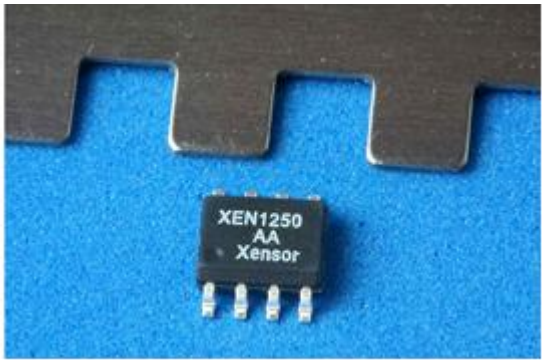
XEN1250
Digital Magnetic Switch

Features

- **Digital magnetic movement sensor.**
- **3 wire operation**
- **Very low magnetic thresholds**
- **Programmable speed and threshold**
- **High magnetic operation range**
- **No permanent effects with magnetic field overloading**
- **North-South pole independent.**
- **No external components**
- **Small size**
- **SOIC8 package**
- **Available in tube**



General Description

The XEN1250 is an ultra-sensitive magnetic movement sensor specifically designed to determine the movement of weak magnetic targets. Typically it can be used with sensor-magnet distances up to or over 20cm. The sensor has two supply pins and a NMOS open drain output pin which pulls a few mA. The output pin is drawn to GND in case a programmed magnetic threshold is exceeded by a magnetic field pulse.

The XEN1250 sensor is sensitive to a magnetic field applied perpendicularly to the ASIC top surface. The XEN1250 should be mounted so that a single positive or a single negative pulse is created with a passing magnet.

Applications

- **Long distance magnetic targets**
- **Slow moving targets**

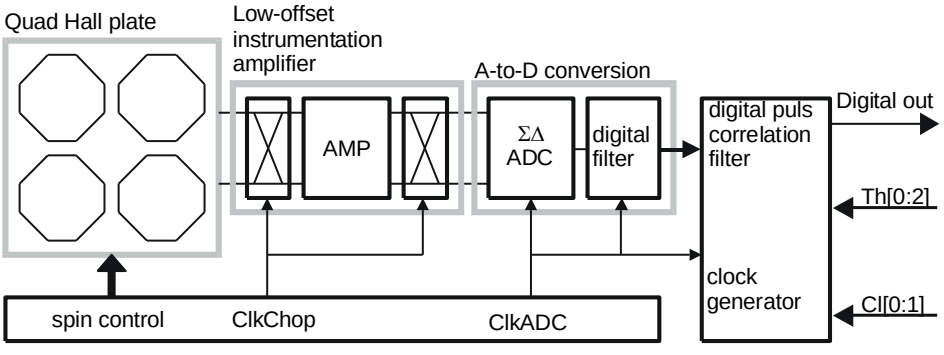


Figure 1: XEN1250 scheme with magnetic movement correlation filter.

Specifications

Table 1: Specifications for the XEN1250.

Specification	Conditions	Min	Typ.	Max	Unit
Power supply					
VDD		4.75	5	5.25	V
IDD		5.5		6.5	mA
Digital output					
Ioutput			1	4	mA
R pullup			10		kOhm
On-time output			219		Clkperiods
On-time output	@ 2.6MHz Clk		200		ms
Temperature range					
operating range		-30		+100	°C
Internal ADC					
output rate			216/217		Clkperiods
output rate	@ 1.3MHz Clk		20/10		Hz
output rate	@ 2.6MHz Clk		40/20		Hz
resolution (LSB)			0.33		µT
range		-10.8		10.8	mT
Internal clock generator					
Cl[0:1]					
00			1		MHz
01			1.3		MHz
10			1.7		MHz
11			2.6		MHz
Absolute accuracy			50		%
Threshold levels (Note 3)					
Th0			16		filterbits
Th1			32		filterbits
Th2			64		filterbits
Pulse correlation filter					
Update rate			As ADC		
Decision delay			5		ADCsamples
Noise performance	@ 25°C				
magnetic noise density			0.1	0.15	$\mu T/\sqrt{Hz}$
magnetic noise density	@ 20Hz ADCsamples		8.6		filterbits

Magnetic Flux Density: 100 micro Tesla (µT) = 1 gauss (G) =1Oe (in air)
Magnetic Field: 1 oersted (Oe) = 79.58 amperes/meter (A/m)
100 000 gamma = 1 Oe = 79.58 A/m
Note 1: Dependant on clock frequency
Note 2: Output rate of internal ADC is 2x as fast with fast conversion activated.
Note 3: Magnetic threshold levels should be at a safe distance from the expected magnetic and sensor noise to avoid false triggering of the sensor

Introduction

The XEN1250 is an ultra low threshold digital magnetic movement sensor. It is based on the Q- Hall technology used in the XEN1210 compass sensor. The factory programmed XEN1250 is activated with magnetic pulses roughly above 2µT or below –2µT with pulse widths between 50ms and 1s. This is equivalent to a magnetic field created by a magnet on a distance to or over 20cm from the sensor.
The XEN1250 should be mounted so that a single positive or a single negative pulse is created with a passing magnet. In case a passing magnet causes a successive positive and negative pulse, the output will trigger twice.

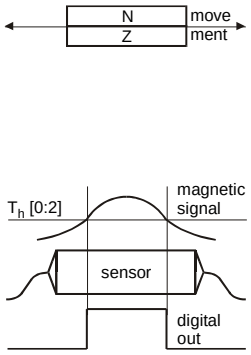


Figure 2: Typical application of the XEN1250

With the detection of a magnetic pulse the output pin is pulled to ground for a predetermined period of typical 300ms by an NMOS open drain transistor. The load on the output pin should not exceed 4mA. The output should be pulled up by a 10kOhm resistor to the supply voltage of the receiving unit. This voltage may not exceed the 5V supply voltage needed for the XEN1250.

The magnetic dynamic range of the XEN1250 is -10mT to 10mT. This assures correct working over the earth magnetic field orientation and disturbing magnetic sources.
The XEN1250 cannot be damaged by high magnetic fields, in contrast to many magneto resistive sensors. The XEN1250 is a mixed-mode ASIC designed for use in combination with digital devices, such as micro-controllers, sharing the same power supply. Adequate decoupling will be beneficial for the performance of the chip. A single 100nF capacitor between VDD and ground is recommended.

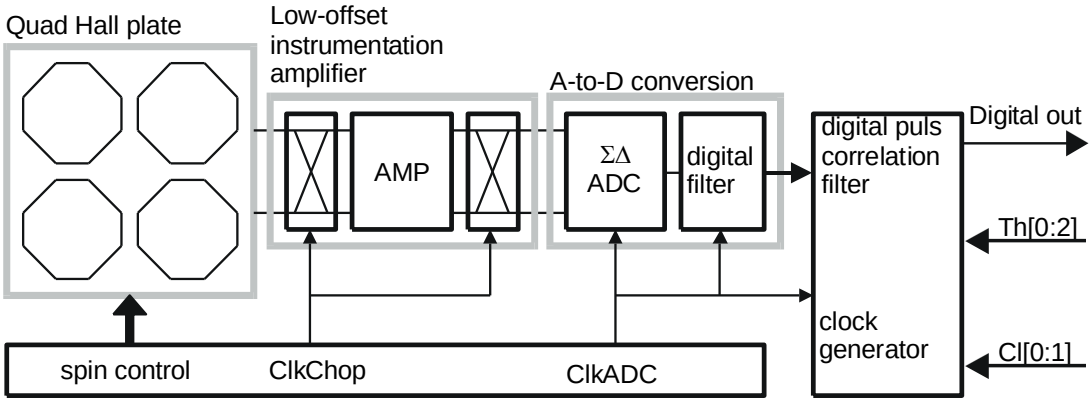


Figure 3: Quad Hall plate scheme

Advanced design Instructions

The XEN1250 magnetic thresholds and speeds can be programmed by the user by pulling one or more of the program pins on the SOIC8 package to GND. In order to make the correct decisions, it is wise to read these advanced design instructions. Please contact us for more details.

Sensor magnetic filtering

The XEN1250 is equipped with sophisticated analog and digital filtering, reducing the interference of magnetic disturbances to the lowest limits. This is done in two steps.

Analog filter

The amplified magnetic signal is continuously integrated in a Sigma-Delta ADC analog loop filter. This offers an excellent interference rejection for high-frequency (electro)magnetic noise sources which could falsely trigger a sensor.
By choosing the integration period as a multiple of the power supply frequency of 50 or 60 Hz,
an excellent normal mode rejection ratio (NMRR) can be obtained as well.
The conversion speed, thus integration period of the ADC is controlled by the internal clock-generator. The output frequency of the generator can be programmed by pulling the two Cl[0:1] pins to ground or leaving them floating, with resulting output frequencies as in Table 2.1. Further control of the integration period is done with the fast conversion (FS) program pin. If it is left unconnected the integration period is 2^{16}, if it is pulled to GND 2^{17} clock periods. A good NMRR is obtained with a CLK frequency of 1311 kHz and FS on GND.

Table 2: Conversion

Cl[0:1]	CLK frequency (kHz)	Conversion time (ms)	Conversion frequency (Hz)
00	1000	62.5/125	16/8
01	1311	50/100	20/10
10	1700	37/75	26/13
11	2622	25/50	40/20

Pulse correlation filter

The ADC values are further processed with a digital bandpass filter, which is particularly tuned to the detection of a passing magnet on a rotating/moving arm.
The middle frequency of this filter is 5 times tunable by choosing the operation speed of the ADC, as discussed in the former section. In this way the performance can be optimized for the expected band of rotation/movement speeds.
The filter phase shift is never more than 5 ADC samples. The filter output and also digital decision will update on the same rate as the internal ADC. The filter is fully symmetrical for North-South magnet orientation and rotation direction.

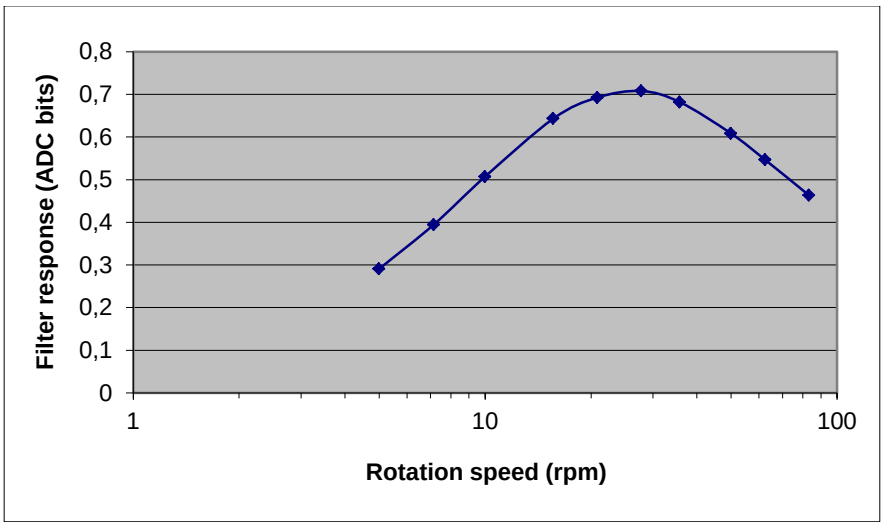


Figure 4: Frequency response of the magnetic pulse correlation filter for an ADC rate of 20Hz.

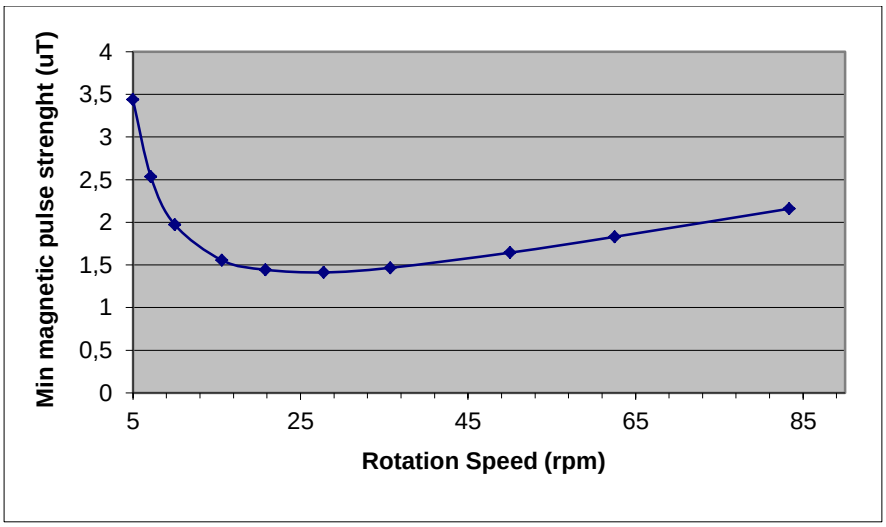


Figure 5: Minimum magnetic field strength of a magnetic pulse from a rotation target which is needed to trigger the XEN1250 with a sample frequency of 20Hz and a threshold level of 32.

The XEN1250 will trigger in case the filter output exceeds a programmed threshold level. The magnetic threshold of the sensor can be programmed with binary code on the T_h[0:2] pins, so values between 16 and 112 can be obtained. Since the sensor is ultra sensitive, it is important that the magnetic background fluctuations and sensor noise peaks do not exceed this level.

Magnetic noise
The sensor noise can be calculated with the sensor speed and noise figures given, and is:

$$\sigma(noise,\ filterbits) \approx 2\sqrt{ADCrate}$$

With an ADC sample rate of 20Hz, this would be a noise level of 9 bits filter output.

Avoid false triggering
In order to avoid false triggering, trigger levels should well exceed this noise. A recommended value would be 3 times the noise level. So the closest programmable threshold level is 32 bits, this would be T_h[0:2]=[010]. With a higher programmed ADC speed, other threshold levels can be calculated and programmed.

Ensure signal triggering
In order to ensure signal triggering the signal should exceed the threshold level with a similar margin.

Background fluctuations
In general lower magnetic thresholds than 32 bits are not wise because magnetic background fluctuations, such as modulation of the earth magnetic field by passing cars can easily be higher.

Lead Pin Configuration

The XEN1250 is delivered in SOIC8.

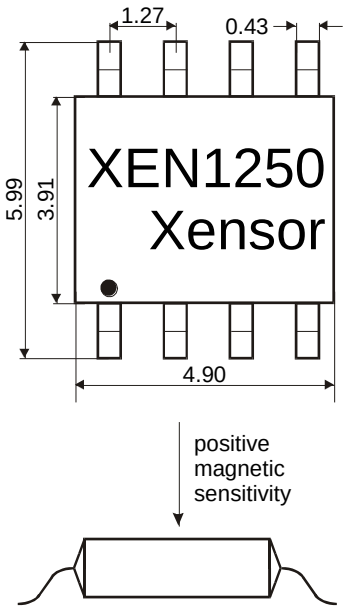


Figure 6: SOIC8 footprint and magnetic sensitivity position.

Table 3: XEN-1250 SOIC8 pin configuration

Pin	Name	Type	Functionality
1	FS	Dig. In	Fast conversion. If unconnected the operation of the ADC is in fast mode. By pulling this pin to GND it can be put in slow mode.
2	Th_0	Dig. In	First program pin for magnetic threshold. If unconnected it is on one. If pulled to GND on zero.
3	Th_1	Dig. In	Second program pin for magnetic threshold. If unconnected it is on one. If pulled to GND on zero.
4	Th_2	Dig. In	Third program pin for magnetic threshold. If unconnected it is on one. If pulled to GND on zero.
5	OUT	Tri-state Out	Open drain output. Should be connected to a maximum of 5V with a pull up resistor of 10k
6	GND	Power	Ground
7	VDD	Power	5 V Supply power connection.
8	Cl_1	Dig. In	Program pin for the internal clock generator. If unconnected it is on one. If pulled to GND on zero.

Ordering information

Table 4: Ordering number.

Ordering number	Product
XEN1250-SOIC8	Single sensor SOIC8

General Information

Product Status

The XEN1250 is in production in SOIC8 and is delivered in tubes.
Customers are encouraged to check for further product developments. Please contact Sensixs Design b.v. for further details.

Right to make changes

Sensixs Design reserves the right to make changes to improve reliability, function or design of the devices. Sensixs Design assumes no responsibility or liability for the use of this product.

Application Information

Applications that are described herein are for illustrative purposes only. Sensixs Design makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Life critical applications

These products are not qualified for use in life support applications, aeronautical applications or devices or systems where malfunction of these products can reasonably be expected to result in personal injury

Sensixs Design b.v.
Distributieweg 28
2645 EJ Delfgauw
The Netherlands

Phone +31 (0)15-3010018
Web: www.sensixs.nl