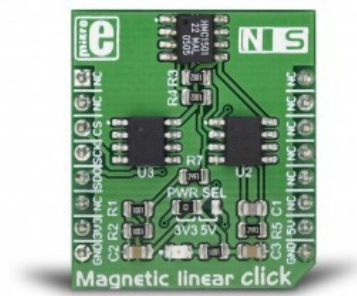


Magnetic linear Click



PID: MIKROE-3274

Magnetic linear click is a very accurate position sensing Click board™ which utilizes the HMC1501, a magnetic field displacement sensor IC. This integrated sensor uses a single saturated-mode Wheatstone bridge which consists of four magneto-resistive elements. The precision of up to 0.07° in the angular range of $\pm 45^\circ$ can be easily achieved using the Magnetic linear click, making it far more accurate than the commonly used Hall-effect sensors.

It comes in the package which also includes the mikroSDK™ software and a library with all the functions. The Click board™ comes as a fully tested and approved prototype, making it a reliable device ready to use on the development board.

The HMC1501 sensor IC produces a highly linear voltage output signal in respect to the magnetic field angle, available directly from the bridge via two differential output pins. To allow simplified usage, the Magnetic linear click features an additional A/D converter, making it a complete solution for the rapid development of various contactless position and direction sensing applications, HMI interfaces, precision measurement applications, proximity detection applications, etc.

How does it work?

The main component of the Magnetic linear click is the [HMC1501](#), a linear magnetic displacement sensor, from [Honeywell](#). The key feature of the HMC1501 IC is the high accuracy of the magnetic field sensing. Unlike most of the magnetic sensors on the market which rely on the Hall-effect, the integrated sensors of the HMC1501 IC are produced using the Honeywell's proprietary Anisotropic Magneto-Resistive (AMR) technology, which yields an absolute

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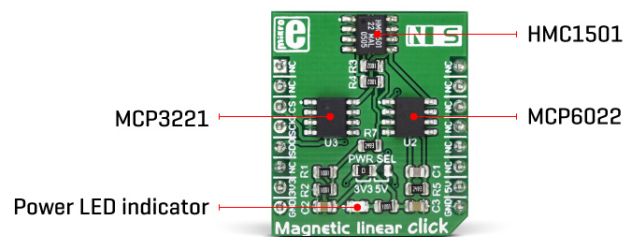


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magnetic angle sensing with the angular error of only 0.07° in the range of $\pm 45^\circ$. The magneto-resistive sensing elements form a single saturated-mode Wheatstone bridge, positioned in the XZ plane (parallel with the surface of the IC). The bridge is positioned towards the edge of the IC casing, allowing which is the optimal position for linear sensing applications. The IC outputs an analog differential voltage with respect to the angle of the magnetic field.



The voltage from the selected mikroBUS™ power rail is directly applied to the internal Wheatstone bridge of the HMC1501. By construction, in the absence of the magnetic field, its outputs will be set at half the supply voltage (with the small offset of 3mV/V typically). The same applies if there is a magnetic field present, but it is positioned at 0° (zero-crossing) in respect to the bridge. In both cases all the magneto-resistive elements forming the bridge, will have identical resistances. Once the magnetic field is applied in any direction in the range of $\pm 45^\circ$, the bridge will become unbalanced, resulting with voltage change on the outputs, which can be calculated using the following formula:

$$\Delta V = -V_S \cdot S \cdot \sin(2\theta)$$

Where:

- ΔV is a differential output voltage
- V_S is the power supply voltage (3.3V or 5V)
- S is the material constant (12mV/V)
- θ is the angle of the magnetic field

The datasheet of the HMC1501 offers a more detailed explanation, along with some use cases. However, Magnetic linear click is supported by the mikroSDK library, which offers easy to use functions. All necessary calculations are encapsulated in these functions, allowing rapid application development. The included example application can be used as a reference and a starting point for a custom design.

Outputs of the Wheatstone bridge are routed to the operational amplifier, which serves as the buffer for the A/D converter. For this purpose, only a single channel of the MCP6022, a dual rail-to-rail op-amp from Microchip, is used. This op-amp is biased to half the power supply voltage and has a gain of 25. This buffered signal is then used as the input for the A/D converter.

Magnetic linear click uses the MCP3201, a 12-bit A/D converter (ADC) with the SPI Interface, produced by Microchip. This ADC has a high resolution which can be used even for more

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demanding applications. At 0°, the ADC will output half of its full-scale (FS) value, and it will swing towards 0 if the angle of the magnetic field is positioned towards the negative direction, and 4095 if the angle of the magnetic field is positioned towards the positive direction. This ADC has a dedicated voltage reference input pin, allowing ADC conversion within the range of the input signal. The converted output value can be read via the SPI interface, routed to the mikroBUS™ SPI pins for easy interfacing with a vast number of different microcontrollers (MCUs).

The power supply voltage for the whole circuit can be selected by switching the SMD jumper, labeled as PWR SEL. It offers a choice of the power supply voltage between 3.3V and 5V, available from the mikroBUS™.

Specifications

Type	Magnetic
Applications	Magnetic linear click can be used for development of various contactless position and direction sensing applications, HMI interfaces, precision measurement applications, proximity detection applications, etc.
On-board modules	HMC1501, a magnetic displacement sensor, from Honeywell; MCP6022, a dual, rail-to-rail operational amplifier; MCP3201, a 12-bit A/D converter with SPI interface by Microchip
Key Features	A very high precision is achieved by implementing the proprietary Anisotropic magneto-resistive (AMR) technology from Honeywell, absolute sensing of the magnetic field, very compact size, differential outputs from the internal Wheatstone bridge
Interface	SPI
Feature	No ClickID
Compatibility	mikroBUS™
Click board size	S (28.6 x 25.4 mm)
Input Voltage	3.3V or 5V

Pinout diagram

This table shows how the pinout on **Magnetic linear click** corresponds to the pinout on the mikroBUS™ socket (the latter shown in the two middle columns).

Notes	Pin					Pin	Notes
	NC	1	AN	PWM	16	NC	
	NC	2	RST	INT	15	NC	
SPI Chip Select	CS	3	CS	RX	14	NC	

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SPI Clock	SCK	4	SCK	TX	13	NC	
SPI Data OUT	SDO	5	MISO	SCL	12	NC	
	NC	6	MOSI	SDA	11	NC	
Power supply	3V3	7	3.3V	5V	10	5V	Power supply
Ground	GND	8	GND	GND	9	GND	Ground

Onboard settings and indicators

Label	Name	Default	Description
LD1	PWR	-	Power LED indicator
J1	PWR SEL	Left	Power supply voltage selection: left position 3.3V, right position 5V

Software support

We provide a library for the Magnetic linear click on our [LibStock](#) page, as well as a demo application (example), developed using MikroElektronika compilers. The demo can run on all the main MikroElektronika development boards.

Library Description

The library contains a function for reading the linear position of the magnet.

Key functions:

- `uint16_t magneticlinear_readData()` - Functions reads Magnetics Linear data

Examples description

The application is composed of the three sections :

- System Initialization - Initializes SPI init and sets CS pin as OUTPUT
- Application Initialization - Initialization driver init
- Application Task - (code snippet) - Reads Magnetics linear data and this data logs to USBUART every 200ms.

The full application code, and ready to use projects can be found on our [LibStock](#) page.

Other mikroE Libraries used in the example:

- GPIO

Additional notes and information

Depending on the development board you are using, you may need [USB UART click](#), [USB UART 2 click](#) or [RS232 click](#) to connect to your PC, for development systems with no UART to USB interface available on the board. The terminal available in all MikroElektronika [compilers](#), or any other terminal application of your choice, can be used to read the message.

Specifications

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Resources

[mikroBUS™](#)

[mikroSDK](#)

[Click board™ Catalog](#)

[Click Boards™](#)

Downloads

[Magnetic linear click example on Libstock](#)

[Magnetic linear click 2D and 3D files](#)

[HMC1501 datasheet](#)

[Magnetic linear click schematic](#)

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