High precision, wide band , with reference voltage output programmable linear Hall sensor IC

FEATURES

- With reference voltage output (typical Value 2.5V)
- Programmable High-speed Liner Hall Sensor
  - Quiescent output voltage
  - Reference voltage
  - Sensitivity （1.0—21 mV/Gs）
  - Temperature coefficient of Sensitivity
- Response time up to 3.6 μ S
- Bandwidth up to120 kHz
- Operating Voltage Range: 4.5—5.5V
- Operating Temperature Range -40—125℃
- Under Circuit, Open Circuit Protection
- SIP4 package

APPLICATIONS

- BLDC current detection
- Over-current detection
- AC/DC convertor
- position detection
- photovoltaic current detection

DESCRIPTION

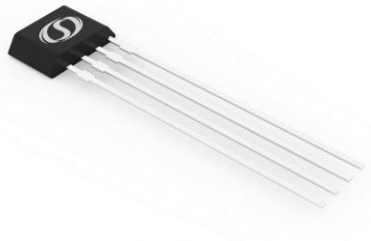
SC4645 is a programmable liner Hall-effect sensor IC, integrated with one magnetic sensor module, a three-level variable low-noise amplifier, output pin and temperature detection, quiescent output compensation, sensitivity compensation, and EEPROM. The sensor reacts to the magnetic field which is perpendicular to the chip, and convert to output voltage according to sensitivity. Which is very suitable to current monitor.

SC4645 have a quiescent output voltage default as half of the supply voltage. And the quiescent voltage can be programmed through V_{DD}-pin and OUT-pin. The sensitivity range of the chip can be changed from 1mV/Gs to 21mV/Gs in order to adapt the current flow of various ranges.

SC4645 is integrated with temperature sensor module. User can compensate the sensitivity of the chip through change temperature coefficient, together with the temperature coefficient of the magnetic ring could enhance accuracy.

The typical supply-voltage of the IC is 5.0V , limited voltage is 15V, operating temperature is -40℃ to 125℃, capable of maintaining stable operation in the harsh automotive environment.

The SC4645 sensor IC is available in a 4-pin surface The package is lead (Pb) free, with 100% matte tin plating.



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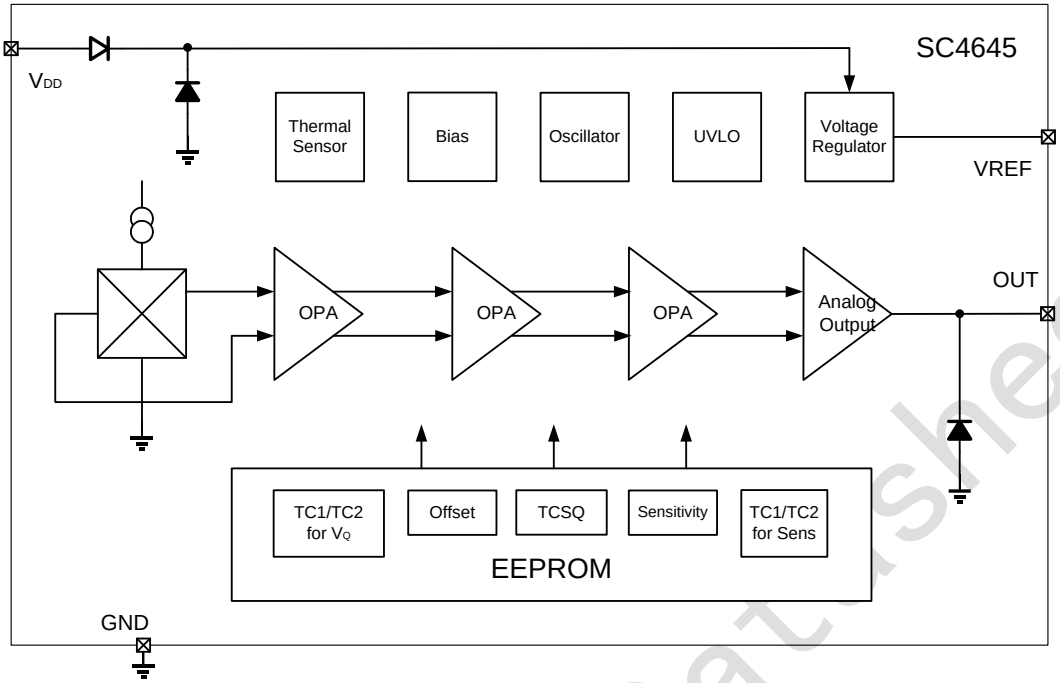
BLOCK DIAGRAM

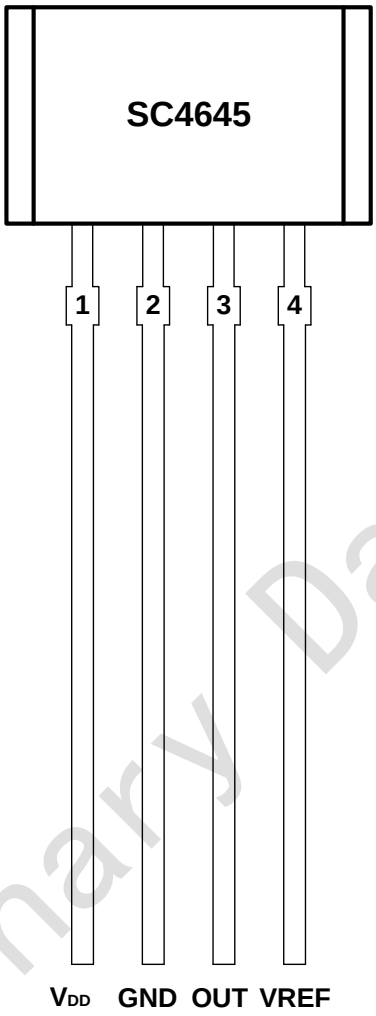


ORDERING INFORMATION

Part Number	Packing	Mounting	Ambient, T_A	Marking
SC4645VB	Bulk,500pcs/bag	4-pin SIP	-40˚C to 125˚C	4645

THERMAL CONFIGURATION

4-Terminal SIP
VB Package
(Top View)



Terminal		Type	Description
Name	Number		
V_{DD}	1	PWR	Supply Voltage 4.5V ~ 5.5 V
GND	2	Ground	Ground terminal
OUT	3	Output	Output terminal
VREF	4	Output	Typical value 2.5V

ABSOLUTE MAXIMUM RATINGS

Characteristic	Symbol	Notes	Min.	Max.	Unit
Forward Supply Voltage	V_{DD}	< 1 hours	0	15	V
Reverse Supply Voltage	V_{RCC}	< 1 hours	0	-0.5	V
Forward Output Voltage	V_{OUT}	< 1 hours	0	15	V
Reverse Output Voltage	V_{ROUT}		0	-0.5	V
Output Source Current	$I_{OUT\ (source)}$	V_{OUT} to GND	0	2.8	mA
Output Sink Current	$I_{OUT\ (sink)}$	V_{DD} to V_{OUT}	0	8.8	mA
Output Source Current	$I_{OUT\ (source)}$	V_{OUT} to GND	0	0.5	mA
Operating Ambient Temperature	$I_{OUT\ (sink)}$	V_{DD} to V_{OUT}	0	0.5	mA
EEPROM Write Cycles				100	cycle
Operating ambient temperature	T_A		-40	125	℃
Storage temperature	T_{STG}		-55	160	℃

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.

ESD Protection

Human Body Model (HBM) tests according to: standard AEC-Q100-002

Characteristic	Symbol	Min.	Max.	Unit
HBM ESD stress voltage	V_{ESD}	-3000	3000	V

OPERATING CHARACTERISTICS

valid through the full operate temperature range, VDD=5V, CBY=0.1uF, unless otherwise specified

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Electrical Characteristics						
Supply Voltage	V_{DD}		4.5	5.0	5.5	V
Supply Current	I_{DD}			14	17	mA
Power-on Time	t_{PO}	C_{BYPASS}=Open, C_L=1nF, Sens= 2mV/G, B=400G	~	80	~	μS
Undervoltage Protection	V_{UVLOH}	V_{DD} rising	~	3.8	~	V
	V_{UVLOL}	V_{DD} falling	~	3.2	~	V
Power-Up Reset Voltage	V_{PORH}	V_{DD} rising	~	2.5	~	V
	V_{PORL}	V_{DD} falling	~	2.2	~	V
Zener Diode Breakdown Voltage	V_Z	I_{DD} = 30mA	12	~	~	V
Bandwidth	BW_i	signal -3dB C_L=1nF	~	120	~	kHz
Chopper frequency	f_C			1000		kHz
Output Characteristics						
Response Time	$t_{RESPONSE}$	B_{step}=400G, Sens=2mV/G	~	3.6	~	μS
Noise	V_N	Sens=2mV/G, BWf=BWi	~	20	~	mV_{p-p}
			~	1	~	mV_{RMS}
Output Saturation Voltage	$V_{SAT(H)}$	$R_{L(DOWN)}$=5K to GND	4.6	~	~	V
	$V_{SAT(L)}$	$R_{L(UP)}$=50K to VDD	~	~	0.4	V
Output Load Resistance	$R_{L(UP)}$	VOUT to VDD	50	~	~	kΩ
	$R_{L(DOWN)}$	VOUT to GND	5	~	~	kΩ
Output Load Capacitance	C_L	VOUT to GND	~	1	10	nF
Reference output impedance	R_{ref}			150	270	Ω
Reference Load Resistance	$R_{REF(UP)}$	VREF to VDD	20	~	~	kΩ
	$R_{REF(DOWN)}$	VREF to GND	20	~	~	kΩ
Reference Load capacitance	C_{REF}		--	100	470	nF

OPERATING CHARACTERISTICS(Continued)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Quiescent Output Voltage VOUT(Q) / Reference						
Initial Quiescent Output Voltage	$V_{OUT(Q)init}$		2.4	2.5	2.6	V
Range of Voq	$V_{OUT(Q)PR}$		2.3	~	2.7	V
Bits of Voq	QVO		~	8	~	bit
Step of Voq	$Step_{VOUT(Q)}$		0.8	1.6	2.4	mV
Initial Reference Output Voltage	$V_{REF(Q)init}$		2.45	~	2.55	V
Range of Vref	$V_{REFQ)PR}$		2.35	~	2.65	V
Bits of Vref	VREF		~	9		bit
Step of Vref	$Step_{VREF}$		0.3	0.6	0.9	mV
Sensitivity						
Factory Default Sensitivity	$Sens_{init}$	$SENS_{\_COARSE}$=00	~	1.5	~	mV/Gs
		$SENS_{\_COARSE}$=01	~	3.3	~	mV/Gs
		$SENS_{\_COARSE}$=10	~	7.2	~	mV/Gs
		$SENS_{\_COARSE}$ =11	~	15	~	mV/Gs
Sensitivity Program Range	$Sens_{PR}$	$SENS_{\_COARSE}$ =00	1	~	2.1	mV/Gs
		$SENS_{\_COARSE}$ E=01	2.1	~	4.2	mV/Gs
		$SENS_{\_COARSE}$ =10	4.2	~	9.4	mV/Gs
		$SENS_{\_COARSE}$ =11	9.4	~	21	mV/Gs
Bit of Sens Coarse	$SENS_{\_COARSE}$		~	2	~	bit
Bit of Sens Fine	$SENS_{\_FINE}$		~	10	~	bit
Sensitive temperature drift						
Sensitivity Drift Through Temperature Range	$\Delta Sens_{TC}$	T_A=25 to 125 ℃	-2.5	~	2.5	%
		T_A=-40 to 25 ℃	-2.5	~	2.5	%
Quiescent Drift and Reference Drift						
Quiescent Output Voltage Through Temperature Range	$\Delta V_{OUT(Q)TC}$	T_A=25 to 125 ℃	-25	~	25	mV
		T_A=-40 to 25 ℃	-25	~	25	mV
Reference Output Voltage Through Temperature Range	ΔV_{REFTC}	T_A=25 to 125 ℃	-25	~	25	mV
		T_A=-40 to 25 ℃	-25	~	25	mV
Lock Bit Programming						
EEPROM Lock Bit	EELOCK		~	1	~	bit
Other characteristics						
Linearity Sensitivity Error	Lin_{ERR}		-1	±0.2	1	%
Symmetry Sensitivity Error	Sym_{ERR}		-1	±0.2	1	%
Packaging On Sensitivity	$\Delta Sens_{PKG}$	after temperature cycling	-1.5	0	1.5	%

FUNCTIONAL DESCRIPTION

Quiescent Output Voltage ($V_{OUT(Q)}$)

Quiescent Output Voltage indicate the output voltage of the IC when there is no magnetic field. Theoretically the output voltage of SC4645 equals to 2.5V, but interfered by the offset voltage, sensitivity, packaging stress and other factors, the Quiescent output Voltage does have some deviation from the Theoretic figure. During factory, the actual Quiescent Voltage can be modified to the theoretic figure ±5mV. Quiescent output Voltage is influenced by temperature coefficient to a extent, which referred in statistics is with the variation of the temperature, the Quiescent Output Voltage also changes (the higher the sensitivity is the more evident it will be) SC4645 is integrated with temperature sensors that could modify the temperature coefficient of the Quiescent Output Voltage.

Sensitivity

When the south pole magnetic field perpendicular to the chip tagged side accurate, the output voltage increases proportionately, until it reaches supply voltage. On the contrary, when the north pole magnetic field perpendicular to the chip tagged side accurate, the output voltage decreases proportionately, until it reaches ground level. Sensitivity is defined as the specific value of the variation of Output voltage and variation of the magnetic field; common unit is mV/Gs or mV/mT

Sens = [$V_{OUT\ (B1)}$ – $V_{OUT\ (B2)}$] / (B1 – B2)

The value of the sensitivity can be programmed according to the customers demand, which ranges from 0.5 to 24mV/Gs. Through the same procedure, the Sensitivity Temperature Excursion can also be programmed, in order to compensate the temperature coefficient of the magnetic ring or the chip itself.

Power-Up Time (t_{PO})

Power-Up time is defined as: At the specific magnetic field, the difference of the time spends between the time spend for Supply Voltage reaches 4.5V and Output voltage reaches 90% of the target value.

Response Time ($t_{RESPONSE}$)

Response time is defined as the difference of the time between the spend of the magnetic field reaches 80% of the target value and the output voltage of the chip to reach 80% of the target value. The Response time is related with the sensitivity of the IC and the size of the Output load capacitance.

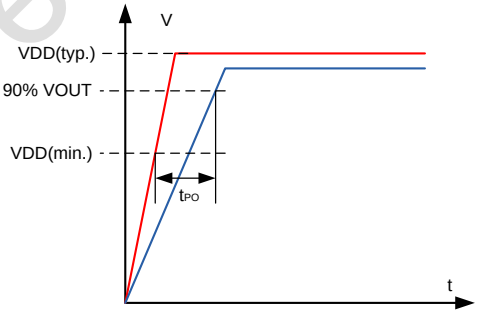


Figure 1. Power-On Time

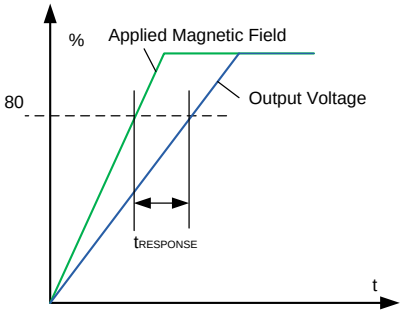
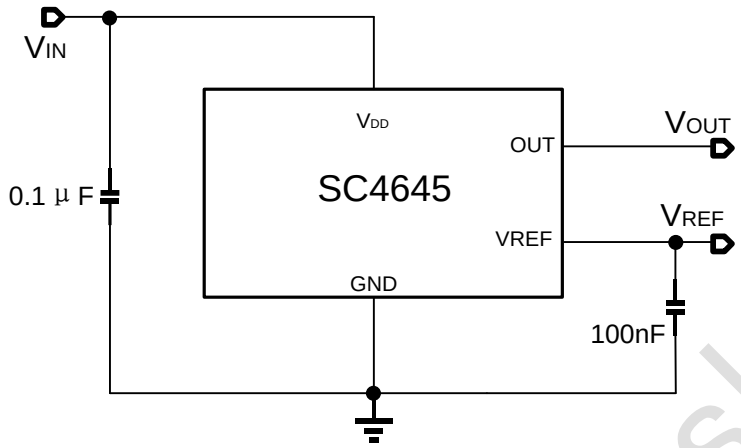
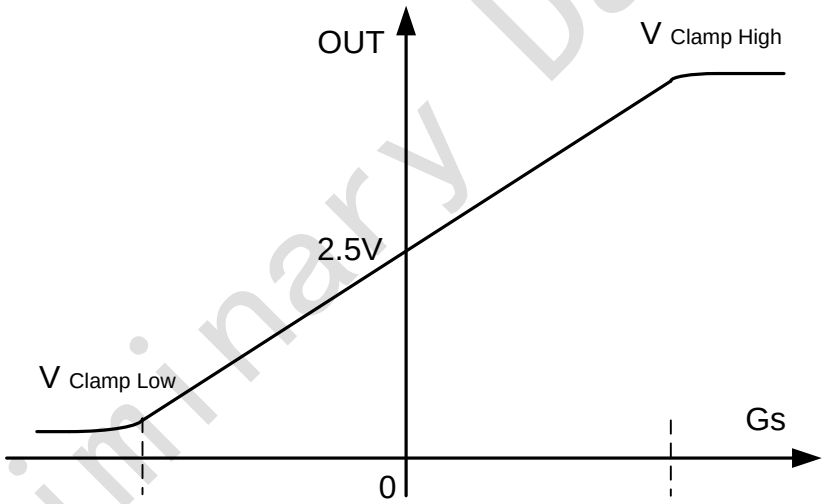


Figure 2. Response Time

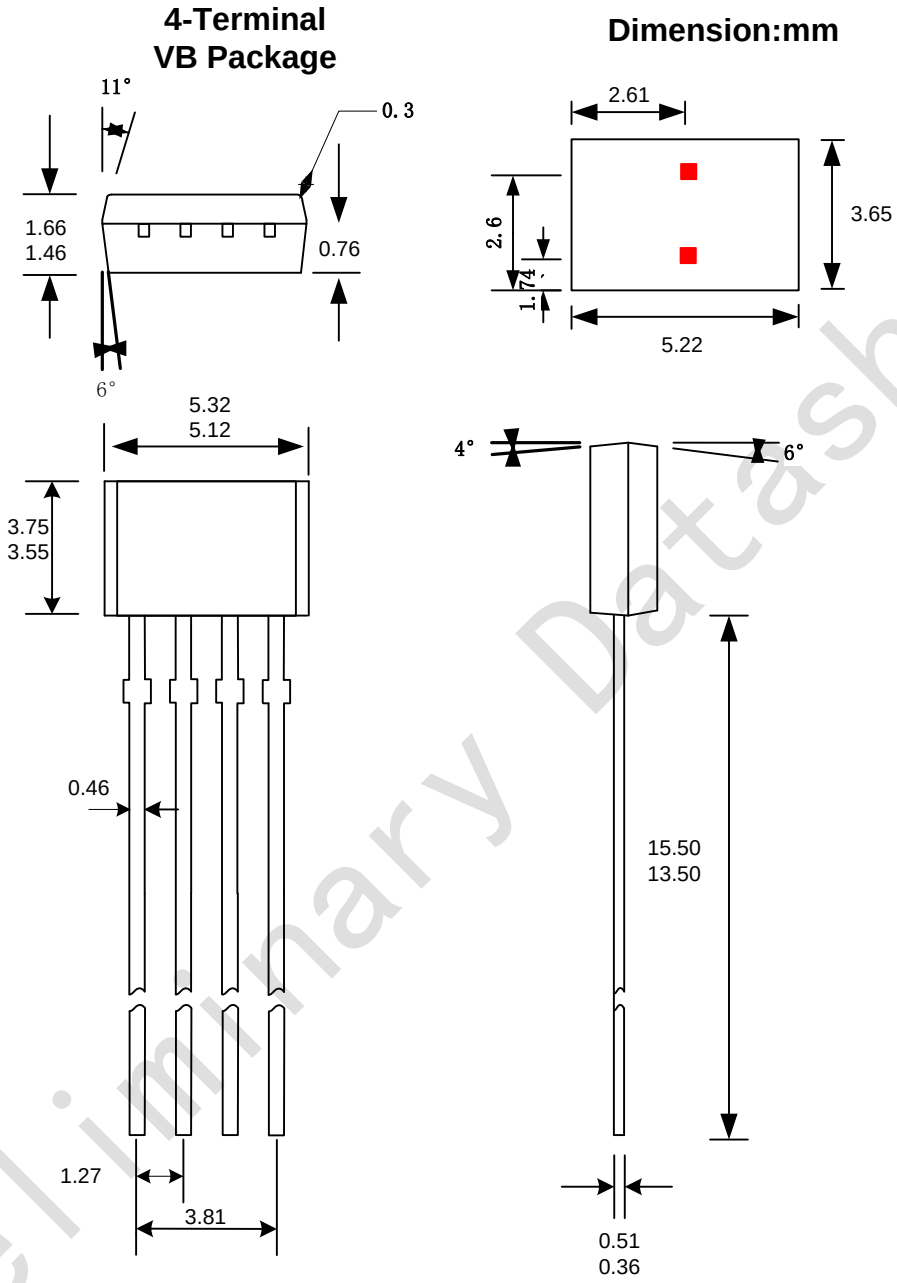
TYPICAL APPLICATION



TRANSFER FUNCTION



PACKAGE INFORMATION (VB)



Notes:

1. *Exact body and lead configuration at vendor's option within limits shown.*
2. *Height does not include mold gate flash.*

Where no tolerance is specified, dimension is nominal.

REVISION HISTORY

Revision	Date	Description
Rev0.01	2019-08-06	Preliminary Datasheet
RevA/1.0	2020-11-19	Unified datasheet format