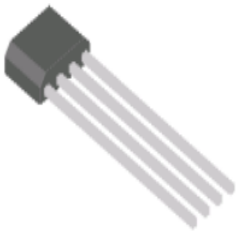
Programmable Linear Hall Sensor

PRODUCT DESCRIPTION

The MS1820 is a programmable linear hall sensor, whose output is an analog output independent of the power supply. It can be used for magnetic field measurements, current measurements and mechanical movement detection. It can be also applied to measuring precise angle or distance. The main characteristics like magnetic field range, sensitivity, offset voltage and temperature figures are programmable in a non-violate storage unit. The MS1820 offers a customer data register to storage some product information (such as product serial data).

The sensor includes a temperature-compensated hall unit, chopper modules, an A/D converter, DSP, an EEPROM with rewrite and lock function, a serial of modules designed for programming, a proportional linear output and some protection circuits.

The MS1820 can be programmed by the power supply without extra programmable pins. 2-point method can be adopted to calibrate the response of output signals to input signals and every customer can make individual adjustments to each sensor, which can optimize characteristics in magnetic pole and mechanical aspects. In addition, by adjusting the first and second order temperature figures of sensitivity, the temperature compensation of hall chip is available to most magnetic materials, which makes the chip keep precise over the full temperature range.



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FEATURES

- Analog Output Proportional to the Magnetic Field, Output Voltage Not Affected by the Power Supply
- Various Programmable Magnetic Characteristics Parameters, Temperature Compensation and Offset Voltage Compensation
- Continuous Measurements Ranges from ±20mT to ±160mT
- Programmable Temperature Characteristics, Matching for All Common Magnetic Materials
- Programming via Power Supply, Providing EEPROM Locking Function
- Power Supply Ranges from 4.5V to 5.5V, Rail-to-rail Output, Bandwidth: 20kHz

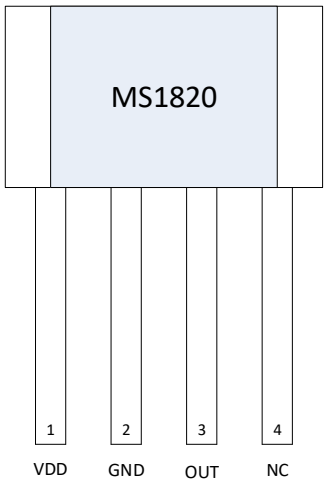
APPLICATIONS

- Linear Position Measurements
- Angle Sensors
- Distance Measurements
- Magnetic Field and Current Measurements

PRODUCT SPECIFICATION

Part Number	Package	Marking
MS1820	TO-94	MS1820

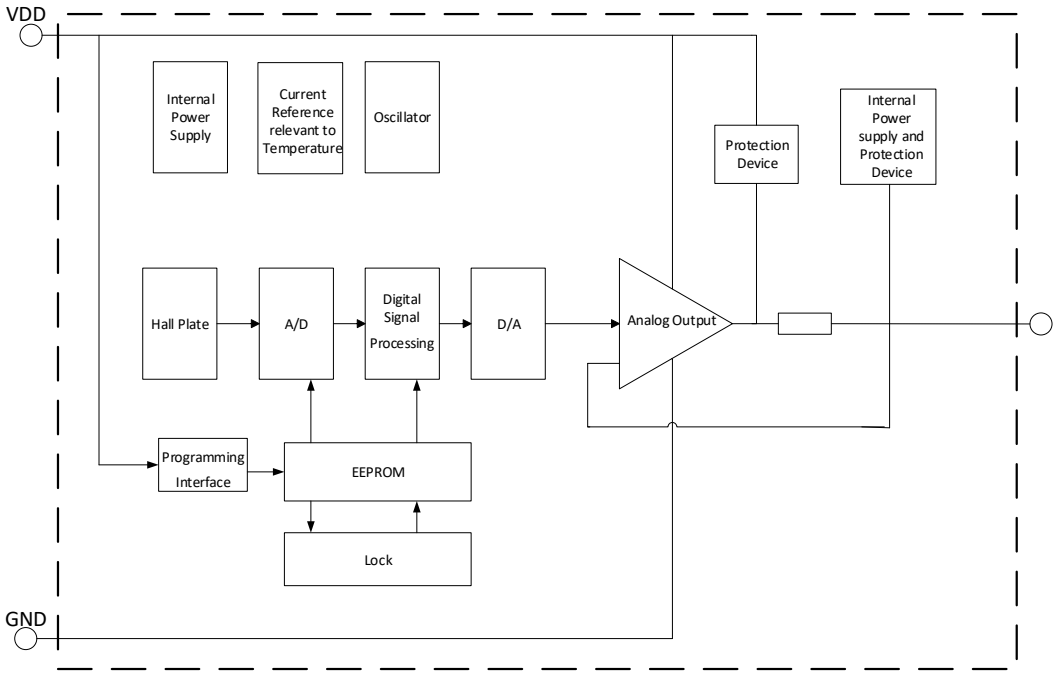
PIN CONFIGURATION



PIN DESCRIPTION

Pin	Name	Type	Description
1	VDD	-	Power Supply
2	GND	-	Ground
3	OUT	O	Output
4	NC	-	Not Connection, Ground Internally

BLOCK DIGRAM



ABSOLUTE MAXIMUM RATINGS

Any exceeding absolute maximum rating application causes permanent damage to device. Because long-time absolute operation state affects device reliability. Absolute ratings just conclude from a series of extreme tests. It doesn't represent chip can operate normally in these extreme conditions.

Parameter	Symbol	Ratings	Unit
Power Supply	VDD	-0.5 ~ 15.5	V
Output Voltage	VOUT	-0.5 ~ 15.5	V
Operating Temperature	T_A	-40 ~ 125	°C
Storage Temperature	T_{stg}	-40 ~ 170	°C
Output Current	I_{OUT}	±5	mA
ESD	VESD	5	kV

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Ratings	Unit
Power Supply	VDD	4.5 ~ 5.5	V
Output Current	I_{OUT}	±1	mA
Load Resistance	R_L	10	kΩ
Load Capacitance	C_L	<47	nF
Number of Programming Times	N_{PRG}	<100	-

ELECTRICAL CHARACTERISTICS

Unless otherwise noted, T_A= 25°C±2°C

Power Supply Parameters

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Power Supply	VDD	Normal Operation	4.5		5.5	V
Power Supply	VDD	Voltage in Programming Mode	5.7		6	V
Power Supply Current	I_{SUP}	VDD=5V	-	6.5	10	mA
Power-on Voltage	V_{PORLH}	from Low Voltage to High Voltage	3.9	4.35	4.5	V
Power-down Voltage	V_{PORHL}	from High Voltage to Low Voltage	3.8	4.2	4.4	V
Power Supply Switching Hysteresis	V_{PORHYS}		0.1	0.175	0.3	V

Output Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Resolution Ratio		-		10		bit
D/A Conversion Nonlinear Error	INL	Percentage of VDD	-1.0		1.0	%
Output Proportional Nonlinear Error	E_R	VOUT/VDD	-1.0		1.0	%
High-level Output Voltage	VOH	VDD=5V, I_{OUT}=±1mA	4.7	4.9		V
Low-level Output Voltage	VOL	VDD=5V, I_{OUT}=±1mA		0.1	0.3	V
Output Response Time	t_{ro}	C_L=10nF, Output from 10% to 90%, Magnetic Field from 0 to Maximum Range		0.05	0.1	ms
Power-on Time	t_{POD}	C_L=10nF		1	1.5	ms
Bandwidth	BW	Alternating Magnetic Field <10mT	-	20	-	kHz
Output Resistance	R_{OUT}			60		Ω

Magnetic Characteristics Parameters

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Sensitivity Drift	ΔSENSE	T_J=25°C	-	±2		%
Offset Voltage Drift	ΔOFFSET	B=0, Range=20mT, Sense=100mV/mT	-300		300	μT
Magnetic Field Range	RANGE		±20		±160	mT
Sensitivity	Sense		10		110	mV/mT
Sensitivity Trim Step	$\Delta sense_{tr}$		0.3		1	mV/mT
Offset Voltage Trim Step	$\Delta offset_{tr}$	OLAN=0 OLAN=1	±2.5 ±10		±312 ±1250	mV

Note: The factory set the magnetic characteristics parameters as fixed value. Power supply is 5V, output 0 magnetic field voltage is 2.5±0.01V; The sensitivity is set to two specifications: 5mV/Gauss and 10mV/Gauss.

Sensitivity Drift Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Sensitivity	Sense	VCC=5V		50 100		mV/mT
0 Magnetic Field Voltage	Vo	VCC=5V	2.49	2.5	2.51	V
Sensitivity Drift	ΔSENSE	VCC=5V, Full Temperature Range from -40°C to 160°C	-6		6	%

FUNCTION DESCRIPTION

General Function

The MS1820 can provide an output voltage proportional to magnetic flux through the hall plate, which is not related to power supply.

When external magnetic field passes through the chip package, the hall plate can generate a hall voltage, which is sensitive to south and north polarity magnetic field. The chip converts this voltage to a digital value, which goes through EEPROM for digital signal processing, converting the digital value to an analog value by a D/A converter. Finally, rail-to-rail output is generated through a buffer amplifier. The integrated temperature figure compensation and offset voltage compensation guarantee that all the system can operate in the best condition over the full temperature range. This chip can also reduce the offset drift resulted from mechanical stress of package. In addition, the power supply pin is equipped with overvoltage and undervoltage function.

The MS1820 also features an error detection function: overflow in the adder or multiplier, overflow in A/D conversion data and overtemperature. When these error occurs, the output will be forced in low level.

The parameter setting of DSP is stored in the EEPROM registers. The measurement data can be readout from the 16-bit output register. This register can only be readout and used in system calibration. There are only 10 bits effective in 16-bit register, whose digital output ranges from -512 to 511.

EEPROM Register

EEPROM Register	Parameter	Data Bit	Function Description
Customer Register	Sensitivity	8	Magnetic Field Sensitivity
	Offset	8	Magnetic Field Offset Voltage
	LOCK	1	Customer EEPROM Lock
	OALN	1	Offset Voltage Range Adjustment Selection
	TCSQ	5	Second-order Temperature Figure
	TC	5	First-order Temperature Figure
	MRANGE	3	Magnetic Field Range

1. Sensitivity

The sensitivity data bits can be used to set the multiplier figure in the digital signal processing module. This value can be set by the 8-bit register, whose adjustment range is from -2 to 2. And the sensitivity data bits are changed in 0.0156 steps.

2. Offset Voltage

The Offset data bits can be used to set the adder figure in the digital signal processing module. Offset refers to the output signal without external magnetic field(B=0). Customer can set OALN bit register to choose the offset voltage adjustment range. When OLAN is set to 1, the adjustment range of OFFSET is -25% to 25% power supply; when OLAN is set to 0, the adjustment range of OFFSET is -6.25% to 6.25% power supply. This value can be set by the 8-bit register.

3. Magnetic Field Range

The MRANGE can be used to adjust the magnetic field of the A/D converter and can be set by 3-bit register. The magnetic field corresponding to the setting value is shown in the following table:

Magnetic Field Range	Setting Value
±20mT	0
±40mT	1
±60mT	2
±80mT	3
±100mT	4
±120mT	5
±140mT	6
±160mT	7

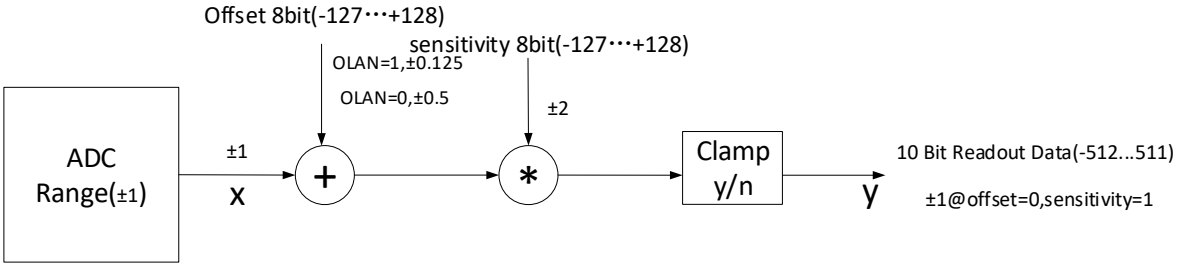
4. TC and TCSQ

TC is used to adjust first-order temperature figure and TCSQ is used to adjust second-order temperature figure, they can be set by the 5-bit register.

5. LOCK

LOCK bit refers to EEPROM locking bit, which can be set by a 1-bit register. When this bit is set to 1, other customer programming bits lock to LOCK bit together, customers can not reset.

6. Signal Path

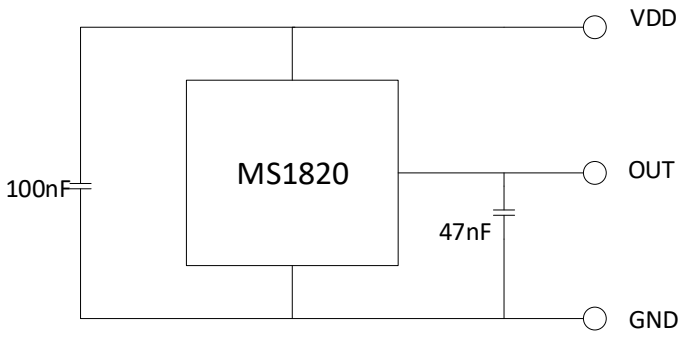


The figure above is the MS1820 signal processing path and process. The transfer function of the whole process:

$$Y=sensitivity*(X-OFFSET)$$

TYPICAL APPLICATION DIAGRAM

The MS1820 typical application diagram is as follows:



PACKAGE OUTLINE DIMENSIONS

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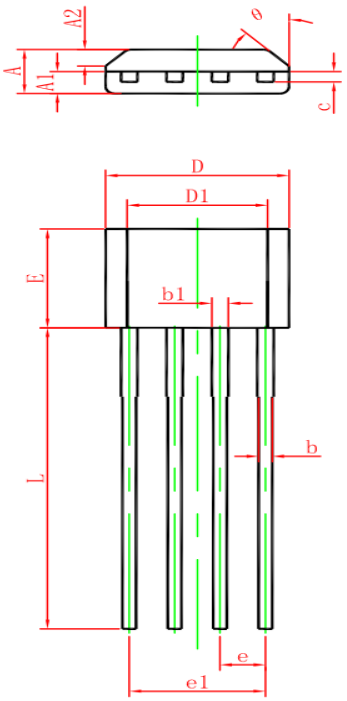

Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.400	1.800	0.055	0.071
A1	0.700	0.900	0.028	0.035
A2	0.500	0.700	0.020	0.028
b	0.360	0.500	0.014	0.020
b1	0.380	0.550	0.015	0.022
c	0.360	0.510	0.014	0.020
D	4.980	5.280	0.196	0.208
D1	3.780	4.080	0.149	0.161
E	3.450	3.750	0.136	0.148
e	1.270 TYP		0.050 TYP	
E1	3.710	3.910	0.146	0.154
L	14.900	15.300	0.587	0.602
θ	45° TYP		45° TYP	

MARKING and PACKAGING SPECIFICATIONS

1. Marking Drawing Description

Product Name: MS1820

Product Code: XXXX

2. Marking Drawing Demand

Laser printing, contents in the middle, font type Arial.

3. Packaging Specification

Device	Package	Piece/Bag	Bag/Box	Piece/Box	Box/Carton	Piece/Carton
MS1820	TO-94	1000	10	10000	10	100000

STATEMENT

- All Revision Rights of Datasheets Reserved for Ruimeng. Don't release additional notice.

  Customer should get latest version information and verify the integrity before placing order.
- When using Ruimeng products to design and produce, purchaser has the responsibility to observe safety standard and adopt corresponding precautions, in order to avoid personal injury and property loss caused by potential failure risk.
- The process of improving product is endless. And our company would sincerely provide more excellent product for customer.

MOS CIRCUIT OPERATION PRECAUTIONS

Static electricity can be generated in many places. The following precautions can be taken to effectively prevent the damage of MOS circuit caused by electrostatic discharge:

1. The operator shall ground through the anti-static wristband.
2. The equipment shell must be grounded.
3. The tools used in the assembly process must be grounded.
4. Must use conductor packaging or anti-static materials packaging or transportation.

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