Zelenograd nanotechnology center

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K1382HM035

VLSI of signal converter for angular position sensors (sensor system on a chip)

Purpose

IC is designed for designing compact and fast responding angular position sensors. IC performs conversion of magnetic field position, generated by annular magnet relative to sensor system embedded into a code and in the form of standard analogue interfaces.

Principle of operation

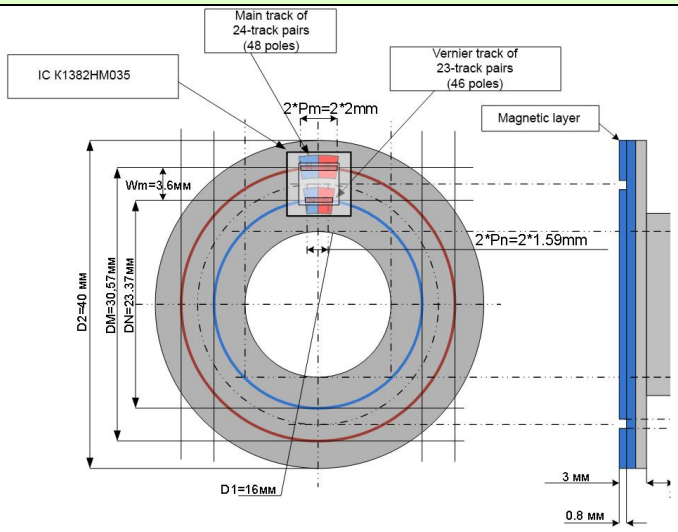
By means of two embedded in Hall elements sensor systems IC converts signal from magnetized multi-pole coded ring (or line) into digital code of absolute position. High total conversion resolution is achieved due to coded disk with two tracks having different number of poles. IC makes it possible to use coded magnetic carriers with different number of pole pairs (up to 64) and different length of pole pair.

IC possesses embedded automated gain control (AGC) at variation of distance between magnet and IC.

To compensate for conversion error caused by inaccuracies of position sensor assembling IC has embedded unit of code position linearization.

IC settings are stored in external nonvolatile memory IC EEPROM with I2C interface (of 24LC01 type and similar ones).

IC settings (programming) is performed through SPI or OWI interfaces.



Arrangement of IC relative to coded annular magnet at creation of angular position sensors

Technic specification

Parameters		not less than	less than
Maximum output voltage at outputs of PWM interface, V	$U_{O.MAX}$	$0.9 \cdot U_{CC}$	–
Minimum output voltage at outputs of PWM interface, V	$U_{O.MIN}$	–	$0.1 \cdot U_{CC}$
Input voltage at low level at terminals of MISO, PO3, PO4, V	U_{OL}	–	0.4
Output voltage at high level at terminals of MISO, PO3, PO4, V	U_{OL}	2.4	–
Current consumed by IC, mA (witout loading)	I_{CC}	–	50
Frequency of clock oscillator, MHz	f_{OSC}	50	–
Maximum tracking frequency, kHz	$f_{MAX.S}$	2	–
Maximum operating frequency of interface SPI, MHz:	f_{SPI}	4	–
Maximum frequency of pulse width modulation interface, kHz	f_{PWM}	20	–
Resolution of angular position readings on one pole pair, bit	RES	12	–
Maximum information capacity, natural units *	N	2^{16}	2^{17}
Conversion error, deg. (with switched and tuned linearization) *	Err	– 0.2	+0.2
Minimum magnetic field induction amplitude value, mT	B_{MIN}	–	5
Delay of signal propagation, microseconds	Td	–	50
Operating temperature range, °C	T	– 40	+125

* Measured at coded magnetic disk with 24 pole pairs.

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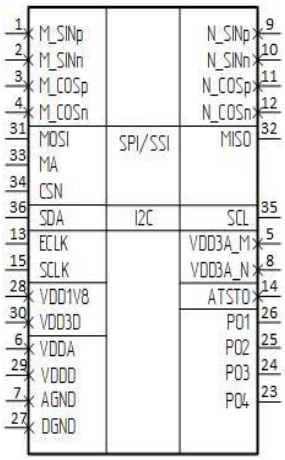
Interfaces Used

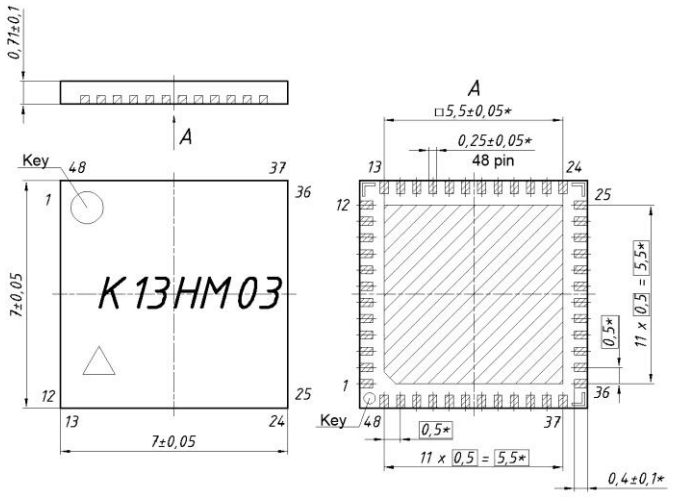
- Analogue output forms voltage proportional to current annular magnet position relative to sensor system;
- SSI/SPI interface is used for setting (programming) IC (in SPI mode) and issuing angular data (in SSI mode)
- OWI interface is used for setting (programming) IC, when access to SPI interface is disabled.
- Pulse width modulation (PWM) unit forms double-pusle sequence corresponding to angular code.
- Incremental interface forms incremental signals A/B/INDEX.

IC contains embedded temperature sensor unit designed to determine die temperature with resolution of 8 bit in temperature range: – 60 …+150 °C.

Graphic symbols

Terminal number	Symbol	Terminal assignment
1	M_SINp	Sine channel output of master track output, positive
2	M_SINn	Sine channel output of master track, negative
3	M_COSp	Cosine channel output of master track, positive
4	M_COSn	Cosine channel output of master track, negative
5	VDD3A_M	Output of master track channel stabilizer
6	VDDA	Analogue units supply
7	AGND	Analogue units ground
8	VDD3A_N	Output of vernier track channel stabilizer
9	N_SINp	Sine channel output of vernier track, positive
10	N_SINn	Sine channel output of vernier track, negative
11	N_COSp	Cosine channel output of vernier track, positive
12	N_COSn	Cosine channel output of vernier track, negative
13	ECLK	Input of external clock frequency, testing
14	ATSTO	Testing analogue output
15	SCLK	Enable input of external clock frequency, testing
16-22	–	Not used
23	PO4	Data output 4
24	PO3	Data output 3
25	PO2	Data output 2
26	PO1	Data output 1
27	DGND	Digital units ground
28	VDD1V8	Stabilizer output
29	VDDD	Digital units supply
30	VDD3D	Stabilizer output
31	MOSI	SPI data input
32	MISO	SPI/SSI data output
33	MA	Input of clock frequency SPI/SSI
34	CSN	Input CSn of SPI interface
35	SCL	Line SCL of external I2C EEPROM
36	SDA	Line SDA of external I2C EEPROM
37-48	–	Not used





Dimensional outline in 48-output package PQFN-7x7-48

Applications

- ✓ Position sensors in inverted motor rotor;
- ✓ Robotics;
- ✓ Industrial position sensors;
- ✓ Position sensors for auto electronics.