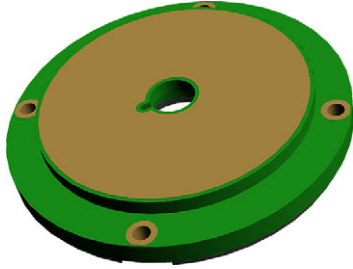


Rotational Absolute Inductive Kit Encoder Version 45 mm Position Sensor



LINKS TO ADDITIONAL RESOURCES



3D Models



Infographics



Did You Know?



Capabilities and Custom Options

QUICK REFERENCE DATA	
Sensor type	ROTATIONAL, inductive technology
Output type	Cable
Market appliance	Avionics, industrial
Dimensions	Diameter 45 mm

FEATURES

- Especially dedicated for safety applications (aeronautic or industrial) with dual functions: one function with full performances, second function with lower performances to safe the first function
- Customized architecture compatible with quality standard DO160/178/254 (on request)
- Off-axis rotational absolute inductive encoder
- High repeatability, high precision, high resolution, single turn
- Rotation speed up to 10 000 rpm
- Not sensitive to external magnetic fields (no hall effect cells), electrical fields and temperature
- Not sensitive to moisture and pollution
- Especially dedicated for harsh conditions (vibrations, shocks, EMC...)
- Plug and play, built-in self-monitoring, ultra flat, and light weight
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


**RoHS
COMPLIANT**

ELECTRICAL SPECIFICATIONS		
PARAMETER	FUNCTION NO. 1	FUNCTION NO. 2
	RAIK045	
Voltage power supply (on sensor connector)	5 V _{DC} ± 0.25 V _{DC}	
Supply current at 5 V _{DC}	≤ 90 mA	
Standard output format	SSI	
Useful electrical angle	360°	
Accuracy at 25 °C	Better than 13 bits (0.044°)	Better than 11 bits (0.17°)
Repeatability	≥ 17 bits	≥ 13 bits
Resolution	262 144 points (18 bits, ≈ 0.0014°)	16 384 points (14 bits, ≈ 0.022°)
Startup time	≤ 5 ms	≤ 5 ms
Data latency time	≤ 12 μs	
Maximum sampling rate	≤ 23 kHz (at frequency SSI = 3 MHz)	

MECHANICAL SPECIFICATIONS (All Versions)	
PARAMETER	
Mechanical angle	360°
Maximum rotation speed	10 000 rpm (more on request)
Rotor weight	≤ 5 g
Stator weight	< 30.5 g



SAP PART NUMBERING GUIDELINES										
TYPE	MODEL	DESIGN	SIZE (mm)	TYPE	FUNCTION	ACCURACY (BITS)	RESOLUTION (BITS)	OUTPUT	PACKAGING	OPTION
R = rotational	AI	K = kit	045	A = aero I = industrial	2	13	18	J = SSI CCW	B = box	xxx = customized design

PERFORMANCE	
PARAMETER	
Standard operating temperature range	-40 °C to +100 °C
Storage temperature range	-55 °C to +125 °C
Humidity	≤ 80 % no condensing
Environmental protection	Coating on PCB components side (on request)
Vibrations	0.05 g ² /Hz, 20 Hz to 2000 Hz for 1 hour along three major axis
Shocks	100 g, 6 ms, ½ sine (one on each axis)

EMC PARAMETERS (features tested on similar design RAIK060)		
PARAMETER	STANDARD	LEVEL
Electrostatic discharge immunity (ESD)	61000-4-2 :2008	Level 4 (8 kV) - contact discharge (important: valid only on the connector interface)
Immunity of radiated radio-frequency electromagnetic field (80 MHz to 6 GHz)	EN 61000-4-3:2020	Level 3 (10 V/m)
Immunity to conducted disturbances induced by radio-frequency fields (150 kHz to 80 GHz)	EN 61000-4-6:2014	Level 3 (10 V)
Immunity to power frequency magnetic field (at 50 Hz)	EN 61000-4-8:2010	Level X (1500 A/m, 2 mT)
Radiated emission (30 MHz to 1 GHz)	EN 55011	Class A Group 1 (Industrial ⁽¹⁾)

Notes

- Levels compliant with EN IEC 61326-1, industrial
 - The sensor does not integrate protection against surges caused by overvoltages from switching and lightning transients (61000-4-5). It is recommended to use external protection if this standard is to be applied. To minimize the risk, we recommend that the power supply cable does not exceed 3 meters, and the data line does not exceed 30 meters
- ⁽¹⁾ This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments

OTHER INFORMATION



ATTENTION!
Observe Precautions for Handling Electrostatic Sensitive Devices!

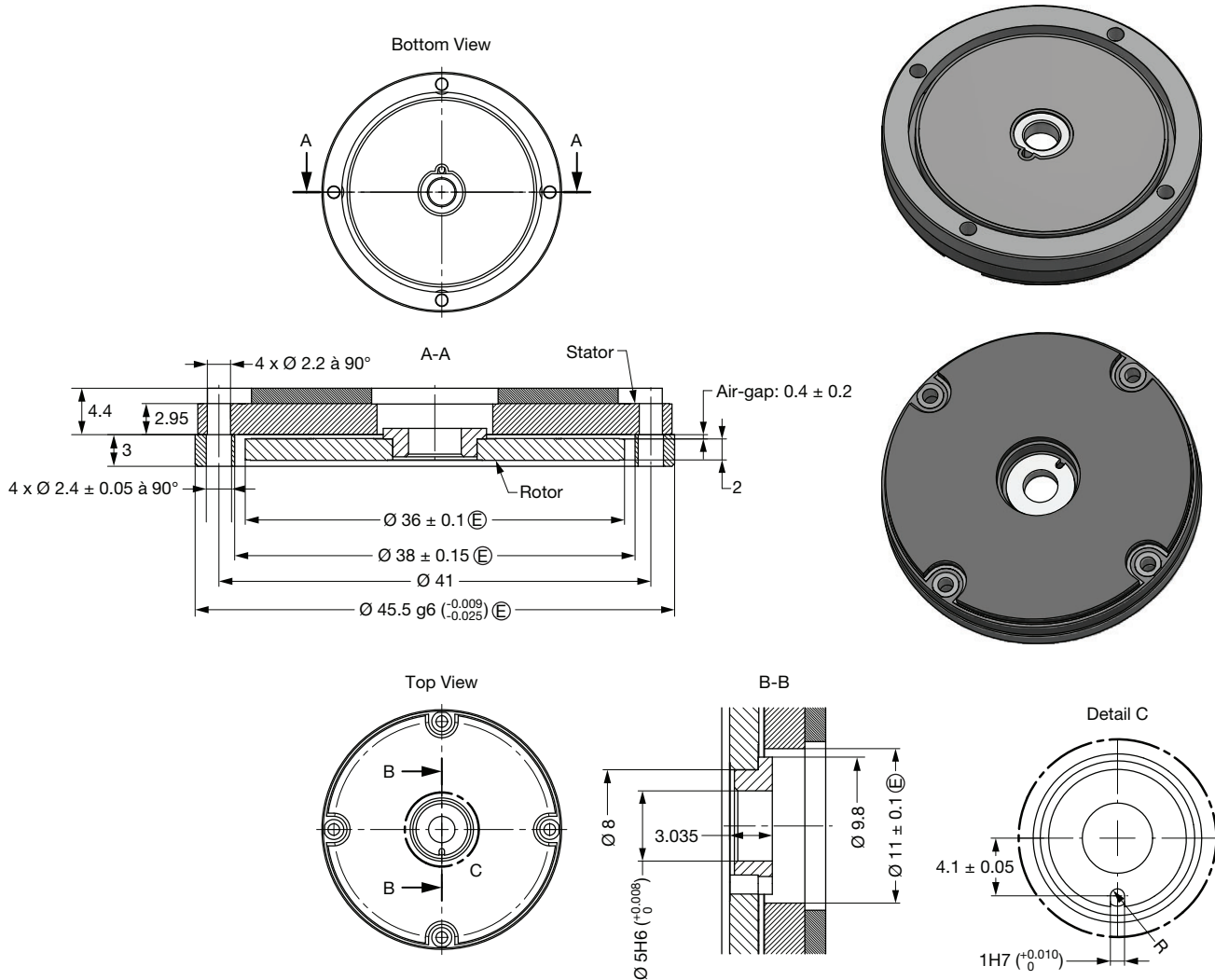
Warning: the rotor and the stator must have the same serial number!

- Do not damage the rotor disk surface
- Do not use cleaning product or chemical product

Environmental protection: conformal coating or potting on request for use in heavy-duty environments (metallic particles, oils, greases, salt spray, moisture, corrosion...)



SENSOR DIMENSIONS



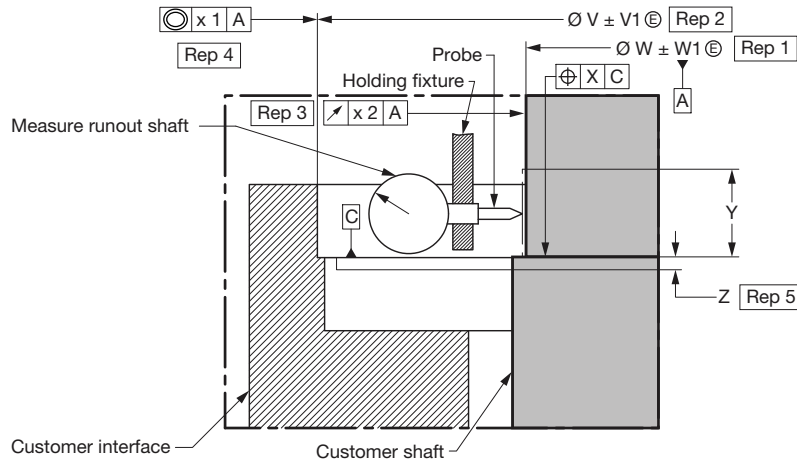
MOUNTING CONDITIONS


Fig. 1 - Mounting Detail

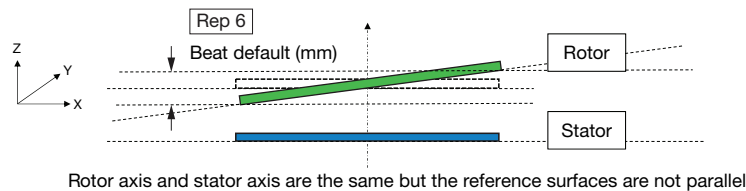


Fig. 2 - Beat

RECOMMENDED DIMENSIONS AND TOLERANCES OF CUSTOMER INTERFACES		
Rep 1	Customer shaft diameter for centering of the rotor (see Fig.1)	Diameter \varnothing 5 g6 (5 mm - 0.004 mm - 0.012 mm)
Rep 2	Customer interface diameter for centering of the stator (see Fig.1)	Diameter \varnothing 45 H7 (45 mm + 0.025 mm - 0.000 mm)
Rep 3	Diameter runout of the customer shaft for the rotor centering (included gap between customer shaft and inner rotor diameter) (see Fig.1)	< 0.005 mm
Rep 4	Misalignment: concentricity of the stator centering diameter versus shaft centering diameter (included tolerances of customer holder and stator interface) (see Fig.1)	< 0.020 mm
Rep 5	Position of the stator reference upper surface versus rotor reference bottom surface (see Fig.1) (air-gap: the condition of previous line avoids to measure the air-gap)	0.4 mm \pm 0.1 mm
Rep 6	Total beat included in the air-gap between ref. C (rotor) and ref. D (stator) (see Fig.2)	< 0.1 mm

Note

- Values at room temperature

MOUNTING AND ELECTRICAL CONNECTION PROCEDURE

1. Observe precautions for handling electrostatic sensitive devices.

COMMUNICATION INTERFACES

SSI signal comply with the RS-422 standard, employing low voltage differential signal (LVDS). To ensure robust EMC immunity, it is highly recommended to use twisted pair wire:

- **SSI:** CLK+ twisted with CLK- / DATA+ twisted with DATA-

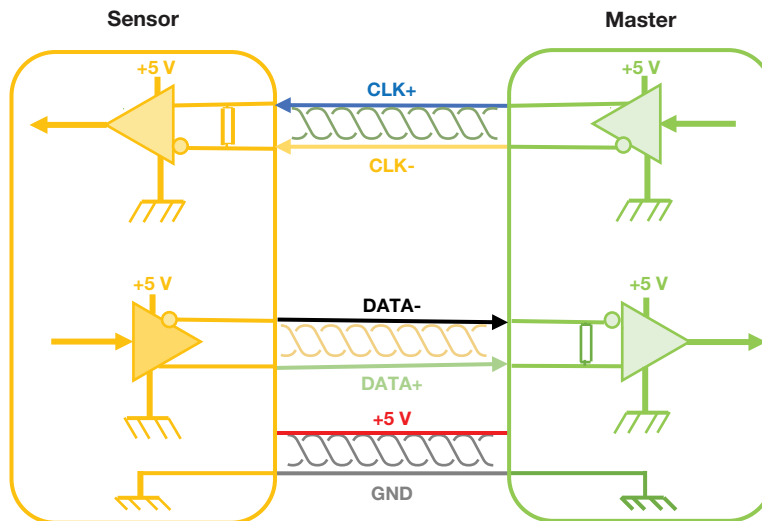
Power supply signal (VCC, GND) does not need to be twisted pair.

The typical impedance of signal lines is 120 Ω. The requirement for termination resistors depends on the total length of the communication bus and the communication speed employed.

6 WIRES CONNECTIONS	
CABLE SIZE	28 AWG
NAME	WIRE COLOR
GND	White
+5 V	Red
DATA+	Green
DATA-	Black
CLK-	Yellow
CLK+	Blue

Note

- FYI: the **GND** is **white** and **DATA-** is **black**



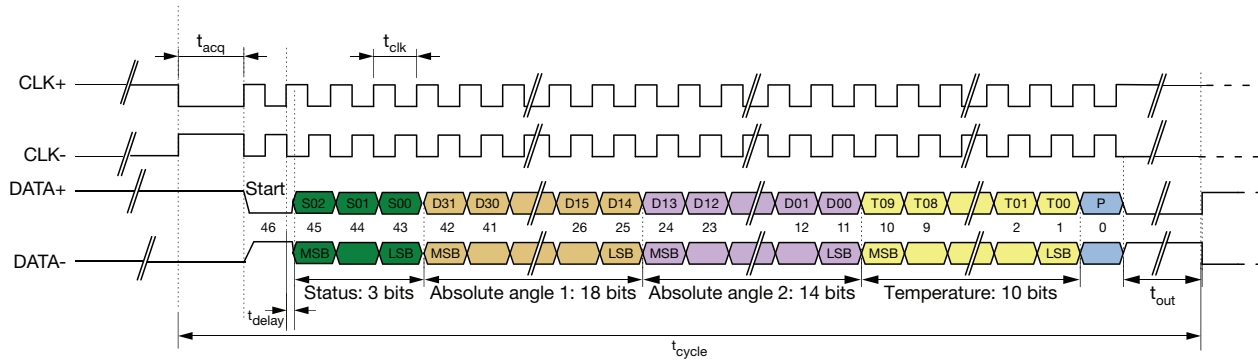
SSI OUTPUT FORMAT
SSI Frame Timing Diagram (Single-Turn Version)


Fig. 3

SSI COMPATIBLE PARAMETERS	
PARAMETER	INFORMATION
Communication protocol	SSI
Output code	Binary signed
Interface	RS422
Clock frequency ($f_{CLK} = 1/t_{CLK}$)	300 kHz to 3 MHz
Termination resistor	120 Ω
Frame bits number	47
Start bit	1 bit always equal to "0"
Status	Bits <S02> to <S00> 000 = normal operation 110 = internal signal error for angle 1 101 = internal signal error for angle 2 111 = internal signal error for angle 1 and 2
Absolute angle 1	Bits <D31> to <D14>
Absolute angle 2	Bits <D13> to <D00>
Temperature	Bits <T09> to <T00>
Parity	Bit <P> is from <S02> to <T00> "P" = 1 when sum of <S02> to <T00> is even "P" = 0 when sum of <S02> to <T00> is odd
Acquisition time (t_{ACQ})	$\leq 12 \mu s$
Propagation delay (t_{delay})	90 ns \pm 10 ns
Time-out (t_{out})	15 μs



Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Vishay products are not designed for use in life-saving or life-sustaining applications or any application in which the failure of the Vishay product could result in personal injury or death unless specifically qualified in writing by Vishay. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.