PRINCIPLES OF OPERATION

Anisotropic magnetoresistance (AMR) occurs in ferrous materials. It is a change in resistance when a magnetic field is applied in a thin strip of ferrous material. The magnetoresistance is a function of $\cos^2\theta$ where θ is the angle between magnetization M and current flow in the thin strip. When an applied magnetic field is larger than 80 Oe, the magnetization aligns in the same direction of the applied field; this is called saturation mode. In this mode, θ is the angle between the direction of applied field and the current flow; the MR sensor is only sensitive to the direction of applied field.

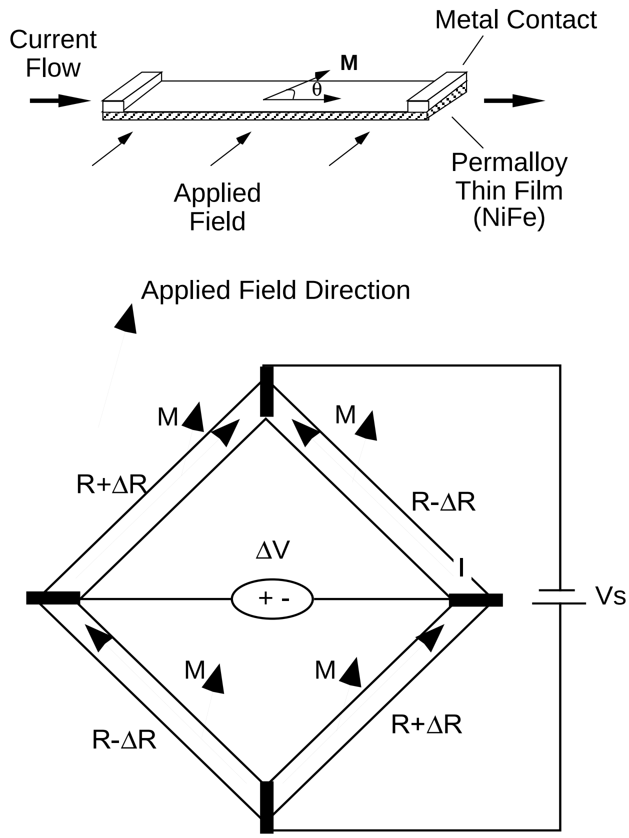


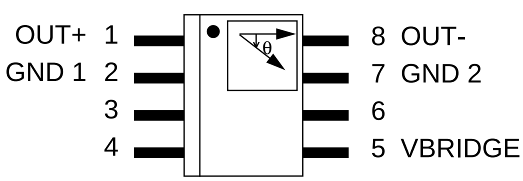
Figure 1

The sensor is in the form of a Wheatstone bridge (Figure 1). The resistance R of all four resistors is the same. The bridge power supply V_S causes current to flow through the resistors, the direction as indicated in the figure for each resistor.

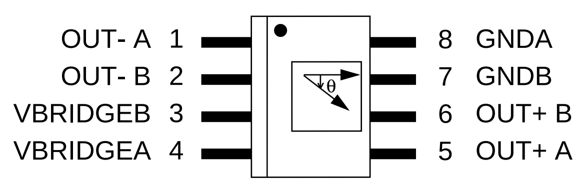
Both HMC1501 and HMC1512 are designed to be used in saturation mode. HMC1501 contains one MR bridge and HMC1512 has two identical MR bridges, coexisting on a single die. Bridge B physically rotates 45° from bridge A. The HMC1501 has sensor output $\Delta V=-V_S S \sin(2\theta)$ and the HMC1512 has sensor output $\Delta V=V_S S \sin(2\theta)$ for sensor A and sensor B output $\Delta V_S=-V_S S \cos(2\theta)$, where V_S is supply voltage, S is a constant, determined by materials. For Honeywell sensors, S is typically 12mV/V.

PINOUT DRAWINGS

HMC1501

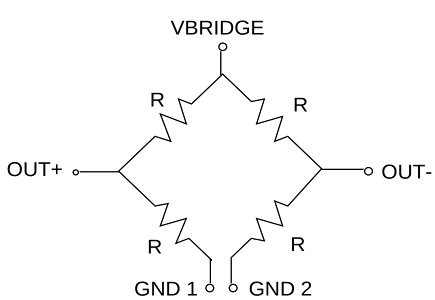


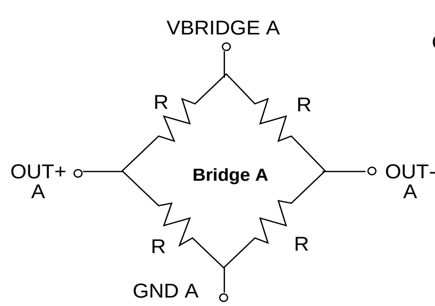
HMC1512

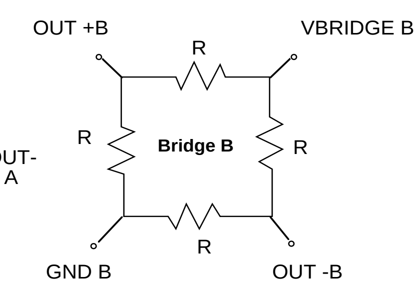


Caution: Do not connect GND or Power to Pin 3,4 &6.

MR SENSOR CIRCUITS

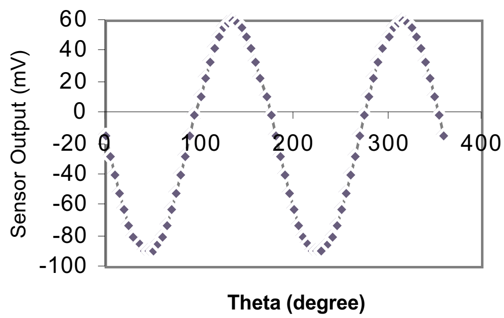




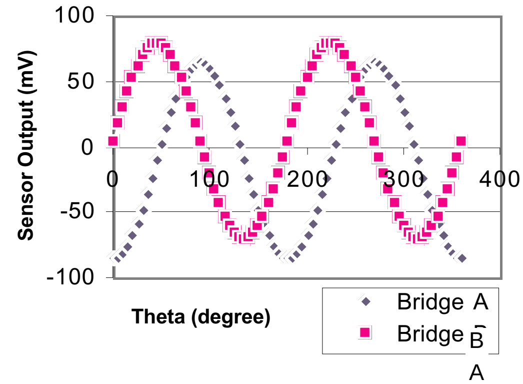


TYPICAL SENSOR OUTPUT

HMC1501 output voltage vs. magnetic field angle

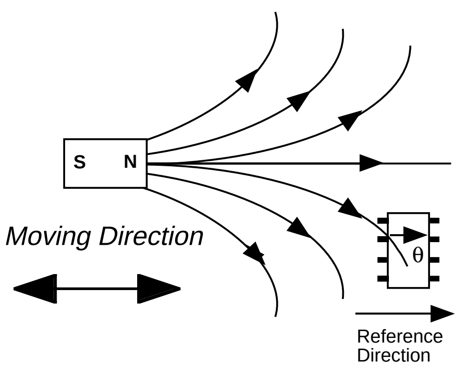


HMC1512 output voltage vs. magnetic field angle

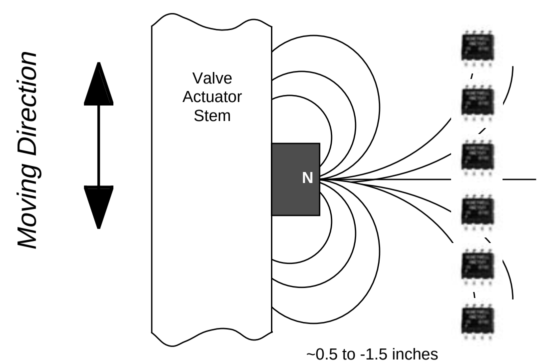


APPLICATION CONFIGURATION

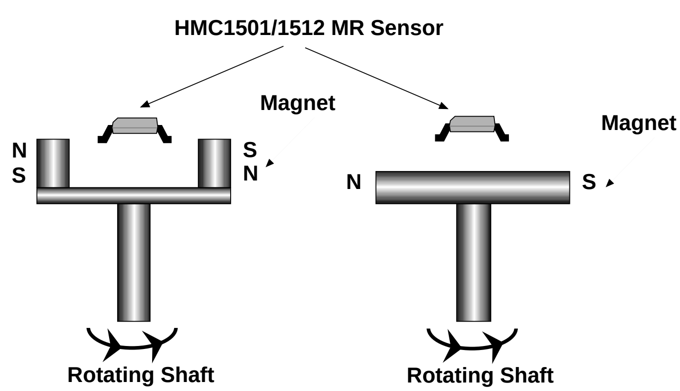
Proximity Position



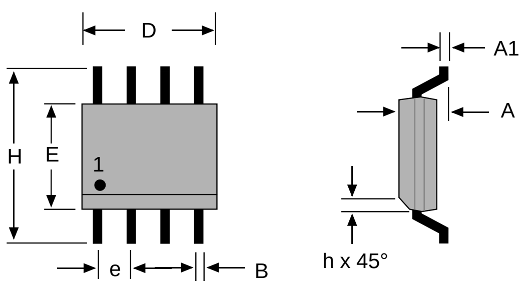
Linear Position



Rotary Position



PACKAGE DRAWING 8-Pin SOIC



Symbol	Millimeters		Inches	
	Min	Max	Min	Max
A	1.371	1.728	.054	.068
A1	0.101	0.249	.004	.010
B	0.355	0.483	.014	.019
D	4.800	4.979	.189	.196
E	3.810	3.988	.150	.157
e	1.270 ref		.050 ref	
H	5.816	6.198	.229	.244
h	0.381	0.762	.015	.030

SPECIFICATIONS

Characteristics	Conditions*	HMC1501			HMC1512			Units
		Min	Typ	Max	Min	Typ	Max	
Bridge supply	Vbridge referenced to GND	1	5	25	1	5	25	V
Bridge resistance	Bridge current—1 mA	4	5	6.5	2.0	2.1	2.8	KΩ
Angle range	≥ Saturation field	-45		+45	-90		+90	deg
Sensitivity	Vbridge = 5V, field 80 Oe, (1) @ zero crossing (2) @ Zero crossing, averaged in the range of 45°		2.1 1.8			2.1 1.8		mV/°
Peak -to-peak Voltage	Vbridge = 5V, field = 80 Oe	100	120	140	100	120	140	mV
Bridge offset	Field 80 Oe, θ =0° Bridge A Bridge B	-7	3	7	0 -4	2.5 0	5 1	mV/V
Saturation field	Repeatability <0.03% FS	80			80			G
Bandwidth	Magnetic signal	0		5	0		5	MHz
Resolution	Bandwidth =10Hz,Vbridge =5V		0.07			0.05		°
Hysteresis error	Magnetic field ≥saturation field, Vbridge = 5V		30 $1.7x10^{-2}$			30 $1.7x10^{-2}$		µV deg
Bridge Ω tempco	T_A = -40° C to +125° C		0.28			0.28		%/° C
Sensitivity tempco	T_A = -40° C to +125° C Vbridge = 5V		-0.32			-0.32		%/° C
Bridge offset tempco	T_A = -40° C to +125° C		-0.01			-0.01		%/° C, FS
Noise Density	Noise at 1Hz, Vbridge = 5V		100			70		nV Hz
Power Consumption	Vbridge = 5V		5			23		mW

*Tested at 25°C except stated otherwise.

Sensitivity tempco $C_s = \frac{S_t - S_o}{S_o * t} = -0.32\%/°C$

Where S_o = sensitivity at zero temperature
t = temperature in the range -40°C to 125°C
S_t = sensitivity at temperature t

Offset tempco $C_o = \frac{V_o(t) - V_o(o)}{V_{P-P} * t} = -0.01\%/°C$

Where $V_o(o)$ = bridge offset at zero temperature
V_{P-P} = peak-to-peak voltage
t = temperature in the range -40°C to 125°C
$V_o(t)$ = offset at temperature t

Power consumption $P = \frac{V^2}{R}$

Where V = Bridge supply voltage
R = Bridge resistance

1 KA/m = 12.5 Gauss
1 Tesla = 10^4 Gauss

Honeywell

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