High precision, wide band, programmable linear Hall sensor IC

FEATURES

- High-speed programmable liner Hall effect sensor IC
  - Quiescent output voltage
  - Sensitivity at (0.6—14 mV/Gs)
  - Temperature coefficient of Sensitivity
- Response time could reach 3.7μs
- Bandwidth up to 120 kHz
- Low noise
- Supply voltage from 4.5V to 5.5V
- Operating temperature from -40℃ to 150℃
- Under-voltage lockout and Short circuit diagnostic capability
- Lead free SIP4 package

APPLICATIONS

- BLDC motor current monitoring
- Over-current detection
- AC/DC converters
- Position sensors

DESCRIPTION

SC4643 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.

SC4643 have a quiescent output voltage default as half of the supply voltage. And the quiescent voltage can be programmed through supply voltage and output-pin. The sensitivity range of the chip can be shifted from 0.6mV/Gs to 14mV/Gs in order to adapt the current flow of various ranges.

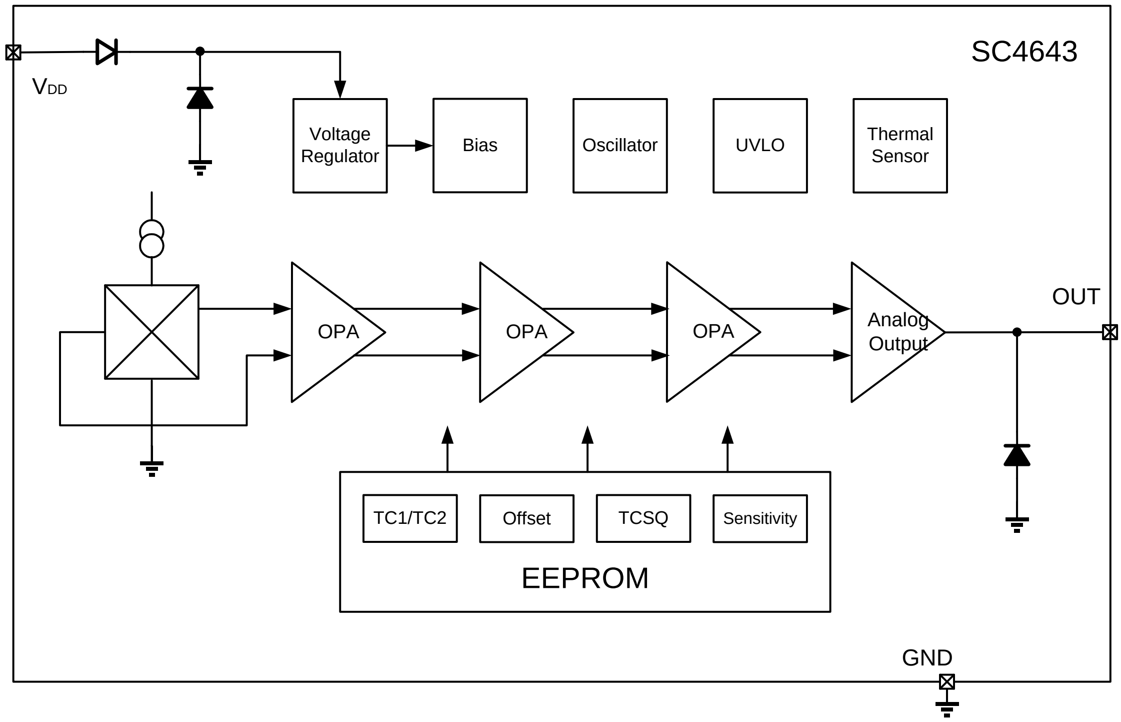
SC4643 is integrated with temperature sensor module. User can compensate the sensitivity of the chip through programmable algorithm, together with the temperature coefficient of the magnetic ring could enhance accuracy.

The typical supply-voltage of the IC is 5.0V , limited voltage is 15V, operating temperature is -40℃ to 150℃, capable of maintaining stable operation in the harsh automotive environment.

The SC4643 sensor IC is available in a 4-pin SIP The package is lead (Pb) free, with 100% matte tin plating.

CONTENTS

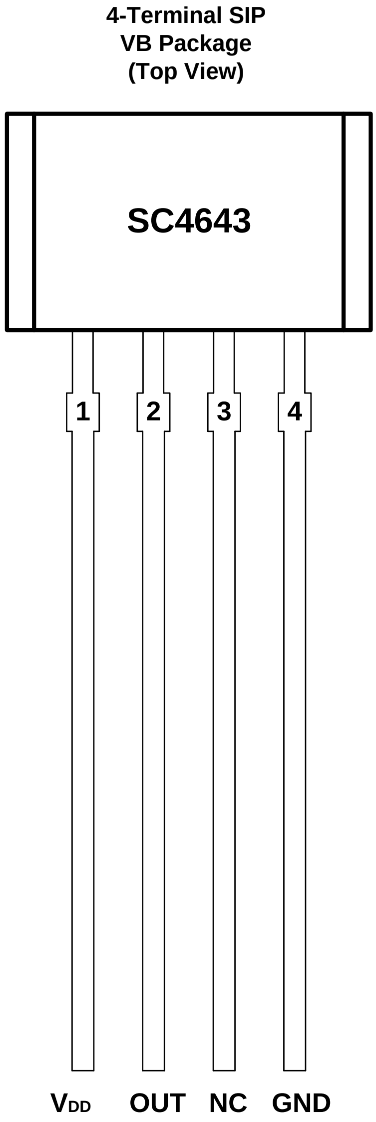
BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Packing	Mounting	Ambient, T_A	Marking
SC4643VB	Bulk,500pcs/bag	4-pin SIP	-40˚C to 150˚C	4643

THERMAL CONFIGURATION



Terminal		Type	Description
Name	Number		
V_{DD}	1	PWR	4.5V ~ 5.5V power supply
OUT	2	Output	Output terminal
NC	3	--	Connect to Ground
GND	4	Ground	Ground terminal

ABSOLUTE MAXIMUM RATINGS

Characteristic	Symbol	Notes	Min.	Max.	Unit
Forward Supply Voltage	V_{DD}		0	15	V
Reverse Supply Voltage	V_{RCC}		-15	0	V
Forward Output Voltage	V_{OUT}		0	15	V
Reverse Output Voltage	V_{ROUT}		-0.5	0	V
Output Source Current	$I_{OUT(source)}$	V_{OUT} to GND	0	3	mA
Output Sink Current	$I_{OUT(sink)}$	V_{DD} to V_{OUT}	0	10	mA
EEPROM Write Cycles				100	cycle
Operating Ambient Temperature	T_A		-40	150	˚C
Storage Temperature	T_{STG}		-55	160	˚C

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}	-4000	4000	V

OPERATING CHARACTERISTICS

Valid through the full operating temperature range, V_{DD+}= 5V, as not otherwise specified in conditions

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Electrical Characteristics						
Supply Voltage	V_{DD}		4.5	5	5.5	V
Supply Current	I_{DD}		~	13	16.5	mA
Power-Up Time	t_{PO}	C_{BYPASS}=Open,C_L=1nF, Sens= 2mV/G, B=400G	~	78	~	µS
Undervoltage Protection	V_{UVLOH}	V_{DD} rising	~	4	~	V
	V_{UVLOL}	V_{DD} falling	~	3.6	~	V
Power-Up Reset Voltage	V_{PORH}	V_{DD} rising	~	2.6	~	V
	V_{PORL}	V_{DD} falling	~	2.3	~	V
Zener Diode Breakdown Voltage	V_Z	I_{DD} = 30mA	15	~	~	V
Bandwidth	BW_i	signal -3dB C_L=1nF	~	120	~	kHz
Chopper frequency	f_C			500		kHz
Output Characteristics						
Response Time	$t_{RESPONSE}$	B_{step}=400G, C_L=1nF, Sens=2 mV/G	3	3.7	~	µS
Noise	V_N	C_L=1nF, Sens=2 mV/G, B_{Wf}=BWi	~	10	~	mV_{p-p}
			~	1	~	mV_{RMS}
Up-raising Time	t_R	B_{step}=400G, C_L=1nF, Sens=2 mV/G	~	3.6	~	µS
Output Clamp Voltage	$V_{CLP(H)}$	$R_{L(DOWN)}$=10K to GND	4.5	4.7	4.85	V
	$V_{CLP(L)}$	$R_{L(UP)}$=10K to VDD	0.15	0.3	0.45	V
Output Saturate Voltage	$V_{SAT(H)}$	$R_{L(DOWN)}$=10K to GND	4.7	~	~	V
	$V_{SAT(L)}$	$R_{L(UP)}$=10K to VDD	~	~	0.3	V
Output Load Resistance	$R_{L(UP)}$	V_{OUT} to V_{DD}	4.7	~	~	kΩ
	$R_{L(DOWN)}$	V_{OUT} to GND	4.7	~	~	kΩ
Output Load Capacitor	C_L	Sens=2 mV/G, C_L=1nF	~	1	10	nF
Output Slew Rate	SR	Sens=2 mV/G, C_L=1nF	~	400	~	V/ms

OPERATING CHARACTERISTICS(Continued)

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Quiescent Output Voltage $V_{OUT(Q)}$						
Factory Quiescent Output Voltage	$V_{OUT(Q)init}$		2.4	2.5	2.6	V
Quiescent Output Voltage Program Range	$V_{OUT(Q)PR}$		2.2		2.8	V
Program Digit	QVO		~	9	~	bit
Program Minimum Step	$Step_{VOUT(Q)}$		1.2	2	2.8	mV
Sensitivity						
Factory Default Sensitivity	$SENS_{INIT}$	$SENS_{\_COARSE}$=00	~	1	~	mV/Gs
		$SENS_{\_COARSE}$ =01	~	2	~	mV/Gs
		$SENS_{\_COARSE}$ =10	~	4.5	~	mV/Gs
		$SENS_{\_COARSE}$ =11	~	10	~	mV/Gs
Sensitivity Program Range	$SENS_{PR}$	$SENS_{\_COARSE}$ =00	0.6	~	1.6	mV/Gs
		$SENS_{\_COARSE}$ =01	1.0	~	3.0	mV/Gs
		$SENS_{\_COARSE}$ =10	2.0	~	7.0	mV/Gs
		$SENS_{\_COARSE}$ =11	4.5	~	14	mV/Gs
Coarse Tuning Digit	$SENS_{\_COARSE}$		~	2	~	bit
Fine Tuning Digit	$SENS_{\_FINE}$		~	9	~	bit
Sensitivity Temperature Excursion						
Sensitivity Temperature Excursion Coefficient	TC_{SENS}	T_A=150˚C to -40˚C, calculated relative to 25˚C	~	0	~	%/˚C
Sensitivity Temperature Excursion Range	$\triangle Sens_{TC}$	T_A=25˚C to 150 ˚C	-2.5	~	2.5	%
		T_A=-40˚C to 25 ˚C	-2.5	~	2.5	%
Sensitivity Temperature Excursion First Derivatives Compensation Digit			~	6	~	bit

OPERATING CHARACTERISTICS(Continued)

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Average Temperature Excursion programming step	$Step_{SENSTC}$		~	<0.3	~	%
Quiescent Voltage Temperature Excursion						
Quiescent Output Voltage Temperature Excursion	TC_{QVO}	T_A=150˚C to -40˚C, calculated relative to 25 ˚C	~	0	~	mV/˚C
Quiescent Output Voltage Range	Δ $V_{OUT(Q)TC}$	T_A=25˚C to 150 ˚C	-10	~	10	mV
		T_A=-40˚C to 25 ˚C	-10	~	10	mV
Temperature Excursion Program Digit				30		bit
Average Temperature Programming Step	$Step_{QVOTC}$		~	1.2	~	mV
Lock Bit Programming						
EEPROM Lock Bit	EELOCK		~	1	~	bit
Other Coefficient						
Linearity	Lin_{ERR}		-1	±0.2	1	%
Symmetry	Sym_{ERR}		-1	±0.2	1	%
Quiescent Output Voltage Range Variation Rate	Rat_{ERRVQ}	Through supply voltage range	-1	0	1	%
Sensitivity Variation Rate	$Rat_{ERRSens}$	Through supply voltage range	-1.5	±0.5	1.5	%
Packaging Influence to Sensitivity	Δ $Sens_{PKG}$	after temperature cycling	-1.25	0	1.25	%

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 SC4643 equals to $V_{DD}/2$, 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) SC4643 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 increase 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 decrease 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 spend 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.

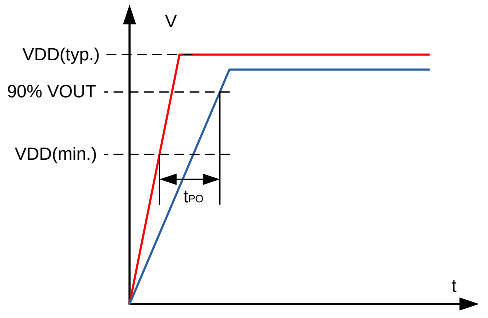


Figure 1. Power-On Time

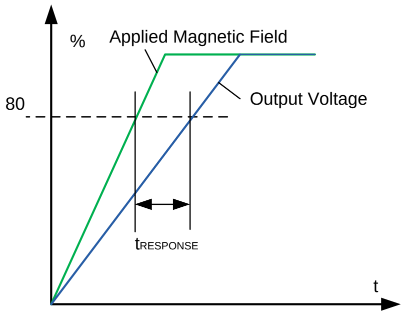
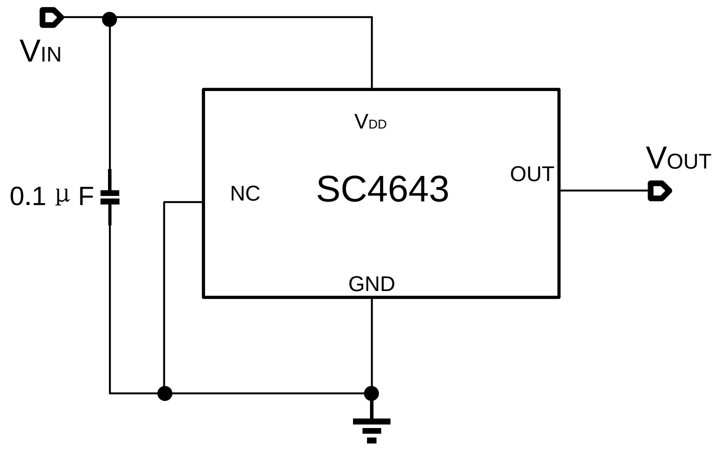
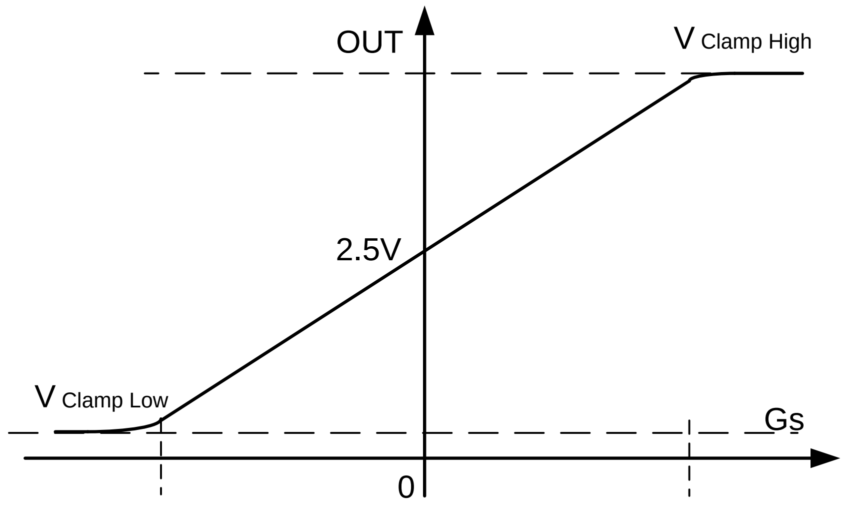


Figure 2. Response Time

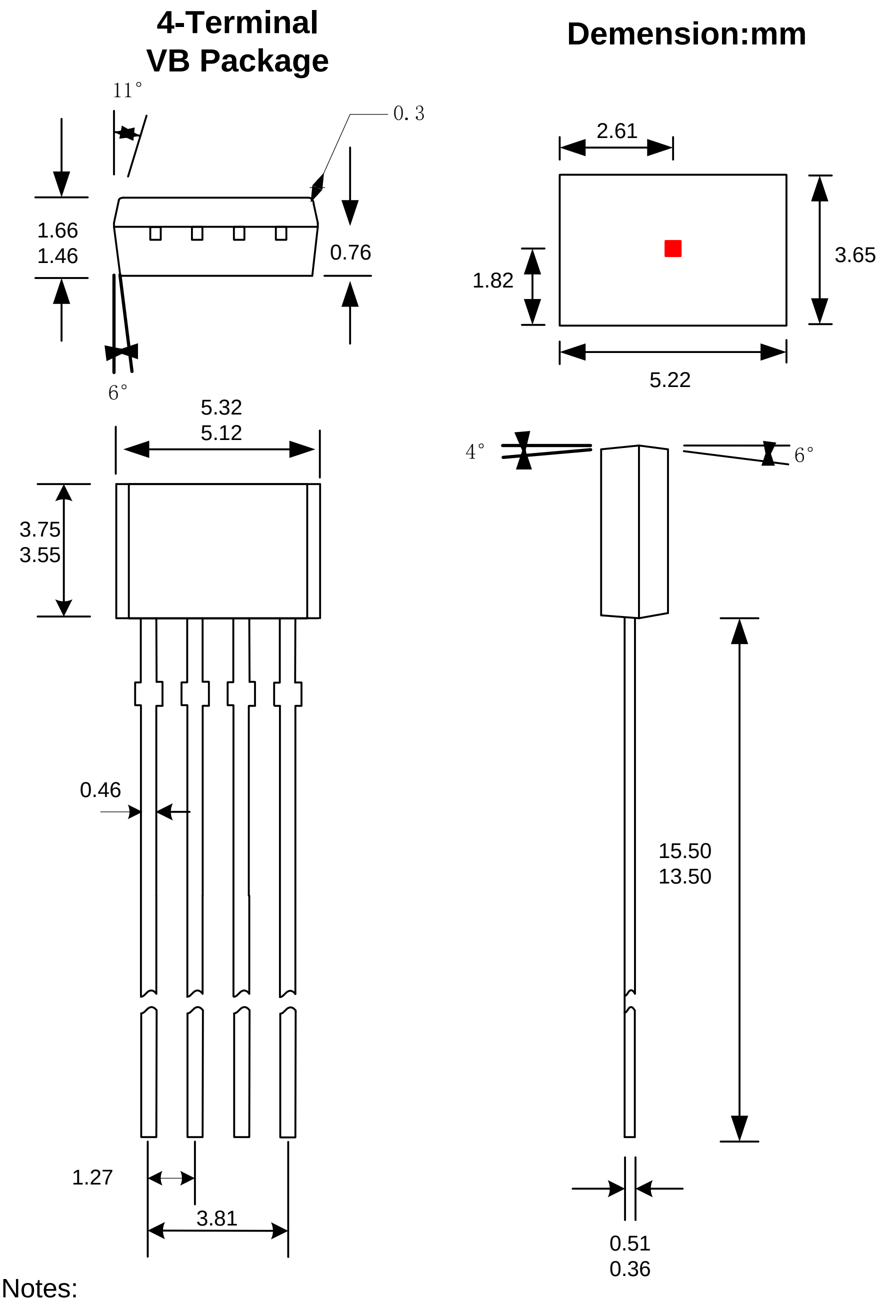
TYPICAL APPLICATION



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
Rev1.0	2018-06-15	Preliminary Datasheet
Rev2.0	2019-05-06	Perfect FEATURES
Rev2.3	2019-04-06	The final revision of old datasheet
RevA/1.0	2020-11-19	Unified datasheet format