

High Performance Digital-Bipolar Hall Effect Sensor

1. Features

- AEC-Q100 qualified
- Latch-type switch Hall
- Optional PCB-less package
- Support a wide operating voltage range:
 - 2.8V to 40V
- Supply voltage transient up to 60V with 200Ω R_S resistor
- Wide operating temperature range:
 - -40°C to 150°C
- Reverse battery protection: -28V
- Current limited open drain output: 40mA
- High EMC/ESD immunity
- Small package:
 - TO-92S (UA)
 - TO-92S (CUA, with capacitor)
 - SOT23-3L (SO)

2. Applications

- Automotive
- Flow meters
- Valve and solenoid status
- BLDC motor with sensors
- Proximity sensing
- Tachometers

3. Description

The SC2498 series is manufactured using advanced 60V BCD technology. It is a chopper-stabilized Hall effect sensor that provides a magnetic sensing solution with excellent sensitivity stability and integrated protection functions. Superior high-temperature performance is made possible through dynamic offset cancellation, which reduces the residual offset voltage normally caused by device over molding, temperature dependencies, and thermal stress. Each device includes a voltage regulator, Hall-voltage generator, small-signal amplifier, chopper stabilization, hysteresis comparator, and the current limited output circuit. An onboard regulator permits with supply voltages of 2.8V to 40V which makes the device suitable for a wide range of industrial and automotive applications.

The device is available in a 3-pin TO92S package (UA) and a 3-pin SOT23-3L style package (SO). Both are lead (Pb) free, with 100% matte tin lead frame plating.



Fig.1 Package Outline

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4. Terminal Configuration

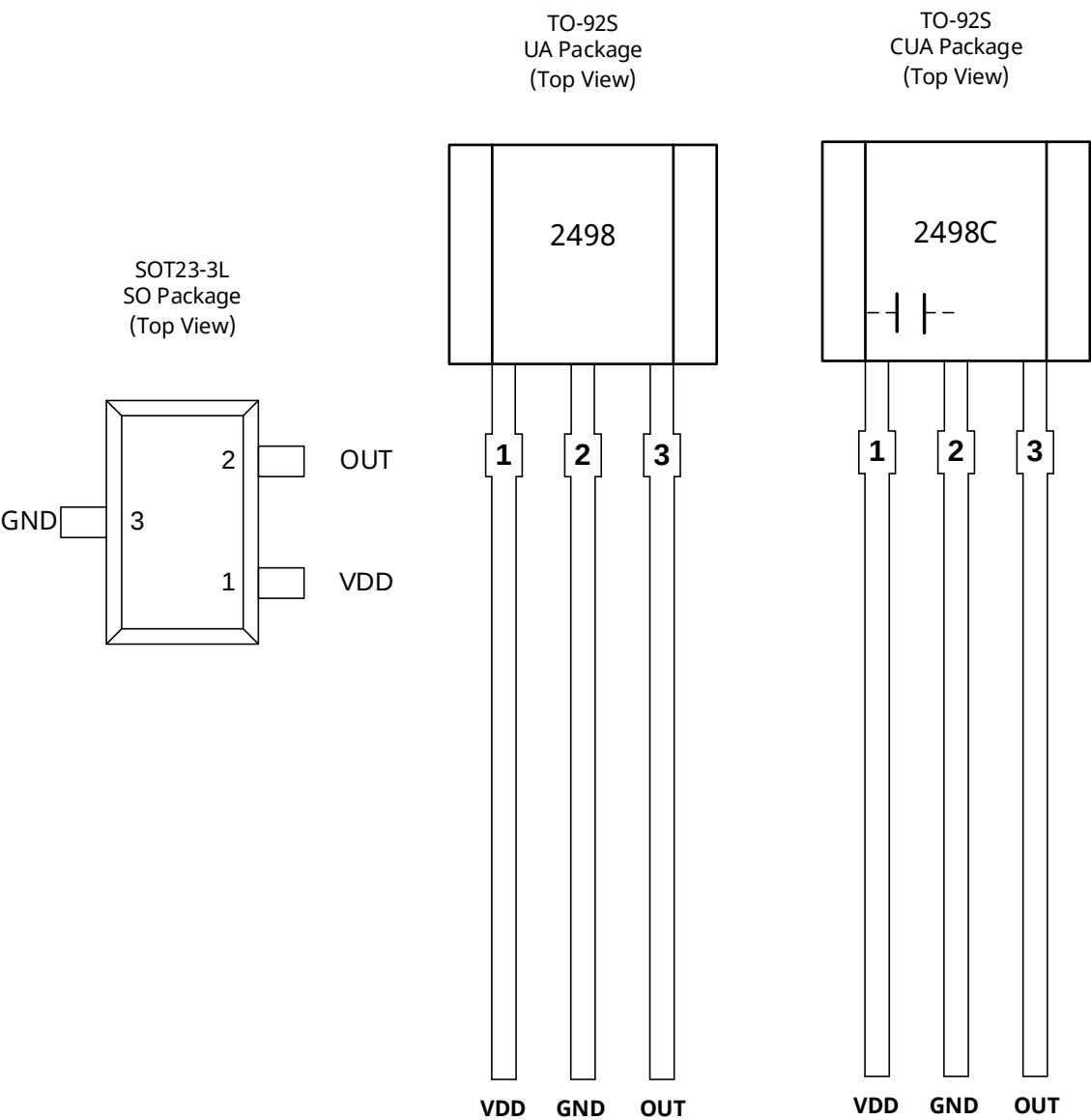


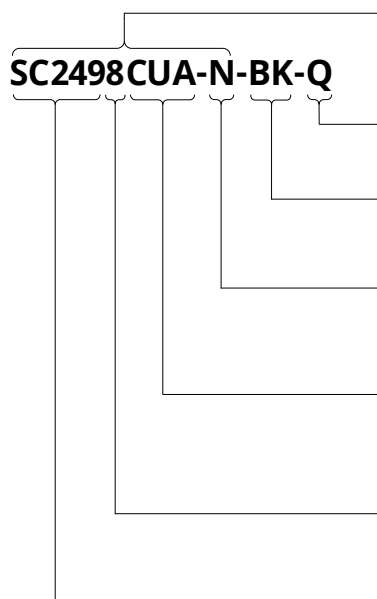
Fig.2 Terminal Configuration

Terminal				Type	Description
Name	UA	CUA	SO		
VDD	1	1	1	PWR	2.8V to 40V power supply
GND	2	2	3	Ground	Ground
OUT	3	3	2	Output	Open-drain output required a pull-up resistor

5. Ordering Information

Order Information	Mark	Option	B _{OP} (Gs)	B _{RP} (Gs)	Ambient, T _A (°C)	Package	Packing	Quantity
SC2498SO-TR-Q	2498	S	+80	-80	-40~150	SOT23-3L	Reel	3000/reel
SC2498UA-N-BK-Q	2498	N	-80	+80	-40~150	TO-92S	Bulk	1000/bag
SC2498CUA-N-BK-Q	2498C	N	-80	+80	-40~150	TO-92S	Bulk	1000/bag

Ordering Information Format



Part Number

Product Grade

Q: Automotive Product

Packing Designation

BK: Bulk

TR: Tape & Reel

Active Magnetic Polarity

N: North Magnetic Field

Default: South Magnetic Field

Package Designation

UA: TO-92S

CUA: TO-92S, with capacitor

SO: SOT23-3L

Magnetic Parameter

B_{OP}: +80Gs, B_{RP}: -80Gs

Device Family

SC2498: High Performance Digital-Bipolar Hall Effect Sensor

6. Absolute Maximum Ratings

Operating temperature range (unless otherwise specified) ⁽¹⁾

Symbol	Parameter	Test conditions	Min.	Max.	Units
V _{DD}	Power supply voltage	Resistance $\geq 200\Omega$, no more than 5 minutes	-28	60	V
V _{OUT}	Output terminal voltage	1.2 k Ω pull up resistor, not exceed 5 min	-0.5	60	V
I _{SINK}	Output terminal current sink		0	40	mA
T _A	Operating ambient temperature		-40	150	°C
T _J	Junction temperature		-55	165	°C
T _{STG}	Storage temperature		-65	175	°C

Note :

(1) 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.

(2) SC2498CUA-N-BK-Q V_{DD} integrates a capacitor, so V_{DD} voltage will derate when the temperature exceeds 125 °C. Please contact Semiment for more information.

7. ESD Protection

Symbol	Parameter	Test conditions	Min.	Max.	Units
V _{ESD_HBM}	HBM	according to standard AEC-Q100-002 HBM	-8	+8	kV
	HBM(PCB-less)	according to standard AEC-Q100-002 HBM	-12	+12	kV
V _{ESD_CDM}	CDM	according to standard AEC-Q100-011 CDM	-750	+750	V

8. Thermal Characteristics

Symbol	Parameter	Test conditions	Rating	Units
R _{θJA}	UA/CUA Package thermal resistance	Single-layer PCB, with copper limited to solder pads	200 ⁽¹⁾	°C/W
	SO Package thermal resistance	Single-layer PCB, with copper limited to solder pads	300 ⁽¹⁾	°C/W

Note:

(1) Maximum voltage must be adjusted for power dissipation and junction temperature, see Thermal Characteristics

9. Operating Characteristics

9.1. Electrical Characteristics

over operating free-air temperature range ($V_{DD} = 5.0V$, unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ. ⁽¹⁾	Max.	Units
V_{DD}	Operating voltage ⁽¹⁾	$T_J < T_{J(Max.)}$	2.8	5.0	40	V
I_{DD}	Operating supply current	$V_{DD}=2.8$ to $40V$, $T_A=25^{\circ}C$	3.5	4.1	7.0	mA
$UVLO_H$	Under Voltage Lockout High	$B > B_{OP} + 2.0mT$, V_{DD} Rising From $2.5V$	-	2.7	-	V
$UVLO_L$	Under Voltage Lockout Low	$B > B_{OP} + 2.0mT$, V_{DD} Decreasing From $3.0V$	-	2.5	-	V
$UVLO_{HYS}$	Under Voltage Hysteresis	$UVLO_H - UVLO_L$	-	0.2	-	V
t_{on}	Power-on time	$V_{DD} \geq 5V$	-	25	40	μs
I_{QL}	Off-state leakage current	Output Hi-Z	-	-	3	μA
V_{SAT}	Output saturation voltage	$V_{DD}=5V$, $I_O=20mA$, $T_A=25^{\circ}C$	-	0.14	0.4	V
t_d	Output delay time	$B=B_{RP}$ to B_{OP}	-	15	25	μs
OCP	Over current protection	Output on $VPULL-UP < 30V$	30	50	70	mA
t_r	Output rise time (10% to 90%)	$R1=1Kohm$, $Co=50pF$	-	0.2	1	μs
t_f	Output fall time (90% to 10%)	$R1=1Kohm$, $Co=50pF$	-	0.1	1	μs

Note:

(1) Typical values are defined at $T_A = +25^{\circ}C$ and $V_{DD} = 5V$

(2) Maximum voltage must be adjusted for power dissipation and junction temperature, see Thermal Characteristics

9.2. Magnetic Characteristics

over operating free-air temperature range ($V_{DD} = 5.0V$, unless otherwise noted)

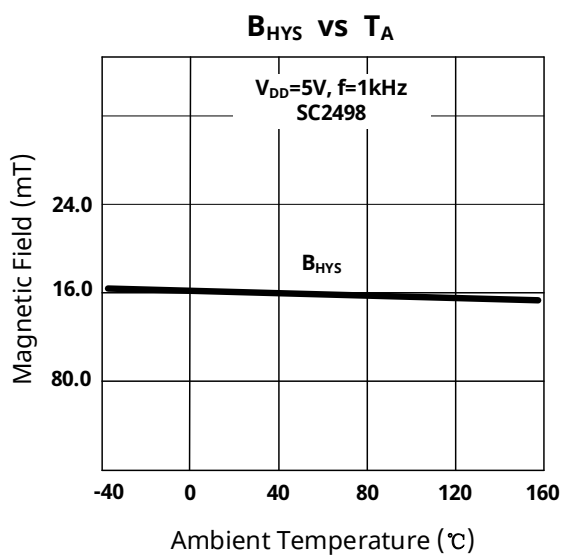
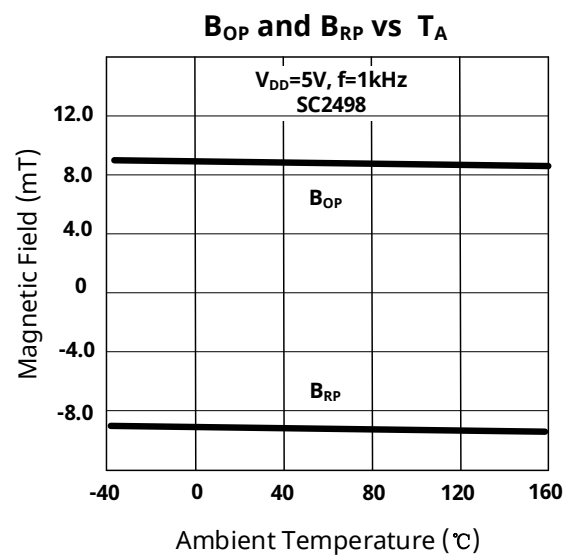
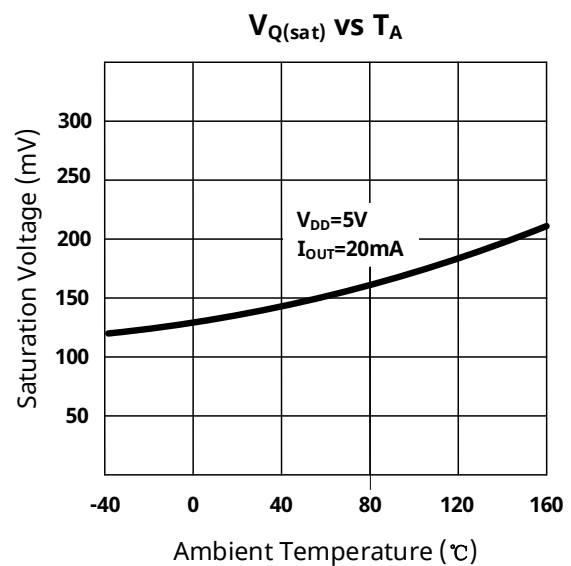
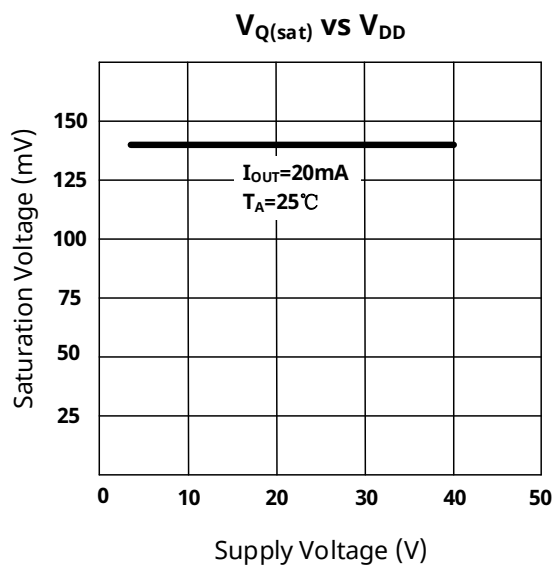
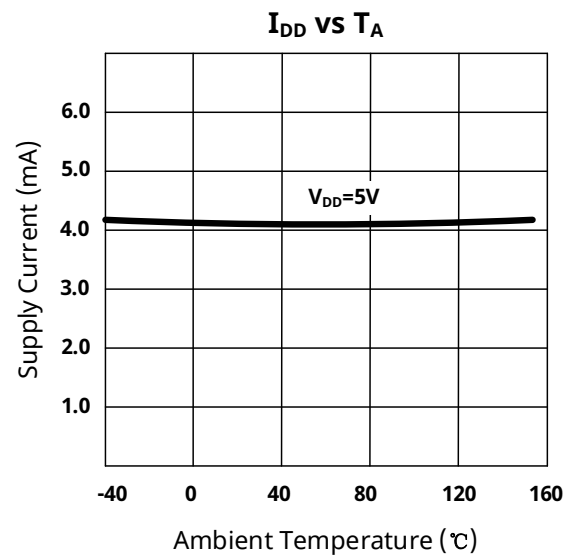
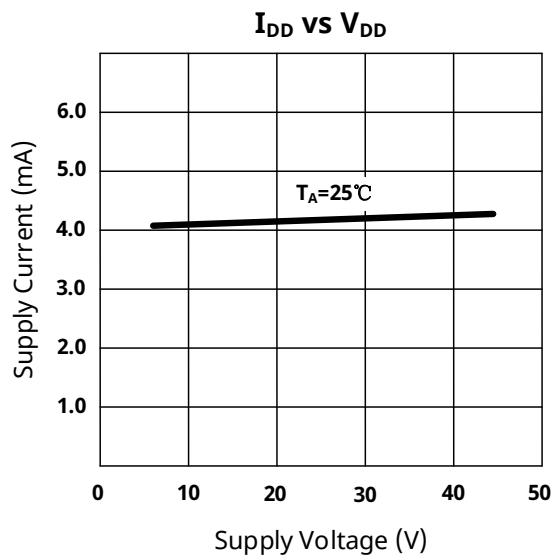
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
f_{BW}	BW		20	-	-	kHz
SC2498 +8.0⁽¹⁾/-8.0 mT⁽²⁾						
B_{OP}	Operating point	$T_A = 25^\circ C$	+6.0	+8.0	+10.0	mT
B_{RP}	Release point		-10.0	-8.0	-6.0	mT
B_{HYS}	Hysteresis		12.0	16	20.0	mT

Note:

(1) Magnetic flux density, B is indicated as a negative value for North-polarity magnetic fields, and as a positive value for South-polarity magnetic fields

(2) $1mT=10Gs$

10. Typical Characteristics



11. Block Diagram

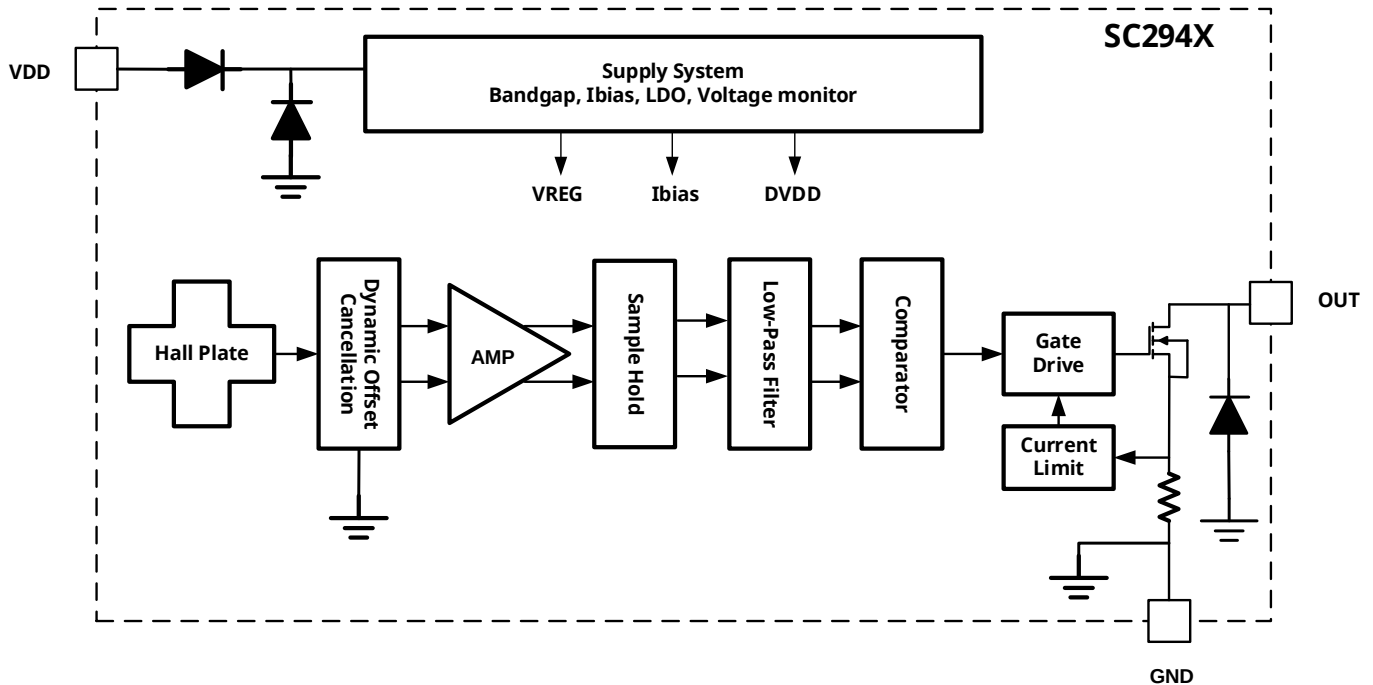


Fig.3 Function Block Diagram

12. Function Description

The SC294X device is a chopper-stabilized Hall sensor with a digital latched output for magnetic sensing applications. The device can be powered with a supply voltage between 2.8 to 40V, and continuously survives continuous -28V reverse-battery conditions.

The output of SC294X switches low (turns on) when a magnetic field perpendicular to the Hall element exceeds the absolute value of the operate point threshold, B_{OP} . After turn-on, the output is capable of sinking 44mA and the output voltage is $V_Q(sat)$. When the magnetic field is reduced below the absolute value of the release point, B_{RP} , the device output goes high (turns off). The difference in the magnetic operate and release points is the hysteresis, B_{HYS} , of the device. This built-in hysteresis allows clean switching of the output even in the presence of external mechanical vibration and electrical noise.

12.1. Field Direction Definition

A positive magnetic field is defined as a South pole near the marked side of the package.

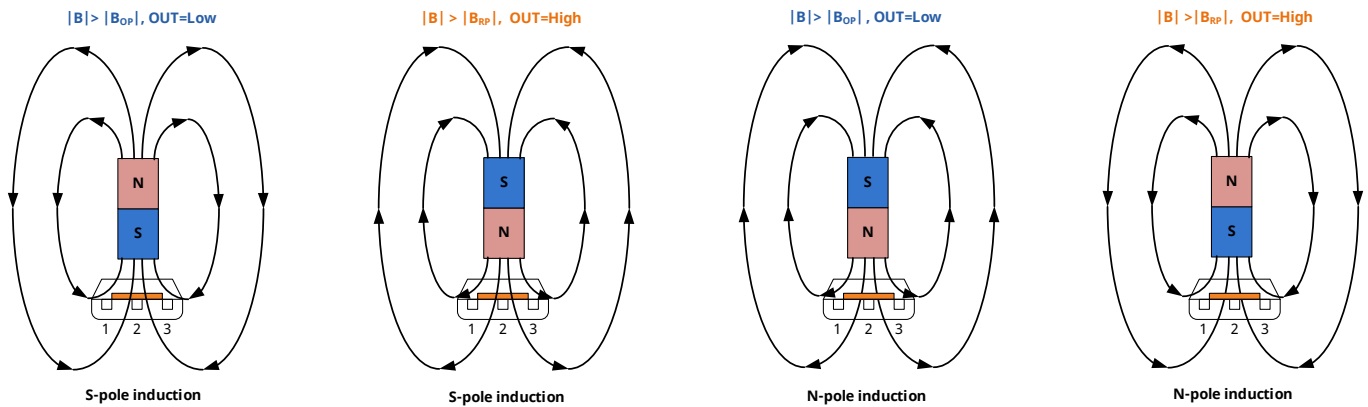


Fig.4 Magnetic Field Direction Definition

12.2. Transfer Function

Powering-on the device in the hysteresis region, less than B_{OP} and higher than B_{RP} , allows an indeterminate output state. The correct state is attained after the first excursion beyond B_{OP} or B_{RP} . If the field strength is greater than B_{OP} , then the output is pulled low. If the field strength is less than B_{RP} , the output is released.

B_{OP} —magnetic threshold for activation of the device output, turning in ON (low) state. Resistance $\geq 200\Omega$, no more than 5 minutes

B_{RP} —magnetic threshold for release of the device output, turning in OFF (high) state.

$$B_{HYS} = B_{OP} - B_{RP}$$

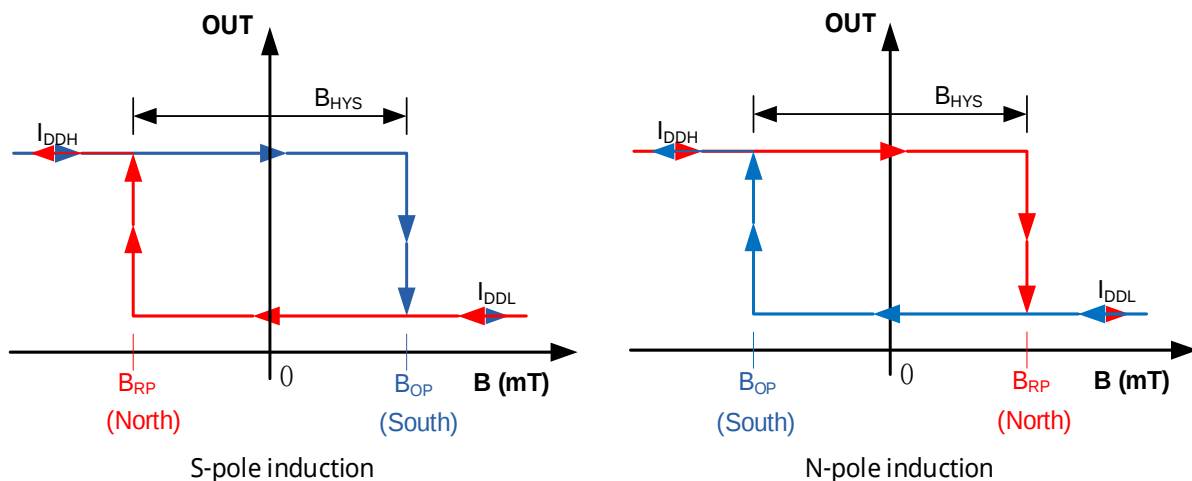


Fig.5 Magnetic Transfer Function

13. Typical Application

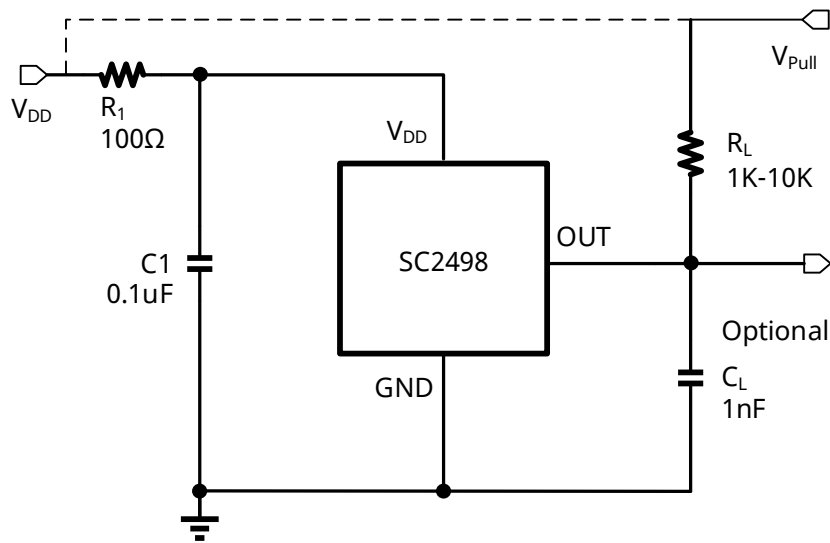


Fig.6 Typical Application Circuit

The SC2498 contains an on-chip voltage regulator and can operate over a wide supply voltage range. In applications that operate the device from an unregulated power supply, transient protection must be added externally. For applications using a regulated line, EMI/RFI protection may still be required. It is recommended that C1 capacitor be connected to the ground in parallel near the VDD power end of the chip, with a typical value of 0.1μF. At the same time in the external optional series resistor R1 and output capacitance CL used for enhanced protection circuit, its typical values for 100Ω and 1nF.

Select a value for CL based on the system bandwidth specifications as:

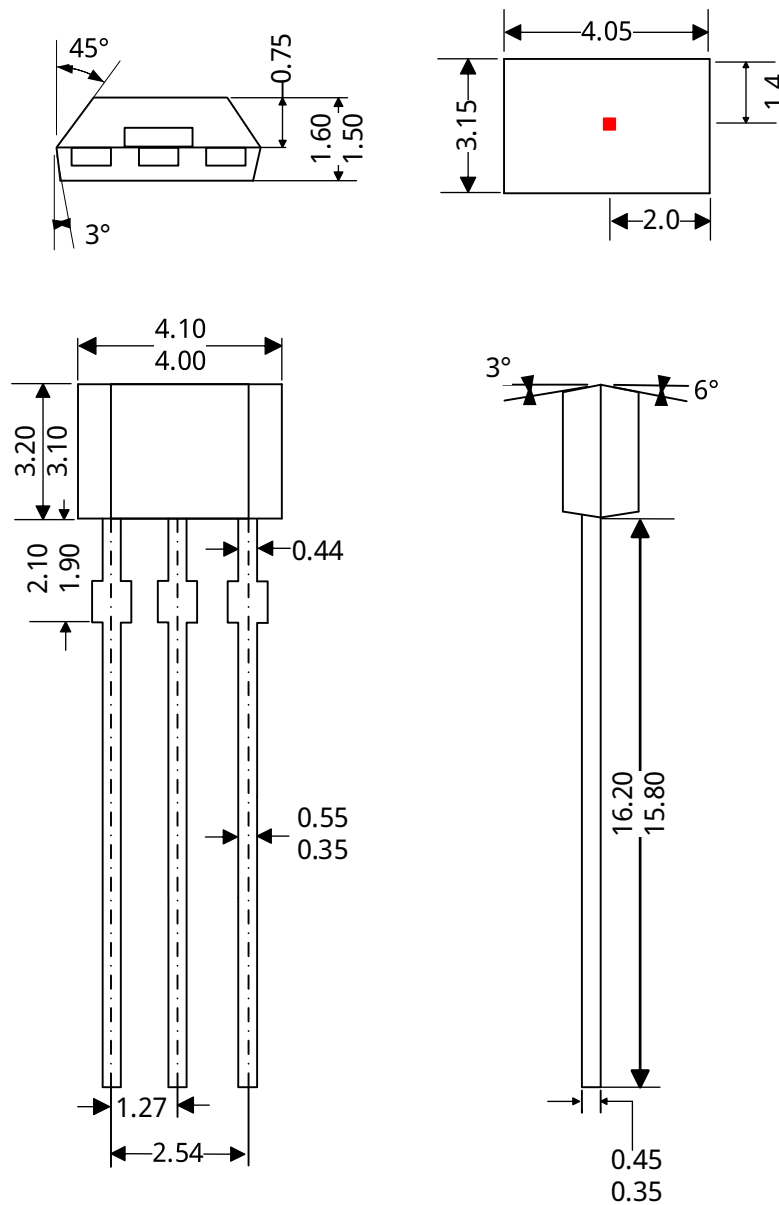
$$C_L < \frac{1}{2\pi \times R_L \times 2 \times f_{BW}(Hz)}$$

V_{PULL} is not restricted to V_{DD} and could be connected to other voltage power supply. The allowable voltage range of this terminal is specified in the Absolute Maximum Ratings.

14. Package Information UA

3-Terminal
S3 Package

Unit:mm

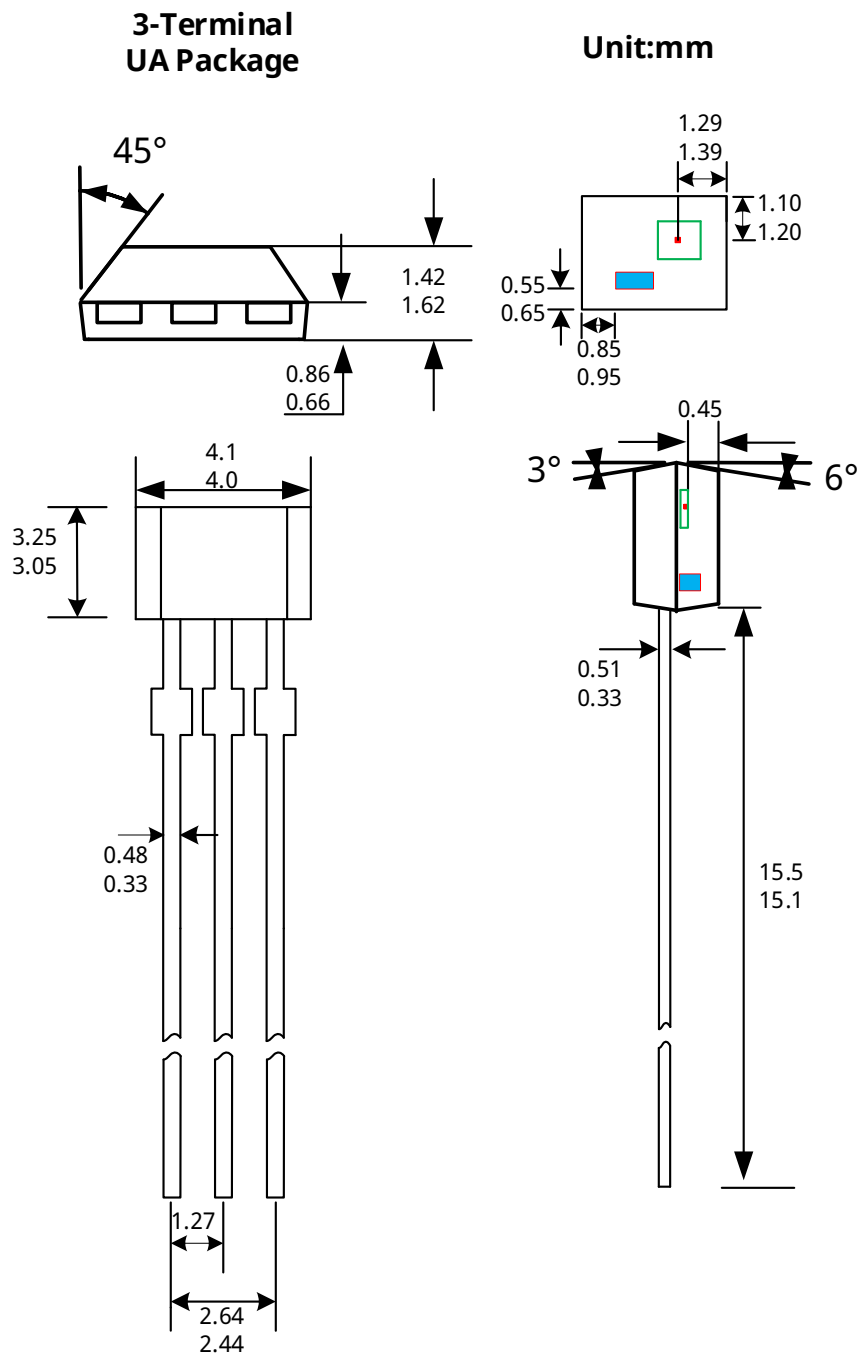


Notes:

- (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.

15. Package Information CUA



Notes:

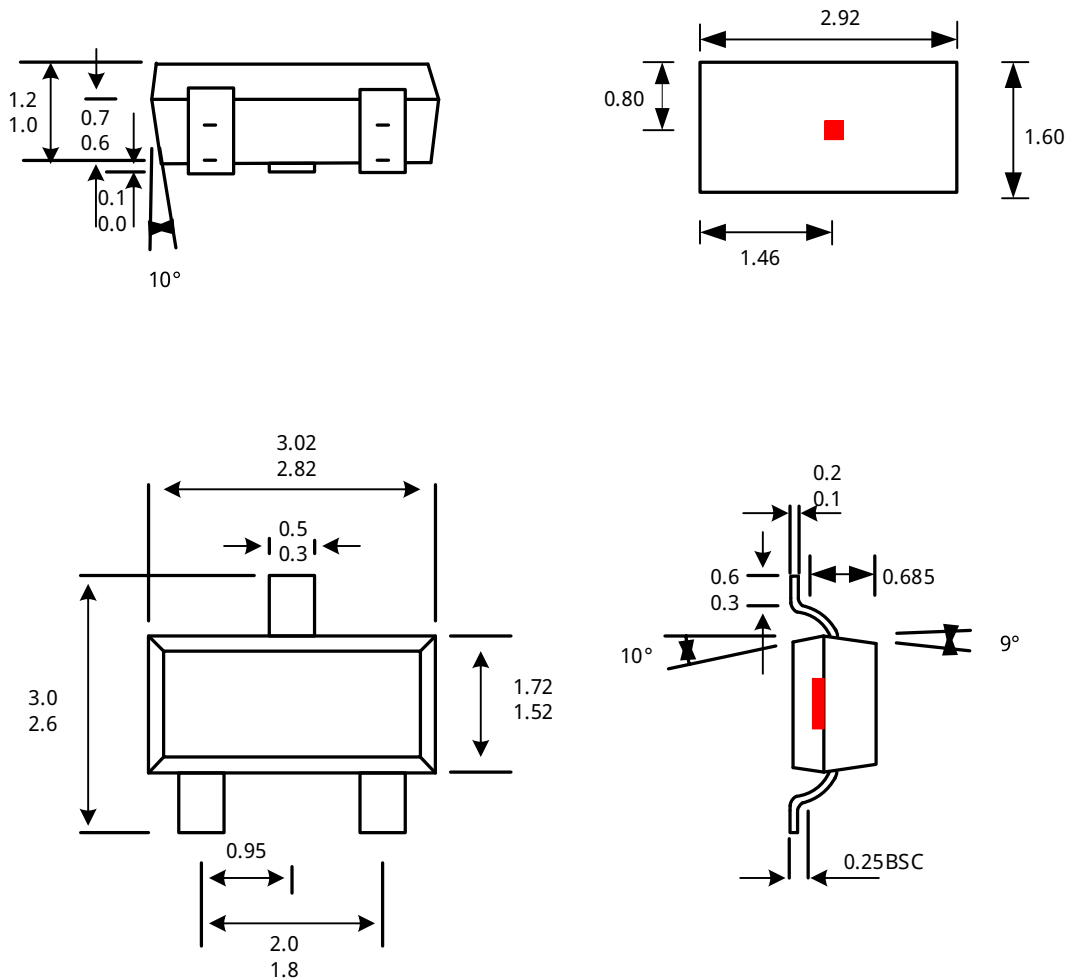
- (1) Exact body and lead configuration at vendor's option within limits shown.
- (2) Height does not include mold gate flash.
- (3) Green is Die; Red is Hall plate; Blue is Cap
- (4) Die Size: 1.14mm*1.02mm*0.3mm; Cap Size: 1.0mm*0.5mm*0.5mm

Where no tolerance is specified, dimension is nominal.

16. Package Information SO

3-Terminal
SO Package

Unit:mm



Notes:

- (1) Exact body and lead configuration at vendor's option within limits shown.
- (2) Height does not include mold gate flash.
- (3) The red mark is Hall element.

Where no tolerance is specified, dimension is nominal.

17. Revision History

Revision	Date	Description
Rev0.1	2022-1-08	Preliminary datasheet
Rev0.2	2022-04-27	1.Output terminal current sink from 40mA to 35mA 2.Power-on time max from 20us to 10us 3.UA package
Rev.A.1.0	2023-08-10	Uniform format and update hall plate position
Rev.A.1.1	2024-05-12	Update EC table
Rev.A.1.2	2024-06-27	1.Add SC2498CUA-N part 2.Add ordering, ESD, EMC table
Rev.A.1.3	2025-02-14	Update ordering information
Rev.A.1.4	2025-03-12	Update EC table of Magnetic Characteristics