User manual

Inclinometer
with Analog-Interface

IK360L

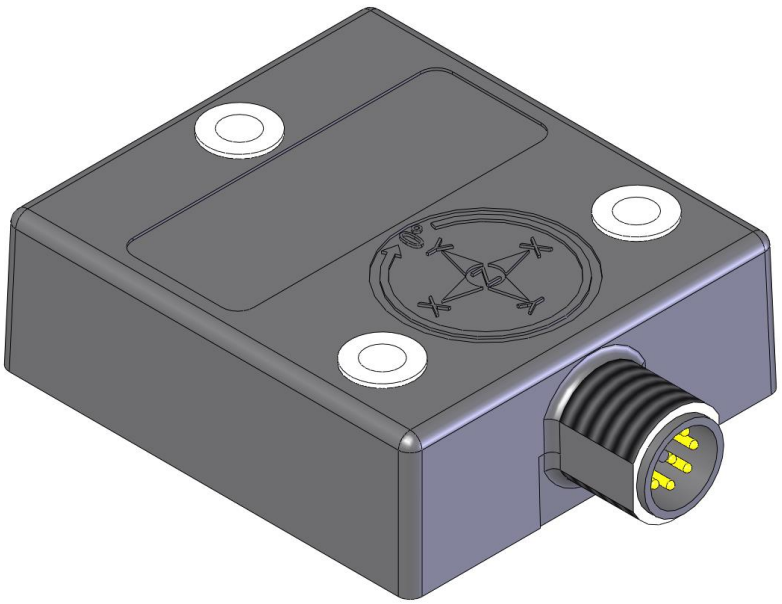


Table of content

1 GENERAL SAFETY ADVICE 3

2 INTRODUCTION 3

2.1 IK360L 3
2.2 ANALOG INTERFACE 4
2.3 IK360L ANALOG 4

3 INSTALLATION 5

3.1 PIN ASSIGNMENT 5
3.2 INSTALLATION PRECAUTIONS 5
3.3 MOUNTING INSTRUCTIONS 6
3.4 MEASUREMENT AXIS 6
3.4.1 Analog Inputs (SET1) 7

4 ANALOG INTERFACE 7

4.1 OUTPUT TYPES 7
4.1.1 IK360L - Voltage 7
4.1.2 IK360L – Current 8

5 IK360L - ANALOG OUTPUT GRAPHS 9

5.1 IK360L (1 AXIS) VOLTAGE 9
5.2 IK360L (1 AXIS) CURRENT 10
5.3 IK360L (2 AXIS) X-AXIS VOLTAGE OUTPUT 10
5.4 IK360L (2 AXIS) Y-AXIS VOLTAGE OUTPUT 10
5.5 IK360L (2 AXIS) X-AXIS CURRENT OUTPUT 11
5.6 IK360L (2 AXIS) Y-AXIS CURRENT OUTPUT 11

1 General Safety Advice

Read these instructions carefully and have a look at the equipment to become familiar with the device before trying to install, operate or maintain it.

The following special messages may appear throughout this documentation & on the equipment to warn of potential hazards or to call attention towards information that clarifies / simplifies a procedure.

The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury, if the instructions are not followed.

This is the safety alert symbol. It is used for alerting, in case of potential personal injury or hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

Please Note

Electrical equipment should be serviced only by qualified personnel. No responsibility is assumed by SIKO for any consequences arising out of the use of this material. This document is not intended as an instruction manual for untrained persons.

About this manual

This user manual explains how to install and configure the IK360L inclinometer with a Analog (Voltage or Current) interface by illustrations.

2 Introduction

2.1 IK360L

IK360L inclinometers sense and measure the angle of tilt (Inclination/Slope/Elevation) of an object with respect to the force of gravity. The angle is measured with the relative change in electrical capacitance.

The basic principle behind this IK360L inclinometer is a Micro-Electro-Mechanical Systems (MEMS) sensor cell, that is embedded to a fully molded ASIC. A simplified version of the sensor consists of two electrodes, one is fixed, and the other is flexible (connected with spring elements). When the inclinometer is parallel to the surface of measurement, a corresponding capacitance is measured. If the sensor is tilted, the flexible electrode will change its position relative to the fixed electrode. This results in a change of the capacitance between the two electrodes, which is measured by the sensor cell. The change of the capacitance is converted to a corresponding inclination value.

Absolute inclinometers identify all the points of a movement by means of an unambiguous signal. Due to their capacity to give clear and exact values to all inclinations positions, inclinometers have become one of the interesting alternatives to singleturn absolute (and incremental) encoders and a link between the mechanical and control systems.

2.2 Analog interface

The analog interface is one of the most common and simplest of the interfaces. It is compatible from simple multimeters to complex control systems and PLCs.

An analog signal is a *continuous* signal which is analogous i. e. comparable to another time varying signal. In our case the variation of current or voltage signal from IK360L is analogous to the variation of measured position.

In IK360L, the position related output from MEMS based capacitance transducer measurement is converted to its analogous current or voltage signals with suitable electronics.

An analog signal virtually has infinite resolution. In practice an analog signal is always subjected to noise and a finite *slew rate*. Therefore, analog systems are subject to limitations in resolution and bandwidth.

Noise and unwanted variation in signals can create losses upon transmission and retransmission over long distances and for long time. Electrically, these losses can be reduced by shielding, good connections and several cable types.

2.3 IK360L Analog

The IK360L Analog inclinometer is a simple, compact and a very low cost inclination measurement device capable of measuring precise absolute position in single axis.

It is compatible to almost all the analog measurement devices.

Electrically, IK360L consists of a highly integrated circuit in SMD technology, temperature compensation, active linearization and the only variation is the analog interface.

Electrically, like all other IK360L variants it consists of a highly integrated circuit in SMD technology, temperature compensation, active linearization and the only variation is the analog interface.

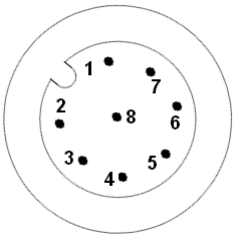
It is protected against polarity inversion and over voltage peak protection. In addition to that, the fully molded plastic housing provides an high resistance to shock/vibration and environmental protection of up to IP67.

3 Installation

3.1 Pin assignment

The inclinometer is connected via a 8 pin round M12 connector (Standard M12, male connector on IK360L, female connector at connection cable).

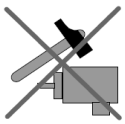
Pin	Description for IK360L (1 axis)	Description für IK360L (2 axis)
1	10-30 V DC	10-30 V DC
2	Do Not Connect	Do Not Connect
3	Do Not Connect	Do Not Connect
4	Ground	Ground
5	Z-Axis Output U/I	X-Axis Output U/I
6	SET1	SET1
7	Do Not Connect	Y-Axis Output U/I
8	Do Not Connect	Do Not Connect



3.2 Installation precautions

ATTENTION!
Do not remove or mount while the inclinometer is under power!

Avert any modifications to the plastic molding!



Avoid mechanical load!

3.3 Mounting instructions

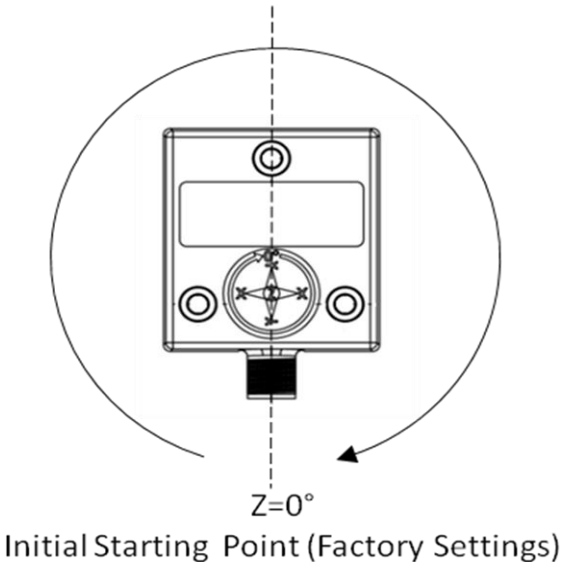
IK360L is a pre-calibrated device, which can be put into immediate operation, upon simple and easy installation with a three point mount and setting of preset. Its compact design and installation "anywhere" makes it versatile.

The IK360L inclinometer can be mounted in any number of fashions, depending on the situation. The mounting surface must be plane and free of dust and grease. It is absolutely necessary, that the IK360L inclinometer is connected to potential equalization in a workmanlike manner. For mounting we recommend cheese head screws with metrical thread M4 or UNC bolts #6 for the best possible and secure mounting. Use all the 3 screws for mounting, but restrict the tightening torque in the range of 1.5 – 2.5 Nm for the screws. The M12 connectors are to be perfectly aligned and screwed till the end with a tightening torque in the range of 0.4 – 0.6 Nm. Use all the three screws for mounting and also note to use the same tightening torque for all the screws. An appropriate and well secured counter connector is also an important constraint for attaining the stated IP69K protection.

Prior to installation, please check for all connection and mounting instructions to be complied with. Please also observe the general rules and regulations on low voltage technical devices, for safety and sustainability of IK360L Inclinometers over long period of time.

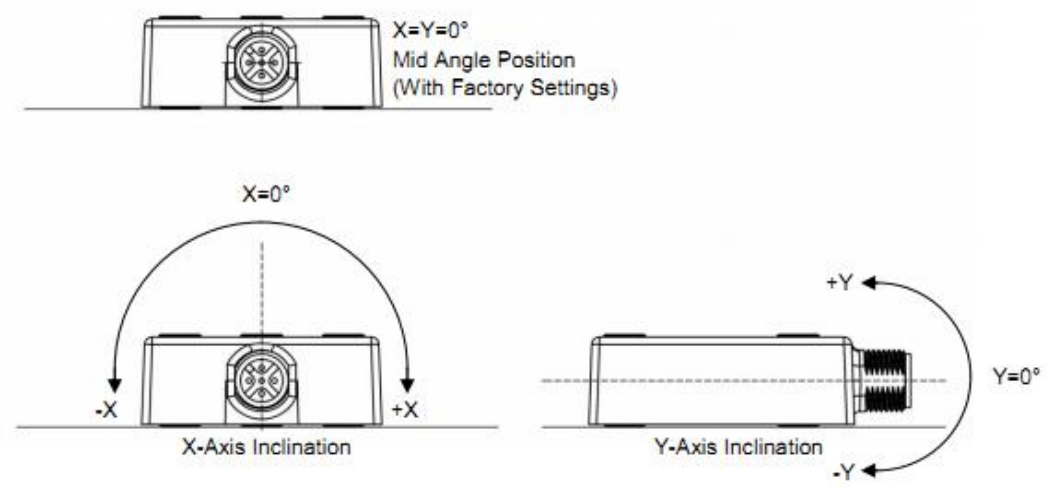
3.4 Measurement axis

IK360L (1 axis)



Measurement axis and mid angle position
(factory setting ~ connector facing down)

IK360L (2 axis)



3.4.1 Analog Inputs (SET1)

The IK360L has ab analog input, SET1 which can be used to configure in the IK360L. To trigger/activate these functionalities:

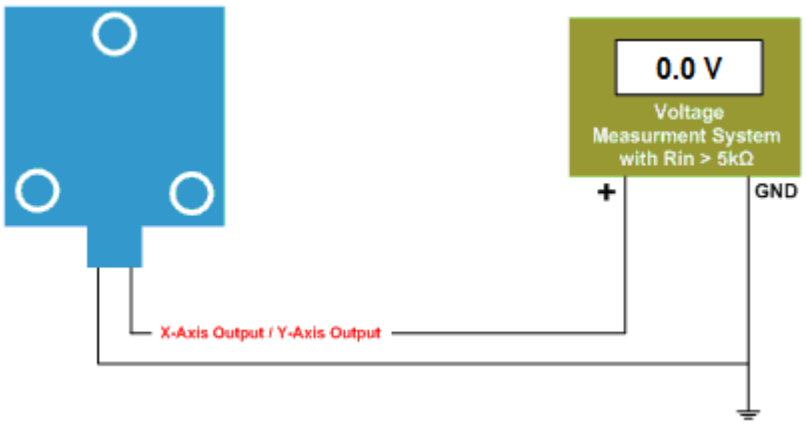
- The user must apply a positive voltage (5 V – 30 V, R_{in} > 110 KΩ) on the SET1 input. When a high edge is recognized a timer starts.
- The voltage must be held at least 100 ms if the voltage has been held less than 100 ms, the timer will be reset. The voltage must be released for postion to be locked.

4 Analog Interface

4.1 Output Types

4.1.1 IK360L - Voltage

Connect the corresponding (voltage analog output pin 5) open end of the connection cable to the measurement system.



IK360L with voltage output

Calculation of angle from IK360L voltage:

Position angle (in °) = (10 V) / (0.02777 Volts per °)

For example:

1. U_{out} = 1.6662 V

Position Angle = (1.6662 V) / (0.02777 V per °) = 60°

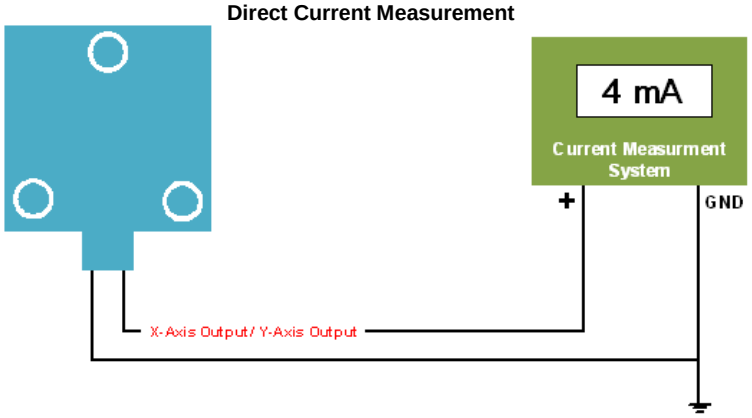
2. U_{out} = 5.554 V

Position Angle = (5.554 V) / (0.02777 V per °) = 200°

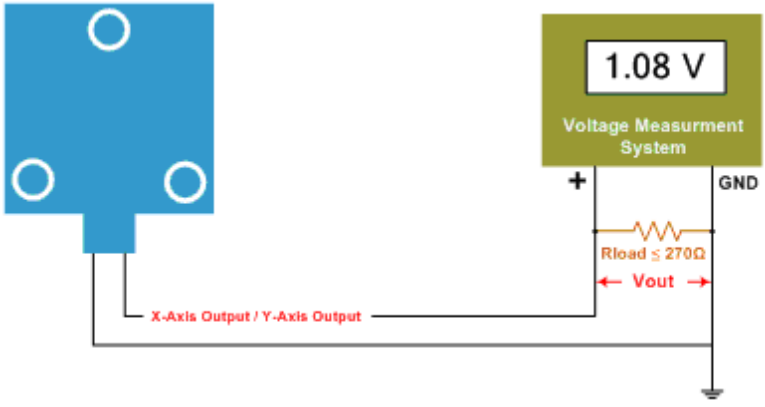
4.1.2 IK360L – Current

Connect the corresponding (current analog output Pin 5) open end of the connection cable to the measurement system. IK360L output current, I_{out} can be directly measured or indirectly measured as voltage, using a shunt resistor (Note: R_{Load} ≤270 Ω).

Direct Current Measurement



Indirect Current Measurement



Calculation of angle from IK360L (1 axis) current:

Position angle (in °) = (I_{out} - 4 mA) / (0.0444 mA per °)

For example:

1. I_{out} = 8.31 mA

Position Angle = (8.31 mA - 4 mA) / (0.0444 mA per °) = 97.07°

2. I_{out} = 11.6 mA

Position Angle = (11.6 mA - 4 mA) / (0.0444 mA per °) = 171.17°

Calculation of angle from IK360L (2 axis) current:

Position angle (in °) = (I_{out} - 12 mA) / (0.1 mA per °)

1. I_{out} = 8.31 mA

Position Angle = (8.31 mA – 12 mA) / (0.1 mA per °) = -36.9°

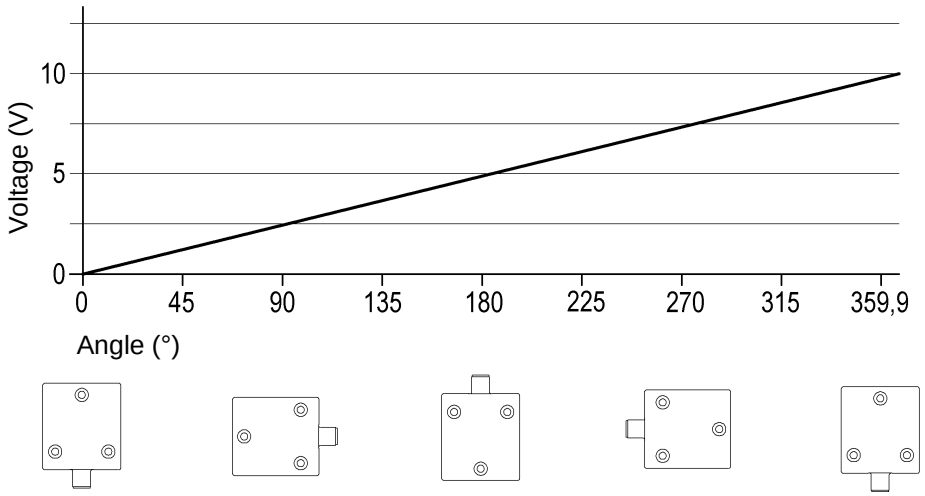
2. I_{out} = 11.6 mA

Position Angle = (11.6 mA – 12 mA) / (0.1 mA per °) = -4°

5 IK360L - Analog Output Graphs

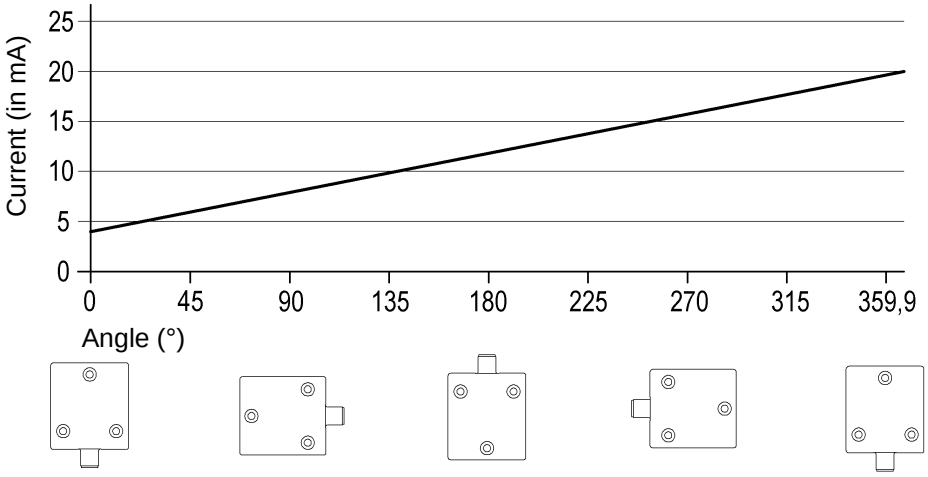
5.1 IK360L (1 axis) Voltage

Output circuit IK360L sensor

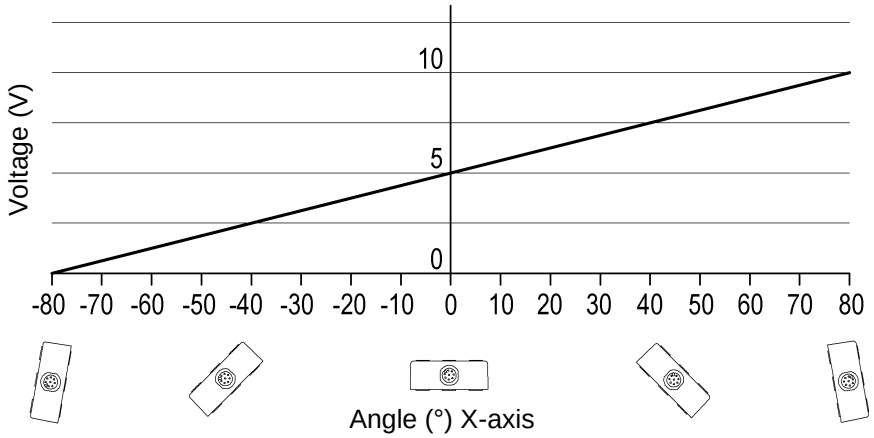


5.2 IK360L (1 axis) Current

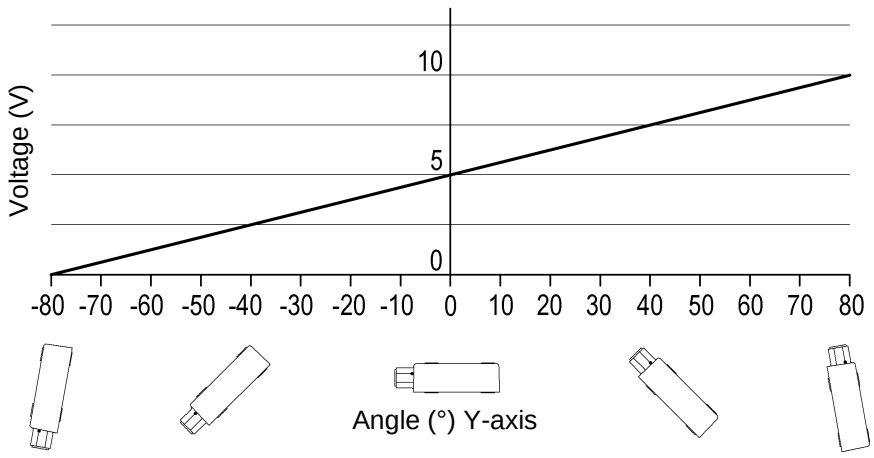
Output circuit IK360L sensor



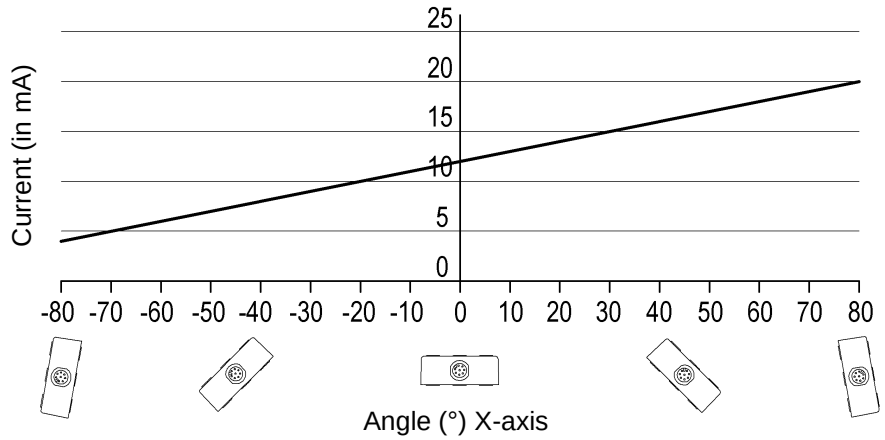
5.3 IK360L (2 axis) X-Axis Voltage Output



5.4 IK360L (2 axis) Y-Axis Voltage Output



5.5 IK360L (2 axis) X-Axis Current Output



5.6 IK360L (2 axis) Y-Axis Current Output