FAIR AND SQUARE

DATASHEET

X-CELL RT 2.0

MAGNETOELASTIC BOTTOM BRACKET
TORQUE AND CADENCE SENSOR

rev. 003/04.2019

thun®

INTRODUCTION

This datasheet describes the details of a bottom bracket torque and cadence sensor system.

PRODUCT/APPLICATION

The torque sensor consists of two main components: a magnetized spindle and an electronic torque sensor unit resting safely overmoulded in the bb-set's composite sleeve. The patented non-contact sensor technology utilizes fundamental mechanical and magnetic properties to measure the applied torque to the torque transmitting spindle. The electronic control unit converts magnetic field changes in the spindle into an analogue output signal. These measurements are highly linear, repeatable and accurate even under harsh environmental and extended operation conditions.

The cadence sensor also consists of two components: a magnetic pole ring featuring 16 magnetic poles and a sensor unit featuring 2 separate Hall-sensors that are also embedded into the bb-set's sleeve (in an offset position to each other). The rotation of the spindle and the pole ring leads to two signals (due to the existence of two Hall-sensors that each sense 16 poles and generate a total output of 32 impulses together) that allow the measurement of cadence whereas their offset position leads to the signals being generated with a time offset that helps to determine the rotational direction. In contrast to the torque signals this part of the sensor system generates digital output signals.

DELIVERABLES (AS ONE PRE-ASSEMBLED SENSOR UNIT)

- **1 x magnetized, square-tapered spindle**
- **2 x ball bearings**
- **1 x magnetic pole ring for cadence sensing**
- **1 x sensor housing with integrated torque and cadence sensor technology**
- **1 x cable with connector featured by Standardized Interface System (see next page)**
- **1 x threaded composite cup (on the right side)**

DELIVERABLES (LOOSE)

- **1 x threaded composite cup (for the left side)**

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STANDARDIZED INTERFACE SYSTEM

The Standardized Interface System consists of a standardized cable (**cable length = 220 mm net length from outlet of bb-set's sleeve to connector**) and a standardized connector (**Higo Mini Z509 FG Male**). This cable and connector form the interface. When OEM customers require a different connector or cable length for the purpose of connecting X-CELL RT 2.0 to their controller they require an extension cable with a connector compatible with the Standard Interface System (Higo Mini Z509 FM Female) on the one side and their desired controller compliant connector on the other side. Such extension cables can be sourced from Thun's cooperation partners A&C Solutions (for European clients) or Higo Electrical Equipment Co., LTD (for Asian-Pacific clients).

THE STANDARDIZED INTERFACE SYSTEM ...

... allows the perfect blend of cable and connector standardization and customization
... drastically reduces lead times
... guarantees availability of spare parts

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TECHNICAL SPECIFICATIONS

GENERAL ATTRIBUTES OF BB-SENSOR

ATTRIBUTES	DESCRIPTIONS/VALUES
Certified as per	EN 15194:2017 part 1 and part 2 as well as ISO 4210-8:2014 mountain bikes (comprises city trekking standard)
Surface of spindle	A2B
Type of ball bearings	61902 2RS
Material of composite cups	Composite D
Thread dimensions of composite cups	BS 1.375" x 24
Compatible assembly key	Standard Shimano® assembly key
Material of sensor sleeve	Composite and Macromelt®
PCB	Nano-coated
IP level of bb-sensor	IP 53 as per EN 60529*
IP level of connector	IP 66 as per EN 60529*
Operating temperature	-40 °C to +80 °C

* IP level and general resistance against water can only be optimally achieved when the sensor/connector is not constantly emerged in standing water. Hence, it is recommended to ensure that water can exit the pedelec/e-bike frame's bb-housing (i.e. by drilling a centred drainage hole with a diameter of approx. 5 mm).

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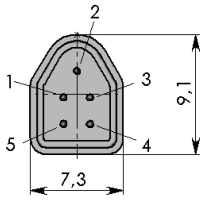
PINOUT AND MAIN DETAILS ON ELECTRONICS AND SIGNALS

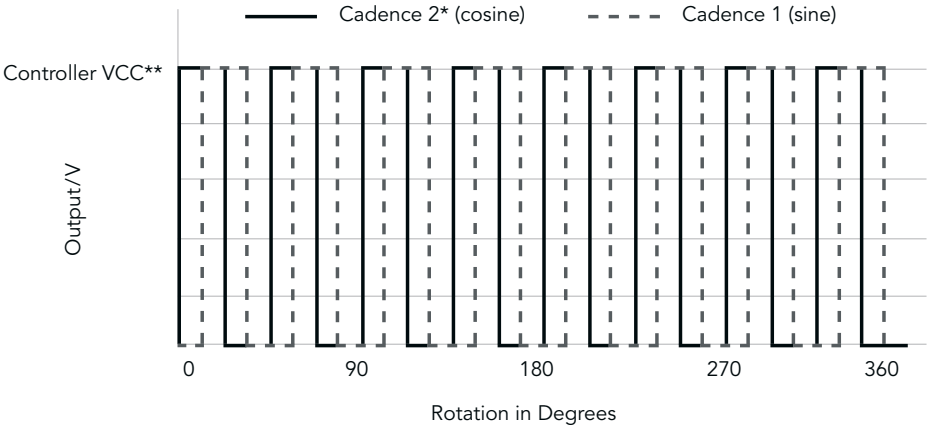
PINOUT		ELECTRONICS	SIGNALS BASIC DETAILS
Red/Pin no. 1	Power	6 V - 16 V, max. 20 mA	
White/Pin no. 2	Torque	0 V - 5 V	Analogue signal, offset +2.5 V at 0 Nm (+/- 10 mV/Nm), bandwidth: 250 Hz at -3 dB
Blue/Pin no. 3	Cadence 2*	0 V - Controller VCC**	Digital signal, cosine square wave, 0 V/open collector, 16 impulses/rotation
Green/Pin no. 4	Cadence 1	0 V - Controller VCC**	Digital signal, sine square wave, 0 V/open collector, 16 impulses/rotation
Black/Pin no. 5	Ground	0 V	



ADDITIONAL DETAILS ON SIGNALS REGARDING CADENCE SENSORS (CADENCE 1 AND CADENCE 2)

ATTRIBUTES	EXPLANATIONS	VALUES
Accuracy		±3° (±0.8 %) per full rotation (360°)
Resolution	Expected angle sensitivity	11.25°
Phase shift nominal		90°
Phase shift tolerance		±30°

SIGNAL CHARACTERISTICS



* Please make sure that the cadence 2 signal (cosine) is embedded in the controller as the leading cadence signal to detect the correct direction of rotation!

** VCC = Voltage supplied by controller (value depends on the controller model)

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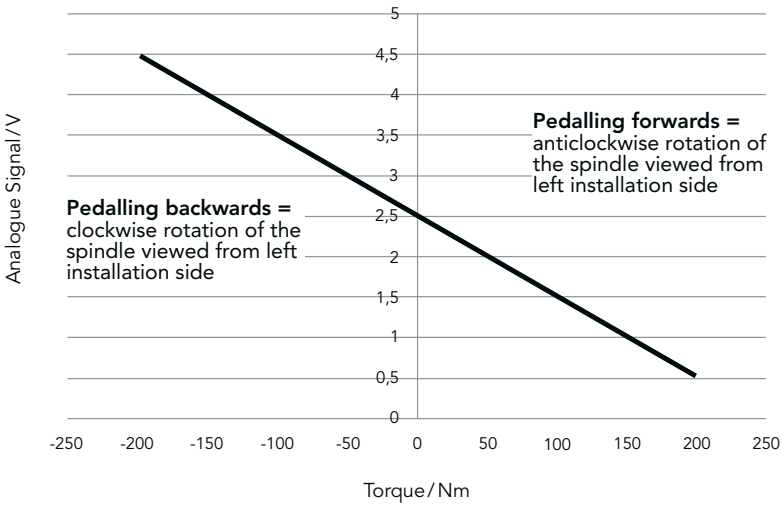
ADDITIONAL DETAILS ON SIGNALS REGARDING TORQUE SENSOR

ATTRIBUTES	EXPLANATIONS	VALUES
Accuracy		±2.5 % of FS (±200 Nm)
FS measurement range	Measurement range output signal positive torque	200 Nm
	Measurement range output signal negative torque	-200 Nm
SH torque	Expected maximal mechanical load	250 Nm
Rotational Signal Uniformity	Rotational signal variation, peak-to-peak value	<±1% of FS
Max SH rotational speed	Maximal rotational speed	200 rpm
Nom SH rotational speed	Maximal rotational speed	60 rpm

SIGNAL CHARACTERISTICS



DO NOT DEGAUS! DO NOT TOUCH WITH MAGNETS, MAGNETIC TOOLS (I.E. MAGNETIC SCREW DRIVERS) OR MAGNET FIXTURES!

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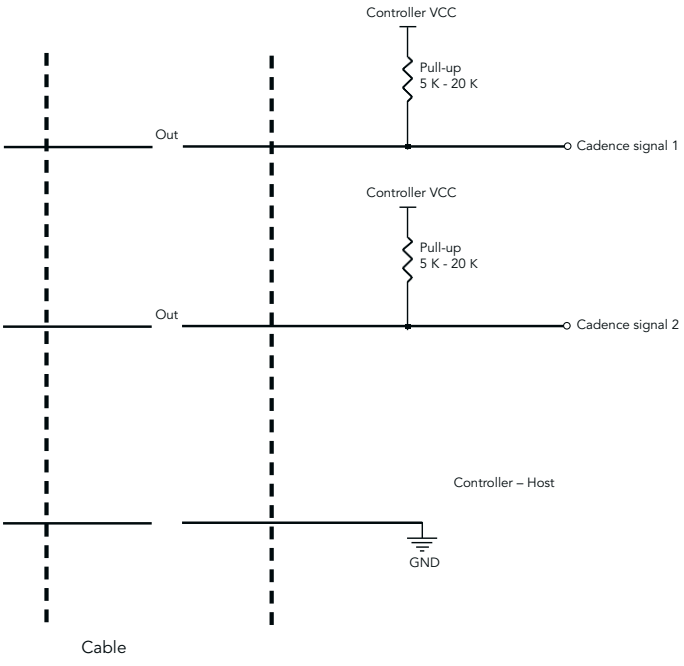
ADDITIONAL DETAILS ON ELECTRONICS
(FOR EACH MEASUREMENT CHANNEL) **REGARDING TORQUE SENSOR**

ATTRIBUTES	EXPLANATIONS	VALUES
Negative output signal	Output signal for -FS signal	0.5 V
Positive output signal	Output signal for +FS signal	4.5 V
Characteristic value	Expected characteristics value (final value given in calibration certificate)	±10 mV/Nm
"Centre" position output	Output signal when primary sensor is in neutral (or centre) position and no mechanical forces are applied	2.5 V
"Zero" offset signal	One time offset of the "zero" signal caused by assembly	±100 mV
Signal-to-noise ratio	Output signal noise level	5 mV
Sensor signal bandwidth	Frequency of sensor system signal bandwidth	250 Hz
Start-up current	Required start-up supply current (excluding the current absorbed by required protection circuits)	<100 mA
Operating current	Nominal operating current	<30 mA
Supply voltage range	Provided single supply voltage (regulated and reverse protect)	6 V - 16 V

ADDITIONAL DETAILS ON ELECTRONICS (CONNECTION PLAN)
REGARDING CADENCE SENSORS (CADENCE 1 AND CADENCE 2)



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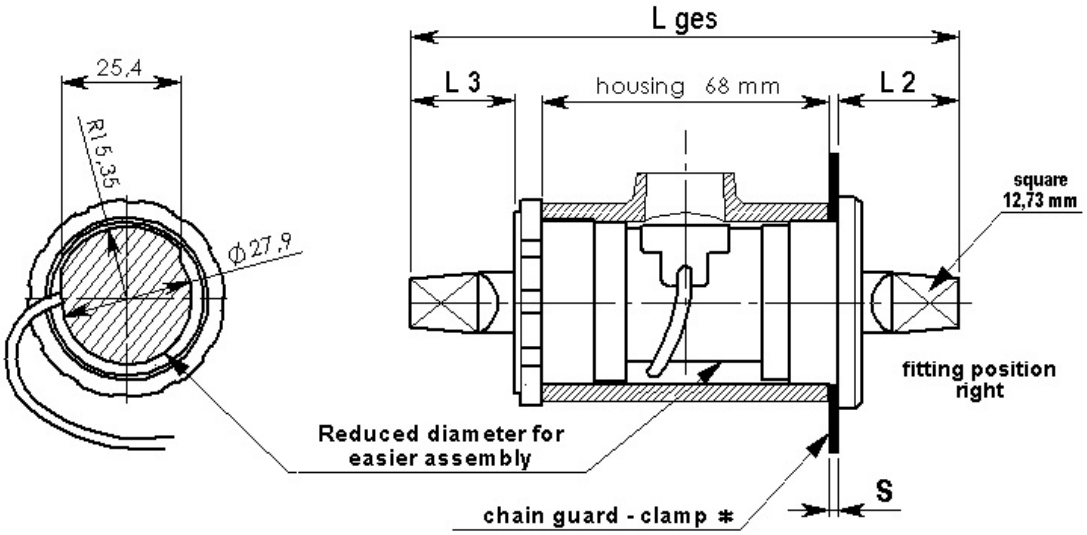
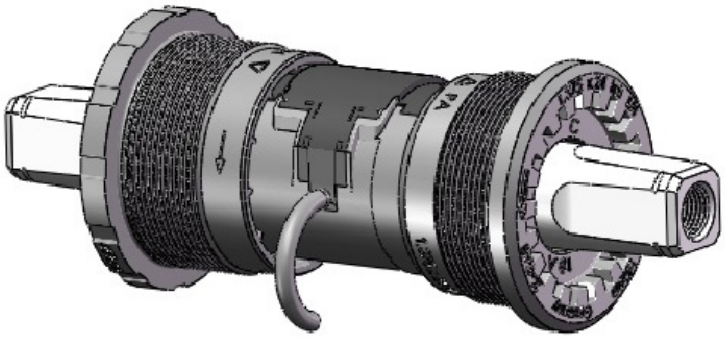
DIMENSIONS AND AVAILABLE LENGTHS





INDEX	TYPE/ DESIGNATION	REFERENCE SIZE [mm]	DIMENSIONS RIGHT-HAND-SIDE L2* ±0.5 mm [mm]	DIMENSIONS LEFT-HAND-SIDE L3* [mm]	TOTAL LENGHT OF SPINDLE Lges ±1.0 mm [mm]
1	120 K	114 115 116	24.40	22.60	120.00
2	120 L	119 122	26.40	20.60	120.00
3	128 K	123	28.40	26.60	128.00
4	128 L	131	30.40	24.60	128.00
5	133 L	133	34.90	25.75	133.65

* When assembled with chain guard kindly add „L2“ to „S“ (L2 + S) and substract „S“ from „L3“ (L3 - S)

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