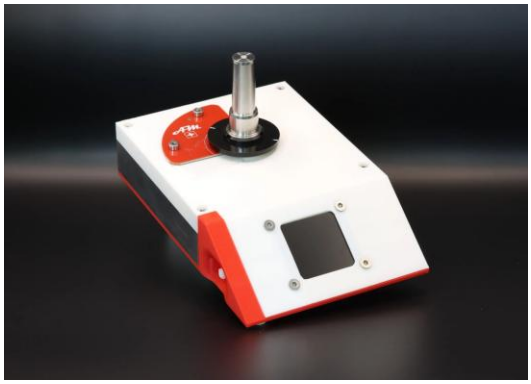
Absolute Magnetics

Smart Sensor Systems

AM INTEGRATE 37q - Eval Kit

Magnetic Encoder



- ✓ **Absolute position encoder**
- ✓ **No calibration needed**
- ✓ **Robust against external stray fields**
- ✓ **Wide mounting tolerances**
- ✓ **Air gap variation possible**
- ✓ **15’000 rpm**
- ✓ **Typical accuracy ±0.2°**

Robust, accurate and stray field immune - innovation for magnetic encoders

Overview

Symbol	Parameter	min.	typ.	max.	Unit
Vcc	Supply voltage	3.1	3.3	3.6	V
Icc	Current consumption	-	60	-	mA
Res_ST$_{ABI}$	Resolution singleturn ABI interface*	8	12	14	bit
Res_ST$_{SPI}$	Resolution singleturn SPI interface	-	16	-	bit
Res_MT$_{SPI}$	Resolution multiturn SPI interface	-	16	32	bit
Acc @1000rpm	Accuracy @ 1’000 rpm	-	± 0.2	-	degree
Acc @7000rpm	Accuracy @ 7’000 rpm	-	± 0.2	-	degree
Acc @15000rpm	Accuracy @ 15’000 rpm	-	± 0.3	-	degree
Rep	Repeatability	-	0.15	-	degree
Speed	Maximum speed	-	15’000	-	rpm
AG	Air gap	0.2	0.7	2.0	mm
Ecc	Eccentricity	-	-	0.5	mm
SF	Stray-field immunity	10	-	-	mT
T$_{amb}$	Operating temperature	-40	-	+125	°C

*configurable resolution, 8 to 14 bit

Contents

1. Accuracy Measurements

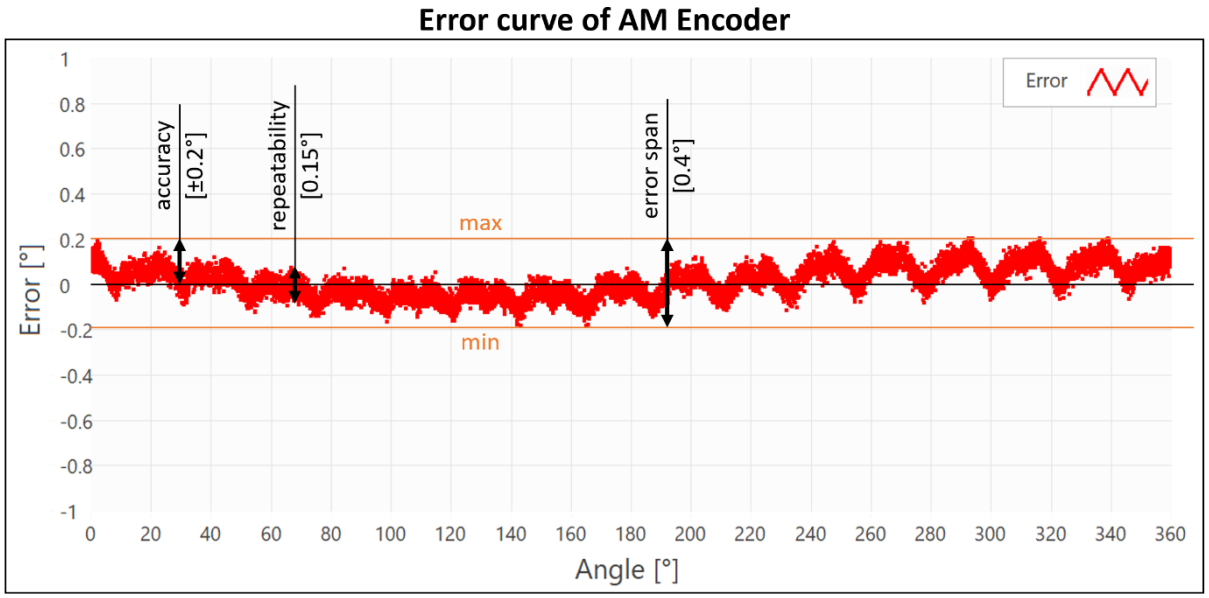


Figure 1: Typical error curve with descriptions, measured at 7'000 rpm at nominal air gap

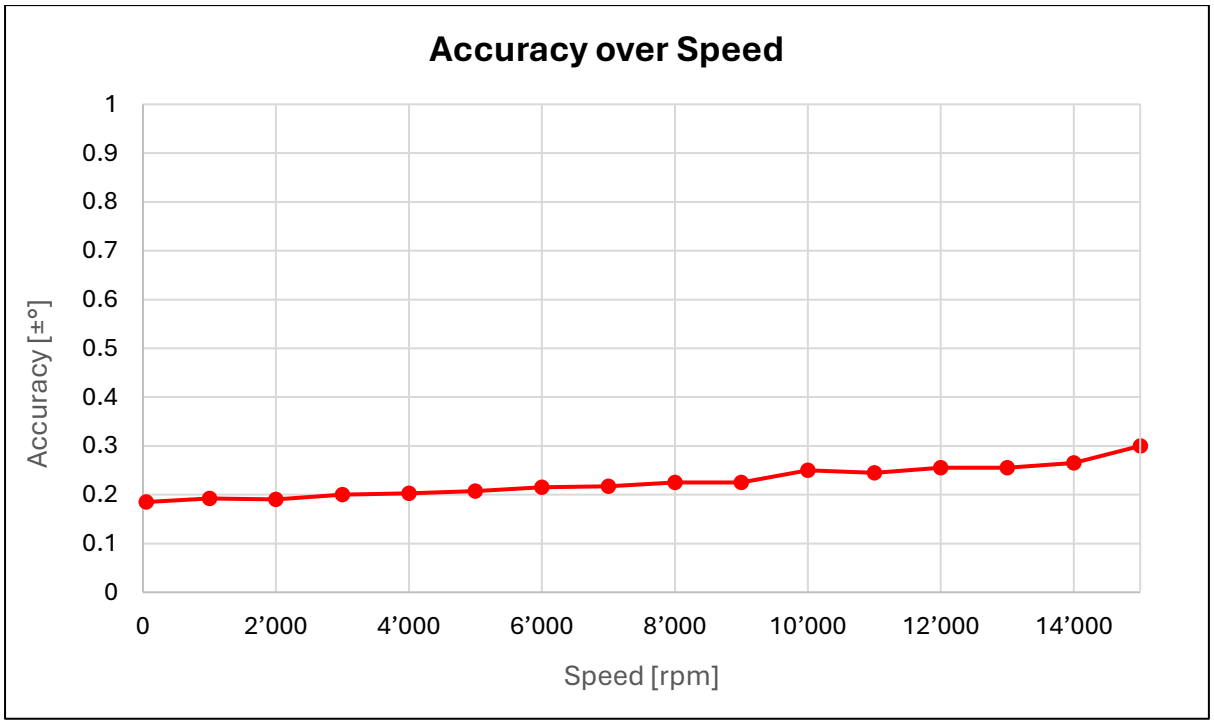


Figure 2: Measurement of accuracy at speeds up to 15'000 rpm, at nominal air gap

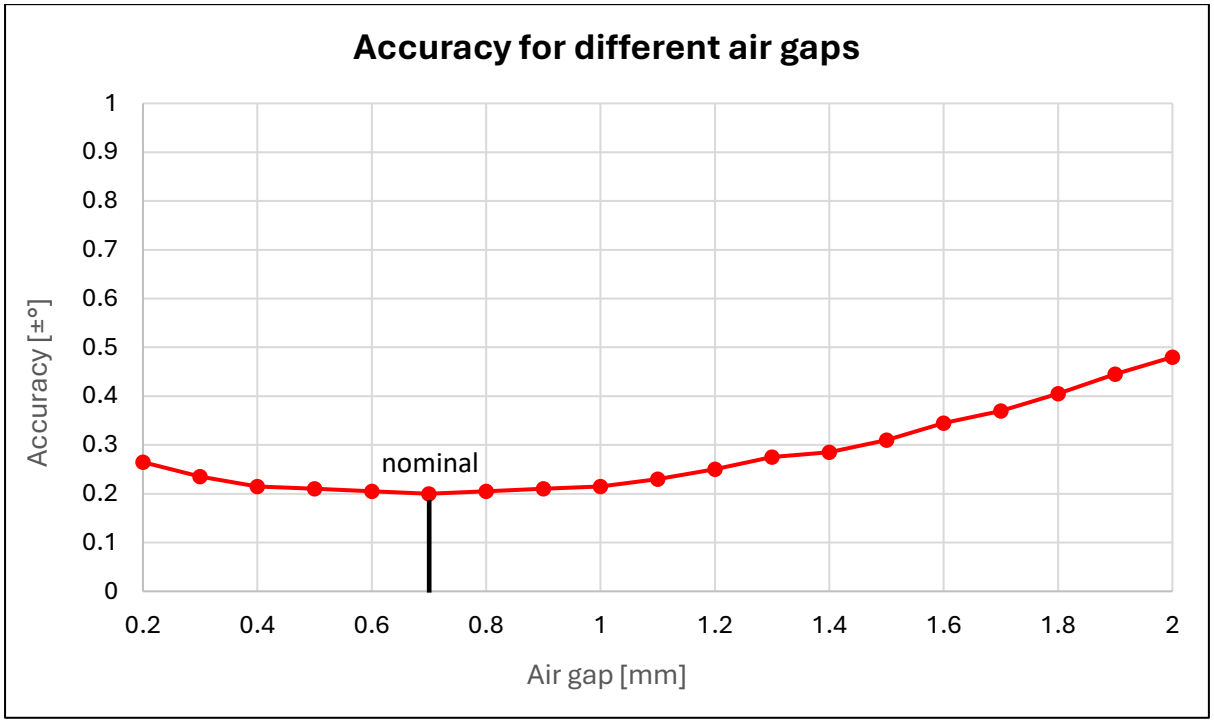


Figure 3: Accuracy for different air gaps, measured at 7'000 rpm

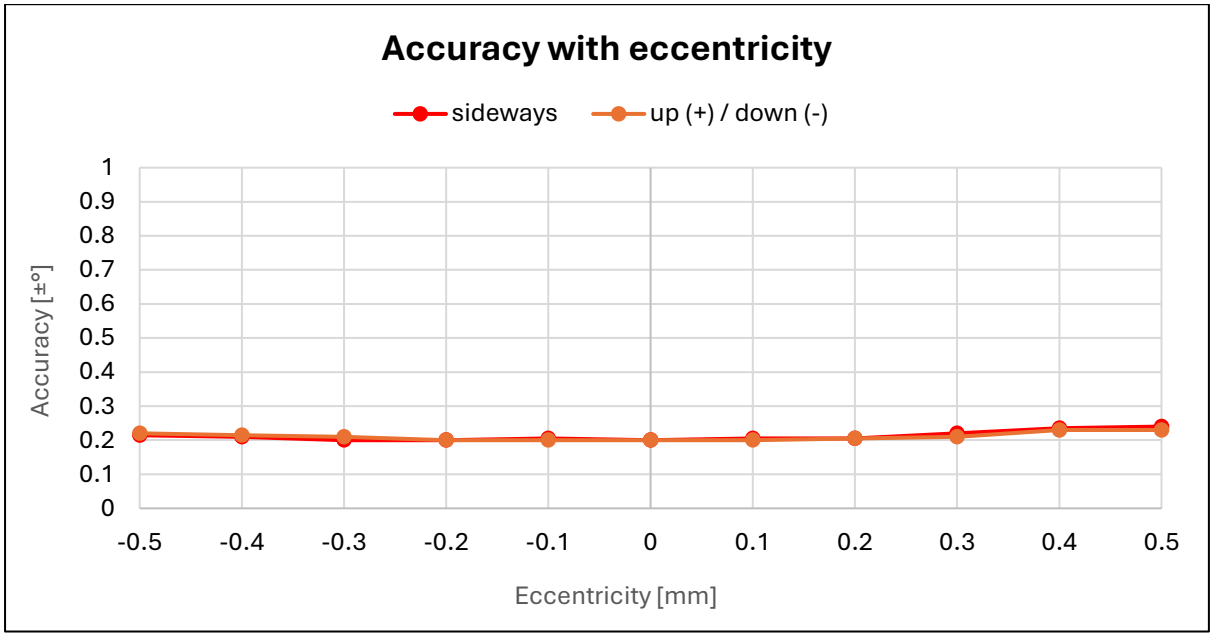


Figure 4: Accuracy with eccentric alignment, measured at nominal air gap with 7'000 rpm

2. Absolute Maximum Ratings

Symbol	Parameter	min.	max.	Unit
Vcc	Supply voltage	-0.3	4.0	V
ESD_{HBM}	ESD tolerance according to Human Body Model	-	2000	V
ESD_{CDM}	ESD tolerance according to Charge Device Model	-	250	V
T_{store}	Storage temperature	-55	+125	°C

3. Electrical Data

Symbol	Parameter	min.	typ.	max.	Unit	Remark
t_{rr}	Position refresh rate	-	10	-	µs	
τ_{ABI}	Latency ABI interface	-	< 1	-	µs	Internal latency compensation of (3* t_{rr})
t_{start}	Start time	-	-	16	ms	
τ_{SPI}	Latency SPI interface	-	-	t_{rr} + $t_{readout}$	-	Internal latency compensation of (2* t_{rr})

4. SPI Interface

4.1. Timings

Symbol	Parameter	min.	typ.	max.	Unit
f_{SPI} $1 / t_{clock}$	SPI clock (SCK) frequency	-	10	-	MHz
t_{setup}(!CS)	!CS setup time	3	-	-	µs
t_{hold}(!CS)	!CS hold time	-	50	-	ns
t_{whigh}(SCK)	SCK high time	-	25	-	ns
t_{setup}(MOSI)	MOSI setup time	3	-	-	ns
t_{hold}(MOSI)	MOSI hold time	1	-	-	ns
t_{enable}(MISO)	MISO enable time	-	-	3	µs
$t_{disable}$(MISO)	MISO disable time	-	-	3	µs
t_{setup}(MISO)	MISO valid time	9	-	12	ns
t_{whigh}(!CS)	Time between two transfers	3	-	-	µs

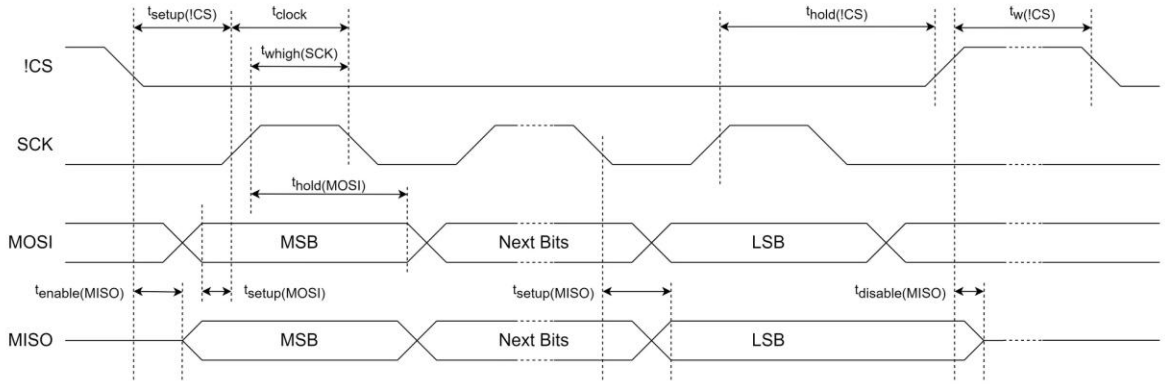


Figure 5: SPI timing diagram

4.2. Protocol

Address	Name	Unit	Datatype
0x0000	Single Turn Position	360/65536 °	16 bit signed
0x0001	Multi Turn Count	-	16 bit signed
0x0017	Serial number upper	-	16 bit unsigned
0x0018	Serial number lower	-	16 bit unsigned
0xAAAA	Command Zero Position	-	-

Figure 6: SPI Protocol

4.3. Example data sequence

The falling edge of the !CS pin will trigger the buffering of the sensor data. All available data will have the same timestamp and can be read sequentially. To get new actual data, the !CS pin must set high and low again respecting the timings.

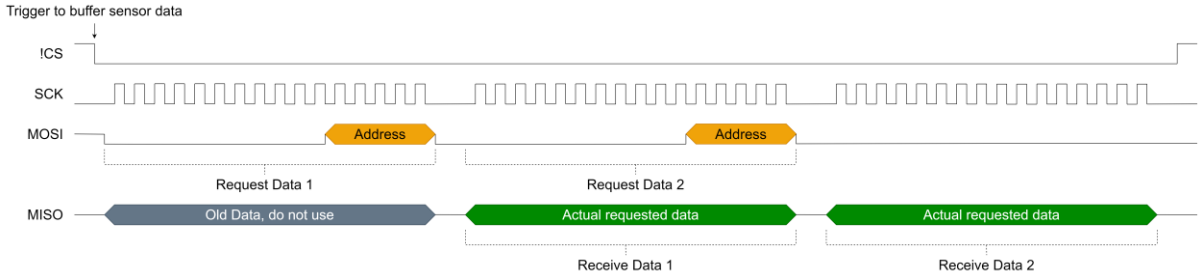


Figure 7: Example SPI data request sequence

5. ABI / UVW Interface

Symbol	Parameter	min.	typ.	max.	Unit
t_r_{ABI}	Rise time ABI pulse	-	<25	170	ns
t_f_{ABI}	Fall time ABI pulse	-	<25	170	ns

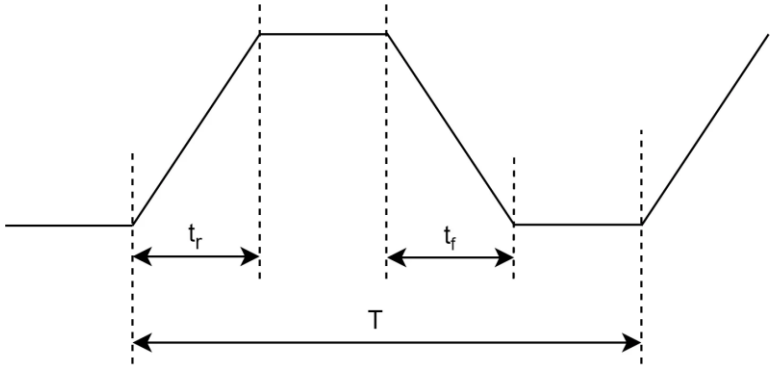


Figure 8: ABI timing diagram

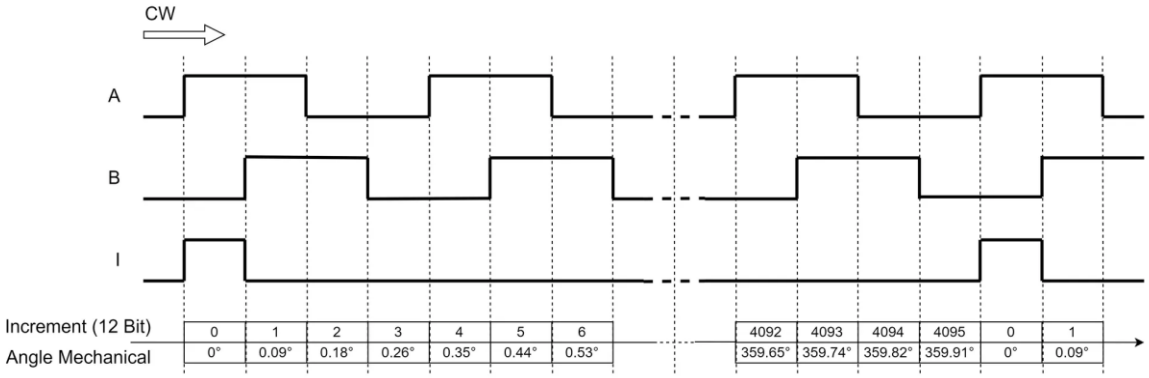


Figure 9: ABI output signal

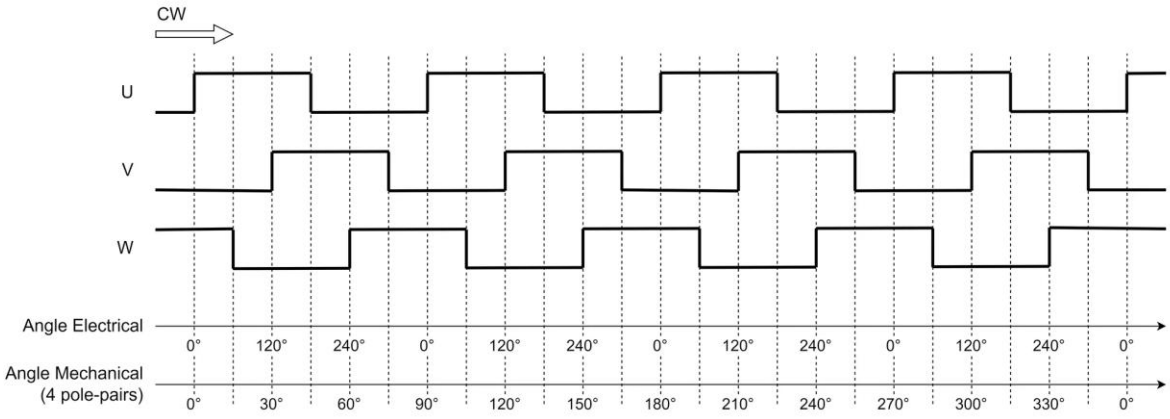


Figure 10: UVW output signal

6. Startup

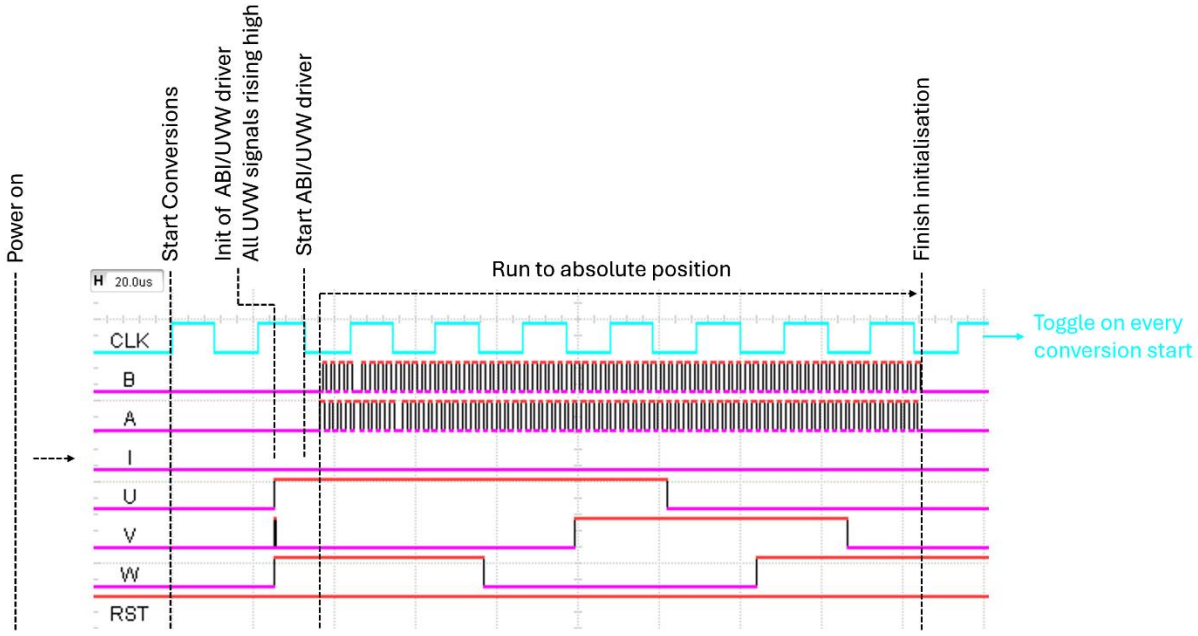


Figure 11: ABI / UVW startup behavior

After power on or reset, the encoder initializes itself. The initialization phase is finished after the TICK (CLK) is starting to toggle. In the first toggle phase, the ABI interface is setting up. The interface starts at position 0 and runs then to the absolute position.

7. Mechanical Data

Symbol	Parameter	min.	typ.	max.	Unit
ID Magnet	Inner diameter magnet	14.983	-	14.994	mm
OD Magnet	Outer diameter magnet	-	37	-	mm
OD PCB	Outer diameter PCB	-	84	-	mm
ID PCB	Inner diameter PCB	-	18.5	-	mm
H	Height of system	-	10	-	mm
AG	Air gap*	0.2	0.7	2.0	mm
Ecc	Eccentricity	-	-	0.5	mm
Mass	Mass magnet assembly	-	16.7	-	g

*Highest element PCB to magnet surface

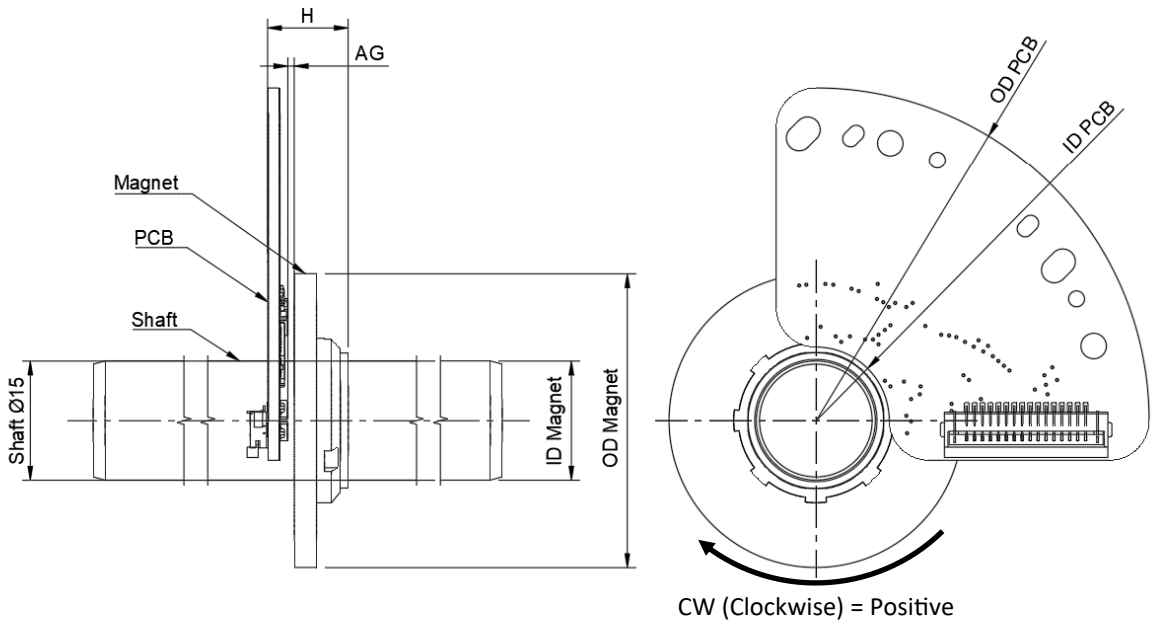


Figure 12: Mechanical dimensions

8. Pinout

Connector: Würth Elektronik – 686116148922

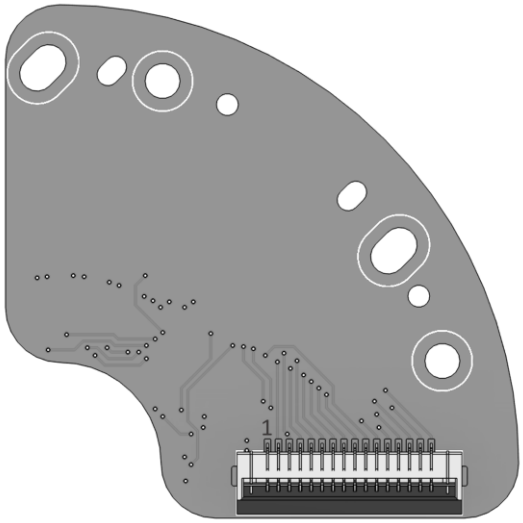


Figure 13: PCB Pinout

Pin	Signal	Description
1	VDD	Power supply 3.3V
2	TICK	Sensor tick (represents t_{rr})
3	!RST	Sensor reset (active low)
4	IO	IO – Reserved for future use
5	TICK	Sensor tick (represents t_{rr})
6	$SPI_{!CS}$	SPI chip select (active low)
7	SPI_{SCK}	SPI clock
8	SPI_{MISO}	SPI MISO signal
9	SPI_{MOSI}	SPI MOSI signal
10	UVW_U	UVW U signal
11	UVW_V	UVW V signal
12	UVW_W	UVW W signal
13	ABI_I	ABI I signal
14	ABI_B	ABI B signal
15	ABI_A	ABI A signal
16	GND	Ground

9. Contact

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All performance data provided are based on laboratory measurements and are for reference only. Actual performance may vary depending on application and conditions.

For additional information, please contact us by e-mail: contact@absolute-magnetics.com

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