ChenYang
Technologies GmbH & Co. KG

Programmable Linear Hall Effect Sensor IC CYL810P

The CYL810P is a monolithic programmable Hall effect linear sensor, manufactured using an advanced BCD (BIPOLAR-CMOS-DMOS, Bipolar-Complementary Metal Oxide Semiconductor-Dual Diffusion Metal Oxide Semiconductor) process, which includes a high sensitivity Hall sensor, a high accuracy Hall temperature compensation unit, a Hall signal pre-amplifier, an oscillator, a dynamic detuning circuit and an amplifier output module, providing a more efficient AC/DC magnetic field detection solution for a wide application area to communication, industrial and consumer electronic devices.

The sensor CYL810P features overcurrent-protected high bandwidth dynamic offset cancellation technology with a static output selectable at 50% V_{CC} or a fixed 2.5V in the absence of a magnetic field. The integrated internal dynamic offset cancellation circuitry makes the sensitivity of the IC unaffected by external stresses and mechanical stresses in the IC package.

The CYL810P output voltage is proportional to the applied magnetic field strength and can be programmed on the power supply pin to adjust the IC sensitivity and static zero-field output voltage to improve performance in the final application.

Features

- Single chip programmable
- Accuracy (typical): ±1mv @25°C
- High linearity: ±0.1% @25°C
- High frequency bandwidth: 65kHz
- Output response time: 4µs (typical)
- Temperature range -40°C to 125°C
- Stability over operating range: 1 .6% @25°C~125°C, 2.5% @ -40°C~25°C
- Low noise analog signal; high immunity to interference
- High resistance to mechanical stress, magnetic field parameters are not shifted by external pressure,
- ESD (HBM) 5kV
- ROSH approved: (EU) 2015 / 863

Applications

- Current sensing
- Position sensing
- Magnetic code reading
- Motor control
- Motor phase current detection (motor control)
- Photovoltaic inverters
- Battery load detection systems
- Speed detection
- Current transformers
- Inverter current detection
- Switching power supplies
- Overload protection devices

Absolute maximum rating

Supply voltage Vcc	6V
Output voltage V_{OUT}	Vcc -0.25V
Output source current, I_{OUT}	80mA
Output sink current, I_{OUT}	40mA
Operating temperature range, T_A	-40°C ~ +125°C
Storage temperature range, T_S	-55°C ~ +165°C
Maximum junction temperature, T_J	165°C
Number of EEPROM programming cycles	200 Cycles

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Static protection

Human Body Model (HBM) testing according to: Standard EIA/JESD22-A114-B HBM

Parameter	Symbol	Standard	Min	max	Unit
Human model HBM electrostatic stress voltage	V_{ESD}	JEDEC JS-001-2017	-5000	5000	V

Electric parameters

Parameters	Symbo	Test conditions	min	Typ.	Max.	unit
Supply voltage	V_{CC}	operation	4.5	5.0	5.5	V
Supply current	I_{CC}	T_A=25°C, no load on output	11.10	11.18	11.25	mA
Built-in band width (-3dB)	BW	Small signal: -3dB, C_L=1nF, T_A=25°C	-	65	-	kHz
Power-up time	T_{PO}	T_A =25°C, C_L=1nF, sensitivity: 2mV/G, constant mag. field：400Gs		100		µs
Temperature compensated power-up time	T_{TC}	T_A =125°C, C_L=1nF，sensitivity: 2mV/G, constant mag. field：400Gs		300		µs
Undervoltage lockout threshold (T$_A$=25°C)	V_{UVLOH}	voltage rises, IC starts to operate	-	4.1	-	V
	V_{UVLOL}	voltage drops, IC stops	-	3.8	-	V
Reset voltage	V_{PORH}	T_A=25°C, V_{CC} rises	-	4.1	-	V
	V_{PORL}	T_A=25°C, V_{CC} drops	-	3.8	-	V
Power-on reset release time	T_{PORR}	T_A=25°C, V_{CC} rises		10		µs
Max. current (source)	I_{SCLP}			80		mA
Maximum current (sink)	I_{SCLN}			40		mA
Analog output saturation low	V_{OL}	R_L>=4.7kΩ		0.5		V
Analog output saturation high	V_{OH}	R_L>=4.7kΩ	-	V_{CC}-0.3	-	V
Output load capacitance	C_L	V_{OUT} to GND	-	0.5	1	nF
Output load resistance	R_L	V_{OUT} to GND		10		kΩ
		V_{OUT} to V_{CC}		10		kΩ
Output resistance	R_{OUT}			9		Ω
Rise time	T_R	T_A =25°C, C_L=1nF，sensitivity: 2mV/G, constant mag. field：400Gs		5.5		µs
Transfer delay time	T_{PD}			4.5		µs
Response time	T_{RESP}			4	5	µs
Noise	V_N	T_A =25°C, C_L=1nF，sensitivity: 2mV/G , B_{Wf} = Bwi		14.1		mVp-p

Magnetic Data

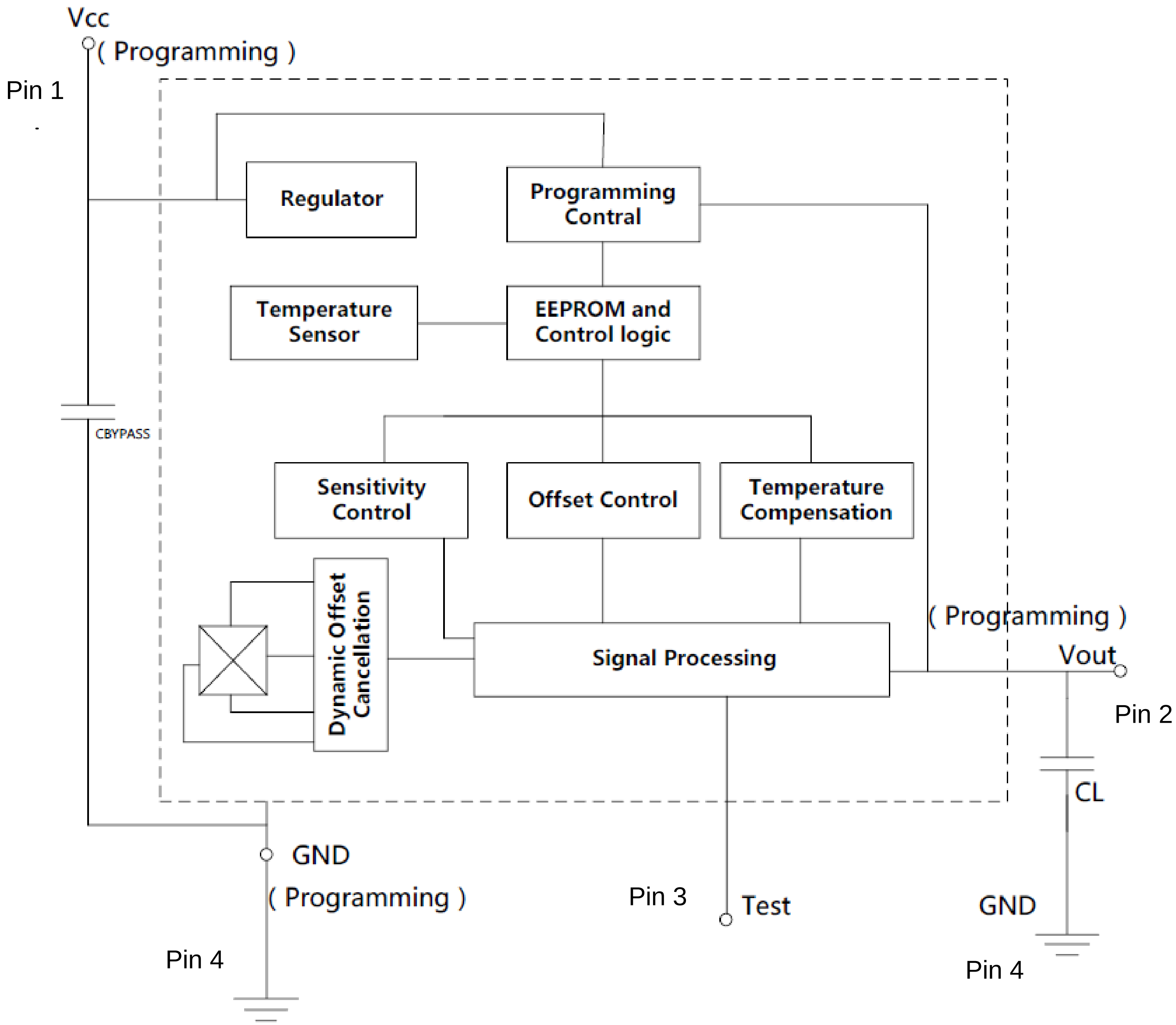
DC operating parameters T_A = 25°C, Vcc = 5V (unless otherwise specified)

parameter	symbol	Part no.	Min.	typ	Max.	unit
sensitivity	Sens	CYL810P-A	1.82	2.73	3.65	mV/Gs
		CYL810P-B	3.65	5.48	7.32	mV/Gs
		CYL810P-C	7.32	11.06	14.8	mV/Gs
		CYL810P-D	14.8	22.0	29.3	mV/Gs

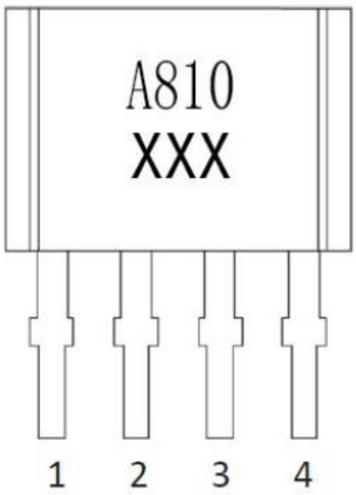
Accuracy parameters

parameter	symbol	Test conditions	Min.	typ	Max.	unit
Linear sensitivity error	LinERR		-0.1	<±0.05	0.1	%
Symmetric sensitivity error	SymERR		-0.1	<±0.05	0.1	%
Static voltage output error	ERAT_VOQ	V_{CC}=4.5~5.5V, T_A=25°C	-	1	-	%
Sensitivity drift (due to packaging)	ΔSNST_PKG	TA=25°C, temperature cycling 25°C to 125°C, then back to 25°C	-	±1.25	-	%

Functional diagram



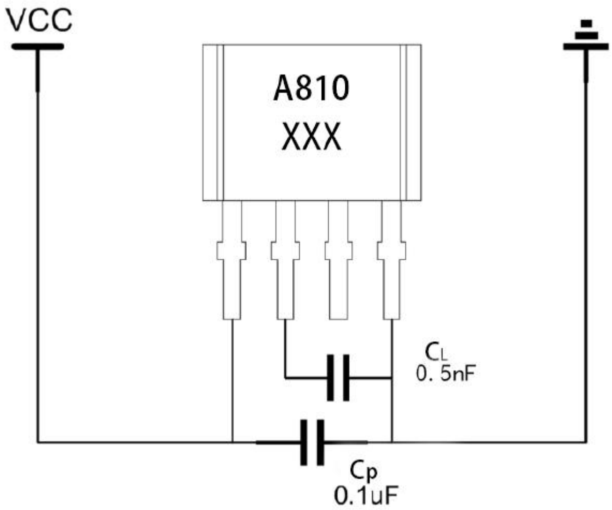
Pin arrangement



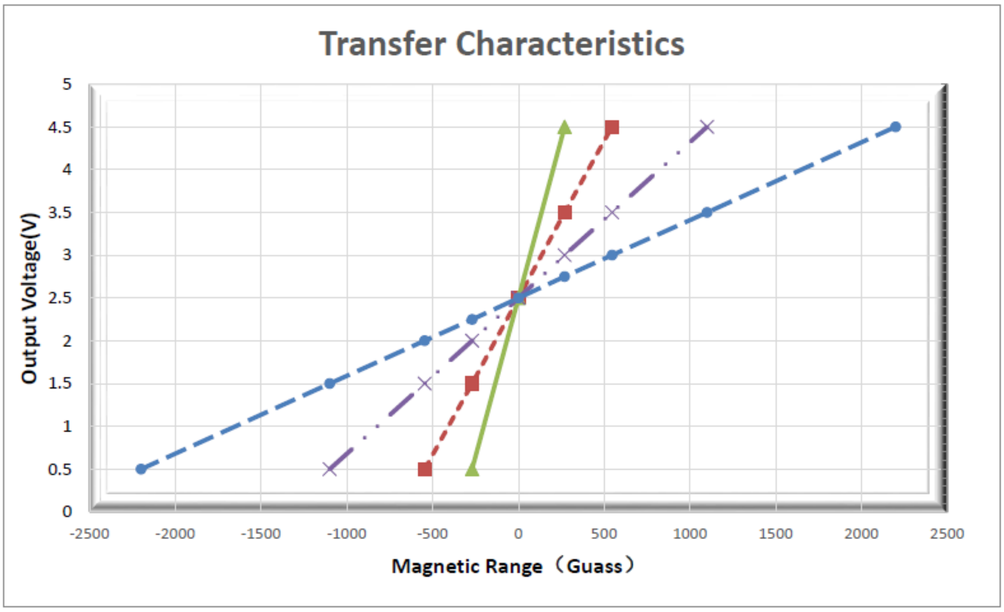
No	symbol	description
1	V_{CC}	Power/Programming Pin
2	V_{OUT}	Analogue outputs/programming pin
3	TEST	Programming test pin/NC
4	GND	Ground/programming pin

Typical Application Wiring

CYL810P typical application circuit,
C_L filter capacitor，
C_P bypass capacitor



Output characteristic curves



Programming parameters

symbol	parameter	Test conditions (T_A=25℃)	Min.	Typ.	Max.	unit
VOUT(Q)_init	Initially programmed static voltage output	VCC=5V	-	2.5	-	V
VOQ_PR	Static voltage output programming range	VCC=5V	2.3	-	2.7	V
VOQ_STEP	Average static voltage output step value	VCC=5V	-	2.38	-	mV
EVOQ_STEP	Static voltage output programming resolution	VCC=5V	-	±0.5xEVOQ_STEP	-	mV
SENS_INIT	Initial unprogrammed sensitivity for each step	SENS_COARSE=001	-	2.5	-	mV/Gs
		SENS_COARSE=000	-	5	-	mV/Gs
		SENS_COARSE=111	-	10	-	mV/Gs
		SENS_COARSE=110	-	20	-	mV/Gs
SENS_PR	Sensitivity programmed range	SENS_COARSE=001	1.82		3.65	mV/Gs
		SENS_COARSE=000	3.65		7.32	mV/Gs
		SENS_COARSE=111	7.32		14.82	mV/Gs
		SENS_COARSE=110	14.82		30.00	mV/Gs
Sens_fine_step	Average fine tuning sensitivity step	SENS_COARSE=001		7.5		µV/Gs
		SENS_COARSE=000		15		µV/Gs
		SENS_COARSE=111		30		µV/Gs
		SENS_COARSE=110		60		µV/Gs

Factory programmed static voltage output temperature coefficient

symbol	parameter	Test conditions	Min.	Typ.	Max.	unit
Δ Sens TC	Sensitivity drift at each temperature level	T_A = 25℃ ~ 125℃	-2.5		2.5	%
		TA = –40℃ ~ 25℃	-3		3	%
SENS_TC_STEP	Average sensitivity temperature compensation step value		-	0.23	-	%
ΔVOQ_TC	Static voltage output drift over temperature range	T_A = 125℃, T_A = –40℃,reference to 25℃	-	0	-	mV/℃
StepQVOTC	Average static voltage output temperature compensation step		-	3.6	-	mV

Programming Locking Bits

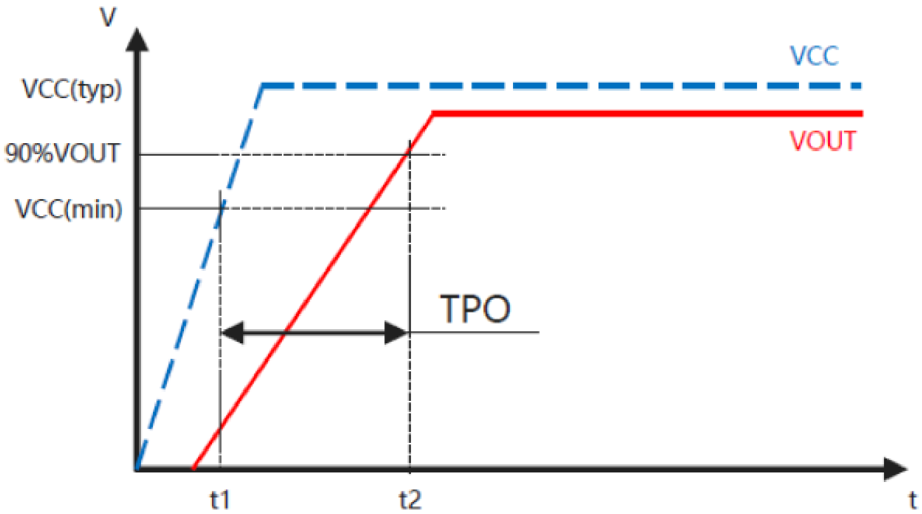
symbol	parameter	Test conditions	Min.	Typ.	Max.	unit
EELOCK_BIT	EEPROM locked digits		-	1	-	Bit

Parameter Definitions

Power on Time - TPO

When the power supply rises to the operating voltage, the IC needs a limited time to power up the internal components before responding to the input magnetic field.

Power-up time: the time taken for the power supply to reach the minimum operating voltage Vcc_{MIN} is t1; in the case of an applied magnetic field, the time taken for the output to reach 90% of its stable value t2. The difference between the two times is the power-up time.

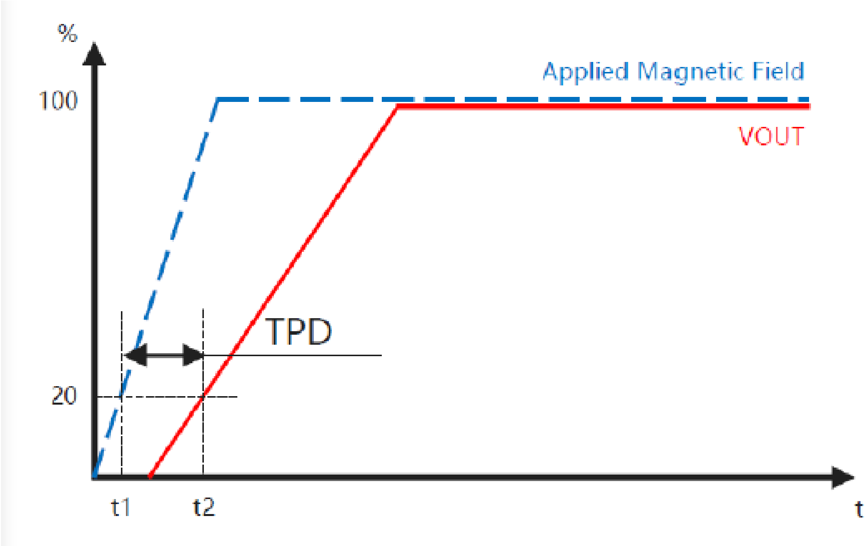


Temperature trimmed power-up time - TTC

After power-up, temperature trim time is required before a valid temperature compensation output is available.

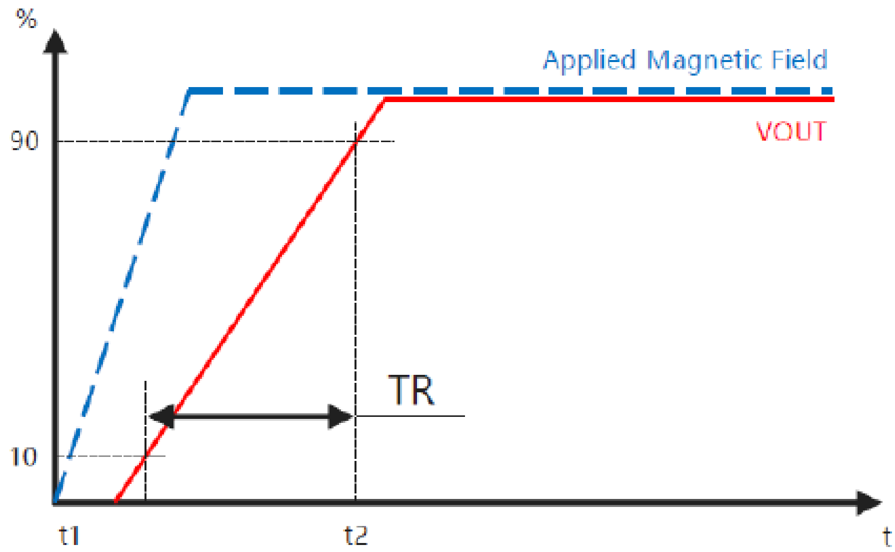
Transmission delay - TPD

It is the time difference between when the external magnetic field reaches 20% of its final value and when the output reaches 20% of its final value.



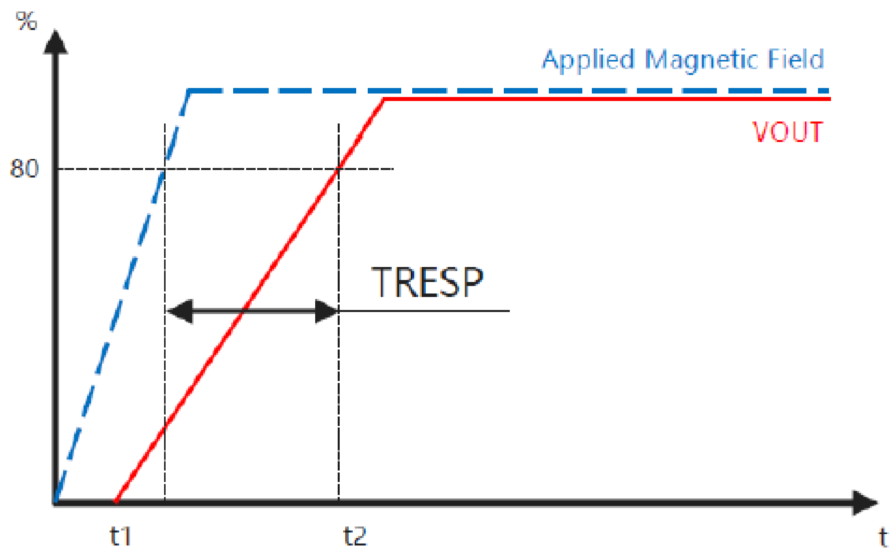
Rise time - TR

The time difference between the rising times of the IC output level from 10% to 90%, TR is negatively affected by eddy currents if a conductive plane ground is used.



Response time – TRESP

It is the time difference when the external magnetic field applied to the IC reaches 80% of its final value and the corresponding output value the IC reaches 80%. The TRESP is negatively affected by eddy currents if a conductive plane ground is used.



Static voltage output - VOQ

It is the output voltage of the IC at a zero magnetic field when both the supply voltage and the surrounding temperature are within the operating range.

Static Voltage Output Error - VOE

It is the difference between the actual output voltage of the sensor and the ideal output voltage when the magnetic field is zero. At a fixed output voltage, the static voltage output error is the difference between the actual output voltage and the 2.5V voltage. In output mode proportional to the supply voltage, the static voltage output error is the difference between the actual output voltage and VCC/2.

Sensitivity - Sens

The sensitivity indicates the change in the sensor output in mV/Gs for every 1 Gauss change in the measured magnetic field.

It is defined by dividing the difference between the two output voltages of the sensor by the difference between the south and north magnetic fields. The sensitivity of the sensor is calculated as follows:

$$SENS = (Vout(GSmax) - Vout(GNmax)) / (GSmax - GNmax)$$

Where GSmax and GNmax are south magnetic field and North magnetic field, respectively, Vout(GSmax) and Vout(GNmax) are the analog output voltages of the sensor for the positive south and north magnetic fields, respectively.

Error Range - ETOT

This error value represents the maximum error of the sensor in various environments. This value is equal to the absolute value of the measuring error in each temperature range over the full measuring range, divided by the maximum dynamic range of the sensor output. This can be expressed as follows:

$$ETOT(IP) = Max(Vout - Vout\_idea) / (Vout(IPmax)\ Voq)$$

Where Max(Vout - Vout_idea) represents the maximum error within the measuring range, and (Vout(IPmax) - Voq) represents the maximum output dynamic range of the sensor.

Nonlinearity error – ELIN

Due to various factors affecting the operation of the sensor, the output voltage of the sensor is in practice not completely linear to the measured magnetic field. After least squares linear fitting, the maximum deviation between the sensor output voltage and the linear fitted line divided by the dynamic range of the sensor is defined as the linearity error of the sensor:

$$ELIN (IP) = \Delta Vout / (Vout(IPmax) - Voq)$$

Where, ΔVout is the maximum absolute linear deviation in the measuring range of the sensor.

Ordering Information

Part number	Sensitivity range	package	packing	Operating temperature range
CYL810P-A	1.82 ~ 3.65mV/Gs	TO94	1000pcs /bag	-40°C ~ 125°C
CYL810P-B	3.65 ~ 7.32mV/Gs	TO94	1000pcs/bag	-40°C ~ 125°C
CYL810P-C	7.32 ~ 14.8mV/Gs	TO94	1000pcs/bag	-40°C ~ 125°C
CYL810P-D	14.8 ~ 29.3mV/Gs	TO94	1000pcs/bag	-40°C ~ 125°C

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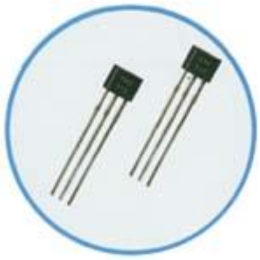
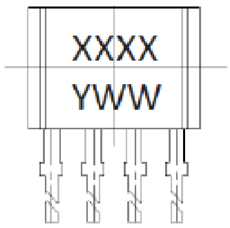
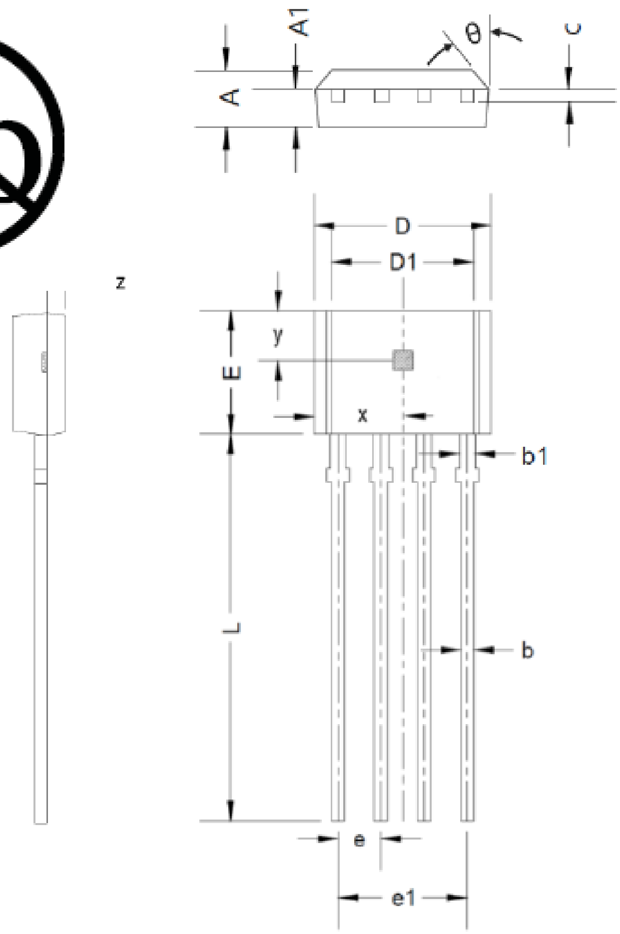
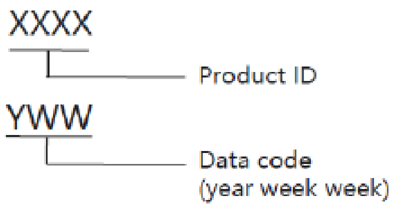
Package Information









symbol	dimensions(mm)		dimensions (inches)	
	Min.	Max.	Min.	Max.
A	1.400	1.800	0.055	0.071
A1	0.700	0.900	0.028	0.035
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(BSC)		0.050(BSC)	
e1	3.710	3.910	0.146	0.154
L	14.900	15.300	0.587	0.602
x	2.565(BSC)		0.101(BSC)	
y	1.170(BSC)		0.046(BSC)	
z	0.500(BSC)		0.020(BSC)	
ϴ	45°		45°	

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Notes

- Hall chips are sensitive devices, so special care should be taken to protect them from static electricity during use and storage.
- The mechanical stress applied to the device housing and leads should be minimized during soldering and use.
- It is recommended that the soldering temperature does not exceed 350°C and the duration does not exceed 5 seconds.
- To ensure the safety and stability of Hall ICs, long-term use outside the parameter range is not recommended.

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