Programmable linear output Hall-effect sensor

1. Features

- Rail-to-rail output
- Client-side calibration
- Sensitivity range: 8mV/Gs~24mV/Gs
- Low quiescent output voltage and sensitivity temperature drift
- The output voltage and sensitivity vary little with the power supply
- Wide ambient temperature range: -40°C~125°C
- Resistant to mechanical stress
- Undervoltage lockout Package：TO-92S

2. Applications

- Combiner box current sensor
- Angle detection
- Overcurrent detection circuit
- Damper control

3. Description

SC4616 is specifically engineered for applications including angle detection and DC current detection. The SC4616 provides a client-side calibration solution at no additional cost, and the programmable nature of the SC4616 allows it to compensate for installation errors in current sensing module assembly.

The output voltage of the SC4616 is proportional to the magnitude of the magnetic field it induces. Both quiescent voltage output and magnetic sensitivity are adjustable. The quiescent voltage output can be set to 2.5V, the sensitivity can be adjusted between 8mV/Gs~24mV/Gs, and the sensing polarity can also be changed.

The SC4616 circuit integrates Hall elements, temperature compensation circuitry, small-signal high-gain amplifier, low-impedance output stage, dynamic chopper technology, and trimming circuitry.

The device is housed in a low-profile 3-pin SIP package for easy integration with a magnetic core to assemble into a highly accurate current sensing module.

The device is available in a 3-pin TO-92S package and is lead (Pb) free, with matte tin lead frame plating.

Fig.1 TO-92S Package Outline

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4. Terminal Configuration

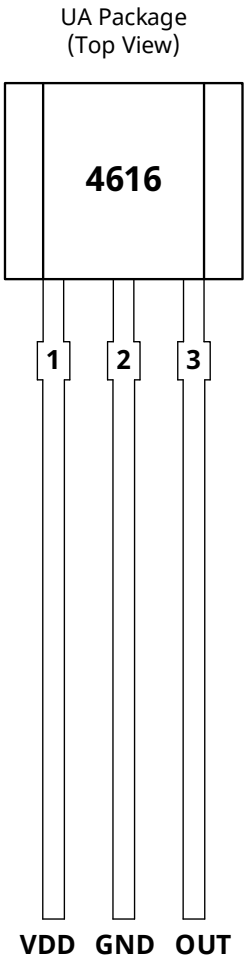


Fig.2 Pin Description

Terminal		Type	Description
Name	Number		
VDD	1	PWR	4.5V~5.5V power supply
GND	2	Ground	ground pins
OUT	3	Output	Output pins

5. Ordering Information

Ordering Information	Marking	Ambient, T_A(℃)	Package	Packing	Quantity
SC4616UA-BK	4616	-40~125	TO-92S	Bulk	1000/bag

6. Absolute Maximum Ratings

(over operating free-air temperature range，unless otherwise noted)

Symbol	Parameter	Test conditions	Min.	Max.	Units
V_{DD}	Power supply voltage	T_J=150˚C	-0.5	6	V
V_{OUT}	The output is voltage-resistant	T_J=150˚C	-0.3	6	V
I_{DD}	Supply current		-	20	mA
I_{OUT}	Output current		-	3	mA
T_A	Operating temperature range		-40	125	℃
T_J	Junction temperature range		-50	165	℃
T_{STG}	Storage temperature range		-65	170	℃

Note：
Stresses above those listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

7. ESD Protection

Symbol	Parameter	Test conditions	Min.	Max.	Units
HBM	ESD	Referring to AEC-Q100-002E HBM standard, R=1.5kΩ, C=100pF	-4	4	kV

8. Operating Characteristics

Within the natural temperature range of operation (unless otherwise stated)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Electrical parameters						
V_{DD}	Operating voltage		4.5	5	5.5	V
I_{DD}	Operating current	V_{DD}=5.0V，T_A=25℃	3.0	5.0	9.0	mA
V_{UVLOHI}	Undervoltage Threshold(1)	T_A=25℃	-	4.0	-	V
$V_{UVLOLOW}$		T_A=25℃	-	3.7	-	V
t_{PO}	Power-on time(2)	T_A=25℃，V_{OUT} to 2.5V	-	6.0	10	μs
BW	bandwidth	Output signal -3dB	3.0	5.0	-	kHz
f_C	Chopper Frequency(3)	T_A=25℃	-	500	-	kHz
Output parameters						
C_L	Output load capacitance	V_{OUT} to GND	-	-	10	nF
I_{Source}	Output load capacity	V_{OUT} to V_{DD}	1.0	-	-	mA
I_{Sink}		V_{OUT} to GND	1.5	-	-	mA
$V_{OUT(H)}$	Output voltage range	T_A=25℃, B=1000Gs	4.8	4.9	4.99	V
$V_{OUT(L)}$		T_A=25℃, B=-1000Gs	0.01	0.1	0.2	V
t_{RESP}	Step response time	Delay output signal up to 90%	120	200	-	μs
V_N	Output Noise(4)	T_A=25℃, Sens=16.0mV/Gs	-	30	-	$mV_{(p-p)}$
Set before programming						
$V_{OUT(Q)init}$	Quiescent voltage output	T_A=25℃, B=0Gs	-	2.5	-	V
$Sens_{init}$	Preset sensitivity	T_A=25℃	-	8.0	-	mV/Gs
Lin_{ERR}	Linear sensitivity error		-	1.0	-	%

Note:

(1) When powered up, the output of the SC4616 will remain low until V_{DD} exceeds V_{UVLOHI}. Once powered up, the output will remain active until the V_{DD} drops below V_{UVLOLO}, at which point the output will be pulled low

(2) Refer to the property definition

(3) f_C does not change by more than 20% over the entire operating ambient temperature range and process

(4) The 6sigma value is obtained from the noise density spectrum.

Operating Characteristics (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Static output voltage programming						
$V_{OUT(Q)}$	Quiescent output voltage range	B=0Gs，T_A=25℃	2.4	2.5	2.6	V
	Static output voltage programming bits		-	6	-	Bits
$Step_{V(Q)}$	Average static programming step size	T_A=25℃	-	4	-	mV
Programming of sensitivity						
Sens	Sensitivity range	T_A=25℃	8	-	24	mV/Gs
	Programming bits of sensitivity		-	9	-	Bits
$Step_{SEN}$	Average sensitivity step size	T_A=25℃	-	40	-	μV/Gs
Temperature drift characteristics						
$\triangle V_{OUT(Q)}$	Quiescent output voltage drift	Sens=10.0mV/Gs	-	20	40	mV
△Sens	Sensitivity drift	Sens=10.0mV/Gs	-	2	-	%

9. Block Diagram

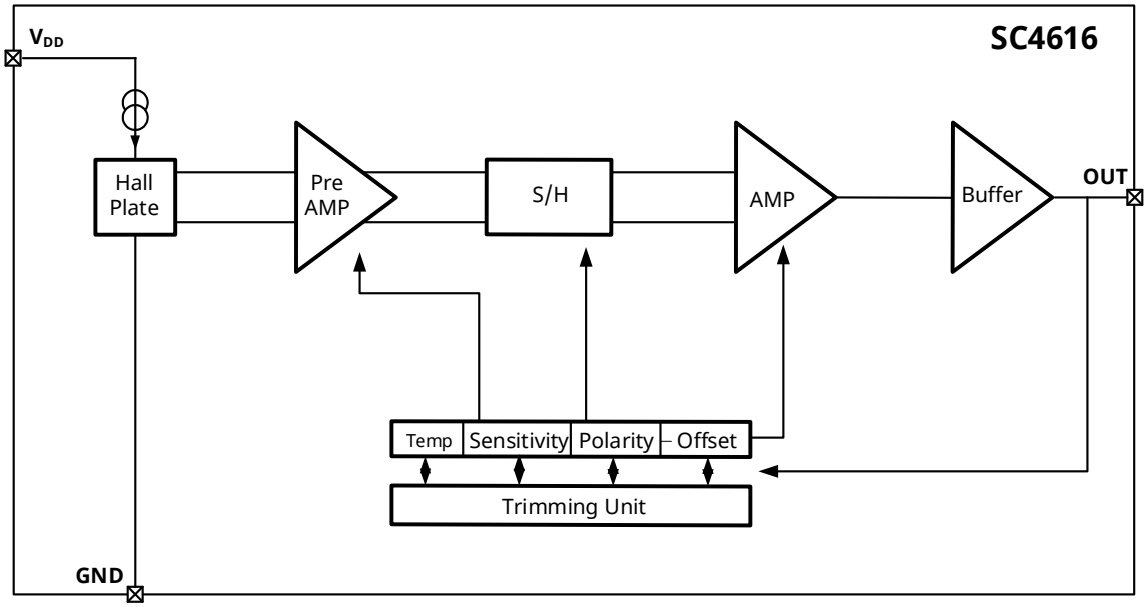


Fig.3 Block Diagram

10. Function Description

Power-on time: When the power supply ramps up to the operating voltage, the device output takes a limited amount of time to react to the input magnetic field. The power-up time is defined as the time it takes for the output voltage to begin responding to an applied magnetic field after the power supply reaches its specified minimum operating voltage, $V_{DD(min)}$.

Quiescent Output Voltage: At rest (magnetic field B = 0).

Quiescent output voltage drifts over temperature: Due to internal component tolerances and temperature considerations, quiescent output voltages can drift from their nominal values at the operating ambient temperature. For specification purposes, the quiescent output voltage drift over temperature $\triangle V_{OUT(Q)}$ is defined as:

$$\triangle V_{OUT(Q)} = \triangle V_{OUT(Q)TA}\ \triangle V_{OUT(Q)25℃}$$

Sensitivity: The S-pole magnetic field perpendicular to the screen surface increases the output voltage. The amount of increase in the output voltage is directly proportional to the magnitude of the applied magnetic field. Conversely, the N-polar magnetic field will cause the output voltage to decrease. This ratio is specified as the magnetic sensitivity of the chip Sens (mV/Gs) and is defined as:

$$Sens = \frac{\mathrm{VOUT(B+)} - \mathrm{VOUT(B-)}}{\mathrm{B(+)} - \mathrm{B(-)}}$$

B(+) and B(-) are two magnetic fields with opposite polarities.

11. Typical Application

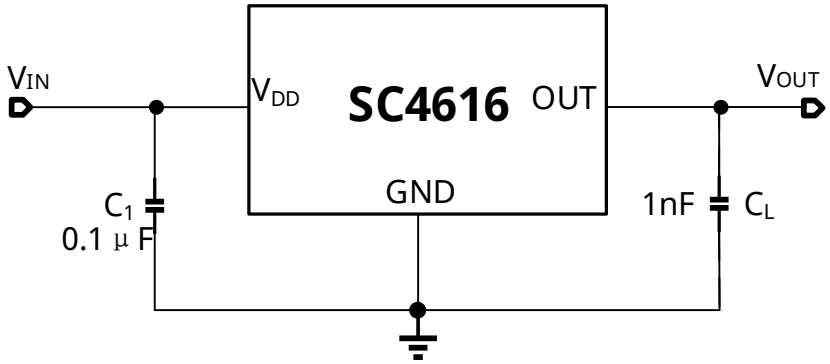


Fig.4 Typical Application Circuit

The static (zero magnetic field strength) output voltage $V_{OUT(Q)}$ of the chip is typically half the supply voltage over the range of the power supply operating voltage. When the South Pole magnetic field perpendicular to the silkscreen surface of the chip is enhanced, the output voltage of the chip increases proportionally. Conversely, when the North Pole acts on the silkscreen side of the chip, the output voltage decreases synchronously in the same proportion. The inductive polarity can be changed. The sensitivity of a chip is defined as the ratio of the amount of change in output voltage (mV) to the change in magnetic field (Gs).

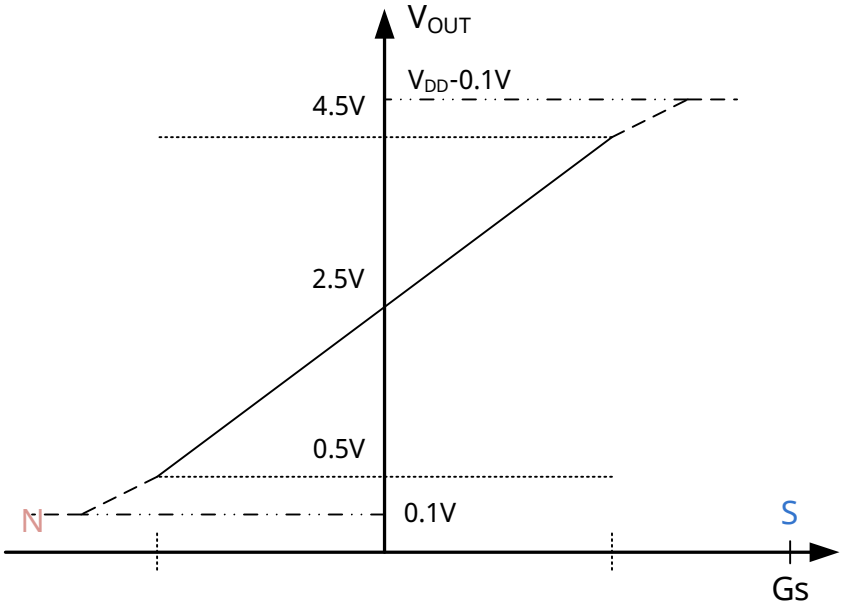
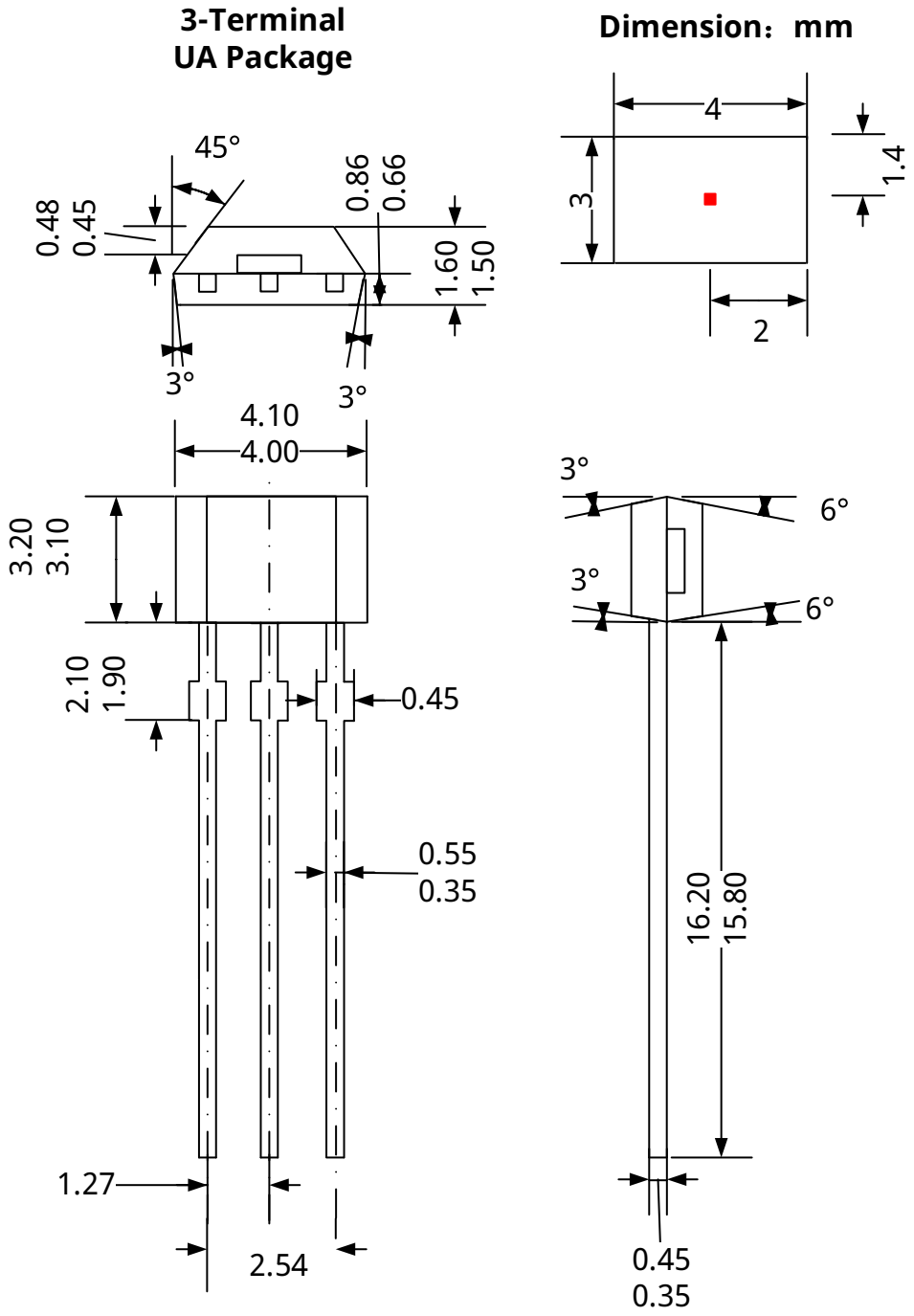


Fig.5 Input output characteristics

12. Package Information "TO-92S"



Notes:

1. *Exact body and lead configuration at vendor's option within limits shown.*
2. *Height does not include mold gate flash.*
3. *The plating thinckness is 7-15um*

Where no tolerance is specified, dimension is nominal.

13. Revision History

Revision	Date	Description
Rev1.0	2017-08-14	Initial release
Rev2.0	2018-11-15	Improve product features
Rev2.3	2019-09-22	The final version number of the previous version of the specification
RevA/1.0	2020-11-19	Publish in a unified format
Rev.A1.1	2025-06-04	Update the ordering information and update the format of the datasheet