

# Rotation Angle of a Vertical Plane



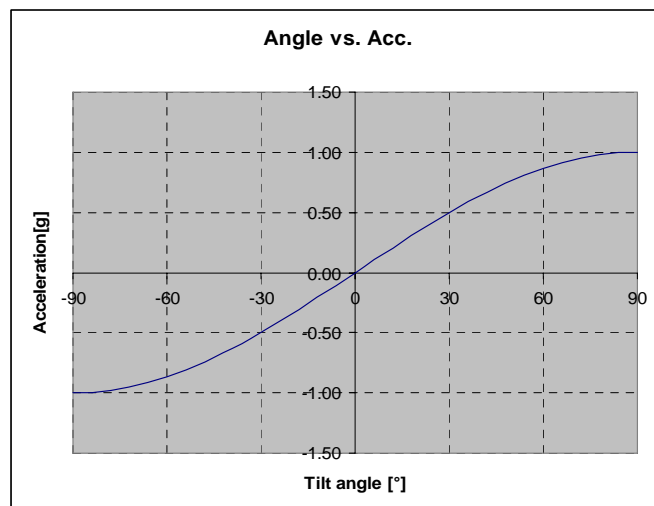
## OBJECTIVE

This document describes how to measure the rotational angle around a horizontal axle. Small inclinations are possible to measure accurately with one sensor, but when exceeding 30°, two sensors are usually required.

## DESCRIPTION OF APPLICATION

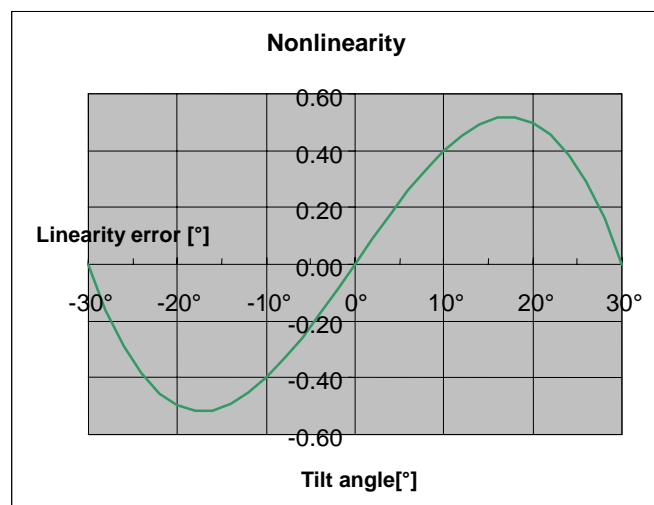
As the sensor is an accelerometer, the signal is linear with respect to the horizontal component of earth's gravity (=acceleration 1g), and sine shaped as a function of the tilt angle. By definition, the sensitivity will decrease when approaching 90° (fig.1.)

Figure1.  
Output in g as a function of the tilt angle.



Close to 0° the correlation between inclination in g and angle is nearly linear (fig.2.), thus enabling the use of the sensors in without additional signal processing.

Figure2.  
In the  $\pm 30^\circ$  range  
nonlinearity is 0,5°.



For linearization, the output signal needs to be transformed by the arcsine function.

$\alpha = \arcsin(x)$  , where x is the inclination in g

However, the accuracy decreases the further away from 0g one is, as does the sensitivity.

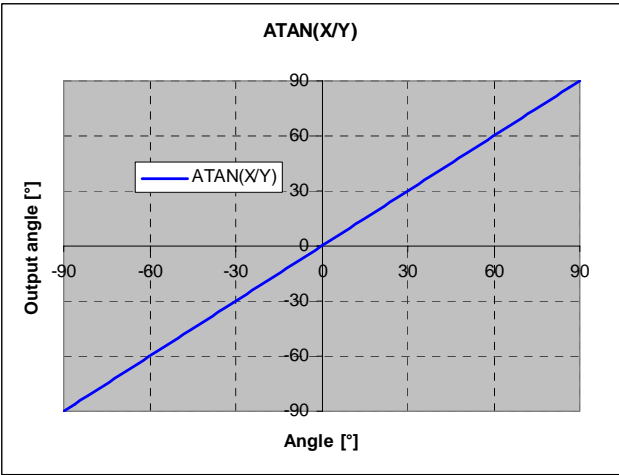


RECOMMENDATION

For good inclination accuracy, a dual axis sensor should be used. The measuring axes should be orthogonal to each other, and perpendicular to the rotation axis. By definition, the signal is linear when calculated as follows:

$\alpha = \arctan(\frac{x}{y})$  , where x and y are inclination in g

Figure 3.  
Linearized output signal by  
using dual axis sensor and  
arctan calculation.



APPLICATIONS

The above solution enables linear measurement over a wide inclination range, for example the counter- and clockwise rotation of a vertical plane.

Angle	0°	0...90°	90°	90...180°	180°	180...270°	270°	Dir. of gravity
X-channel	0g	0 => 1g	+1g	1 => 0g	0g	0 => -1g	-1g	
Y-channel	1g	1 => 0g	0g	0 => -1g	-1g	-1 => 0g	0g	
Position (module)								

SUITABLE VTI PRODUCTS

All VTI dual axis products with the measuring range ≥ 1g (90°) are suitable for this application.  
Parts available in the following series are: SCA1000, SCA100T, SCA121T, SCA124T, and SCA125T.