

Rotational Absolute Inductive Encoder Diameter 27 mm Aero Variant and Industrial Variant Position Sensor



LINKS TO ADDITIONAL RESOURCES



3D Models



Infographics



Did You Know?



Capabilities and Custom Options

FEATURES

- Especially dedicated for safety applications (aeronautic or industrial) with single or full redundant functions variants
- Dedicated architecture compatible with quality standard DO160/254 (on request)
- Rotational absolute inductive encoder
- High repeatability, high precision, high resolution, single turn
- Not sensitive to external magnetic fields (no hall effect cells), electrical fields and temperature
- Especially dedicated for harsh conditions (vibrations, shocks, EMC...)
- Plug and play, built-in self-monitoring, robust body, EMC protection, and SEU immunity
- Embedded supplying voltage survey and temperature survey to start the sensor at -40 °C
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


RoHS
COMPLIANT

QUICK REFERENCE DATA

Sensor type	ROTATIONAL, inductive technology
Output type	Cable or wires
Market appliance	Aviation, industrial, military
Dimensions	Diameter 27 mm

ELECTRICAL SPECIFICATIONS

PARAMETER	SSI	Analog (ratiometric)
Standard output		
Voltage power supply	5 V _{DC} ± 0.25 V _{DC}	From ± 7.5 V (± 5 %) to ± 30 V (± 5 %)
Supply current	≤ 30 mA	≤ 16 mA at ± 10 V
Useful electrical angle	360°	-175° to +175°
Accuracy (over the temperature range)	≥ 12 bits (0.088°, 0.02 %)	
Repeatability	≥ 15 bits	
Resolution	18 bits (262 144 points, ≈ 0.0014°)	16 bits (65 535 points, ≈ 0.0055°)
Startup time	≤ 20 ms (TBC)	
Data latency time	≤ 10 μs	≤ 20 μs (TBC)
Maximum sampling rate	≤ 23 kHz (at frequency SSI = 3 MHz)	n/a
Noise	n/a	0.01° peak to peak

MECHANICAL SPECIFICATIONS (All Versions)

PARAMETER	
Mechanical angle	360°
Maximum rotation speed	5000 rpm
Weight (first stage)	≤ 23 g
Weight (additional stage)	< 11 g

SAP PART NUMBERING GUIDELINES

TYPE	MODEL	DESIGN	SIZE (mm)	TYPE	FUNCTION	ACCURACY (BITS)	RESOLUTION (BITS)	OUTPUT	PACKAGING	OPTION
R = rotational	AI	E = encoder	027	A = aero I = industrial	1 2 3	12	16 18	A = analog CW J = SSI CCW	B = box	xxx = customized design

Note

- For analog output variant, contact us to provide the part number in function of supplying voltage value (5 V, or 10 V, or 24 V, ...)

PERFORMANCE

PARAMETER	
Standard operating temperature range	-40 °C to +105 °C
Storage temperature range	-55 °C to +125 °C
Humidity	≤ 80 % no condensing
Environmental protection	Coating on PCB components (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⁾)

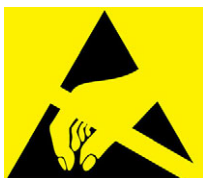
Notes

- 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
 - These levels of EMC parameters will be upgraded with next tests campaign
- ⁽¹⁾ This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments

VARIANT (on request)

Possibility of replacing the detection function in inductive technology with magnetic technology, thus allowing technological redundancy.

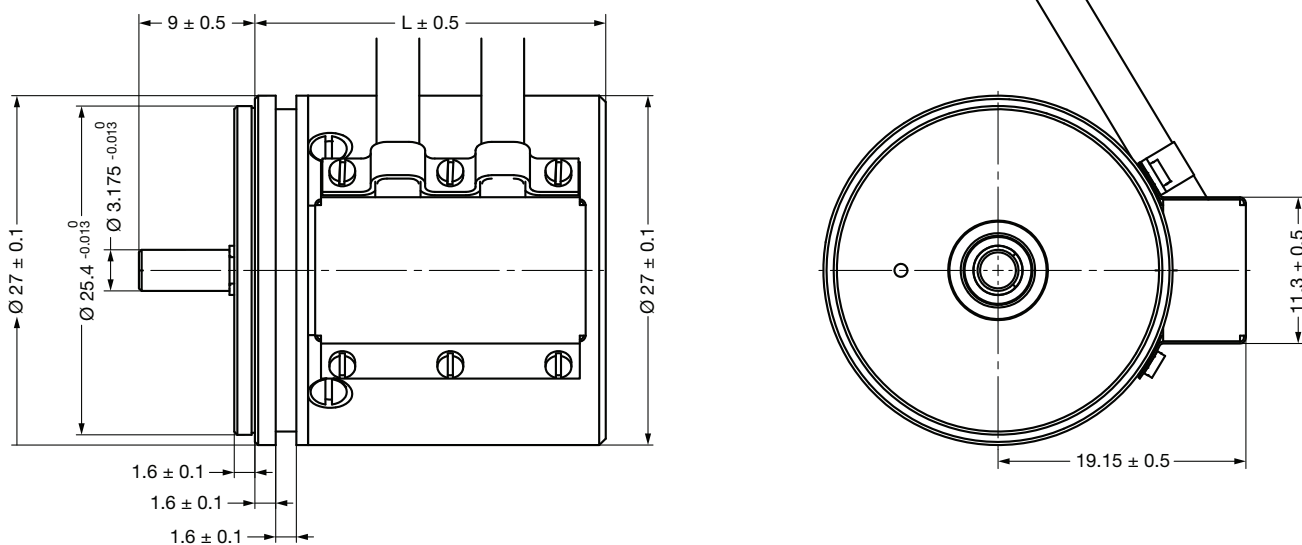
The electrical performances and mechanical parameters remain the same. Current consumption is reduced.

OTHER INFORMATION

ATTENTION!

Observe Precautions for Handling Electrostatic Sensitive Devices!



SENSOR DIMENSIONS



Number of cups	1	2	3
L	20.1	27.2	43.7

MOUNTING AND ELECTRICAL CONNECTION PROCEDURE

1. Observe precautions for handling electrostatic sensitive devices.

SSI INTERFACE

The SSI encoder interface is provided via a shielded cable with four twisted pairs.

SSI signals comply with the RS-422 standard and use low-voltage differential signals (LVDS).

If the output cable is extended, twisted pair wire is highly recommended to ensure robust EMC immunity: CLK+ twisted with CLK-, DATA+ twisted with DATA-.

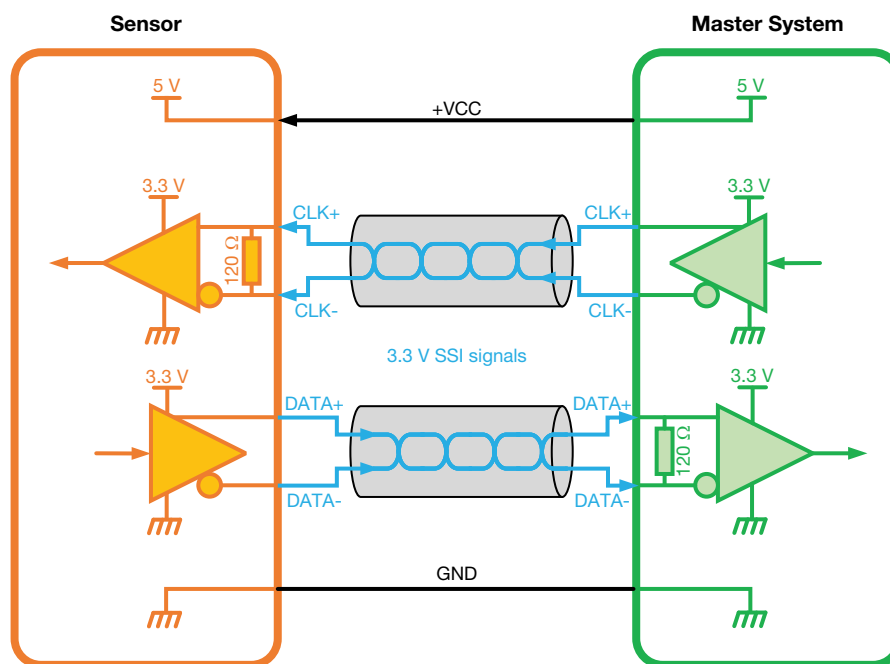
The power supply (VCC, GND) and the GH (GH, GND) signals do not need to be a twisted pair.

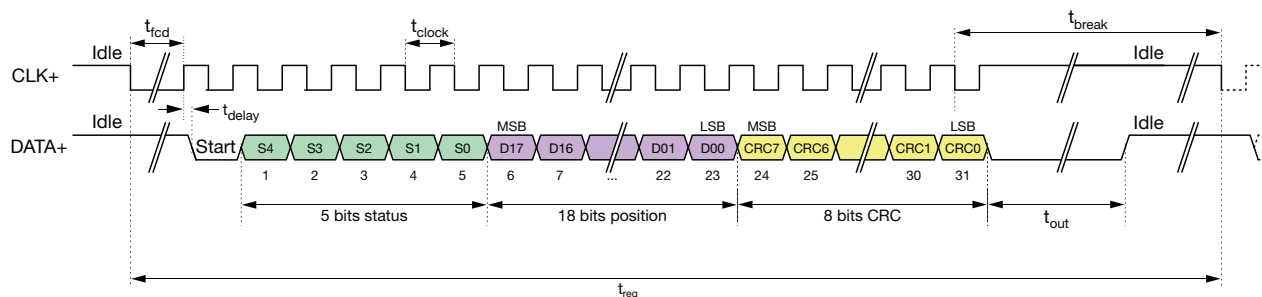
The typical impedance of the SSI signal lines is 120 Ω . The requirement for termination resistors depends on the total length of the communication bus and the communication speed employed.

WIRE CONNECTION		
TWISTED PAIR NUMBER	SIGNAL NAME	WIRE COLOR
1	VCC	Red
	GND	White
2	GH	Green
	GND	Black
3	CLK+	Blue
	CLK-	Yellow
4	DATA+	Purple
	DATA-	Grey

Notes

- Wire size: 28 AWG
- Nominal outer diameter: 3 mm $\pm$ 0.4 mm



**SSI OUTPUT FORMAT****SSI Timing Diagram****SSI COMPATIBLE PARAMETERS**

PARAMETER	INFORMATION	
	MIN.	MAX.
SSI configuration	SLAVE mode only	
Clock and data interface	RS422 according to the EIA-RS422	
Position data (D17 to D00)	18 bits binary code (0 to 262 143)	
Error detection (CRC7 to CRC0)	CRC, 8 bits, inverted polynomial: $0x97 (X^8 + X^7 + X^4 + X^2 + X + 1)$ CRC start value = "0"	
CRC data input	23 bits (from S4 to D00)	
Total number of bit	31 bits	
First clock delay period (t_{fcd}) ⁽¹⁾	4.2 μ s	14 μ s
Propagation delay (t_{delay})	20 ns	50 ns
Transfer time-out period - monoflop time (t_{out})	15 μ s	
Time period between two consecutive clock sequences (t_{break})	20 μ s	-
Master clock frequency ($f_{clk} = 1/t_{clock}$)	100 kHz	3 MHz
Master request frequency ($f_{req} = 1/t_{req}$)	-	23 kHz ⁽²⁾

Notes

⁽¹⁾ Position acquisition is synchronized with the first falling edge of CLK. The first clock delay period is required for data acquisition, calculation, and storage in the communication buffer

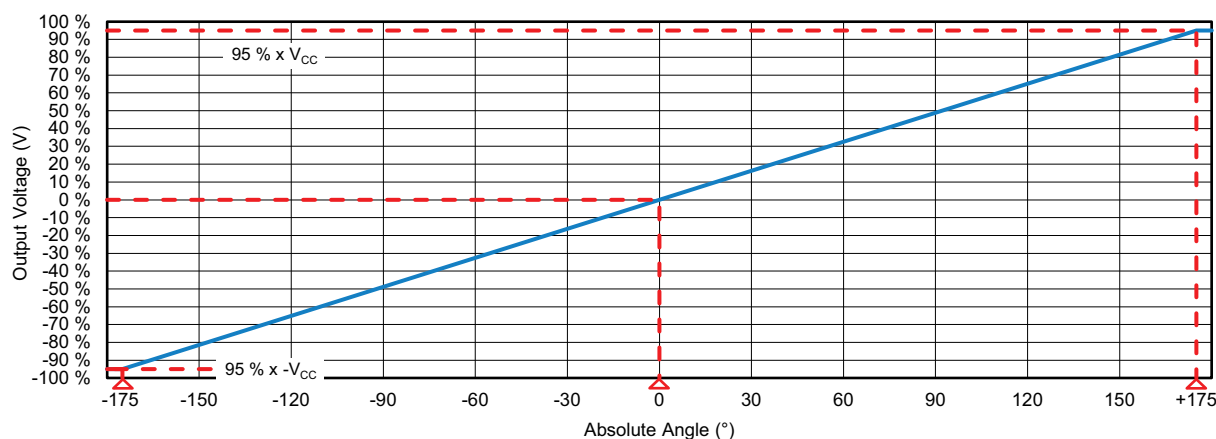
⁽²⁾ With 3 MHz master clock frequency



ANALOG OUTPUT

WIRE CONNECTION		
TWISTED PAIR NUMBER	SIGNAL NAME	WIRE COLOR
1	+VCC	Red
	GND	White
2	GH	Green
	GND	Black
3	ANALOG OUT	Blue
	-VCC	Yellow

Analog Output Signal



Note

- The output voltage waveform can be adjusted to meet the customer's requirements

GH OUTPUT

The GH (Good Health) signal is a safety output used to indicate when the encoder has detected abnormal operation or when a parameter (temperature, voltage...) is outside the expected range.

GH is an active-low signal:

GH OUTPUT	DESCRIPTION
High	Normal operation
Low	Default detected by the sensor. In this case, the output position data must be considered invalid.

The GH signal becomes active (low) in the following cases:

- Encoder temperature out of the operating range (under and over-temperature detection)
- Input voltage out of the operating range
- Internal voltage fault
- Internal system not responding (watchdog timeout)
- Fault detected in position sensor chip



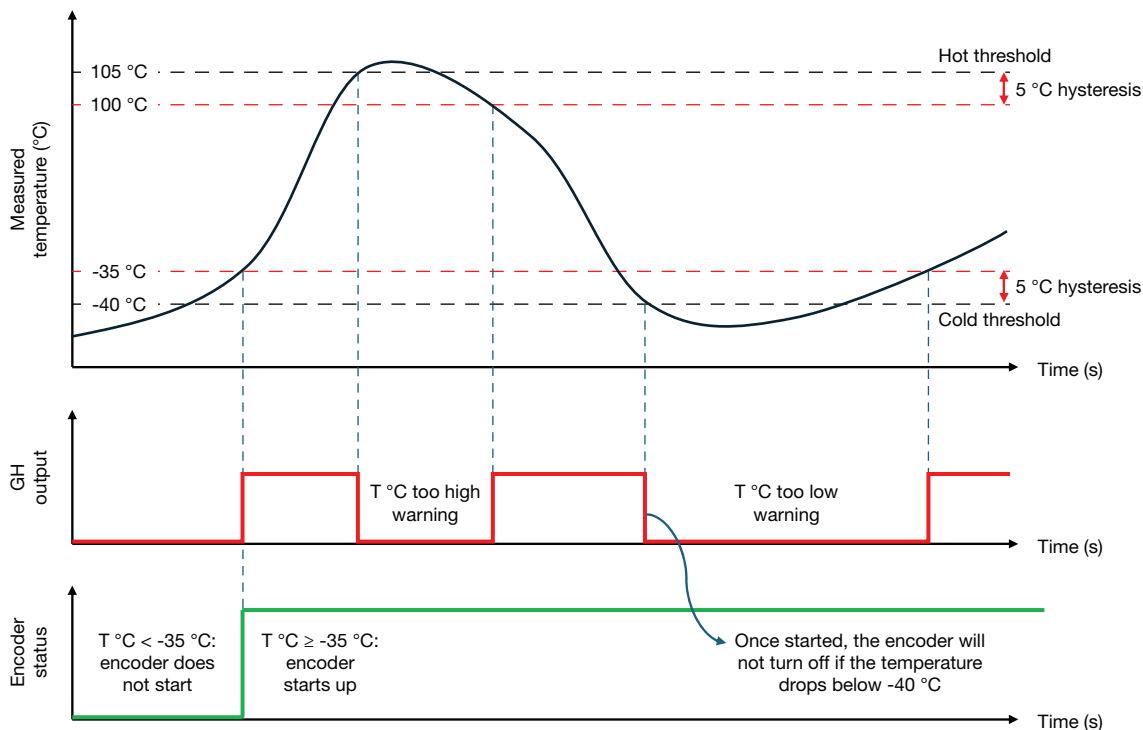
START-UP TEMPERATURE CONDITION

The encoder includes an internal temperature sensor that manages cold start conditions.

The system prevents start-up below -35°C to ensure that all circuits power up under proper conditions.

Once the encoder has started, dropping the temperature below -40°C does not turn off the encoder.

The diagram below illustrates this behavior:





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