

High Performance Digital-Bipolar Hall Effect Sensor

1. Features

- AEC-Q100 Certification
- High chopping frequency
- Support a wide operating voltage range:
 - 2.8-40V
 - Operating from unregulated supply
- Wide operating temperature range:
 - -40-160°C
- Enable 40V load dump compliance
- Reverse battery protection
- Output short-circuit protection
- Robust EMC performance
- Solid-state reliability
- 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 is a Hall-effect latch designed in BCD process technology. The device integrates a voltage regulator, Hall sensor with dynamic offset cancellation system, Schmitt trigger and an open-drain output driver, all in a single package.

The wide operating voltage range and extended choice of temperature range make it suitable for use in automotive, industrial and consumer applications.

The device is available in a 3-pin SIP package TO-92S (UA) and a 3-pin SOT23-3L (SO). Both are lead (Pb) free, with 100% matte tin lead-frame plating.



Fig.1: Package Outline

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4. Terminal Configuration

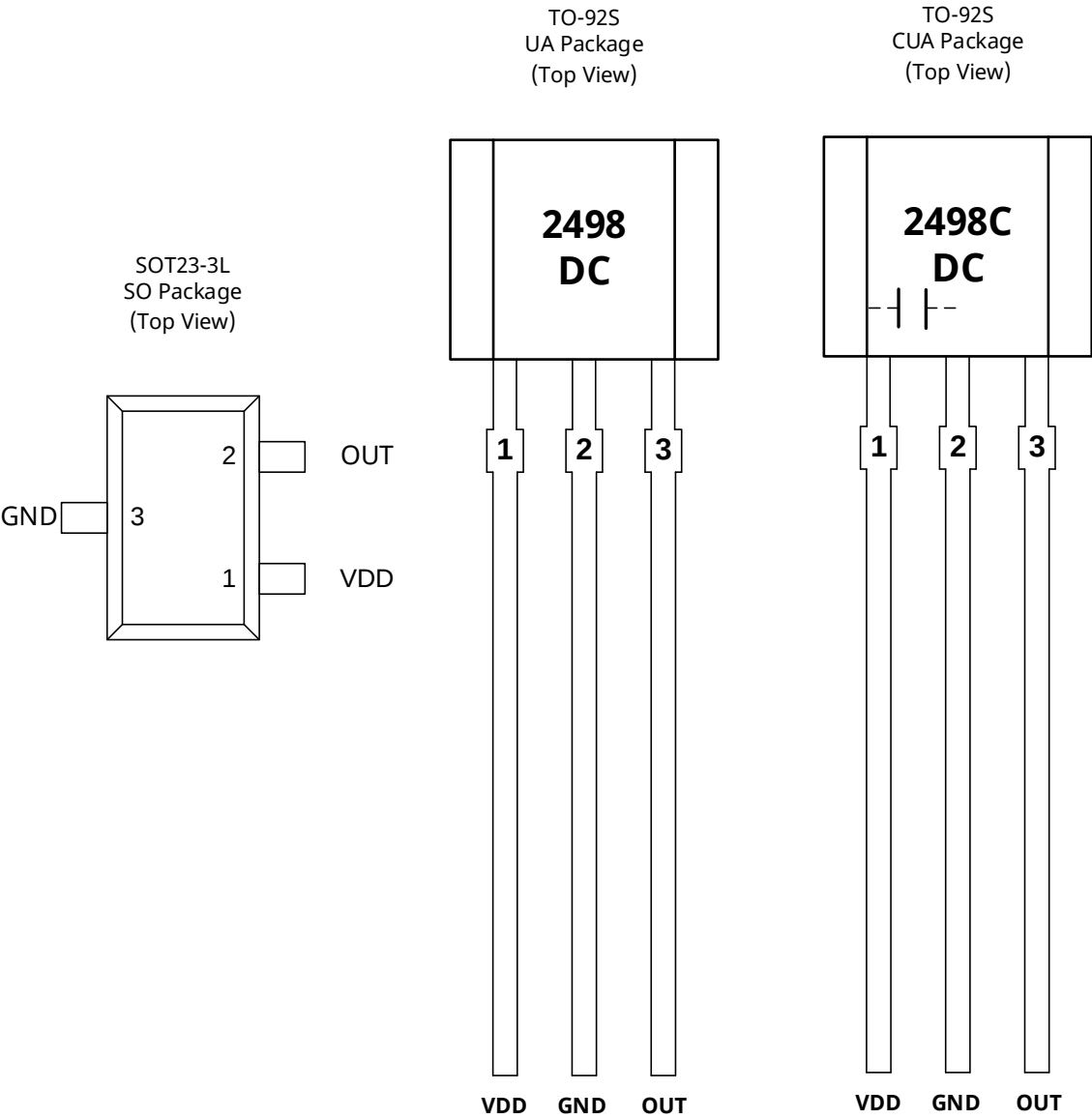


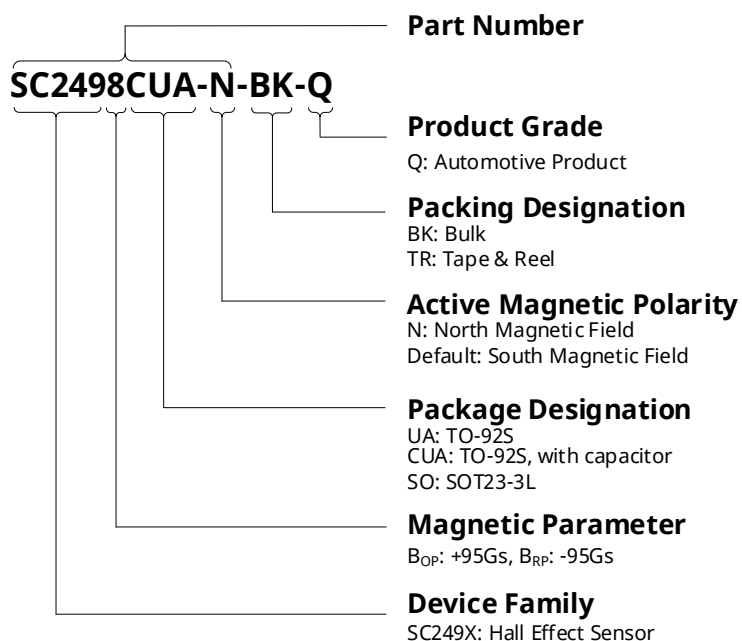
Fig.2: Pin Description

Terminal				Type	Description
Name	UA	CUA	SO		
VDD	1	1	1	PWR	2.8V ~ 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	Class	B _{OP} (Gs)	B _{RP} (Gs)	Ambient, T _A (°C)	Package	Packing	Quantity
SC2498SO-TR-Q	2498		Q	+95	-95	-40~150	SOT23-3L	TR	3000/reel
SC2498UA-N-BK-Q	2498	N	Q	-95	+95	-40~150	TO-92S	BK	1000/reel
SC2498CUA-N-BK-Q	2498C	N	Q	-95	+95	-40~150	TO-92S	BK	1000/bag

Ordering Information Format



6. Absolute Maximum Ratings

(over operating free-air temperature range, unless otherwise noted)⁽¹⁾

Symbol	Parameter	Test conditions	Min.	Max.	Units
V _{DD}	Power supply voltage		-43	43 ⁽²⁾	V
V _{OUT}	Output terminal voltage	For 5 Min. @1.0K pull-up resistor	-0.5	43	V
I _{SINK}	Output terminal current sink		-	35	mA
T _A	Operating ambient temperature		-40	160	°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 VDD integrates a capacitor, so VDD 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	SC2498CUA-N-BK-Q: Refer to AEC-Q100-002E HBM standard, R=1.5kΩ, C=100pF	-12	12	kV
		SC2498SO-TR-Q & SC2498UA-N-BK-Q: Refer to AEC-Q100-002E HBM standard, R=1.5kΩ, C=100pF	-8	8	kV
V _{ESD_CDM}	CDM	Refer to AEC-Q100-011C CDM standard	-750	750	V

8. EMC

Symbol	Parameter	Part Number	Level	Status
V _{EMC}	Test pulse 3b	SC2498SO-TR-Q & SC2498UA-N-BK-Q	150V	A
		SC2498CUA-N-BK-Q	800V	A

Ref: ISO 7637-2; 2nd edition 06/2004; conducted on supply line; V_S = 13.5 V, T_A = 25°C

9. Thermal Characteristics

Symbol	Parameter	Test conditions	Rating	Units
R _{θJA}	UA/CUA Package thermal resistance	Single-layer PCB, with copper limited to solder pads	166 ⁽¹⁾	°C/W
	SO Package thermal resistance	Single-layer PCB, with copper limited to solder pads	228 ⁽¹⁾	°C/W

Note:

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

10. Operating Characteristics

10.1. Electrical Characteristics

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Supply Characteristics						
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
t_{on}	Power-on time	-	-	6	10	μs
Output Characteristics						
I_{QL}	Off-state leakage current	Output Hi-Z	-	-	3	μA
V_{SAT}	Output saturation voltage	$V_{DD}=5V$, $I_O=20mA$	-	200	500	mV
t_d	Output delay time	$B=B_{RP}$ to B_{OP}	-	15	25	μs
t_r	Output rise time (10% to 90%)	$R1=1Kohm$, $C_o=50pF$	-	-	0.5	μs
t_f	Output fall time (90% to 10%)	$R1=1Kohm$, $C_o=50pF$	-	-	0.2	μs
On-Board Protection						
OCP	Over current protection	Output on VPULL-UP<30V	45	65	80	mA
$V_{Z(SLY)}$	Supply Zener Clamp Voltage	$I_{DD}=I_{DD(max)}+3mA$	40	-	-	V
$V_{Z(OUT)}$	Output Zener Clamp Voltage	Output Hi-Z, $I_{OUT}=1.5mA$	40	-	-	V
V_{RZ}	Reverse Battery Zener Clamp Voltage	$I_{DD}=-5mA$	40	-	-	V

Note:

(1) Maximum voltage must be adjusted for power dissipation & junction temperature,
see 6 Absolute Maximum Ratings & 9 Thermal Characteristics.

10.2. Magnetic Characteristics

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

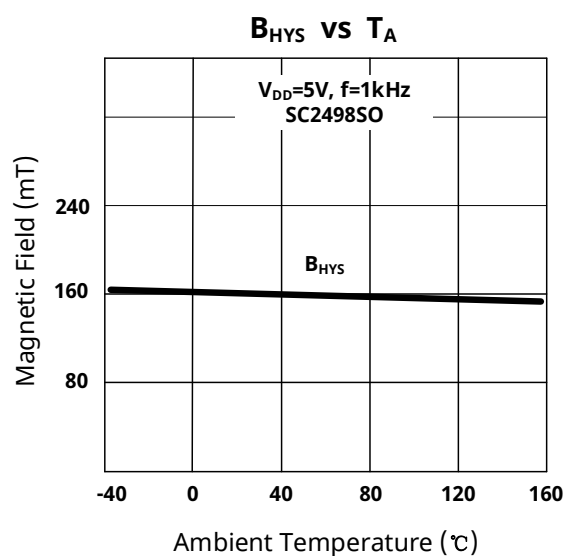
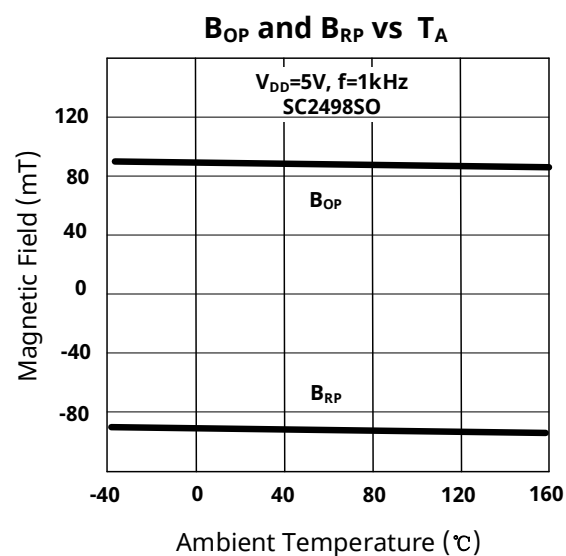
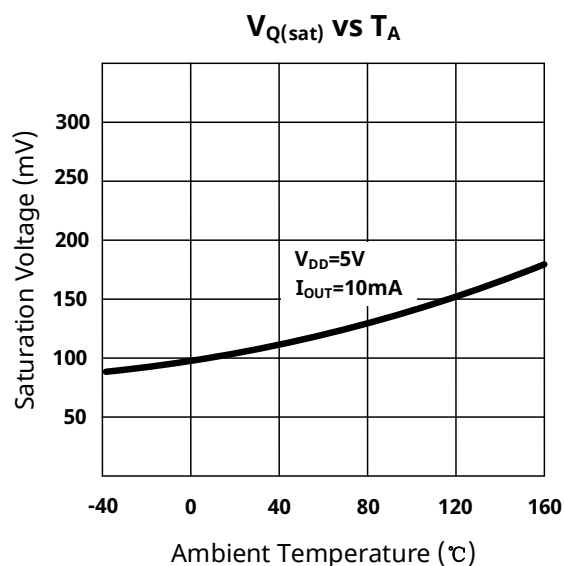
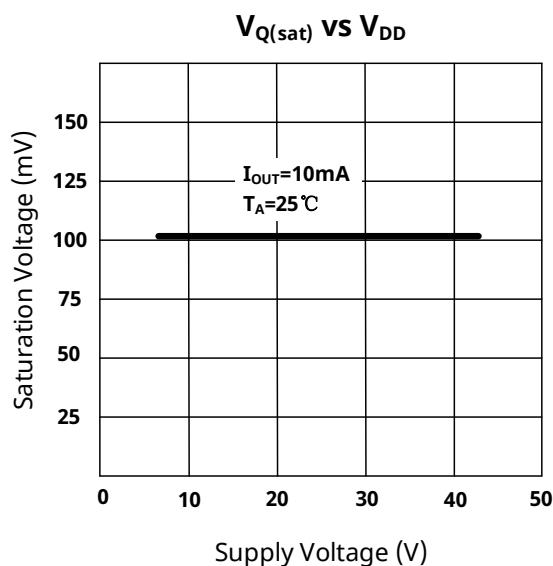
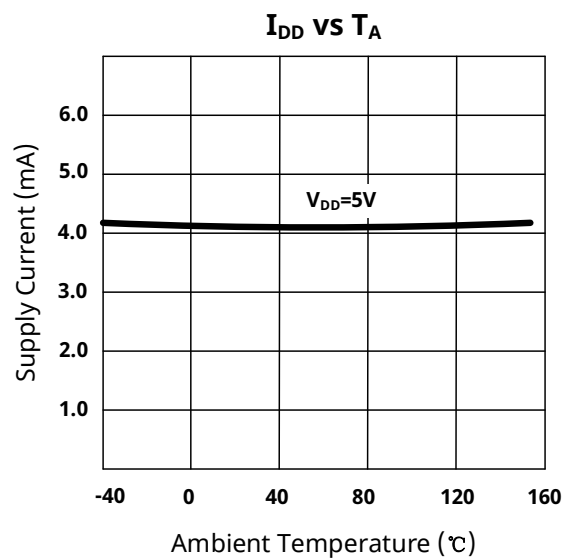
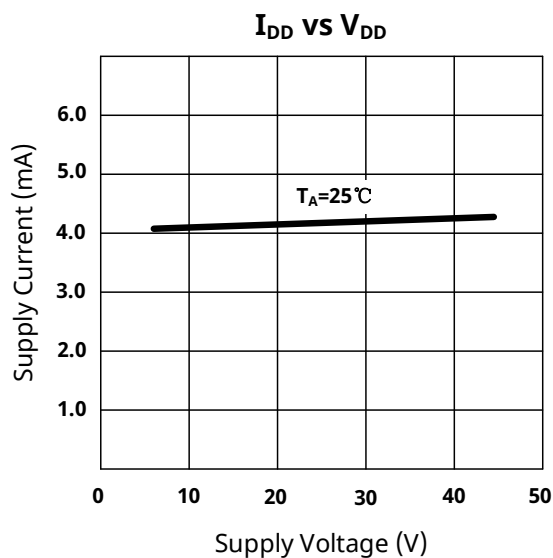
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
f _{BW}	BW		20	-	-	kHz
SC2498SO-TR-Q						
B _{OP}	Operating point	T _A =-40°C to 160°C	6	9.5	13	mT ⁽¹⁾
B _{RP}	Release point		-13 ⁽²⁾	-9.5	-6	mT
B _{HYS}	Hysteresis		12	19	26	mT
SC2498UA-N-BK-Q						
B _{OP}	Operating point	T _A =-40°C to 160°C	-13	-9.5	-6	mT
B _{RP}	Release point		6	9.5	13	mT
B _{HYS}	Hysteresis		12	19	26	mT
SC2498CUA-N-BK-Q						
B _{OP}	Operating point	T _A =-40°C to 160°C	-13	-9.5	-6	mT
B _{RP}	Release point		6	9.5	13	mT
B _{HYS}	Hysteresis		12	19	26	mT

Note:

(1) $1mT=10Gs$

(2) 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.

11. Typical Characteristics



12. Block Diagram

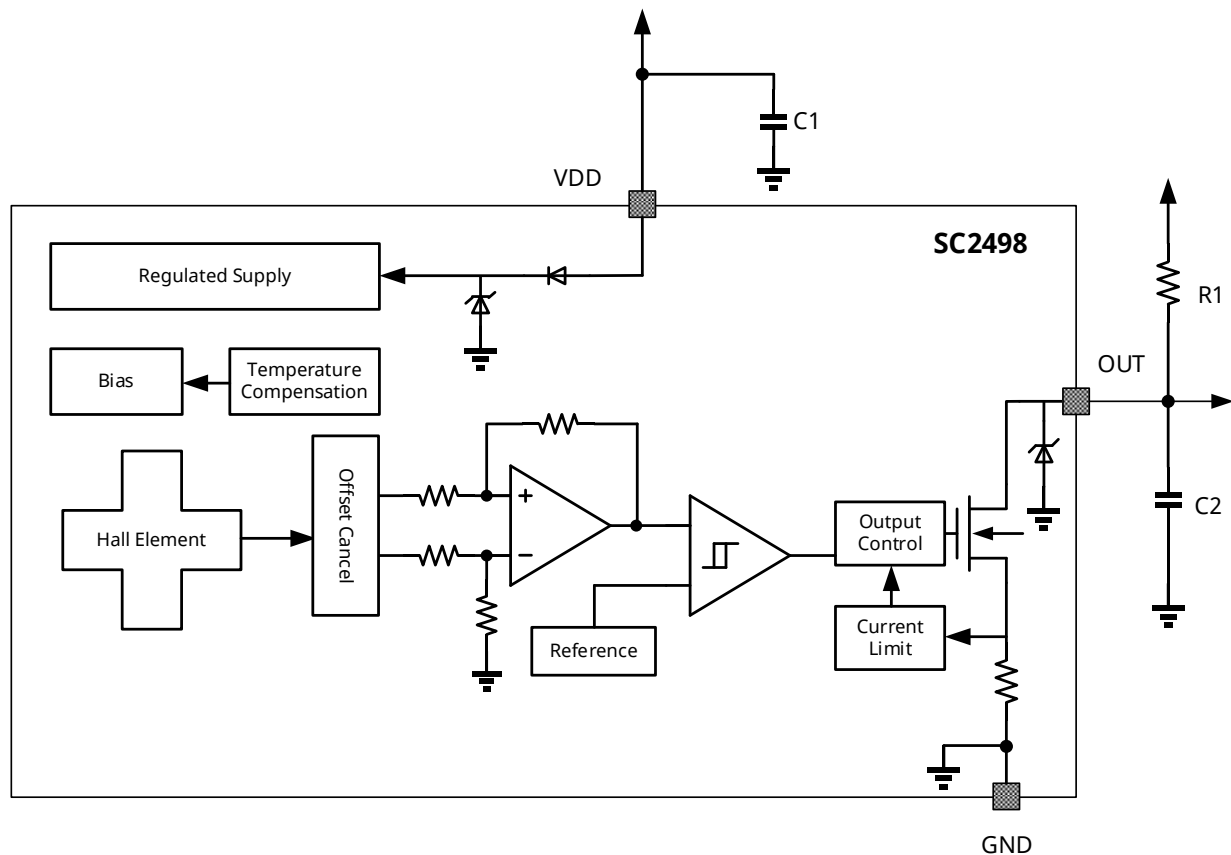


Fig.3: Block Diagram

13. Function Description

The SC2498 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 2.8V and 40V. The device does not operate when -0.5 to 2.5V is applied to the VDD terminal (with respect to the GND terminal). In addition, the device can withstand voltages up to 45V for transient durations.

The output of SC2498 switches low (turns on) when a magnetic field (South polarity) perpendicular to the Hall element exceeds the operate point threshold, B_{OP} . After turn-on, the output is capable of sinking 30mA and the output voltage is $V_{Q(sat)}$. When the magnetic field is reduced below 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.

An external output pull-up resistor is required on the OUT terminal. The OUT terminal can be pulled up to VDD or to a different voltage supply. This allows for easier interfacing with controller circuits.

13.1. Field Direction Definition

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

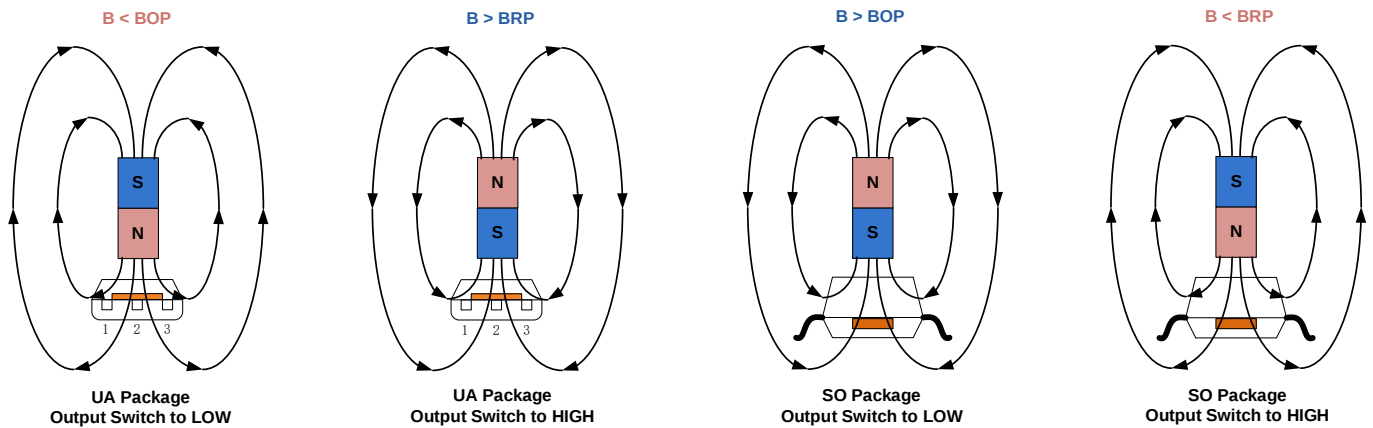


Fig.4: Switch Points versus Magnetic Signal

13.2. 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.

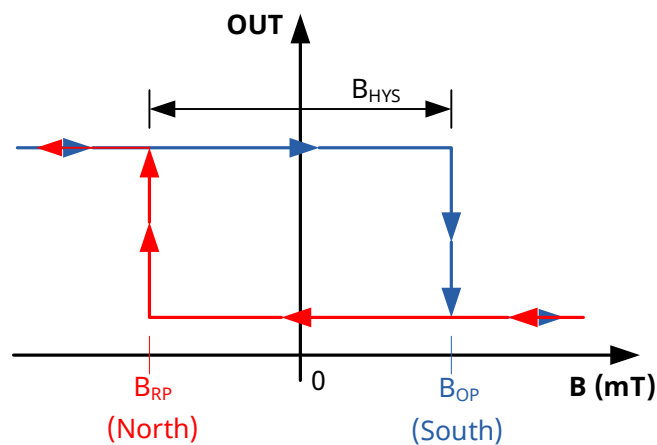


Fig.5: Magnetic Transfer Function

14. Typical Application

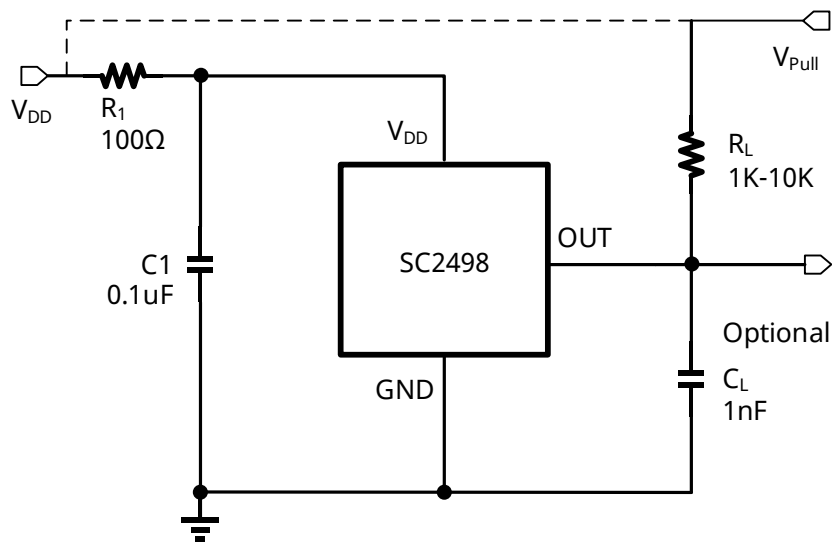


Fig.6: Typical Application Circuit

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.

The SC2498 device output stage uses an open-drain NMOS, and it is rated to sink up to 30mA of current. For proper operation, calculate the value of the pull-up resistor RL is required. The size of RL is a tradeoff between OUT rise time and the load capacity when OUT is pulled low. A lower current is generally better, however faster transitions and bandwidth require a smaller resistor for faster switching.

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

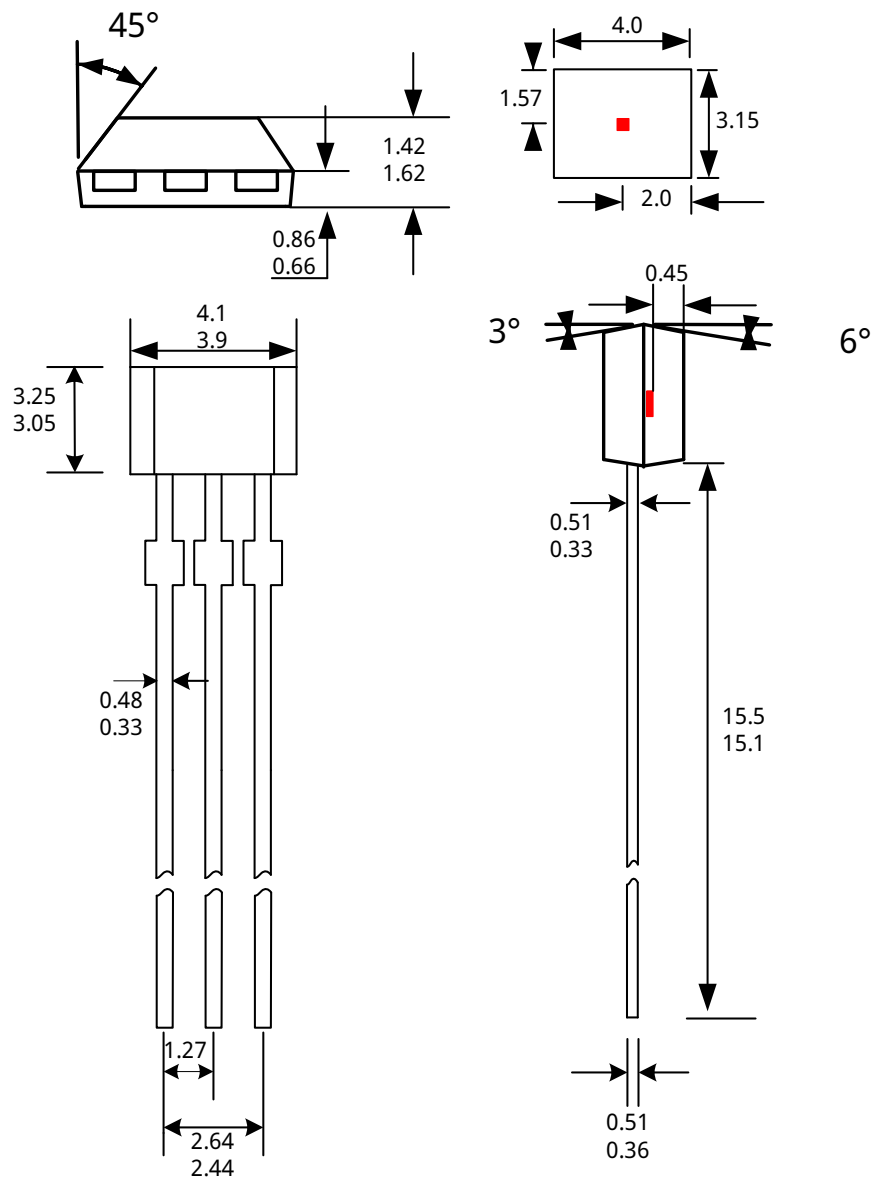
$$C_L < \frac{1}{2\pi \times R_L \times 2 \times f_{BW}(Hz)}$$

Vpull is not restricted to VDD, and could be connected to other voltage reference. The allowable voltage range of this terminal is specified in the Absolute Maximum Ratings.

15. Package Information “UA”

3-Terminal
UA Package

Dimension:mm

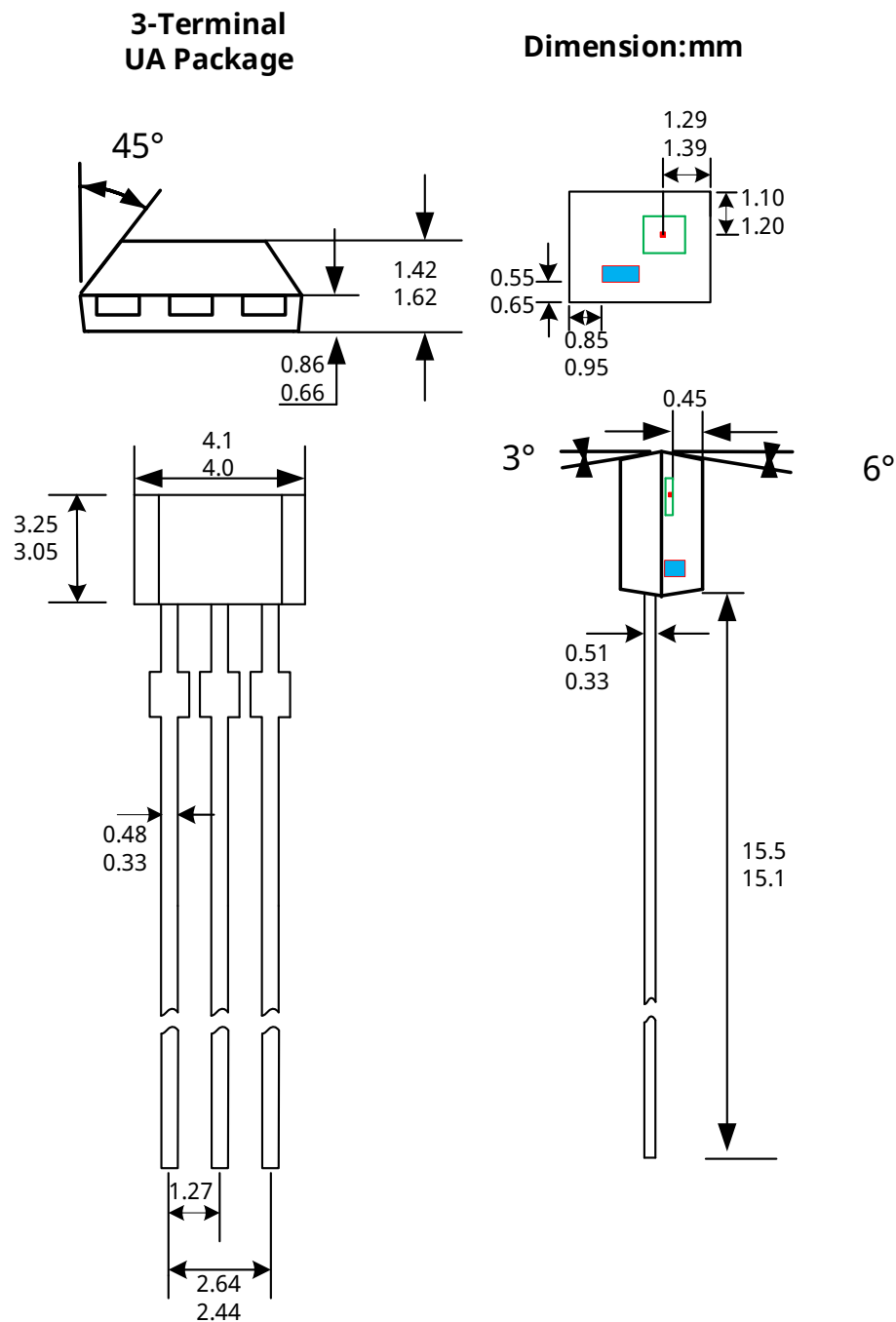


Notes:

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.

16. Package Information “CUA”



Notes:

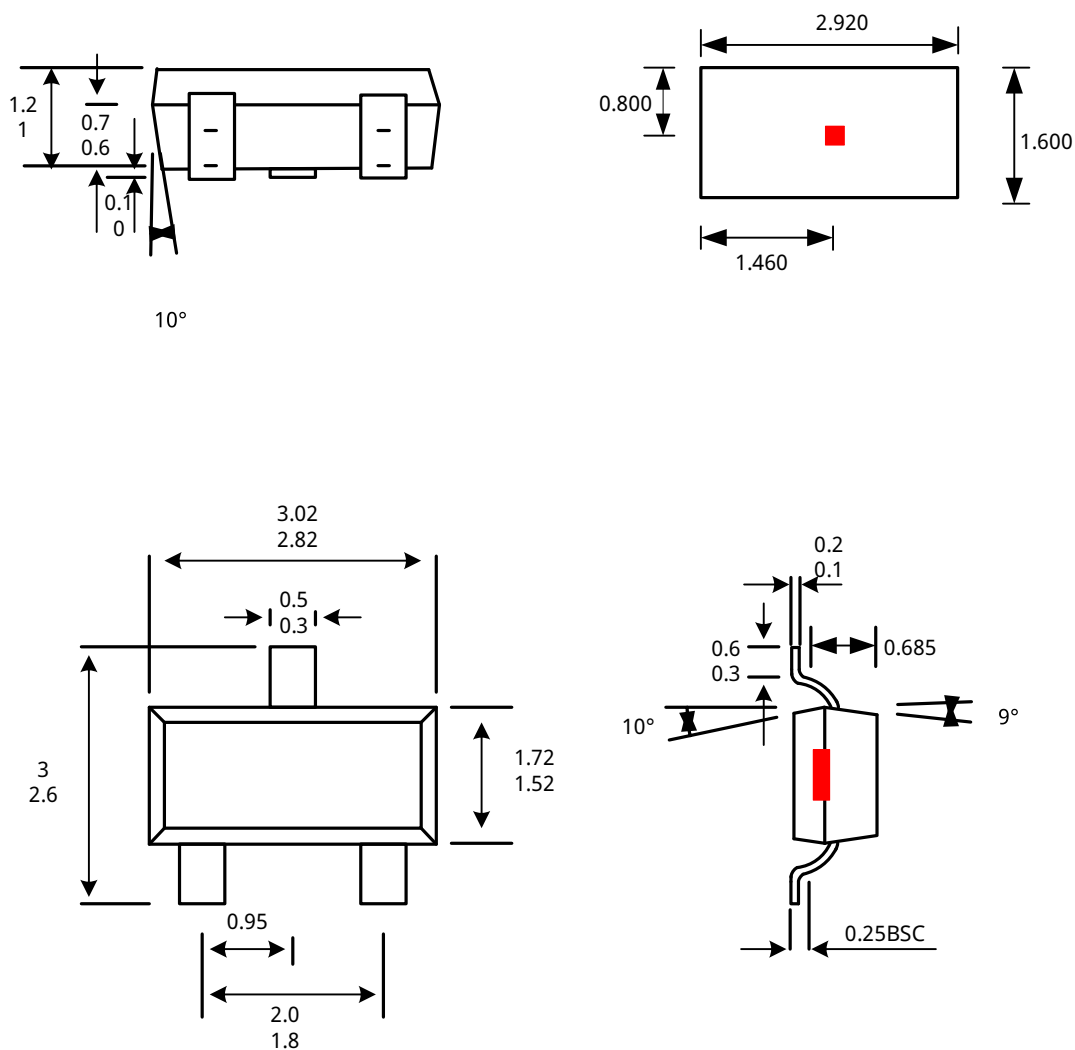
1. Exact body and lead configuration at vendor's option within limits shown.
2. Height does not include mold gate flash.
3. Green is Die; Red is Hall plate; Blue is Cap
4. Die Size: 1.14mm*1.02mm*0.3mm; Cap Size: 1.0mm*0.5mm*0.5mm

Where no tolerance is specified, dimension is nominal.

17. Package Information “SO”

3-Terminal
SO Package

Dimension: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 Hale element.

Where no tolerance is specified, dimension is nominal.

18. 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