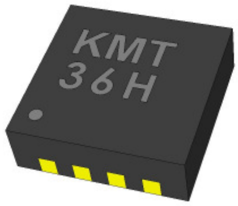
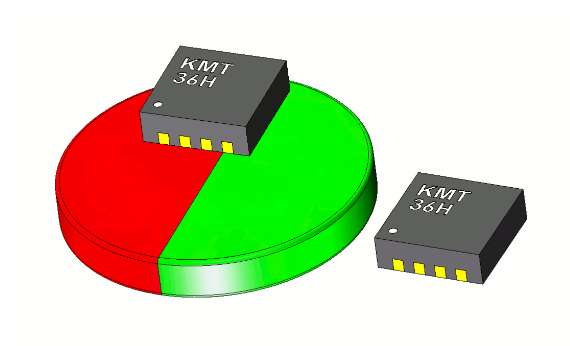
KMT36H 360° Angular Sensor

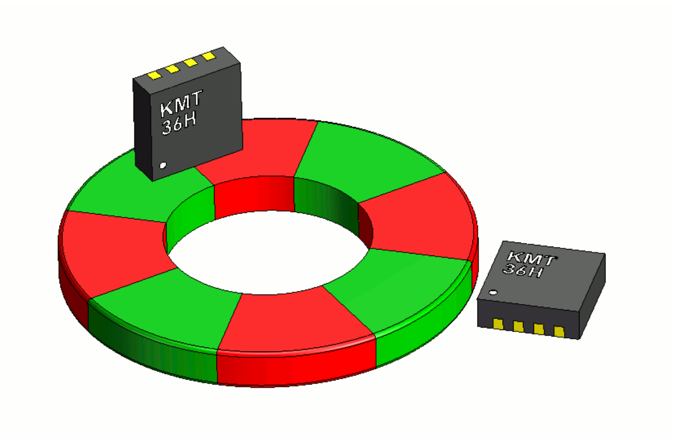


- **AMR Sensor with 360° capability**
- **TDFN outline 2.5x2.5x0.75 mm^3**
- **Three 120° phase-shifted signals**
- **Moderate field strength requirements**

DESCRIPTION

The **KMT36H** is a magnetic field sensor utilizing the anisotropic magnetoresistance effect. Therefore the sensor is sensing the **magnetic field direction** rather than the magnetic field strength. The sensor contains three Wheatstone bridges rotated by 120°. A rotating magnetic field (typical strength 25 kA/m in the sensor plane) will result in three sinusoidal output signals with a period of 180°, phase shifted by 60° field angle. By use of a modified *atan* algorithm the field angle can be calculated with high accuracy.





As an unique feature, the KMT36H is able to measure full 360° by utilizing an additional magnetic field which is generated by a planar coil which is located on the chip. The 180°/360° determination is done by a simple sign distinction and may be proceeded periodically or only once at power up.

FEATURES

- Ideal for harsh environments due to magnetic sensing principle
- Contactless absolute angular measurement over 360°
- Accuracy +/- 0.5°
- Three bridge signals with 120° phase difference
- Tiny TDFN-Housing 2.5 x 2.5 x 0.8 mm^3

APPLICATIONS

- Absolute angle measurement
- Potentiometer replacement
- Motor motion control
- Camera positioning
- Robotics

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CHARACTERISTIC VALUES

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Mechanical dimensions						
Length		X		2.5		mm
Width		Y		2.5		mm
Height		Z		0.8		mm
Operating limits						
Supply voltage		V_{CC}		5	12	V
Coil current		I_{COIL}		20	50	mA
Operating temperature			-40		+125	°C
Storage temperature			-40		+125	°C

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Sensor specification						
Applied magnetic field	2), 3)	H	15	25	60	kA/m
Bridge resistance	T = 25 °C	R_B	2.4	3	3.6	kΩ
max. signal range	T = 25 °C, H = 25 kA/m	$\Delta V/V_{CC}$	16	20	25	mV/V
Offset voltage 4)	T = 25 °C	V_{OFF}/V_{CC}	-5		+5	mV/V
Hysteresis 1) (Repeatability)	H = 25 kA/m	Hyst		0.15	0.3	deg
Accuracy 1)	H = 25 kA/m	$\Delta\alpha$		0.15	0.3	deg
TC of amplitude	Ref. temperature = -25 °C, H = 25 kA/m	TC_{AMP}		-0.32		%/K
TC of bridge resistance	Ref.temp. = -25 °C	TC_R		+0.32		%/K
Coil resistance	T = 25 °C	R_{COIL}	75	100	150	Ω

1) Hysteresis and accuracy are depending nearly inversely proportional on the magnetic field strength.
2) Generated with reference magnet 67.044 Magnetfabrik Bonn (25 kA/m @ 5,2 mm distance).
3) Minimum value depends on decreasing accuracy, upper limit on decreasing coil influence. Both are no absolute limits, but depend on the given application requirements.
4) Offset voltages measured as difference voltages V_{O1}-V_{O2}, V_{O2}-V_{O3} and V_{O3}-V_{O1} in relation to V_{CC}.

BLOCK DIAGRAM

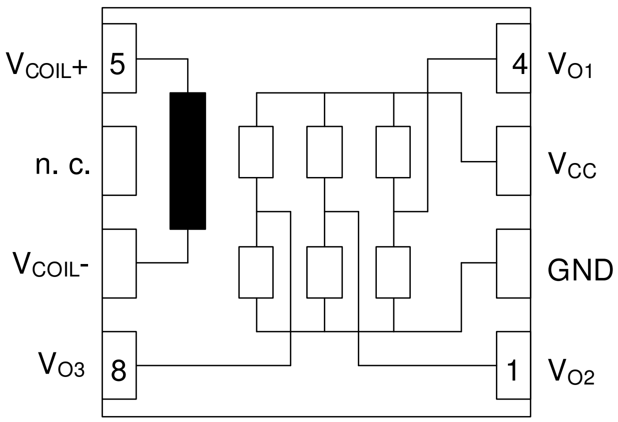

Figure 1: internal and external connections (TDFN, Chip)

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SENSOR OUTLINE

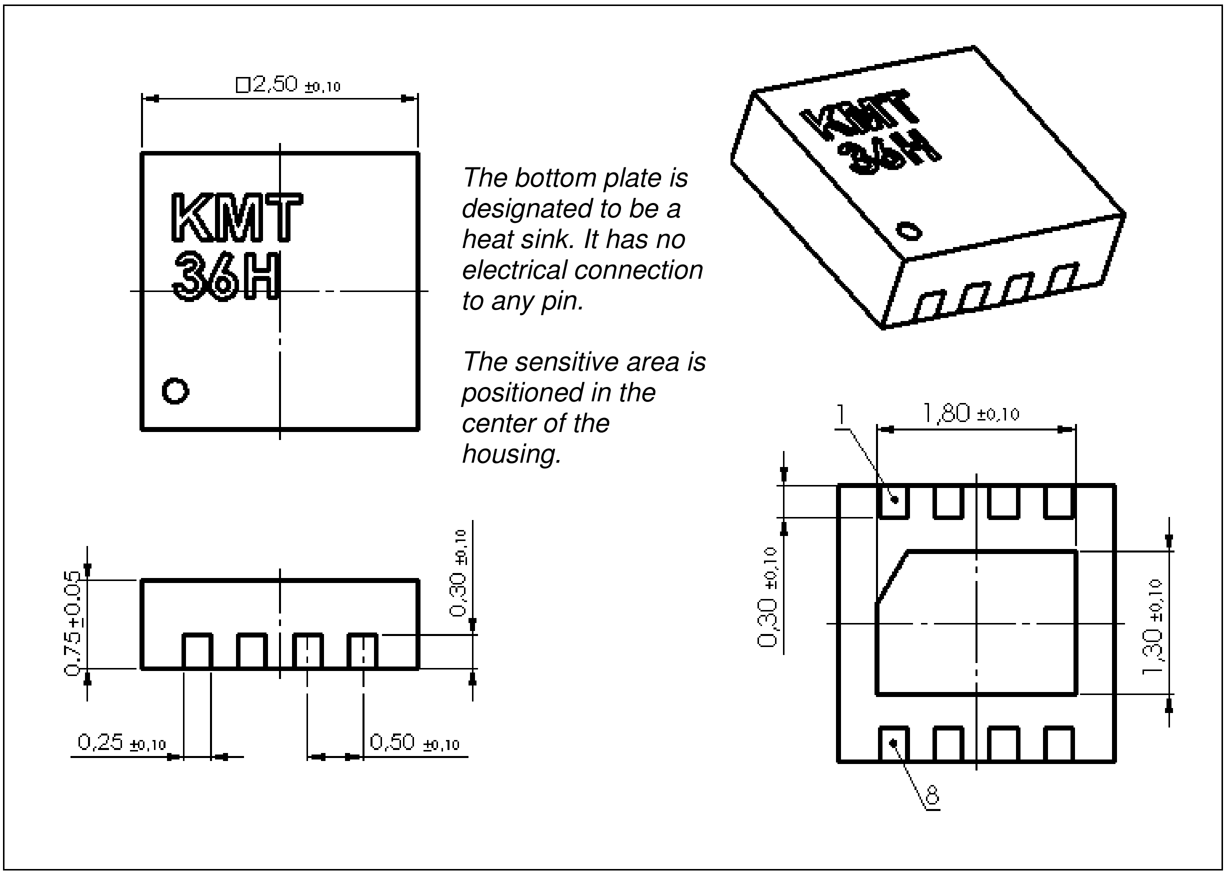
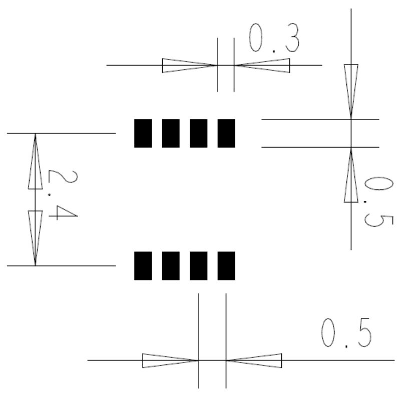


Figure 2: TDFN-outline

Pin assignment:

Pin	Symbol	Function
1	V_{O2}	signal output 2
2	GND	negative supply voltage
3	V_{CC}	positive supply voltage
4	V_{O1}	signal output 1
5	V_{COIL+}	positive coil input
6	n. c.	not connected
7	V_{COIL-}	negative coil input
8	V_{O3}	signal output 3

Recommended Solder Layout:



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TYPICAL PERFORMANCE CURVES

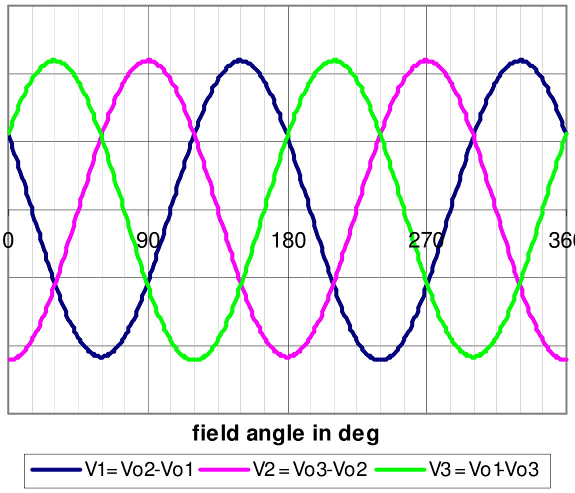

Figure 3: output voltages

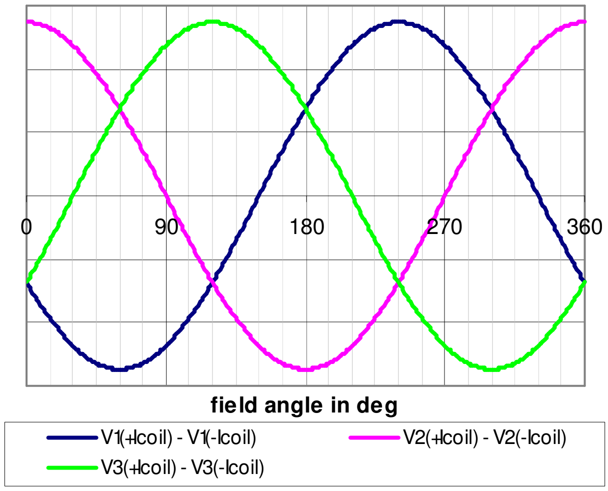

Figure 4: output voltage change due to coil influence

SIGNAL EVALUATION

180° EVALUATION

As output voltages (V_1, V_2, V_3) we use the three possible differences between the three signal outputs (see fig. 3). At first the true offsets must be subtracted from the raw signals. The field angle α in a 180°-range then can be calculated in the following manner:

$$\alpha = \frac{1}{2} \cdot \arctan\left(\frac{2 \cdot \frac{Vn}{Vm} + 1}{\sqrt{3}} \right)$$

Using the three possible combinations of output signals (m,n = 1,2 ; 2,3 ; 3,1) three results are obtained, which can be averaged to increase accuracy. Comparing the three results gives additional information about their reliability.

360° EVALUATION

To distinguish between α and α+180° two measurements are needed one with positive, the other with negative coil current. In the next step the change in the signals due to the influence of the coil current must be calculated. The sign of these coil-induced output voltage changes gives the 360°-information by case differentiation (see fig. 4) .

APPLICATION EXAMPLES

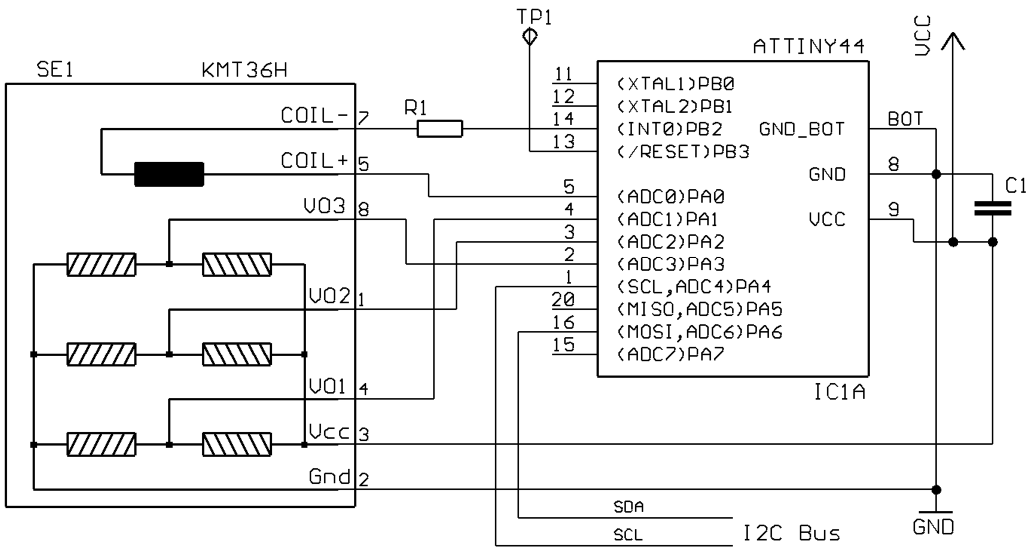

Figure 5: One exemplary hardware configuration using an Atmel ATtiny µC

ORDERING INFORMATION

DEVICE	PACKAGE	PART NUMBER
KMT36H	TDFN 2.5 x 2.5	G-MRCO-021