

## KMXP<sub>N</sub>002 SERIES

### Anisotropic Magneto-Resistive (AMR) Linear Position Sensors

Position sensors play an increasingly important role in many industrial, robotic and medical applications. Advanced applications in harsh environments need sensors that perform well, even when exposed to oil, dirt and dust.

The TE Connectivity KMXP position sensor is the right choice to meet those needs thanks to its Magneto Resistive technology and available form factors. The KMXP sensor provides greater precision than commonly used Hall sensors and is designed to provide reliable and accurate measurements in harsh environments including high temperatures.

The sensor measuring principle is based on the anisotropic magneto resistance effect (AMR effect).

The sensors are offered in two different DFN packages for multiple orientation options. These packages can be easily integrated to almost any automated assembly process.

## FEATURES

- High Resolution and high precision – Magneto Resistive (MR) sensor with contactless measurement which provides accuracy of 10-50  $\mu\text{m}$  in ranges between 1 – 5 mm.
- Easy Assembly – VDFN package ideal for any PCB assembly processes
- Tape & Reel packaging for easy integration
- Perpendicular soldering and a small sensor wall thickness for large application air gaps.
- Superior Performance – Up to 125°C, EMC proof in any dirty environment and insensitive to dirt, oil or dust.

## APPLICATIONS

Contactless linear or angular position measurement in applications like:

- Industrial machinery like sawing or drilling equipment
- Medical high precision mechanical controls like bed control, advanced prosthesis steering, precision catheters, X-ray equipment, or syringe pumps
- Robotics in industrial automation

MEASUREMENT PRINCIPLE

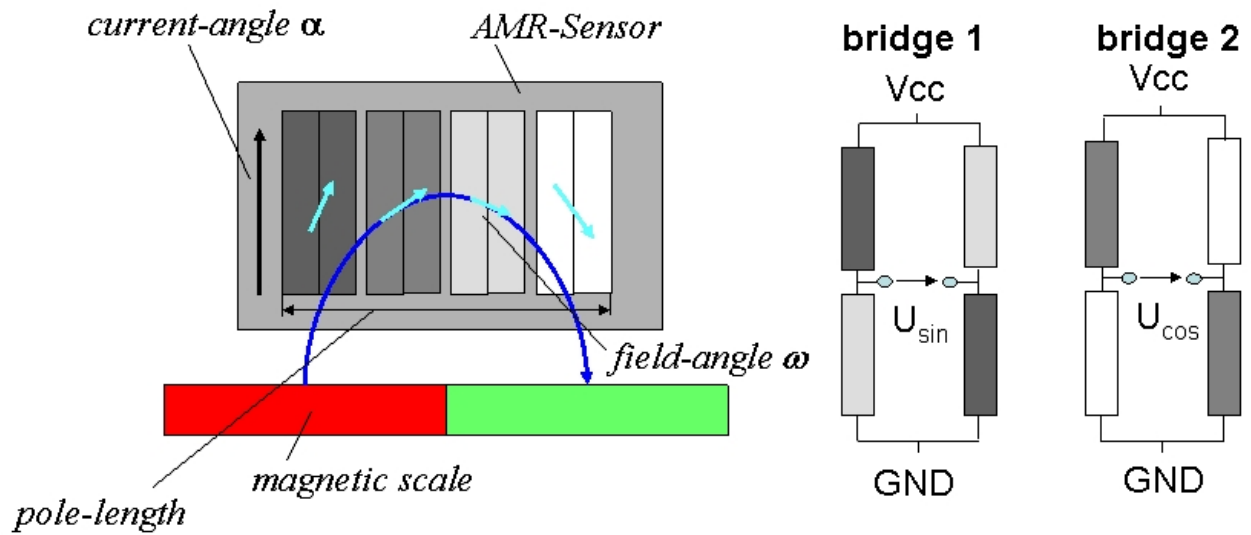


Figure 1: Principle function of the sensor

The KMXPn002 sensors consist of two magneto resistive Wheatstone bridges, whose resistors are placed in a such way that the characteristic magnetic field distribution of a magnetic scale with matching pole pitch produces a sine and a cosine signal output when the sensor is moved along the scale.

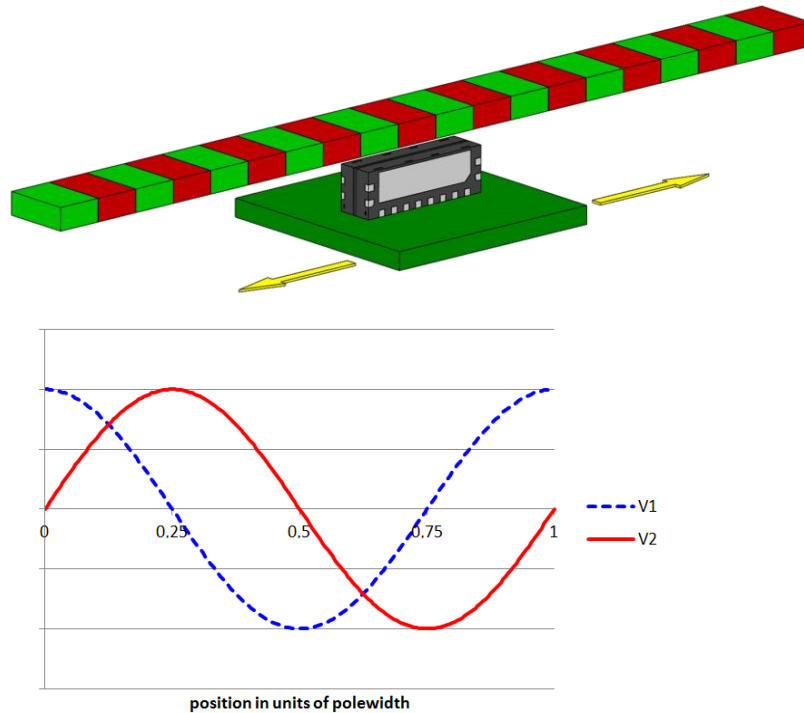


Figure 2: Typical application of a PCB mounted KMXPn002 sensor moving relative to a magnetic pole and the corresponding output signal voltage depending on sensor position

## PERFORMANCE SPECIFICATIONS

PARAMETER	SYMBOL	COND.	TYPE	MIN	TYP	MAX	UNIT
<b>1. Operating Limits</b>							
Max. supply voltage	$V_{cc,max}$		all			<b>10</b>	V
Max. current (both bridges)	$I_{cc,max}$		KMXP 1002 KMXP 2002/5002			<b>5</b> <b>10</b>	mA
Operating temperature	$T_{op}$		all	<b>-40</b>		<b>+150</b>	°C
Storage temperature	$T_{st}$		all	<b>-40</b>		<b>+150</b>	°C
<b>2. Sensor Specifications (T=25 °C)</b>							
Supply voltage	$V_{cc}$		all		<b>5</b>		V
Pole pitch 1)	p		KMXP 1002 KMXP 2002 KMXP 5002		<b>1000</b> <b>2000</b> <b>5000</b>		μm
Air gap package front – magnetic scale 2)	D		KMXP 1002 KMXP 2002 KMXP 5002	<b>0.1</b> <b>0.2</b> <b>0.5</b>	<b>0.4</b> <b>0.8</b> <b>2</b>	<b>0.8</b> <b>1.8</b> <b>4</b>	mm
Resistance (both bridges)	$R_b$		KMXP 1002 KMXP 2002/5002	<b>2000</b> <b>1000</b>	<b>3000</b> <b>1500</b>	<b>4000</b> <b>2000</b>	Ω
Output signal range	$\Delta V_n/V_{cc}$	A, B	all	<b>18</b>	<b>22</b>	<b>26</b>	mV/V
Offset voltage	$V_{n\ off}$	A, B	all	<b>-1</b>	<b>0</b>	<b>+1</b>	mV/V
<b>3. Sensor Specifications</b>							
TC of amplitude	TCSV	A, C	All		<b>-0.35</b>		%/K
TC of resistance	TCBR	A, C	All		<b>+0.35</b>		%/K
TC of offset	TCVoff	A, C	all	<b>-4</b>	<b>0</b>	<b>+4</b>	μV/V/K

n = 1;2 (bridge number); Stress above one or more of the limiting values may cause permanent damage to the device. Exposure to limiting values for extended periods may affect device reliability.

1) Other pole pitches on request

2) Typical values for conventional magnetic scales. Air gap for maximum accuracy depends on the used scale.

**MEASUREMENT SET UP CONDITIONS**

PARAMETER	SYMBOL	UNIT	CONDITION
<b>A. Set Up Conditions</b>			
Ambient temperature	T	°C	T = 25 °C (unless otherwise noted)
Supply voltage	V <sub>cc</sub>	V	V <sub>cc</sub> = 5 V
Applied magnetic field	H	kA/m	H > 10 kA/m
<b>B. Sensor Specifications (T=25 °C, 360° turn , H=25 kA/m , Vo<sub>max</sub>&gt;0, Vo<sub>min</sub>&lt;0)</b>			
Output signal range	ΔV <sub>n</sub> / V <sub>cc</sub>	mV/V	ΔV <sub>n</sub> / V <sub>cc</sub> = (V <sub>n max</sub> - V <sub>n min</sub> ) / V <sub>cc</sub>
Signal offset	V <sub>off n</sub>	mV/V	V <sub>off n</sub> = (V <sub>n max</sub> + V <sub>n min</sub> ) / V <sub>cc</sub>

<b>C. Sensor Specifications (T=-25°C, +125°C)</b>			
Ambient temperatures	T	°C	T <sub>1</sub> = -25 °C, T <sub>0</sub> = +25 °C, T <sub>2</sub> = +125 °C
TC of amplitude	TCSV	%/K	$TCV = \frac{1}{(T_2 - T_1)} \cdot \frac{\frac{\Delta V_n(T_2)}{V_{cc}} - \frac{\Delta V_n(T_1)}{V_{cc}}}{\frac{\Delta V_n(T_1)}{V_{cc}}} \cdot 100\%$
TC of resistance	TBR	%/K	$TCR = \frac{1}{(T_2 - T_1)} \cdot \frac{R_n(T_2) - R_n(T_1)}{R_n(T_1)} \cdot 100\%$
TC of offset	TCVoff	μV/(VK)	$TCVoff_n = \frac{Voff_n(T_2) - Voff_n(T_1)}{(T_2 - T_1)}$

n = 1;2 (bridge number)

**BLOCK DIAGRAM**

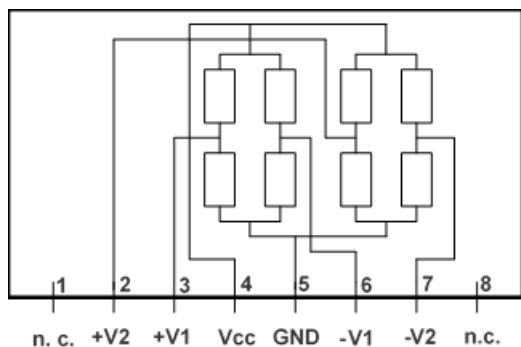


Figure 3a: KMXP 1002/2002

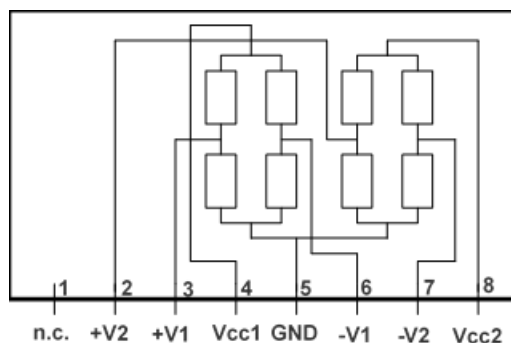
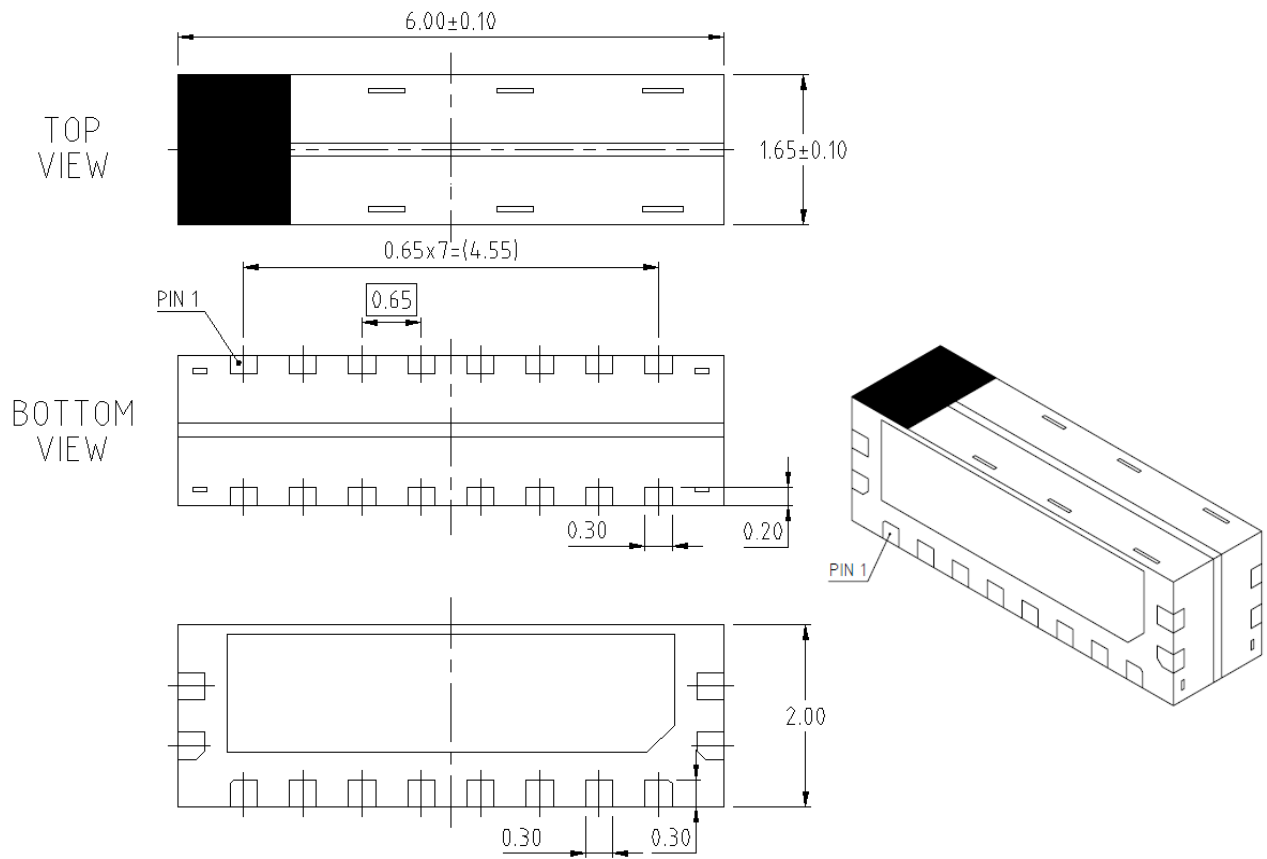


Figure 3b: KMXP 5002



**PHYSICAL DIMENSIONS**

Fig. 4: Physical dimensions of sensor package

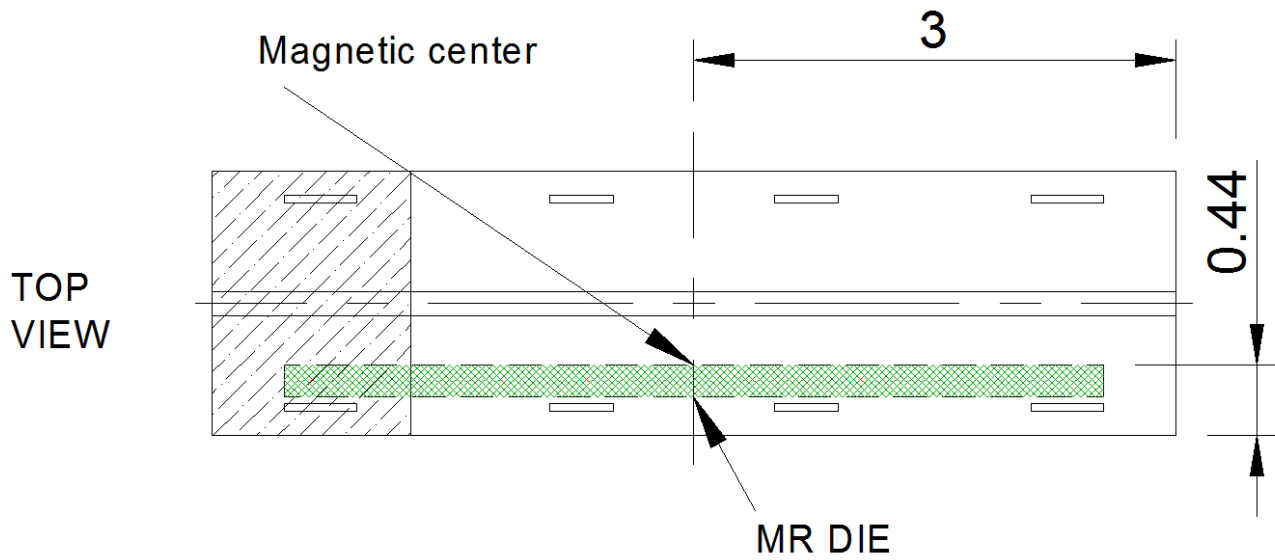


Fig. 5: Magnetic center of sensor package

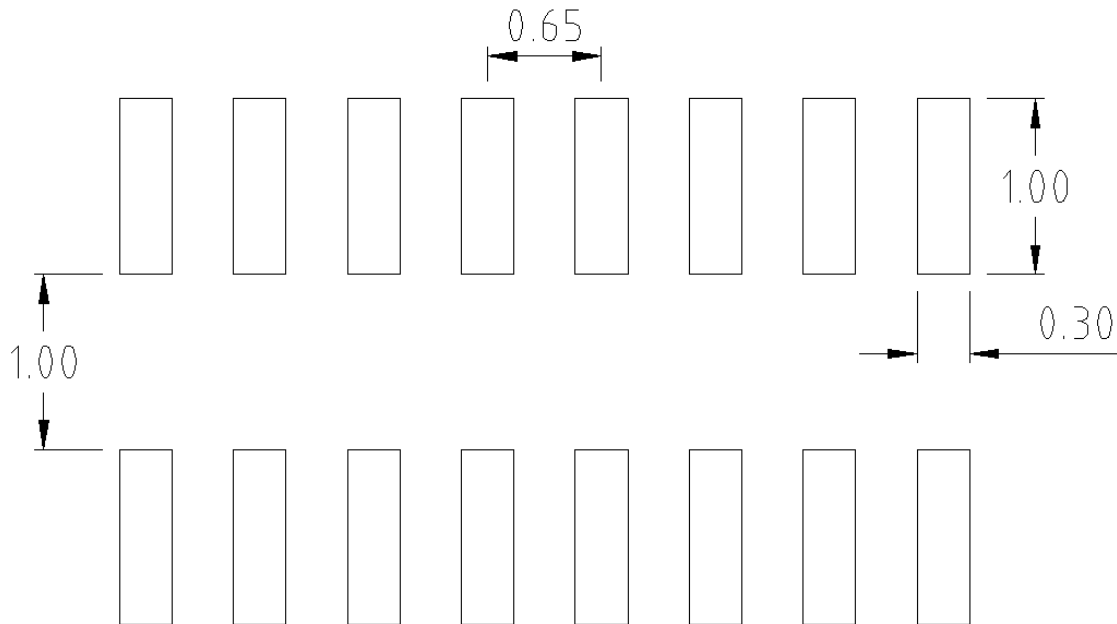


Fig. 5: Foot print of sensor package

Reflow profile for this package according to IPC/JEDEC J-STD-020 Revision D.1 (March 2008).

### PIN ASSIGNMENT

The pin assignment is pin compatible for all KMXP types and allows a common PCB layout for all types:

Pin	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
KMXP 1002	N/C	+V <sub>2</sub>	+V <sub>1</sub>	V <sub>cc</sub>	GND	-V <sub>1</sub>	-V <sub>2</sub>	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
KMXP 2002	N/C	+V <sub>2</sub>	+V <sub>1</sub>	V <sub>cc</sub>	GND	-V <sub>1</sub>	-V <sub>2</sub>	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
KMXP 5002	N/C	+V <sub>2</sub>	+V <sub>1</sub>	V <sub>cc1</sub>	GND	-V <sub>1</sub>	-V <sub>2</sub>	V <sub>cc2</sub>	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C

## APPLICATION EXAMPLE

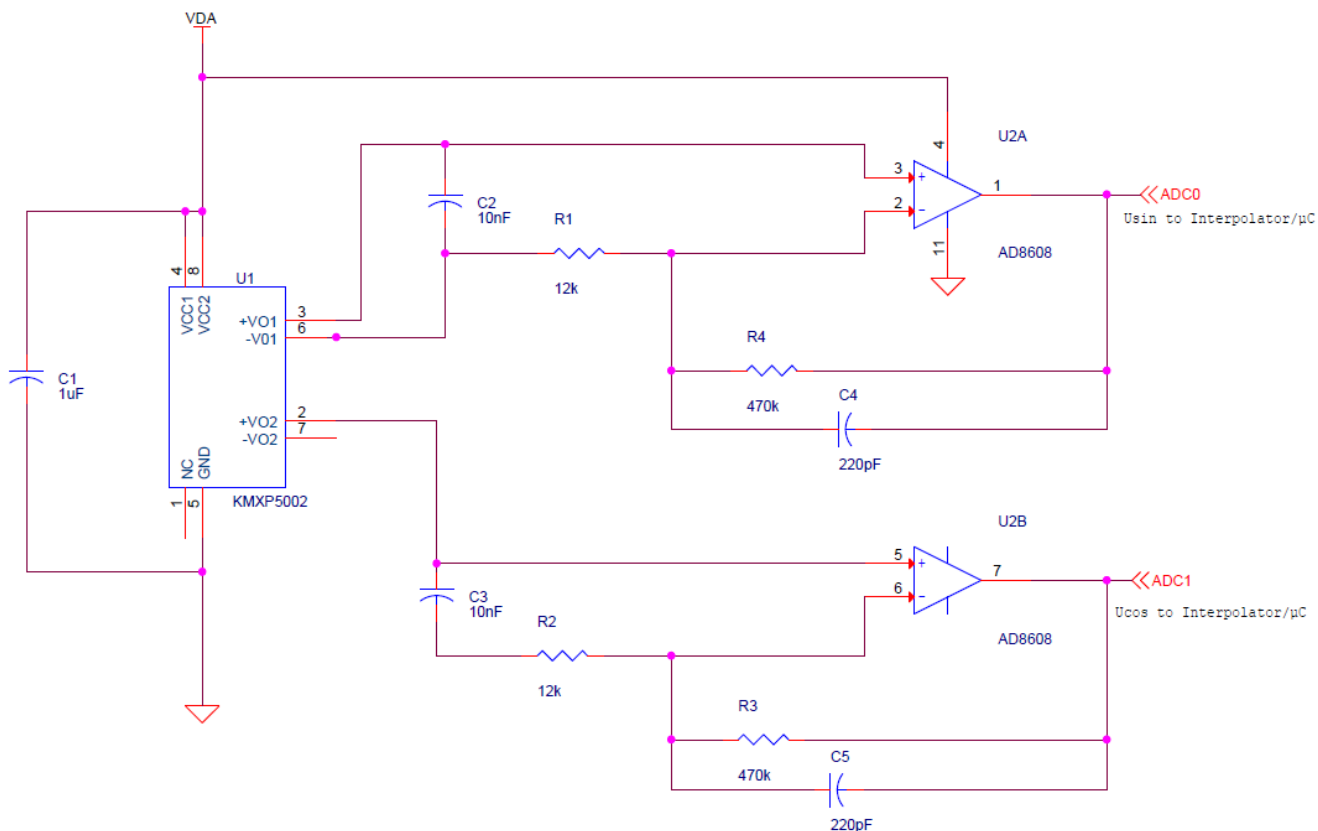


Fig. 6: Exemplary hardware configuration for the usage with a conventional microcontroller using an Analog Devices AD8608 amplifier for the preprocessing of the sensor signals.

## Example of Printed Circuit Board Assembly

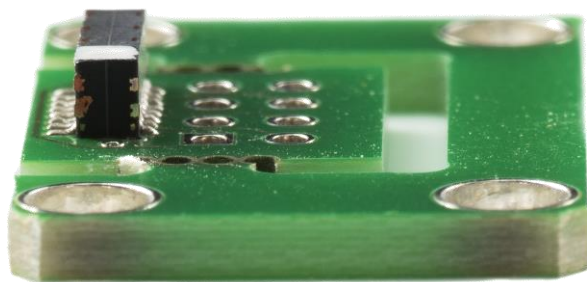





Figure 7: Perpendicular mounted KMXP5002 on a PCB


## KMXPn002

### LINEAR POSITION SENSOR

#### SENSOR TYPE CODING

Sensor	Color Coding	Type
	RED	KMXP1002
	SILVER	KMXP2002
	WHITE	KMXP5002

#### TAPE AND REEL INFORMATION

Description	Reel size	Units/Reel	Pin 1 orientation	Note
KMXPn000	7"	500	Bottom-left of sprocket hole side	

#### ORDERING CODES

Device	Pole Pitch	MOQ
KMXP1002	1 mm	1 reel
KMXP2002	2 mm	1 reel
KMXP5002	5 mm	1 reel