**125°C OPERATION
HIGH-WITHSTAND VOLTAGE HIGH-SPEED
BIPOLAR HALL EFFECT LATCH IC**

Rev.2.1_02

This IC, developed by CMOS technology, is a bipolar Hall effect latch IC with high-withstand voltage, high-speed detection and high-accuracy magnetic characteristics.

The output voltage changes when this IC detects the intensity level of magnetic flux density and a polarity change. Using this IC with a magnet makes it possible to detect the rotation status in various devices.

This IC includes an output current limit circuit.

This IC is available in various systems by using the insertion TO-92S package.

Due to its high-accuracy magnetic characteristics, this IC can make operation's dispersion in the system combined with magnet smaller.

ABLIC Inc. offers a "magnetic simulation service" that provides the ideal combination of magnets and our Hall ICs for customer systems. Our magnetism simulation service will reduce prototype production, development period and development costs. In addition, it will contribute to optimization of parts to realize high cost performance.

For more information regarding our magnetism simulation service, contact our sales office.

■ Features

- Pole detection: Bipolar latch
- Output logic[1]: V_{OUT} = "L" at S pole detection
     V_{OUT} = "H" at S pole detection
- Output form[1]:   Nch open-drain output
     Nch driver + built-in pull-up resistor
- Magnetic sensitivity[1]: B_{OP} = 1.8 mT typ.
     B_{OP} = 3.0 mT typ.
     B_{OP} = 6.0 mT typ.
- Chopping frequency: f_C = 500 kHz typ.
- Output delay time: t_D = 8.0 μs typ.
- Power supply voltage range: V_{DD} = 3.5 V to 26.0 V
- Built-in regulator
- Built-in output current limit circuit
- Operation temperature range: Ta = $-40°C$ to $+125°C$
- Lead-free (Sn 100%), halogen-free

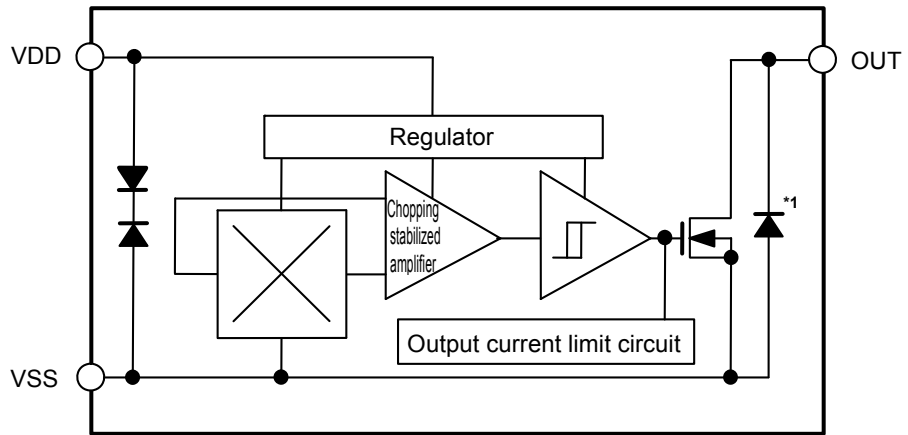***1.** The option can be selected.

■ Applications

- Home appliance
- DC brushless motor
- Housing equipment
- Industrial equipment

■ Packages

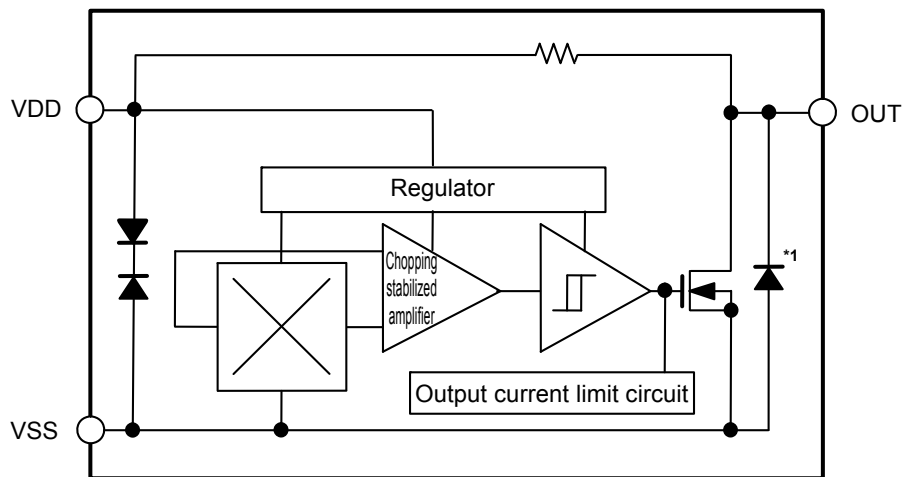- TO-92S (Straight)
- TO-92S (Forming)

■ Block Diagrams

1. Nch open-drain output product

*1. Parasitic diode

Figure 1

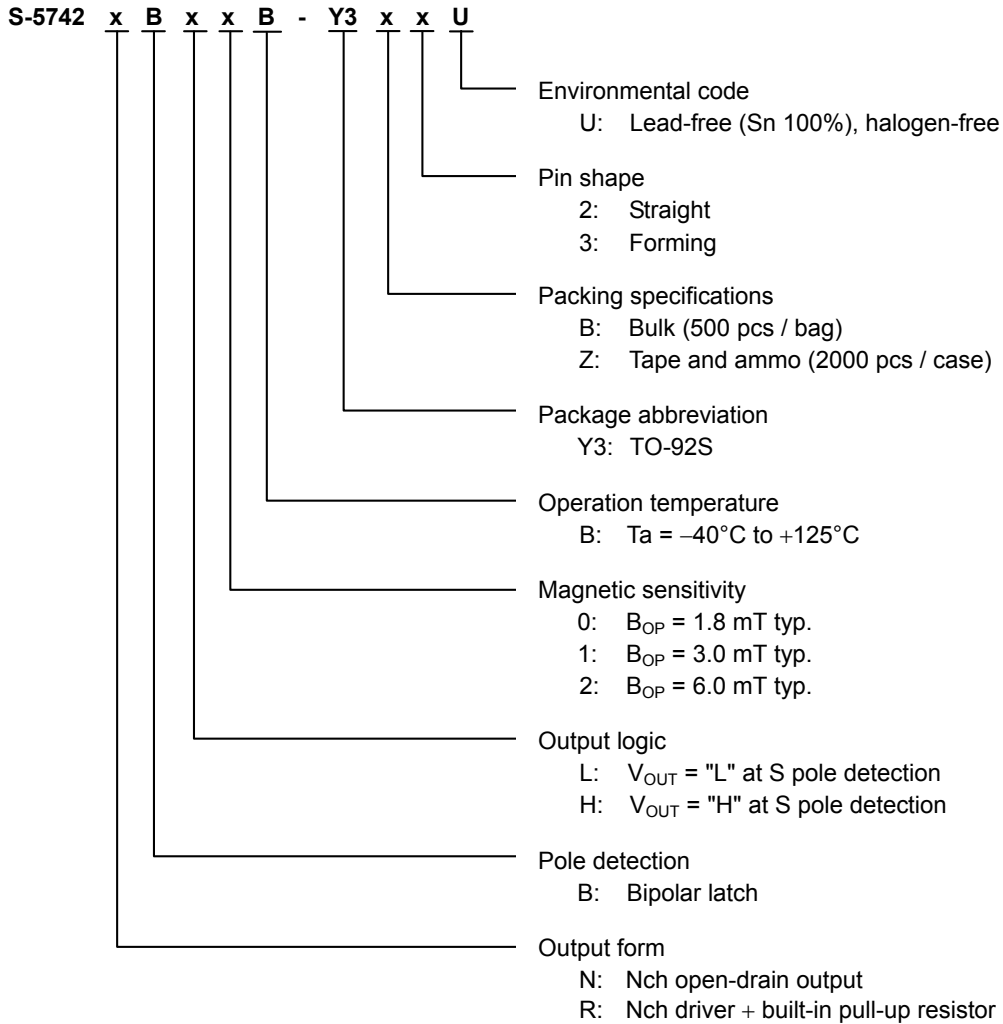### 2. Nch driver + built-in pull-up resistor product

*1. Parasitic diode

Figure 2

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■ Product Name Structure

1. Product name

S-5742 x B x x B - Y3 x x U

Environmental code
　　U: Lead-free (Sn 100%), halogen-free

Pin shape
　　2: Straight
　　3: Forming

Packing specifications
　　B: Bulk (500 pcs / bag)
　　Z: Tape and ammo (2000 pcs / case)

Package abbreviation
　　Y3: TO-92S

Operation temperature
　　B: Ta = −40°C to +125°C

Magnetic sensitivity
　　0: B_{OP} = 1.8 mT typ.
　　1: B_{OP} = 3.0 mT typ.
　　2: B_{OP} = 6.0 mT typ.

Output logic
　　L: V_{OUT} = "L" at S pole detection
　　H: V_{OUT} = "H" at S pole detection

Pole detection
　　B: Bipolar latch

Output form
　　N: Nch open-drain output
　　R: Nch driver + built-in pull-up resistor

2. Packages

Table 1　Package Drawing Codes

Package Name		Dimension	Tape	Ammo Packing
TO-92S (Straight)	Bulk	YB003-A-P-SD	–	–
	Tape and ammo		YC003-A-C-SD	YC003-A-Z-SD
TO-92S (Forming)	Bulk	YB003-B-P-SD	–	–
	Tape and ammo		YC003-B-C-SD	YC003-B-Z-SD

3. Product name list

3. 1 TO-92S (Straight)

Table 2

| Product Name[*1]	Output Form	Pole Detection	Output logic	Magnetic Sensitivity (B_{OP})
S-5742NBL0B-Y3n2U	Nch open-drain output	Bipolar latch	V_{OUT} = "L" at S pole detection	1.8 mT typ.
S-5742NBL1B-Y3n2U	Nch open-drain output	Bipolar latch	V_{OUT} = "L" at S pole detection	3.0 mT typ.
S-5742NBL2B-Y3n2U	Nch open-drain output	Bipolar latch	V_{OUT} = "L" at S pole detection	6.0 mT typ.
S-5742NBH0B-Y3n2U	Nch open-drain output	Bipolar latch	V_{OUT} = "H" at S pole detection	1.8 mT typ.
S-5742NBH1B-Y3n2U	Nch open-drain output	Bipolar latch	V_{OUT} = "H" at S pole detection	3.0 mT typ.
S-5742NBH2B-Y3n2U	Nch open-drain output	Bipolar latch	V_{OUT} = "H" at S pole detection	6.0 mT typ.
S-5742RBL0B-Y3n2U	Nch driver + built-in pull-up resistor	Bipolar latch	V_{OUT} = "L" at S pole detection	1.8 mT typ.
S-5742RBL1B-Y3n2U	Nch driver + built-in pull-up resistor	Bipolar latch	V_{OUT} = "L" at S pole detection	3.0 mT typ.
S-5742RBL2B-Y3n2U	Nch driver + built-in pull-up resistor	Bipolar latch	V_{OUT} = "L" at S pole detection	6.0 mT typ.
S-5742RBH0B-Y3n2U	Nch driver + built-in pull-up resistor	Bipolar latch	V_{OUT} = "H" at S pole detection	1.8 mT typ.
S-5742RBH1B-Y3n2U	Nch driver + built-in pull-up resistor	Bipolar latch	V_{OUT} = "H" at S pole detection	3.0 mT typ.
S-5742RBH2B-Y3n2U	Nch driver + built-in pull-up resistor	Bipolar latch	V_{OUT} = "H" at S pole detection	6.0 mT typ.

***1.** "n" changes according to the packing specification as follows.
B: Bulk, Z: Tape and ammo

Remark Please contact our sales office for products other than the above.

3. 2 TO-92S (Forming)

Table 3

Product Name[*1]	Output Form	Pole Detection	Output logic	Magnetic Sensitivity (B_{OP})
S-5742NBL1B-Y3n3U	Nch open-drain output	Bipolar latch	V_{OUT} = "L" at S pole detection	3.0 mT typ.
S-5742NBL2B-Y3n3U	Nch open-drain output	Bipolar latch	V_{OUT} = "L" at S pole detection	6.0 mT typ.
S-5742RBH1B-Y3n3U	Nch driver + built-in pull-up resistor	Bipolar latch	V_{OUT} = "H" at S pole detection	3.0 mT typ.

***1.** "n" changes according to the packing specification as follows.
B: Bulk, Z: Tape and ammo

Remark Please contact our sales office for products other than the above.

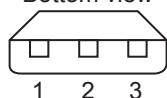## ■ Pin Configuration

1. TO-92S

Bottom view

1 2 3
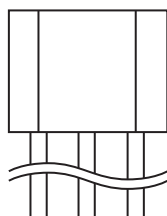
Figure 3

Table 4

Pin No.	Symbol	Description
1	VDD	Power supply pin
2	VSS	GND pin
3	OUT	Output pin

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■ **Absolute Maximum Ratings**

Table 5

(Ta = +25°C unless otherwise specified)

Item		Symbol	Absolute Maximum Rating	Unit
Power supply voltage		V_{DD}	$V_{SS} - 0.3$ to $V_{SS} + 28.0$	V
Output current		I_{OUT}	20	mA
Output voltage	Nch open-drain output product	V_{OUT}	$V_{SS} - 0.3$ to $V_{SS} + 28.0$	V
	Nch driver + built-in pull-up resistor product		$V_{SS} - 0.3$ to $V_{DD} + 0.3$	V
Operation ambient temperature		T_{opr}	−40 to +125	°C
Storage temperature		T_{stg}	−40 to +150	°C

Caution   The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

■ **Thermal Resistance Value**

Table 6

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Junction-to-ambient thermal resistance	θ_{JA}	TO-92S	–	153[1]	–	°C/W

*1.   When not mounted on board

Remark   Refer to "■ **Power Dissipation**" for details.

■ Electrical Characteristics

Table 7

(Ta = +25°C, V_{DD} = 12.0 V, V_{SS} = 0 V unless otherwise specified)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Power supply voltage	V_{DD}	–	3.5	12.0	26.0	V	–
Current consumption	I_{DD}	Nch open-drain output product Average value	–	3.0	4.0	mA	1
		Nch driver + built-in pull-up resistor product Average value, V_{OUT} = "H"	–	3.0	4.0	mA	1
Output voltage	V_{OUT}	Nch open-drain output product Output transistor Nch, V_{OUT} = "L", I_{OUT} = 10 mA	–	–	0.4	V	2
		Nch driver + built-in pull-up resistor product Output transistor Nch, V_{OUT} = "L", I_{OUT} = 10 mA	–	–	0.5	V	2
Output drop voltage	V_D	Nch driver + built-in pull-up resistor product V_{OUT} = "H", $V_D = V_{DD} - V_{OUT}$	–	–	20	mV	2
Leakage current	I_{LEAK}	Nch open-drain output product Output transistor Nch, V_{OUT} = "H" = 26.0 V	–	–	10	μA	3
Output limit current	I_{OM}	V_{OUT} = 12.0 V	22	–	70	mA	3
Output delay time	t_D	–	–	8.0	–	μs	–
Chopping frequency	f_C	–	–	500	–	kHz	–
Start up time	t_{PON}	–	–	20	–	μs	4
Output rise time	t_R	Nch open-drain output product C = 20 pF, R = 820 Ω	–	–	2.0	μs	5
		Nch driver + built-in pull-up resistor product C = 20 pF	–	–	6.0	μs	5
Output fall time	t_F	C = 20 pF, R = 820 Ω	–	–	2.0	μs	5
Pull-up resistor	R_L	Nch driver + built-in pull-up resistor product	7	10	13	kΩ	–
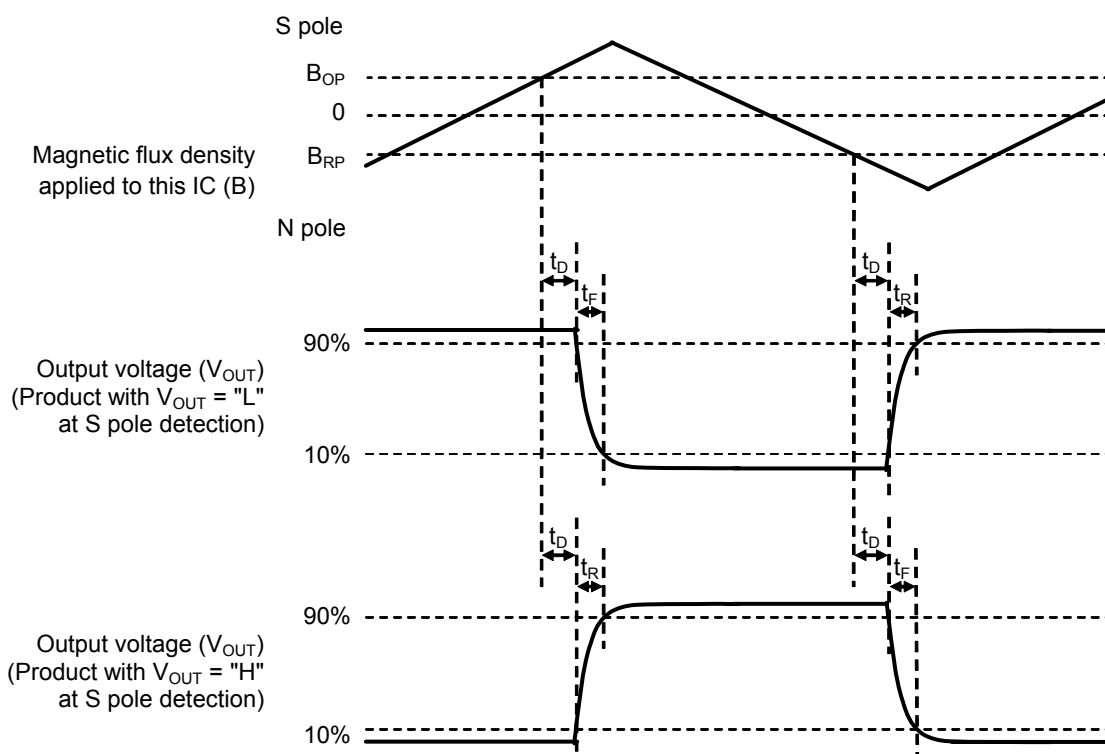
Figure 4   Operation Timing

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■ Magnetic Characteristics

1. Product with B_{OP} = 1.8 mT typ.

Table 8

(Ta = +25°C, V_{DD} = 12.0 V, V_{SS} = 0 V unless otherwise specified)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Operation point[*1]	S pole	B_{OP}	–	0.3	1.8	3.3	mT	4
Release point[*2]	N pole	B_{RP}	–	−3.3	−1.8	−0.3	mT	4
Hysteresis width[*3]		B_{HYS}	$B_{HYS} = B_{OP} - B_{RP}$	–	3.6	–	mT	4

2. Product with B_{OP} = 3.0 mT typ.

Table 9

(Ta = +25°C, V_{DD} = 12.0 V, V_{SS} = 0 V unless otherwise specified)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Operation point[*1]	S pole	B_{OP}	–	1.5	3.0	4.5	mT	4
Release point[*2]	N pole	B_{RP}	–	−4.5	−3.0	−1.5	mT	4
Hysteresis width[*3]		B_{HYS}	$B_{HYS} = B_{OP} - B_{RP}$	–	6.0	–	mT	4

3. Product with B_{OP} = 6.0 mT typ.

Table 10

(Ta = +25°C, V_{DD} = 12.0 V, V_{SS} = 0 V unless otherwise specified)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Operation point[*1]	S pole	B_{OP}	–	3.0	6.0	9.0	mT	4
Release point[*2]	N pole	B_{RP}	–	−9.0	−6.0	−3.0	mT	4
Hysteresis width[*3]		B_{HYS}	$B_{HYS} = B_{OP} - B_{RP}$	–	12.0	–	mT	4

*1. B_{OP}: Operation point
B_{OP} is the value of magnetic flux density when the output voltage (V_{OUT}) changes after the magnetic flux density applied to this IC by the magnet (S pole) is increased (by moving the magnet closer).
V_{OUT} retains the status until a magnetic flux density of the N pole higher than B_{RP} is applied.

*2. B_{RP}: Release point
B_{RP} is the value of magnetic flux density when the output voltage (V_{OUT}) changes after the magnetic flux density applied to this IC by the magnet (N pole) is increased (by moving the magnet closer).
V_{OUT} retains the status until a magnetic flux density of the S pole higher than B_{OP} is applied.

*3. B_{HYS}: Hysteresis width
B_{HYS} is the difference of magnetic flux density between B_{OP} and B_{RP}.

Remark   The unit of magnetic flux density mT can be converted by using the formula 1 mT = 10 Gauss.

■ Test Circuits
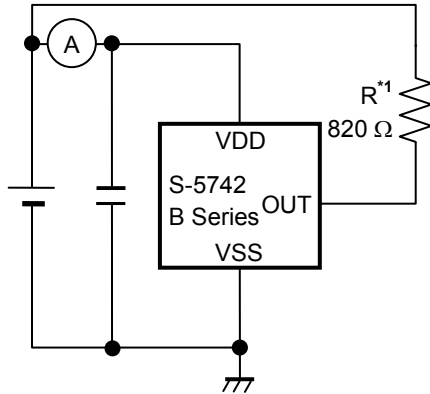
*1.   Resistor (R) is unnecessary for Nch driver + built-in pull-up resistor product.
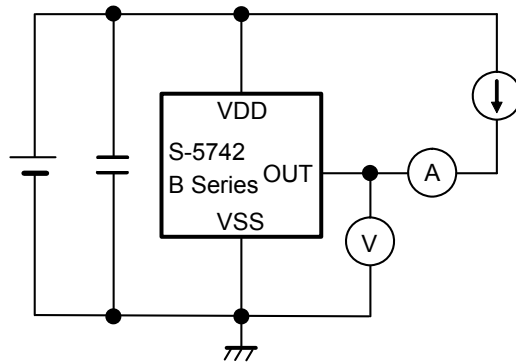
Figure 5   Test Circuit 1
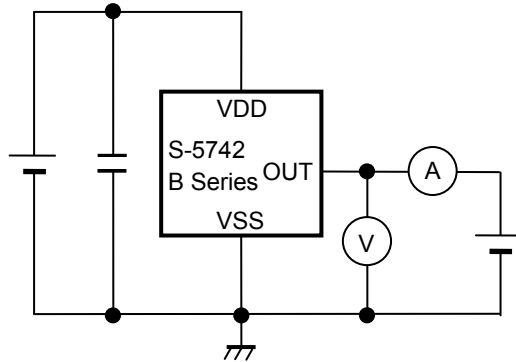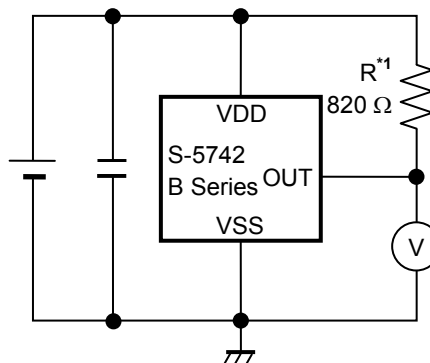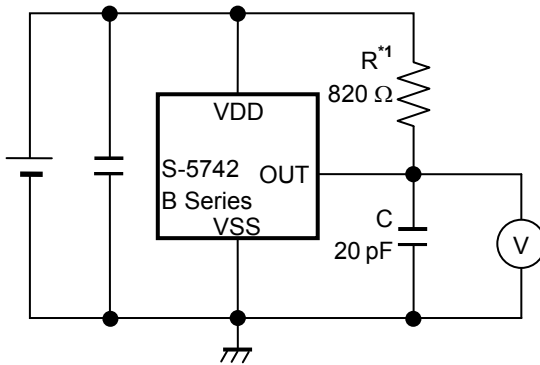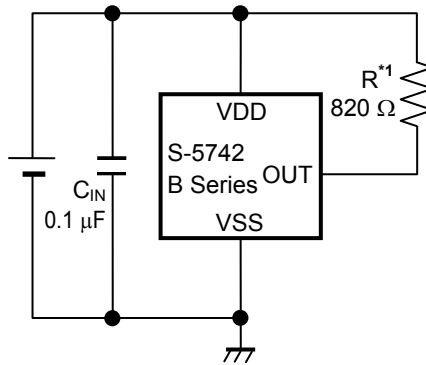

Figure 6   Test Circuit 2

Figure 7 Test Circuit 3

*1.   Resistor (R) is unnecessary for Nch driver + built-in pull-up resistor product.

Figure 8   Test Circuit 4

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*1. Resistor (R) is unnecessary for Nch driver + built-in pull-up resistor product.

Figure 9   Test Circuit 5

■ Standard Circuit

*1. Resistor (R) is unnecessary for Nch driver + built-in pull-up resistor product.

Figure 10

Caution   The above connection diagram and constant will not guarantee successful operation. Perform thorough evaluation using the actual application to set the constant.

■ Operation

1.   Direction of applied magnetic flux

This IC detects the magnetic flux density which is vertical to the marking surface.
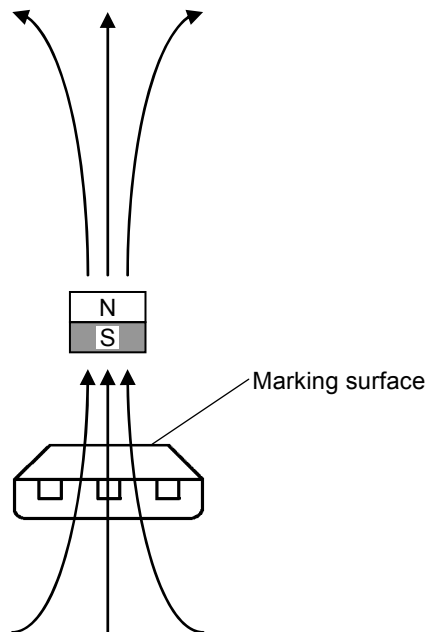**Figure 11** shows the direction in which magnetic flux is being applied.

Figure 11

2.   Position of Hall sensor

Figure 12 shows the position of Hall sensor.
The center of this Hall sensor is located in the area indicated by a circle, which is in the center of a package as described below.
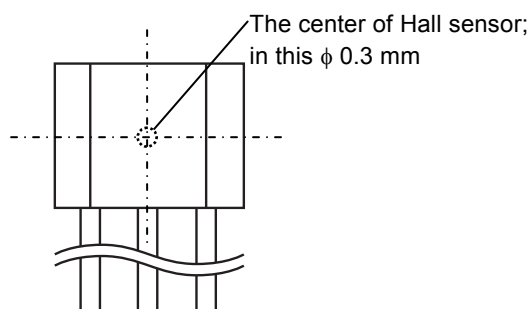
Figure 12

3.   Basic operation

This IC changes the output voltage (V_{OUT}) according to the level of the magnetic flux density and a polarity change (N pole or S pole) applied by a magnet.

3. 1   Product with V_{OUT} = "L" at S pole detection

When the magnetic flux density of the S pole perpendicular to the marking surface exceeds the operation point (B_{OP}) after the S pole of a magnet is moved closer to the marking surface of this IC, V_{OUT} changes from "H" to "L". When the N pole of a magnet is moved closer to the marking surface of this IC and the magnetic flux density of the N pole is higher than the release point (B_{RP}), V_{OUT} changes from "L" to "H". In case of $B_{RP} < B < B_{OP}$, V_{OUT} retains the status. **Figure 13** shows the relationship between the magnetic flux density and V_{OUT}.

Figure 13

3. 2   Product with V_{OUT} = "H" at S pole detection

When the magnetic flux density of the S pole perpendicular to the marking surface exceeds B_{OP} after the S pole of a magnet is moved closer to the marking surface of this IC, V_{OUT} changes from "L" to "H". When the N pole of a magnet is moved closer to the marking surface of this IC and the magnetic flux density of the N pole is higher than B_{RP}, V_{OUT} changes from "H" to "L". In case of $B_{RP} < B < B_{OP}$, V_{OUT} retains the status.
Figure 14 shows the relationship between the magnetic flux density and V_{OUT}.
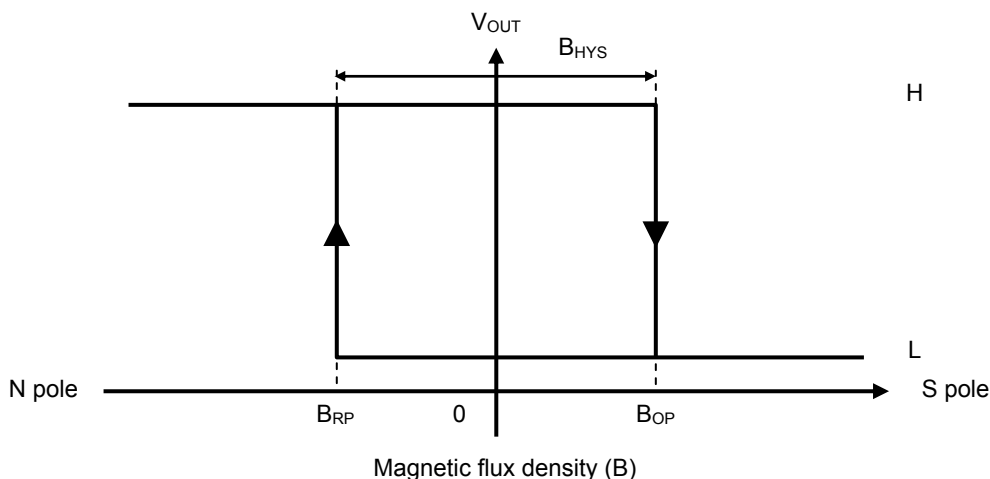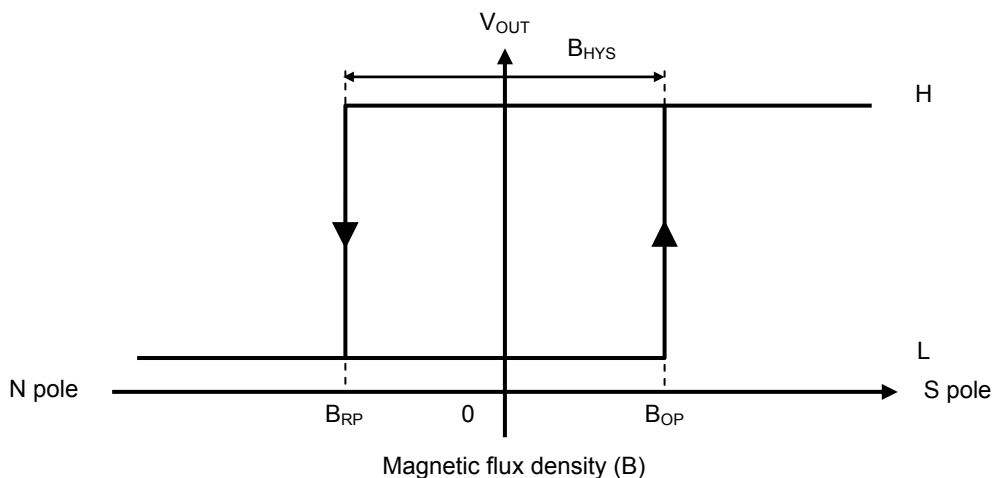

Figure 14

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4. Timing chart

Figure 15 shows the operation timing at power-on.
The initial output voltage at rising of power supply voltage (V_{DD}) is either "H" or "L".
In case of $B > B_{OP}$ (operation point) or $B < B_{RP}$ (release point) at the time when the start up time (t_{PON}) is passed after rising of V_{DD}, this IC outputs V_{OUT} according to the applied magnetic flux density.
In case of $B_{RP} < B < B_{OP}$ at the time when t_{PON} is passed after rising of V_{DD}, this IC maintains the initial output voltage.

Product with V_{OUT} = "L" at S pole detection   **Product with V_{OUT} = "H" at S pole detection**
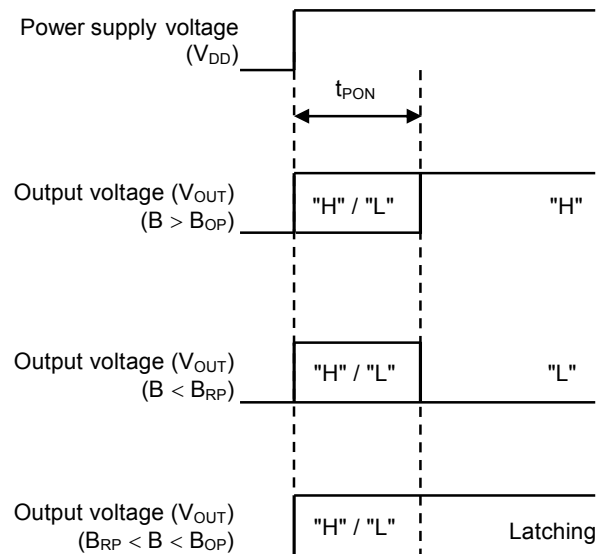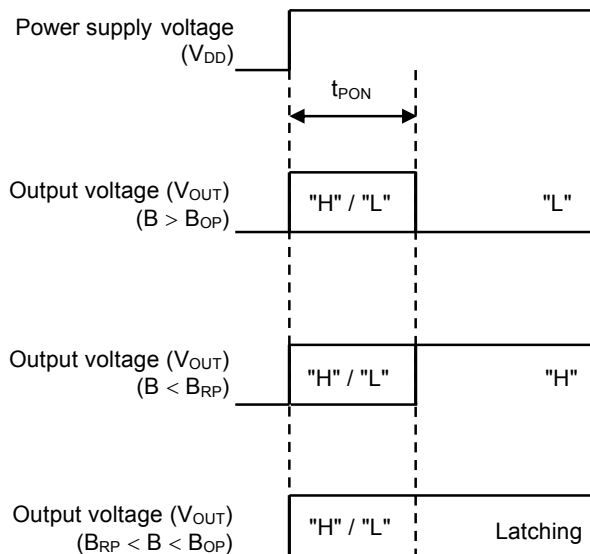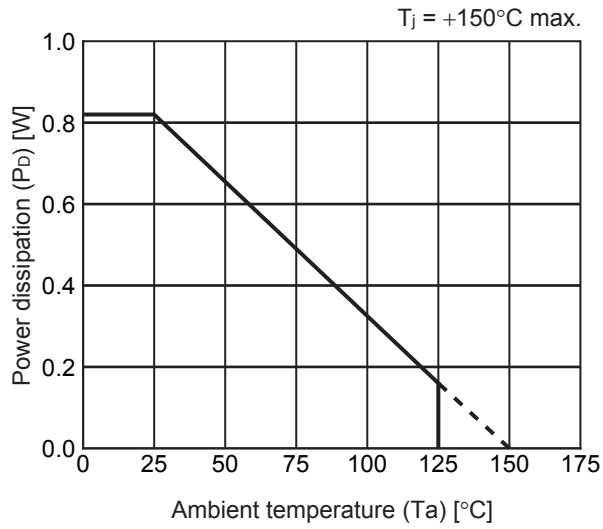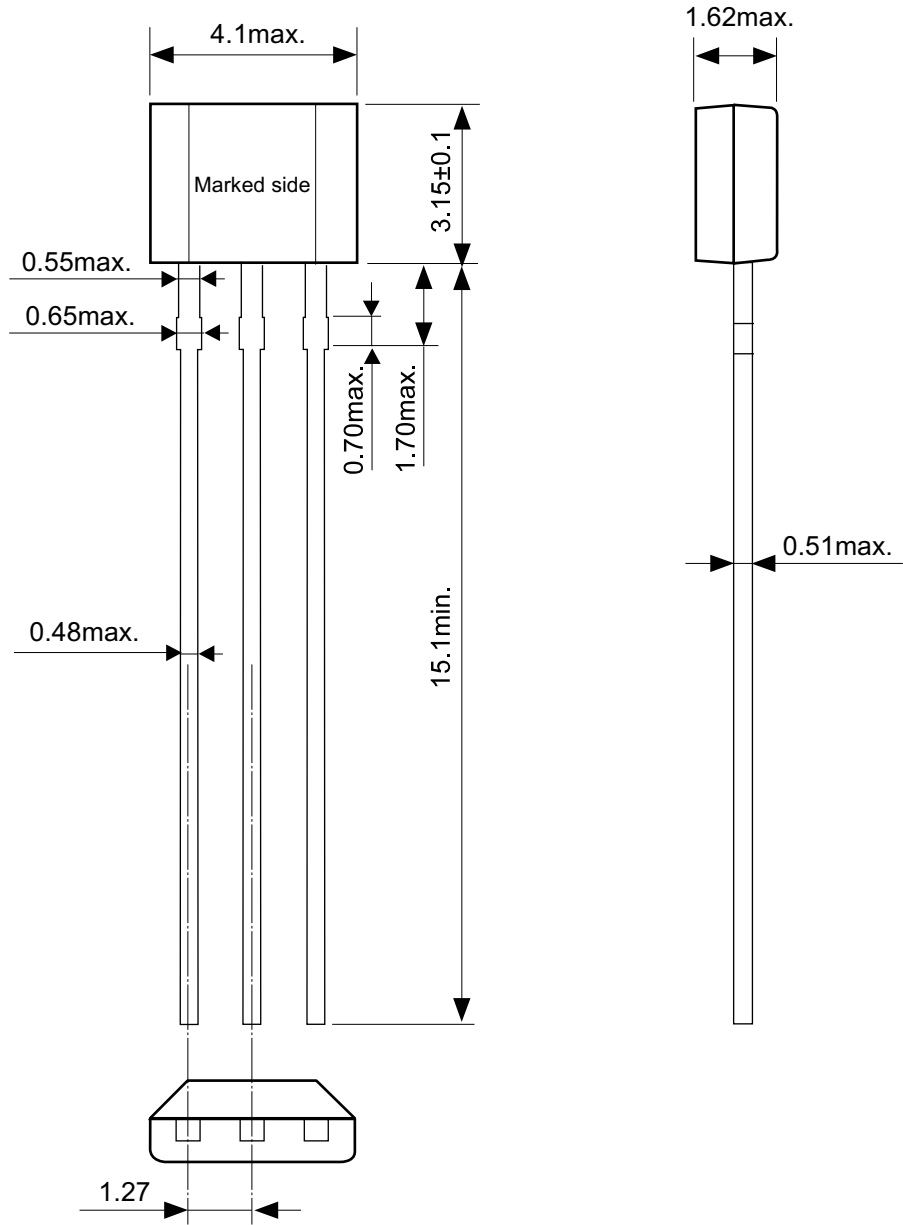

Figure 15

■ Precautions

- If the impedance of the power supply is high, the IC may malfunction due to a supply voltage drop caused by feed-through current. Take care with the pattern wiring to ensure that the impedance of the power supply is low.

- Note that the IC may malfunction if the power supply voltage rapidly changes. When the IC is used under the environment where the power supply voltage rapidly changes, it is recommended to judge the output voltage of the IC by reading it multiple times.

- Do not apply an electrostatic discharge to this IC that exceeds the performance ratings of the built-in electrostatic protection circuit.

- Although this IC has a built-in output current limit circuit, it may suffer physical damage such as product deterioration under the environment where the absolute maximum ratings are exceeded.

- The application conditions for the power supply voltage, the pull-up voltage, and the pull-up resistor should not exceed the power dissipation.

- Large stress on this IC may affect on the magnetic characteristics. Avoid large stress which is caused by the handling during or after mounting the IC on a board.

- ABLIC Inc. claims no responsibility for any disputes arising out of or in connection with any infringement by products including this IC of patents owned by a third party.

■ **Power Dissipation**

TO-92S

$T_j = +150°C$ max.

Power Dissipation (P_D)
0.82 W (when not mounted on board)

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4.1max.

1.62max.

Marked side

3.15±0.1

0.55max.

0.65max.

0.70max.

1.70max.

0.51max.

0.48max.

15.1min.

1.27

No. YB003-A-P-SD-1.0

TITLE	TO92S-C-PKG Dimensions
No.	YB003-A-P-SD-1.0
ANGLE	
UNIT	mm
ABLIC Inc.	

1.0max.

12.7±0.3

Marked side

1.0max.

24.25max.

2.5min.

1.0max.

6.0±0.2

Marked side

Marked side

Marked side

1#pin

3#pin

19.0 +2.0 -1.0

9.0±0.5

18.0 +1.0 -0.5

1.45max.

6.35±0.3

ø4.0±0.2

12.7±0.2

Marked side

Marked side

Marked side

Feed direction

No. YC003-A-C-SD-1.1

TITLE	TO92S-E-Radial Tape
No.	YC003-A-C-SD-1.1
ANGLE	
UNIT	mm
ABLIC Inc.	

Spacer(Sponge)

15

310

35

Side spacer placed in front side

157

320

Space more than 4 strokes

162

333

43

No. YC003-A-Z-SD-1.0

TITLE	TO92S-E-Ammo Packing		
No.	YC003-A-Z-SD-1.0		
ANGLE		QTY.	2,000
UNIT	mm		
ABLIC Inc.			

4.1max.

Marked side

3.15±0.1

0.55max.

0.65max.

0.70max.

1.70max.

0.48max.

14.5 min.

2.5±0.3

1.27

1.62max.

0.51max.

No. YB003-B-P-SD-1.0

TITLE	TO92S-D-PKG Dimensions
No.	YB003-B-P-SD-1.0
ANGLE	⊕ ⊏
UNIT	mm

ABLIC Inc.

1.0max.

12.7±0.3

Marked side

1.0max.

24.25max.

2.5min.

1.0max.

6.0±0.2

Marked side

Marked side

Marked side

1#pin

3#pin

19.0 +2.0 -1.0

9.0±0.5

18.0 +1.0 -0.5

ø4.0±0.2

6.35±0.3

12.7±0.2

1.45max.

Marked side

Marked side

Marked side
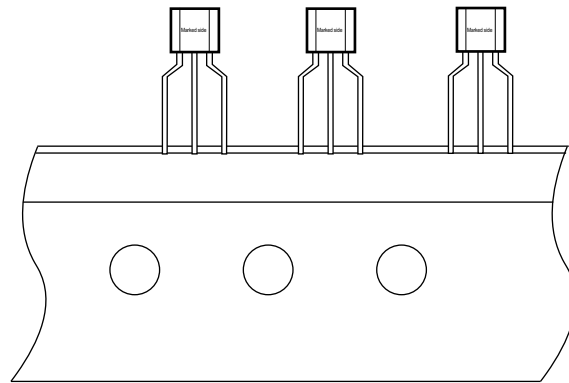
Feed direction

No. YC003-B-C-SD-1.1

TITLE	TO92S-F-Radial Tape
No.	YC003-B-C-SD-1.1
ANGLE	
UNIT	mm

ABLIC Inc.

Spacer(Sponge)

15

310

35

Side spacer placed in front side

157

320

Space more than 4 strokes

162

333

43

No. YC003-B-Z-SD-1.0

TITLE	TO92S-F-Ammo Packing		
No.	YC003-B-Z-SD-1.0		
ANGLE		QTY.	2,000
UNIT	mm		
	ABLIC Inc.		

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3. ABLIC Inc. is not responsible for damages caused by the incorrect information described herein.

4. Be careful to use the products within their specified ranges. Pay special attention to the absolute maximum ratings, operation voltage range and electrical characteristics, etc.
   ABLIC Inc. is not responsible for damages caused by failures and / or accidents, etc. that occur due to the use of the products outside their specified ranges.

5. When using the products, confirm their applications, and the laws and regulations of the region or country where they are used and verify suitability, safety and other factors for the intended use.

6. When exporting the products, comply with the Foreign Exchange and Foreign Trade Act and all other export-related laws, and follow the required procedures.

7. The products must not be used or provided (exported) for the purposes of the development of weapons of mass destruction or military use. ABLIC Inc. is not responsible for any provision (export) to those whose purpose is to develop, manufacture, use or store nuclear, biological or chemical weapons, missiles, or other military use.

8. The products are not designed to be used as part of any device or equipment that may affect the human body, human life, or assets (such as medical equipment, disaster prevention systems, security systems, combustion control systems, infrastructure control systems, vehicle equipment, traffic systems, in-vehicle equipment, aviation equipment, aerospace equipment, and nuclear-related equipment), excluding when specified for in-vehicle use or other uses. Do not apply the products to the above listed devices and equipments without prior written permission by ABLIC Inc.
   Especially, the products cannot be used for life support devices, devices implanted in the human body and devices that directly affect human life, etc.
   Prior consultation with our sales office is required when considering the above uses.
   ABLIC Inc. is not responsible for damages caused by unauthorized or unspecified use of our products.

9. Semiconductor products may fail or malfunction with some probability.
   The user of the products should therefore take responsibility to give thorough consideration to safety design including redundancy, fire spread prevention measures, and malfunction prevention to prevent accidents causing injury or death, fires and social damage, etc. that may ensue from the products' failure or malfunction.
   The entire system must be sufficiently evaluated and applied on customer's own responsibility.

10. The products are not designed to be radiation-proof. The necessary radiation measures should be taken in the product design by the customer depending on the intended use.

11. The products do not affect human health under normal use. However, they contain chemical substances and heavy metals and should therefore not be put in the mouth. The fracture surfaces of wafers and chips may be sharp. Be careful when handling these with the bare hands to prevent injuries, etc.

12. When disposing of the products, comply with the laws and ordinances of the country or region where they are used.

13. The information described herein contains copyright information and know-how of ABLIC Inc.
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14. For more details on the information described herein, contact our sales office.

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ABLIC Inc.
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