

Incremental encoder for linear or rotary movements in various industrial applications, for example:

- Motor integrated encoder
- Motor feedback system
- Linear position measurement

Quick Reference Guide

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{CC}	Supply voltage	4.5	5.0	5.5	V
I_C	Current consumption	-	26	-	mA
F	Flanks per pitch ¹⁾	4.0	-	400	-
V_{out}	Output voltage ²⁾	0.8	1.0	1.2	V_{SS}
T_{amb}	Ambient temperature	-25	-	+100	°C

¹⁾ Applies to the digital type only. Depends on programmed resolution.

²⁾ Applies to the analogue type only.

Measurement Setup

Depiction	Configuration	Application
	Ferromagnetic toothed rack with fixed pitch; sensor with bias magnet mounted perpendicularly to the rack.	Incremental length measurement
	Ferromagnetic toothed wheel with fixed pitch; sensor with bias magnet mounted radially to the toothed wheel.	Incremental angle measurement at the shaft circumference



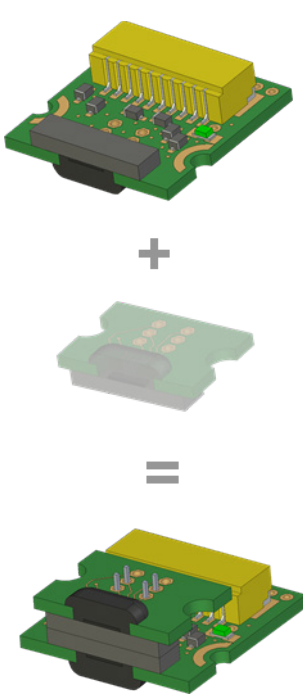
Product Overview

Article	Output Type	Reference	Description
EBI7811xBx-DA-UA	digital	-	Sensor module for different tooth pitches with a digital differential A/B output and programmable resolution.
EBI7811xDB-DA-UA	analogue	-	Sensor module for different tooth pitches with analogue differential sine/cosine output (1Vss).
EBR7811xBx-DA-UA	digital	x	Sensor module for different tooth pitches with a digital A/B output and programmable resolution and reference signal (an additional reference track at the scale is needed).
EBR7811xDB-DA-UA	analogue	x	Sensor module for different tooth pitches with analogue differential sine/cosine output (1 Vss) and reference signal (an additional reference track at the scale is needed).

Electrical Data

Article Description	Pitch	Typical Air Gap ¹⁾
EBx7811Oxx-DA-UA	1 mm	200 µm
EBx7811Pxx-DA-UA	2 mm	400 µm
EBx7811Qxx-DA-UA	3 mm	600 µm
EBR7811Rxx-DA-UA	0.94 mm (module 0.3)	190 µm
EBx7811Sxx-DA-UA	1.57 mm (module 0.5)	310 µm

¹⁾ Typical air gap between sensor module and scale.



EBI7811

The EBI7811 sensor module in its compact construction method can be used for incremental measurement of tooth structures.

Reference board (optional)

The reference board contains of an additional sensor that is aligned the the mainboard (EBI7811) and allows to detect a tooth reference.

EBR7811

Combining a refboard and a mainboard provides a sonsor solution that is capable to detect both the tooth structure and an additional reference tooth.

Fig. 1: Comparison of EBI7811 and EBR7811.

Absolute Maximum Ratings

In accordance with the absolute maximum rating system (IEC60134).

Symbol	Parameter	Min.	Max.	Unit
V_{CC}	Supply voltage	-0.3	+6.0	V
T_{amb}	Ambient temperature	-25	+100	°C
T_{stg}	Storage temperature	-25	+100	°C

Stresses beyond those listed under "Absolute maximum ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Electrical Data

Digital Output Type, $T_{amb} = 25\text{ °C}$; $V_{CC} = 5\text{ V}$; unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{CC}	Supply voltage		4.5	5.0	5.5	V
I_C	Current consumption	No load	-	26	400	mA
F	Flanks per pitch ¹⁾		4	-	400	-
T_{amb}	Ambient temperature		-25	-	+100	°C
f_{in}	Maximum input frequency ¹⁾		10	-	500	kHz
Hys	Hysteresis ²⁾		0	2.7	11.7	Deg
$I_{out,pin}$	Current per output (source and sink)		-50	-	50	mA
V_{outH}	Output high level	$I_{source} = 20\text{ mA}$	4.6	-	5.0	V
V_{outL}	Output low level	$I_{sink} = 20\text{ mA}$	0.0	-	0.4	V

¹⁾ Depends on programmed resolution.

²⁾ Programmable feature.

Electrical Data

Analogue Output Type, $T_{amb} = 25\text{ °C}$; $V_{CC} = 5\text{ V}$; unless otherwise specified.

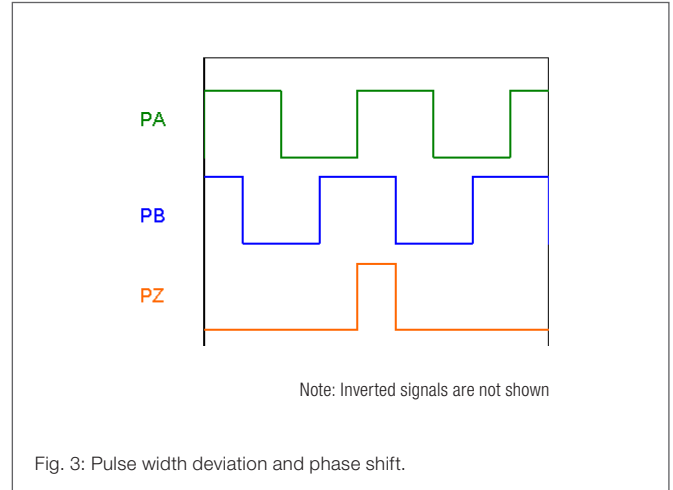
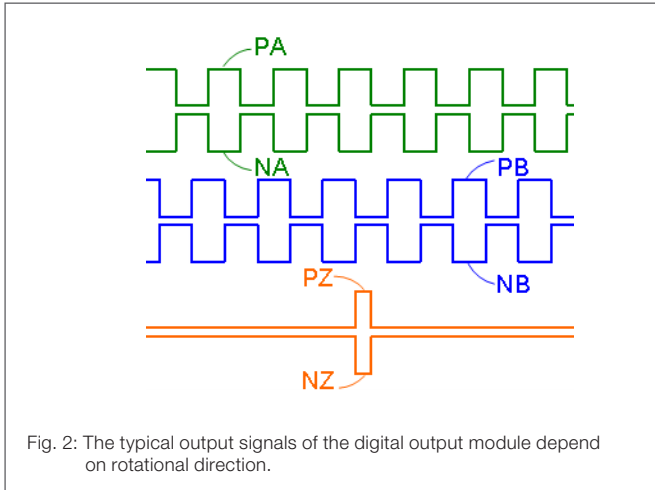
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{CC}	Supply voltage		4.5	5.0	5.5	V
I_C	Current consumption	No load	-	22	100	mA
T_{amb}	Ambient temperature		-25	-	+100	°C
f_g	Cut-off frequency	$C_L = 250\text{ pF}$	500	-	-	kHz
R_{load}	Load on output	differential	100	-	-	Ω
V_{out}	Output voltage		0.8	1.0	1.2	VSS

Environmental Data

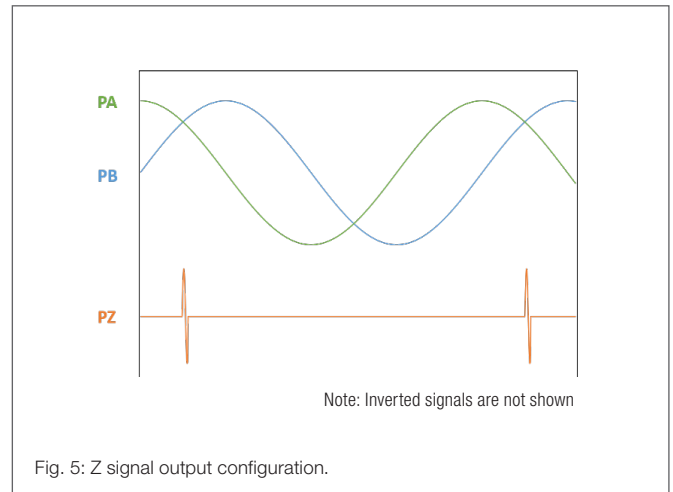
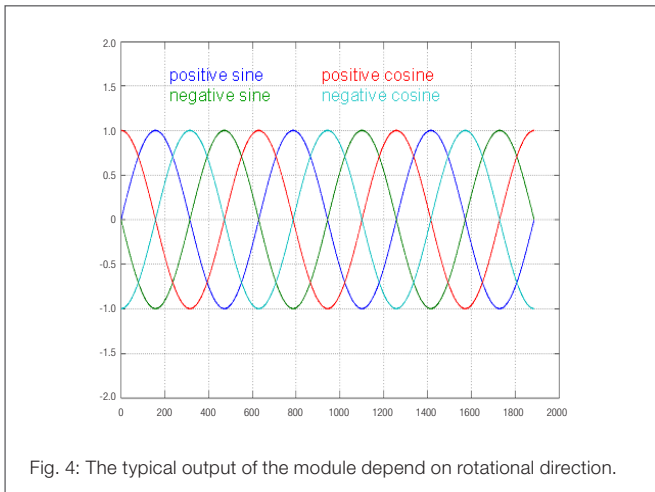
Parameter	Conditions	Min.	Typ.	Max.	Unit
Vibration resistance (IEC 60068-2-6)	10...2.000 Hz	-	-	400	m/s ²
Shock resistance (IEC 60086-2-27)	4 ms	-	-	1,500	m/s ²
Electromagnetic compatibility	5 kHz	-	-	2	kV
Humidity	85 °C	-	-	85	%

Typical Performance Graphs

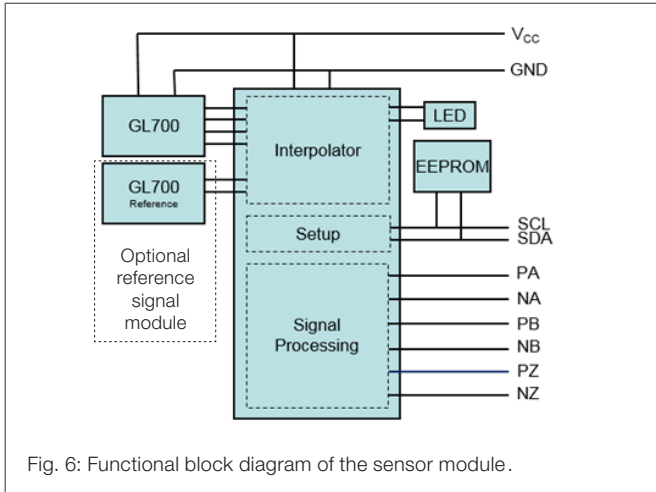
Digital Output Type



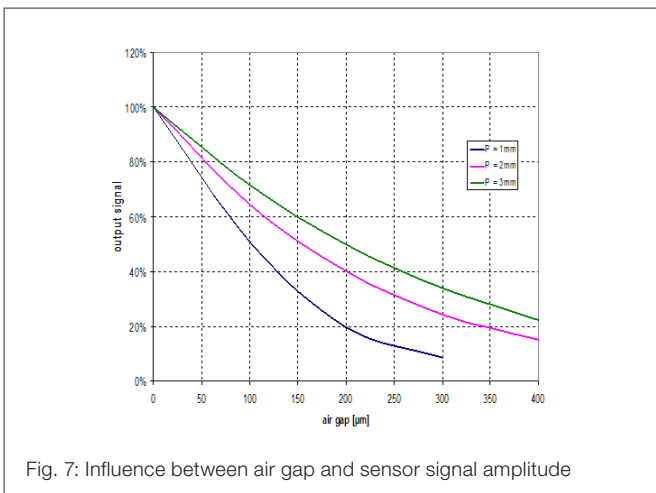
Analogue Output Type



Common Graphs



i The LED indicates the loss of the magnetic field. It glows red when the air gap is too large.



i The influence of the air gap also affects the digital output type. To achieve best performance, the air gap must not exceed the recommended typical value.

Programmable Parameters of EBx7811xBx (Digital Output Type)

The input frequency depends on the number of teeth and the rotation speed. For more information see page 7. Input signal period of 360° corresponds to one pitch.

Resolution

Flanks per Pole	Interpolation Factor (IPF)	Resulting maximal Input Frequency f_{in}
4	1	200 kHz
8	2	200 kHz
12	3	200 kHz
16	4	200 kHz
20	5	200 kHz
24	6	166 kHz
32	8	125 kHz
40	10	100 kHz
48	12	83 kHz
64	16	62.5 kHz
80	20	50 kHz
96	24	40 kHz
100	25	40 kHz
128	32	30 kHz
192	48	20 kHz
200	50	20 kHz
384	96	10 kHz
400	100	10 kHz

Logical Assignment for Z-Signal

Logical Assignment	Description
A_{low}, B_{high}	
A_{low}, B_{high}	
A_{low}, B_{high}	
$A_{low}, B_{high}^{1)}$	

¹⁾ Default configuration.

Hysteresis

Hysteresis	Effect Accuracy	Effect Output Stability	Description
0 deg	High accuracy	Low output stability	Value related to one period (360 degree) per tooth pitch. For example: 2.7 deg at 2 mm pitch corresponds to 15 µm hysteresis. A higher hysteresis provides a more stable output but decreases the absolute accuracy. The resulting absolute angular error corresponds to half the hysteresis.
0,9 deg	↑	↓	
1.8 deg			
2.7 deg ¹⁾			
3.6 deg			
...			
11.7 deg	Low accuracy	High output stability	

¹⁾ Default configuration.

Minimal Edge

Minimal Edge Distance	Description
200 ns ¹⁾	A higher edge distance (ED) may be useful for controls with slower, limited inputs. Restricting the minimal edge distance has an impact on the maximal input frequency. $ED = \frac{1}{f_{in} \cdot IPF \cdot 4} \qquad f_{in} = \frac{1}{ED \cdot IPF \cdot 4}$
400 ns	
600 ns	
800 ns	
1 µs	
1.2 µs	
1.4 µs	
1.6 µs	

¹⁾ Default configuration.

Output Driver

Output Current	Description
2 mA	In use with external line drivers
8 mA	-
40 mA	-
100 mA ¹⁾	For RS422 application

¹⁾ Default configuration.

Calculation of the Resolution at a Tooth Wheel for oneTurn

For example a tooth wheel with 16 teeth. Per pitch the sensor generates a sine and a cosine period of 360 degrees (electrical). A turn of the wheel by 360 degree (mechanical) will be subdivided in 16 sine and 16 cosine periods.

It follows that 1 pitch corresponds to 22.5 degree.

With a programmed resolution of 64 flanks per pitch you will get a resolution of 0.35 degree over a full 360 degree mechanical turn of the wheel.

$$resolution_{360} = \frac{360^\circ}{n \times resolution_{prog}}$$

$resolution_{360}$ - resolution over one 360° turn of the wheel
 $resolution_{prog}$ - programmed resolution in flanks
 n - number of teeth (per revolution)

Input Frequency and Output Frequency at the Application

1. The input frequency depends on the number of teeth, the pitch with and on the rotational speed.

a) Tooth wheel

f_i - input frequency in Hz

$$f_i = \frac{(n \times R)}{60}$$

n - number of teeth (per revolution)
 R - rotation speed in rpm

Example:

tooth wheel with 50 pitches and rotating speed 1000 rpm

$$f_i = \frac{(50 \times 1000)}{60} = 833.3 \text{ Hz}$$

b) Linear scale

$$f_i = \frac{v}{p} \times 1000$$

f_i - input frequency in Hz
 p - pitch in mm
 v - velocity in m/s

Example:

linear scale with 1 mm pitch, velocity 2 meters per second

$$f_i = \frac{2}{1} \times 1000 = 2000 \text{ Hz}$$

2. The output frequency depends on the input frequency and the programmed resolution (applied only for digital output type).

$$f_o = f_i \times \frac{res}{4}$$

f_i - input frequency in Hz
 f_o - output frequency in Hz
 res - programmed resolution in flanks

Example:

input frequency is 1260 Hz, programmed resolution 8

$$f_o = 1260 \times \frac{8}{4} = 2520 \text{ Hz}$$

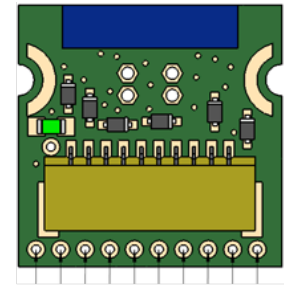


For the analogue output type there is no programmable resolution. The output frequency is equal to the input frequency.

Pinning

Pad	Symbol	Color ¹⁾
1	PZ	white
2	NZ	brown
3	PA	green
4	NA	yellow
5	PB	grey
6	NB	pink
7	GND	blue
8	V _{CC}	red
9	SCL	black
10	SDA	purple

Plug manufacturer: JST (type SM010B-SRSS-TB).



1 2 3 4 5 6 7 8 9 10

Top view

Fig. 8: Pinning of EBx7811.

¹⁾ Color of standard cable.

Electrical Data

Pad	Symbol	Parameter	Additional Information
1	PZ	Positive output Z ¹⁾ REFERENCE+	Differential signal output with push-pull driver. For optimal signal transmission. Signal Z is logically linked to signal A, B and the reference tooth.
2	NZ	Negative output Z ¹⁾ REFERENCE-	
3	PA	Positive output A SINE+	Differential signal output with push-pull driver. For optimal signal transmission. Signal A 90 degree phase shifted to signal B for direction detection.
4	NA	Negative output A SINE-	
5	PB	Positive output B COSINE+	Differential signal output with push-pull driver. For optimal signal transmission. Signal B 90 degree phase shifted to signal A for direction detection.
6	NB	Negative output B COSINE-	
7	GND	Ground	Ground
8	V _{CC}	Supply voltage	Typically 5 V (4.5 V to 5.5 V)
9	SCL	Communication interface: clock ²⁾	Use with the intended programming adapter only
10	SDA	Communication interface: data ²⁾	Use with the intended programming adapter only

¹⁾ Signal PZ and NZ only available at EBR7811 with reference board.

²⁾ Use with the intended programming adapter only.

Dimensions

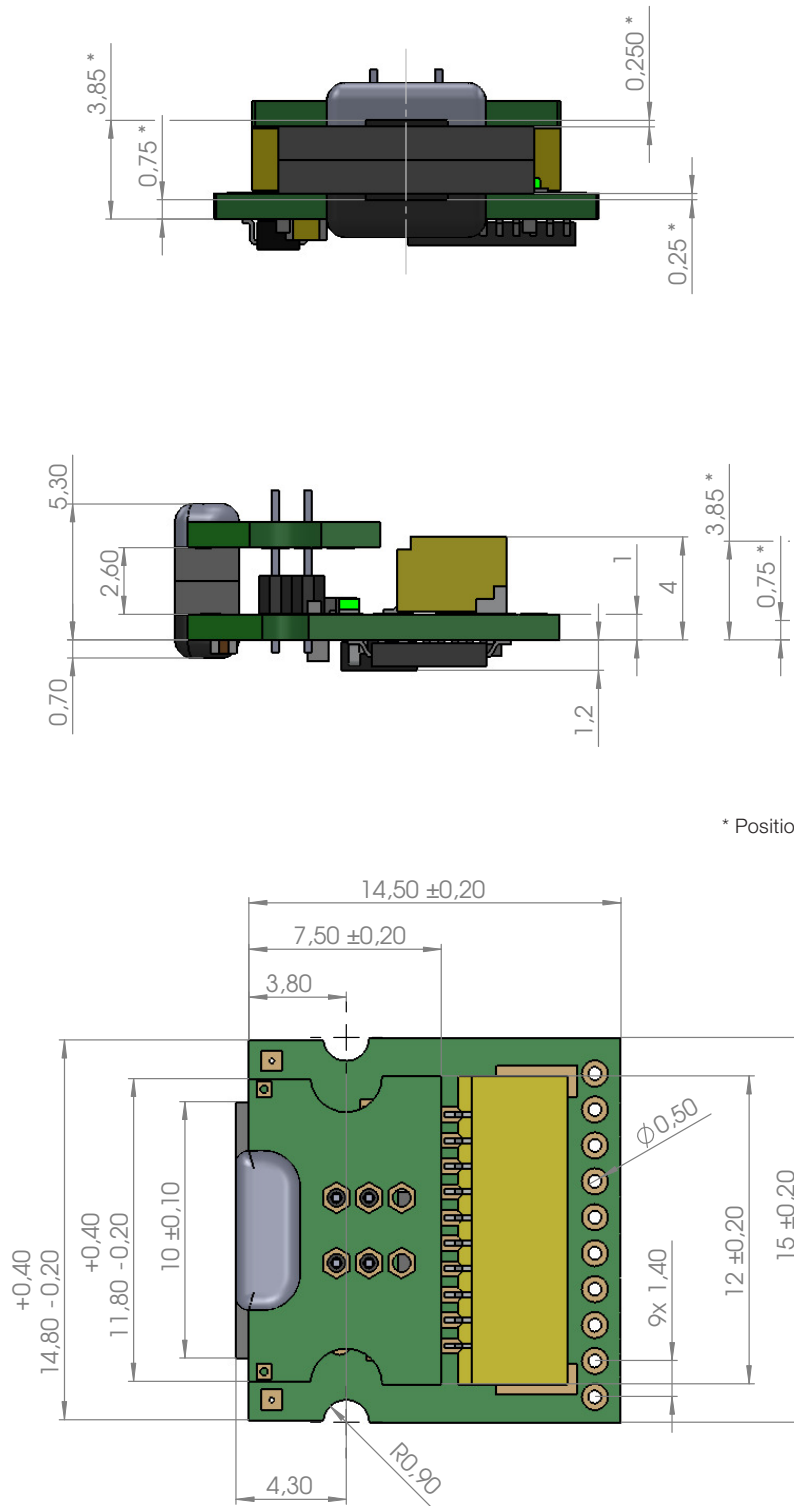


Fig. 9: Dimensions of the sensor module (all dimensions in mm).

Product Overview

Standard Products

Pitch	Resolution	Interpolation Factor	Reference	Article Description
1.00	400	100		EBI7811OBL-DA-UA
1.00	400	100	X	EBR7811OBL-DA-UA
2.00	400	100		EBI7811PBL-DA-UA
2.00	400	100	X	EBR7811PBL-DA-UA
3.00	400	100		EBI7811QBL-DA-UA
3.00	400	100	X	EBR7811QBL-DA-UA
0.94	400	100		EBI7811RBL-DA-UA
0.94	400	100	X	EBR7811RBL-DA-UA
1.57	400	100		EBI7811SBL-DA-UA
1.57	400	100	X	EBR7811SBL-DA-UA
1.00	-	-		EBI7811ODB-DA-UA
1.00	-	-	X	EBR7811ODB-DA-UA
2.00	-	-		EBI7811PDB-DA-UA
2.00	-	-	X	EBR7811PDB-DA-UA
3.00	-	-		EBI7811QDB-DA-UA
3.00	-	-	X	EBR7811QDB-DA-UA
0.94	-	-		EBI7811RDB-DA-UA
0.94	-	-	X	EBR7811RDB-DA-UA
1.57	-	-		EBI7811SDB-DA-UA
1.57	-	-	X	EBR7811SDB-DA-UA

Special Products

Article Description	Resolution	Special Feature
Other resolutions available on demand	-	-

Purchased Parts Package and Delivery Form

Quantity	Part	Description
1 ¹⁾	EBx7811xxx-DA-UA	Incremental sensor module in an ESD Packaging

¹⁾ Up to 20 pieces per single packaging.

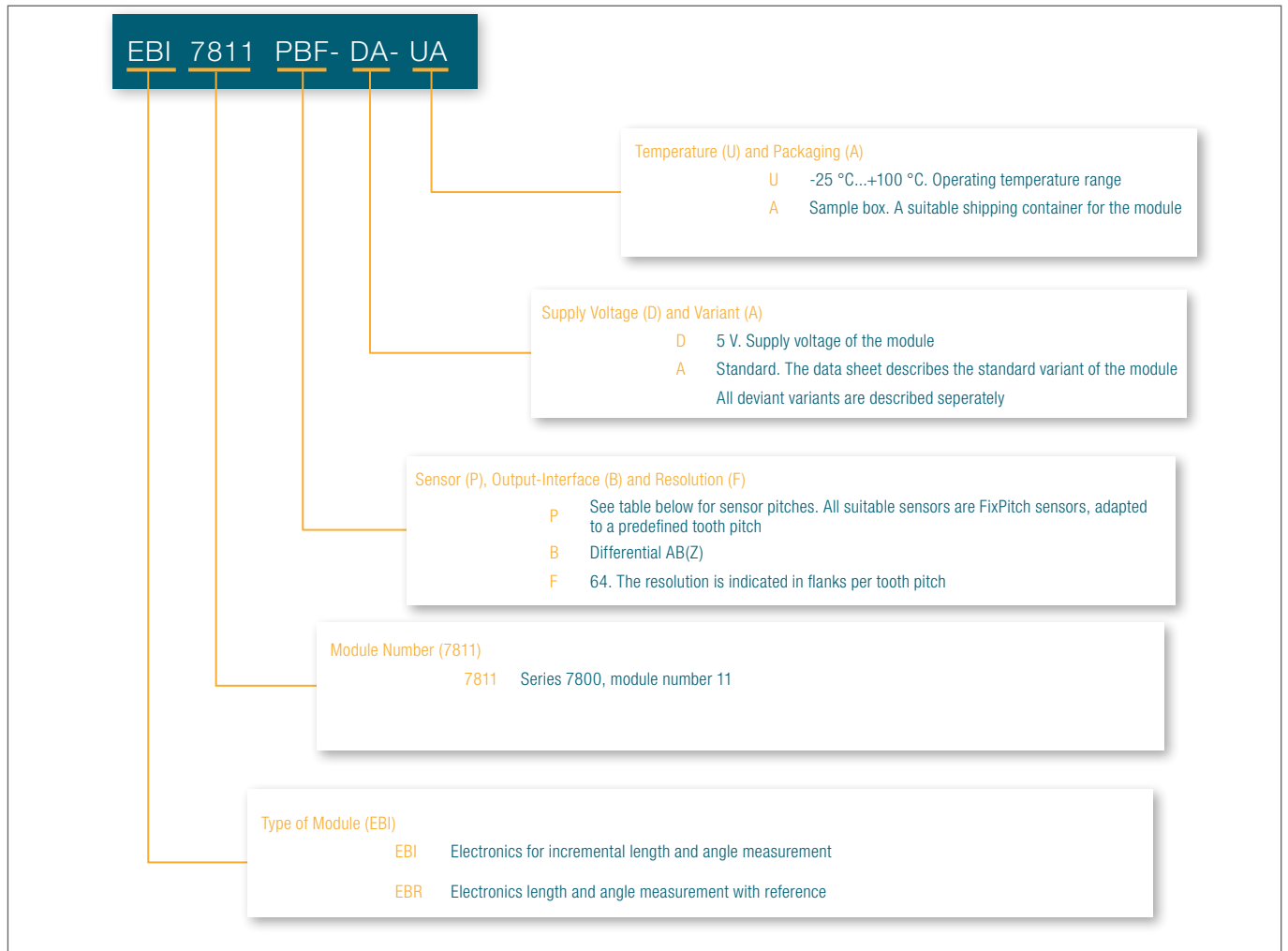
Package Label

Customer No.: xxxxxx
 Sensitec No.: 5112.25xx.0
EBx7811xxx-DA-UA
 Qty.: 5 (1/5) ^{*)}
 Shipping No.: xxxxxx
 Order No.: xxxxxx / xx
 Date: xx.xx.201x

*) Quantity: 5,
package 1 of 5

Fig. 10: Package label of EBx7811.

Additional Information on Ordering Code



Output	Type (Code)
4	A
8	B
16	C
20	D
32	E
64	F
80	G
100	H
128	I
200	J
400	L

Output	Type (Code)
Digital (A/B)	B_
Analogue (1Vss)	DB
Type	Type (Code)
Incremental	EBI
Incremental with reference	EBR

Sensor Chip	Sensor (Code)	Marking
GL711 (1 mm)	O	white
GL712 (2 mm)	P	red
GL713 (3 mm)	Q	yellow
GL714 (0.94 mm)	R	blue
GL715 (1.57 mm)	S	black

FixPitch sensors are adapted to the pole length (pitch) of the measurement scale. The linearity of the sensor is optimized and the influence of interference fields is minimized.

General Information

Product Status

Phase	Status
EBx7811xBx-DA-UA	The product is in series production.
Note	The status of the product may have changed since this data sheet was published. The latest information is available on the internet at www.sensitec.com .

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Changelist

Version	Description of the Change	Date
EBx7811xBx-DA-UA-DSE.06	Disclaimer supplement	06/2022
EBx7811xBx-DA-UA-DSE.05	Change of corporate design (pp. 1-13)	01/2022
EBx7811xBx-DA-UA-DSE.00	Original (pp. 1-11)	06/2010

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