METIRIO Readhead

The **METIRIO** Readhead is an analog high precision encoder, designed and manufactured to meet the most stringent market requirements for closed-loop nano-positioning. The readhead constitutes the core of the METIRIO encoder, and is encapsulated in a small package, featuring maximum miniaturization, low noise and high bandwidth. It is suited for the deployment in UHV and in conjunction with linear, rotary and convex scales.

Features

- Compact size: 6.6 (L) X 5.1 (W) x 1.7 (H) mm^3
- High resolution: < 1 nm
- Low noise: 450 μV_{RMS} @ 500 kHz bandwidth
- Low current consumption: 20 mA
- Operational under UHV conditions: 10^{-11} mbar
- Suitable for PCB soldering

Applications

- Rotary encoders
- Linear encoders
- Robots
- Linear motors
- Precision stages
- Galvanometers

Absolute Maximum Ratings

Parameter	Symbol	Condition	Value	Unit
Operating temperature	T_O	no dew condensation	0 to +80	°C
Storage temperature	T_S	no dew condensation	-20 to +80	°C
Maximum baking temperature	T_B	> 48 hrs.	120	°C
Supply voltage	V_{DD}	to GND	3.0 to 5.5	V
Maximum Power consumption	P_{el}	all outputs terminated	310	mW
ESD susceptibility		HBM (AEC-Q101)	4	kV
Max. radiant output power	Φ_{max}	short circuit current I_F=1000 mA	< 360	mW
Ambient pressure	p	---	> 10^{-11}	mbar

Electrical & Optical Characteristics

Parameter	Symbol	Condition	Value	Unit
Current consumption	I_{DD}	typical	20	mA
Analog output voltage	$U_{sin,cos}$	Sin, Cos	1	V_{PP}
Reference output	U_{Ref}	---	RS485	Square wave
Integrated noise	U_{RMS}	500 kHz bandwidth	450	μV_{RMS}
Max. bandwidth	f_{3dB}	3 dB cutoff	500	kHz
Central emission wavelength	λ_{pk}	---	850	nm
Radiant output power	Φ_e	typical	< 45	mW
Compatible scale pitch	---	---	20	µm

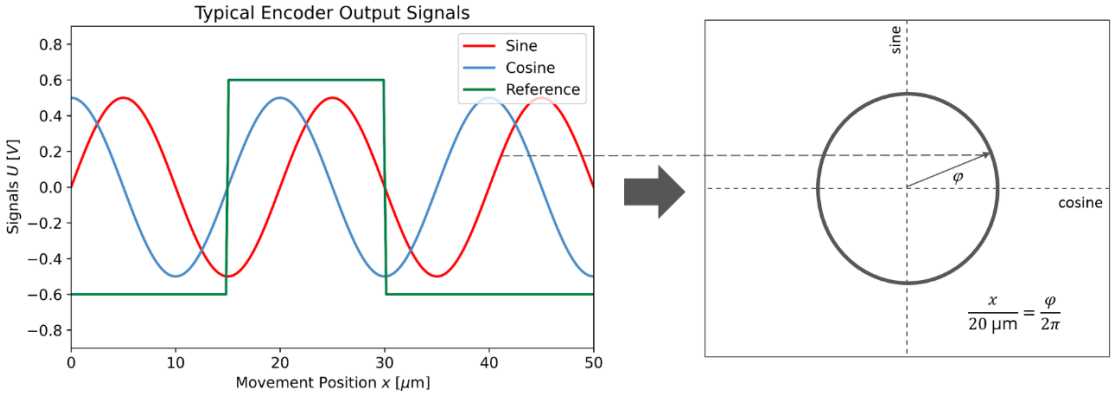
Scale Conditions

Parameter	Value	Unit
Grating	Reflective amplitude grating	
Pitch	20	µm
Working distance	1.2	mm
Scale types	linear, rotary, convex	

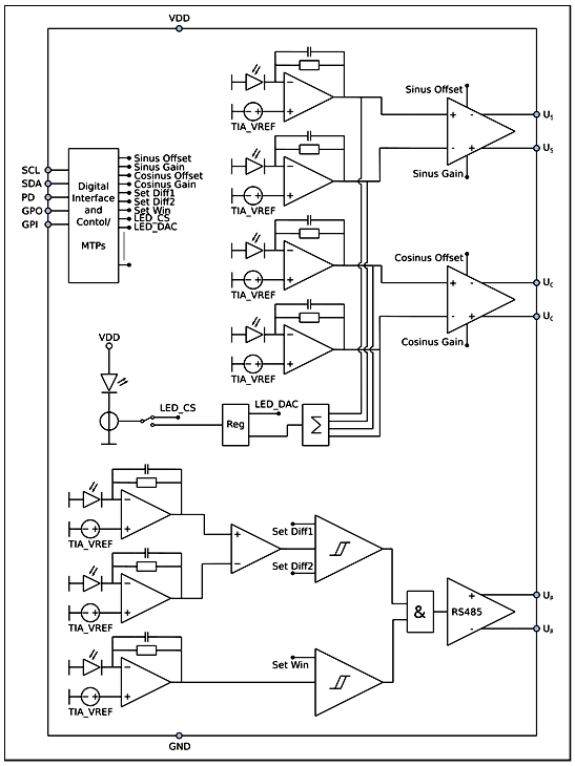
Functional Description

Through an index grating, a built-in LED (850 nm) illuminates a scale with a pitch size of 20 µm. The reflected diffraction image is projected onto a photodiode array by means of an analyzer grating, residing in front of the detector. As a result of the relative movement between the readhead and the scale, an analog sine/cosine signal with a cycle period of 20 µm can be induced to determine the displacement and direction of motion. An integrated ASIC is utilized for signal detection and processing, as well as for producing a digital reference pulse to determine the initial position and direction of motion. Two differential analog signals (sine/cosine) are output with 1 V_{pp} – the reference signal is a digital differential pulse supplied via an integral RS 485 interface.

Output Waveform



Block Diagram



Adjustment

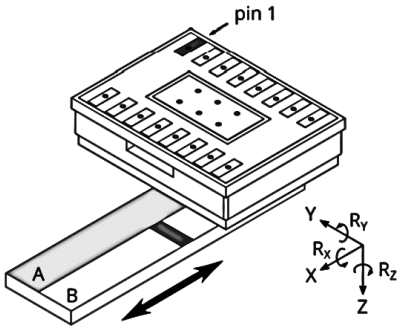
Offset and gain of the sine/cosine, threshold, position, and width of the reference signal, as well as the LED current and brightness can be set either via I2C bus or by applying SmarAct Metrology's **ENCODER** Evaluation **MODULE** and Program. Consult with us for more details.

Alignment

The readhead's optical center is offset from the scale by 1.2 mm in the vertical direction. If using a rotary scale, the scale offset in the horizontal direction needs to be taken into account as well. Optimum alignment may vary due to mounting tolerances, so thorough evaluation is required to adjust appropriate conditions. The glass surface of the device, the frame, and fiducial mark facilitate the entire optical-mechanical alignment process. SmarAct Metrology also offer validated alignment technology and software tools (**ENCODER** EVALUATION **PROGRAM**) that support our customers with achieving fast and individualized installations.

Alignment Tolerances

Parameter	Value	Unit
X	Direction of motion	---
Y	0 ± 0.5 (centered between A and B)	mm
Working distance Z	1.18± 0.15	mm
Yaw angle (R_Z)	0 ± 1.1	deg
Roll angle (R_X)	0 ± 1.1	deg
Pitch angle (R_Y)	0 ± 2.0	deg



PIN Description

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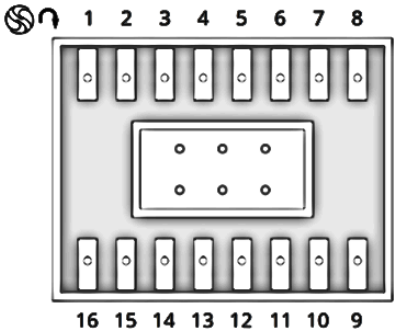
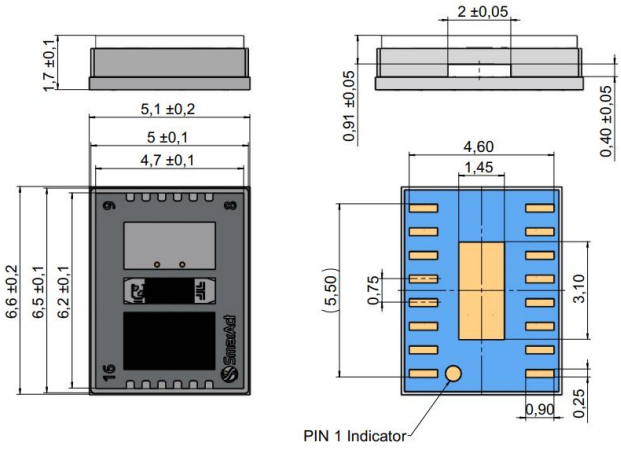
1	2	3	4
U_{cos+} (out)	*U_{cos-} (out)*	*U_{sin+} (out)*	*U_{sin-} (out)*
5	6	7	8
V_{DD} (in)	*U_{Ref+} (out)*	*U_{Ref-} (out)*	*GND*
9	10	11	12
SCL (in)	*SDA (i/o)*	*PD (in)*	*GND*
13	14	15	16
GPO (out)	*GPI (in)*	*d.n.c.*	*GND*



Dimensional Outline

Parameter	Specification
Dimensions	6.6 x 5.1 x 1.7 mm³
Package	flat-no-leads ceramic circuit board
Window	Glass
Soldering pads	Gold
Pad size	0.9 x 0.25 mm²
Pad pitch	0.75 mm
Cable	None
Materials	None magnetic RoHS Compliant Low Outgassing (UHV)
Weight	0,12 g



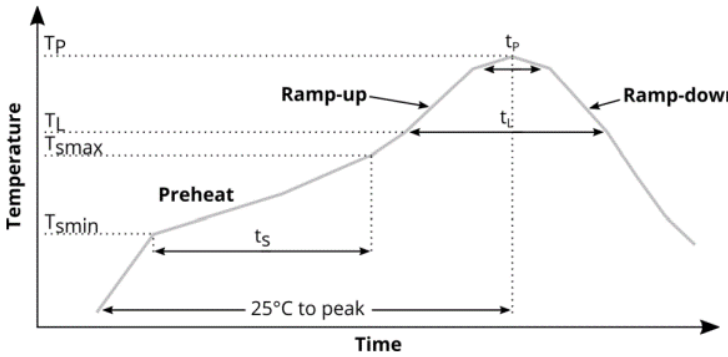
Mounting Precautions

Thermal performance is directly linked to the printed circuit board (PCB) design and operating environment. Careful attention to the PCB thermal design is required. The junction from the thermal resistance to the ambient air is θ_{JA} = 130 K/W. Measurements have been conducted based on the JEDEC JESD51-2A.

Soldering Precautions

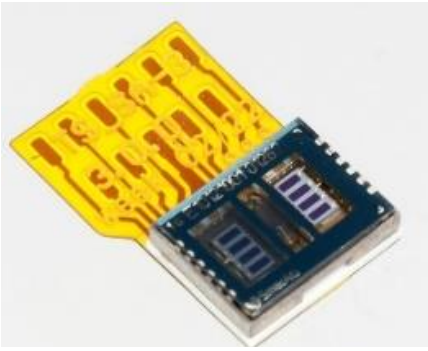
When soldering, ensure there is no foreign matters adhering to the surface of the read-head. After soldering, it's advised that no mechanical stress or strong vibration is applied until the device has reached room temperature.

Profile Feautre	Value
Preheat min. T_{smin}	150 °C
Preheat max. T_{smax}	200 °C
Preheat time t_s	60 s – 120 s
Ramp-up rate T_L to T_p	Max. 3 °C/s
Liquidous Temp. T_L	217 °C
Time t_L above T_L	60 s – 150 s
Peak body Temp. T_p	260 °C
Time t_p within 5°C of peak Temp.	< 30 s
Ramp-down Rate T_p to T_L	6 °C/s



Soldering on PCB

Customized soldering ensures precision and reliability for specific integration requirements. The readhead can be either glued or soldered. For soldering/gluing, it's either directly mounted on a PCB and electrically connected to the substrate's solder pads, or solder-wired. Below example shows how the METIRIO readhead fuses with a flexible circuit board.



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