

## High Sensitivity Micropower Omnipolar Hall-Effect Switch

**AH9247**

### General Description

The AH9247 is an ultra-sensitive Hall-effect switch with digital latched output, mainly designed for battery-operation, handheld equipments.

Special CMOS process is used for low-voltage and low-power requirement. A chopper stabilized amplifier improves stability of magnetic switch points. A sleep-awake logic controls the IC in sleep time or awake time. This function will reduce the average operating current of the IC. During the awake time, the output is changed with the magnetic flux density. During the sleep time, the output is latched in its previous state and the current consumption will reduce to some  $\mu\text{A}$ .

The IC switching behaviour is omnipolar, either north or south pole sufficient strength will turn the output on. If the magnetic flux density is larger than operating point ( $B_{OP}$ ), the output will be turned on; if it is less than releasing point ( $B_{RP}$ ), the output will be turned off.

The AH9247 is available in TO-92S-3, SOT-23-3 and DFN-2 $\times$ 2-3 packages which are optimized for most applications.

### Features

- Micropower Operation
- 2.5 to 5.5V Power Supply
- Switching for Both Poles of a Magnet (Omnipolar)
- Stabilized Chopper
- Superior Temperature Stability
- Digital Output Signal
- Built-in Pull-up Resistor
- ESD (HBM) 6000V

### Applications

- Cover Switch in Notebook PC/PDA
- Handheld Wireless Application Awake Switch
- Magnet Switch in Low Duty Cycle Applications

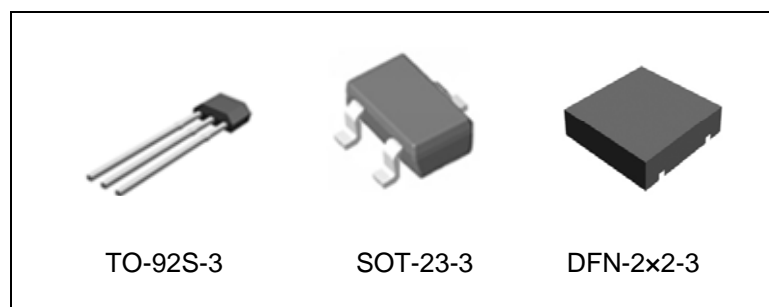


Figure 1. Package Types of AH9247

**High Sensitivity Micropower Omnipolar Hall-Effect Switch**

**AH9247**

**Pin Configuration**

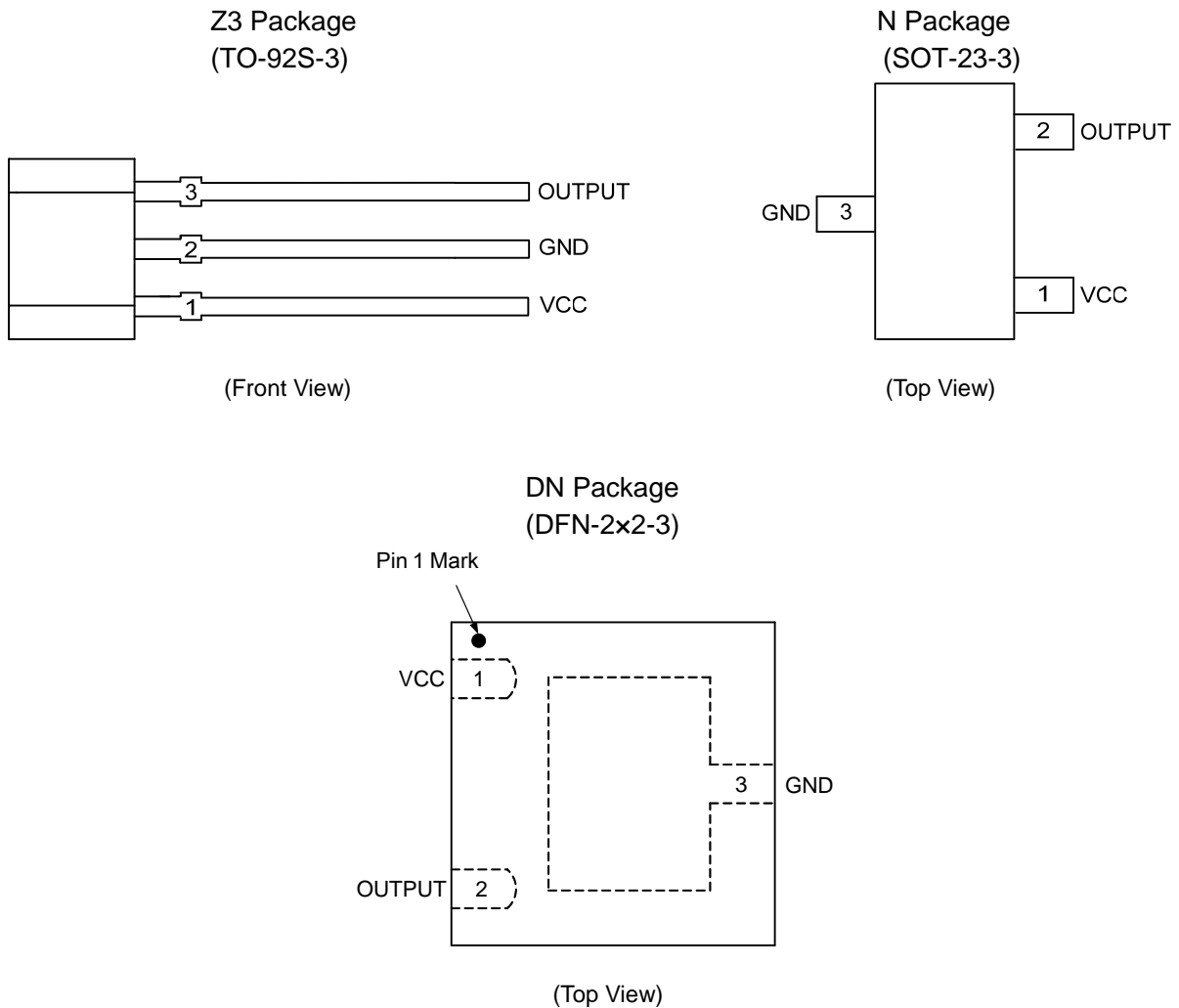


Figure 2. Pin Configuration of AH9247

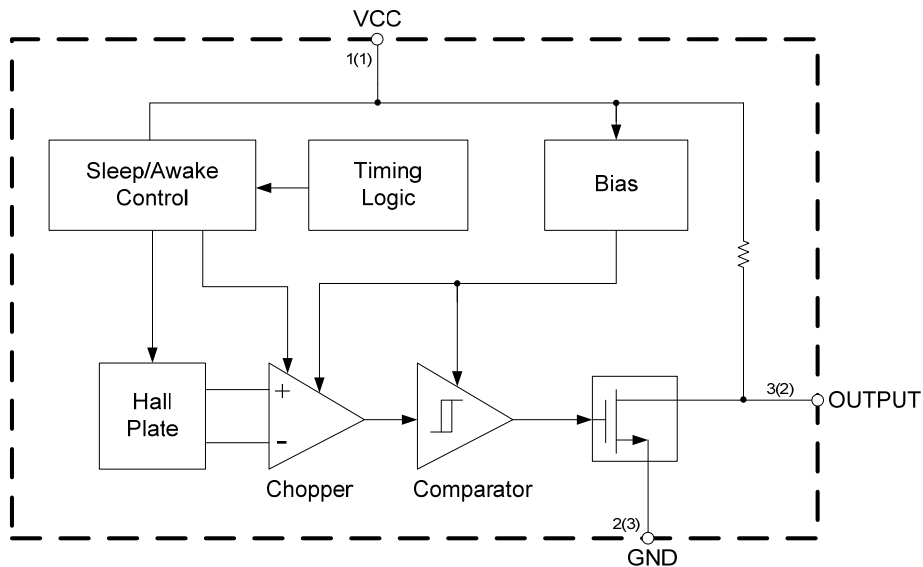
**Pin Description**

| Pin Number |          |           | Pin Name | Function         |
|------------|----------|-----------|----------|------------------|
| TO-92S-3   | SOT-23-3 | DFN-2x2-3 |          |                  |
| 1          | 1        | 1         | VCC      | Power supply pin |
| 2          | 3        | 3         | GND      | Ground pin       |
| 3          | 2        | 2         | OUTPUT   | Output pin       |

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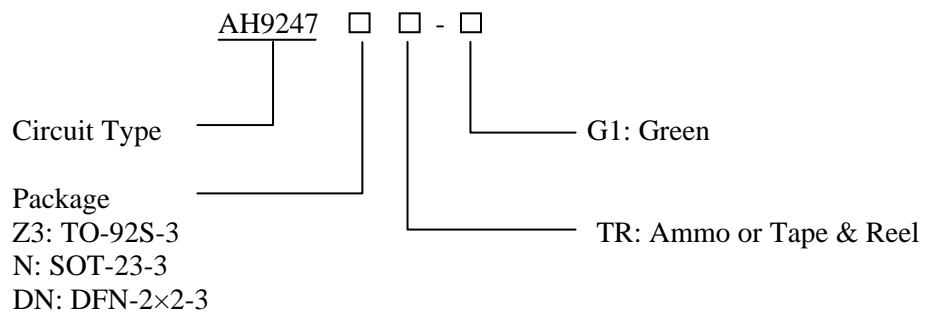
**Functional Block Diagram**



A (B)  
 A for TO-92S-3  
 B for SOT-23-3 and DFN-2x2-3

Figure 3. Functional Block Diagram of AH9247

**Ordering Information**



| Package   | Temperature Range | Part Number   | Marking ID | Packing Type |
|-----------|-------------------|---------------|------------|--------------|
| TO-92S-3  | -40 to 85°C       | AH9247Z3TR-G1 | 9247       | Ammo         |
| SOT-23-3  |                   | AH9247NTR-G1  | GX8        | Tape & Reel  |
| DFN-2x2-3 |                   | AH9247DNTR-G1 | JF         | Tape & Reel  |

BCD Semiconductor's Pb-free products, as designated with "G1" suffix in the part number, are RoHS compliant and green.

**High Sensitivity Micropower Omnipolar Hall-Effect Switch****AH9247****Absolute Maximum Ratings (T<sub>A</sub>=25°C, Note 1)**

| Parameter                       | Symbol           | Value      | Unit  |    |
|---------------------------------|------------------|------------|-------|----|
| Supply Voltage                  | V <sub>CC</sub>  | 7          | V     |    |
| Supply Current (Fault)          | I <sub>CC</sub>  | 6          | mA    |    |
| Output Voltage                  | V <sub>OUT</sub> | 7          | V     |    |
| Output Current                  | I <sub>OUT</sub> | 2          | mA    |    |
| Magnetic Flux Density           | B                | Unlimited  | Gauss |    |
| Power Dissipation               | P <sub>D</sub>   | TO-92S-3   | 400   | mW |
|                                 |                  | SOT-23-3   | 230   |    |
|                                 |                  | DFN-2×2-3  | 230   |    |
| Storage Temperature             | T <sub>STG</sub> | -55 to 150 | °C    |    |
| Junction Temperature            | T <sub>J</sub>   | 150        | °C    |    |
| ESD (Human Body Model) (Note 2) |                  | 6000       | V     |    |
| ESD (Machine Model) (Note 2)    |                  | 400        | V     |    |

Note 1: Stresses greater than those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “Recommended Operating Conditions” is not implied. Exposure to “Absolute Maximum Ratings” for extended periods may affect device reliability.

Note 2: Electronic semiconductor products are sensitive to Electro Static Discharge (ESD). Always observe Electro Static Discharge control procedures whenever handling semiconductor products.

**Recommended Operating Conditions**

| Parameter             | Symbol          | Min | Max | Unit |
|-----------------------|-----------------|-----|-----|------|
| Supply Voltage        | V <sub>CC</sub> | 2.5 | 5.5 | V    |
| Operating Temperature | T <sub>OP</sub> | -40 | 85  | °C   |

**High Sensitivity Micropower Omnipolar Hall-Effect Switch****AH9247****Electrical Characteristics** $V_{CC}=3V$ ,  $T_A=25^{\circ}C$ , unless otherwise specified.

| Parameter          | Symbol    | Conditions      | Min | Typ  | Max | Units   |
|--------------------|-----------|-----------------|-----|------|-----|---------|
| Supply Voltage     | $V_{CC}$  | Operating       | 2.5 | 3    | 5.5 | V       |
| Supply Current     | $I_{AW}$  | Awake           |     | 1.8  | 3   | mA      |
|                    | $I_{SL}$  | Sleep           |     | 4    | 10  | $\mu A$ |
|                    | $I_{AVG}$ | Average         |     | 8    | 15  | $\mu A$ |
| Output Current     | $I_{OUT}$ |                 |     |      | 1.0 | mA      |
| Saturation Voltage | $V_{SAT}$ | $I_{OUT}=1.0mA$ |     |      | 0.4 | V       |
| Awake Mode Time    | $t_{AW}$  | Operating       |     | 120  |     | $\mu s$ |
| Sleep Mode Time    | $t_{SL}$  | Operating       |     | 80   | 120 | ms      |
| Duty Cycle         | D         |                 |     | 0.15 |     | %       |
| Chopper Frequency  | $f_C$     |                 |     | 15   |     | kHz     |

**Magnetic Characteristics (Note 3)** $V_{CC}=3V$ ,  $T_A=25^{\circ}C$ , unless otherwise specified.

For TO-92S-3 Package

| Parameter       | Symbol    | Conditions  | Min | Typ | Max | Unit  |
|-----------------|-----------|---|-----|-----|-----|-------|
| Operating Point | $B_{OPS}$ | South pole to branded side<br>$B > B_{OPS}, V_{OUT} = \text{low}(\text{output on})$   | 15  | 30  | 55  | Gauss |
|                 | $B_{OPN}$ | North pole to branded side<br>$B > B_{OPN}, V_{OUT} = \text{low}(\text{output on})$   | -55 | -30 | -15 | Gauss |
| Releasing Point | $B_{RPS}$ | South pole to branded side<br>$B < B_{RPS}, V_{OUT} = \text{high}(\text{output off})$ | 5   | 20  | 45  | Gauss |
|                 | $B_{RPN}$ | North pole to branded side<br>$B < B_{RPN}, V_{OUT} = \text{high}(\text{output off})$ | -45 | -20 | -5  | Gauss |
| Hysteresis      | $B_{HYS}$ | $  B_{OPX} - B_{RPX}  $ (Note4)   |     | 10  |     | Gauss |

**High Sensitivity Micropower Omnipolar Hall-Effect Switch**
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**Magnetic Characteristics (Note 3) (Continued)**
 $V_{CC}=3V$ ,  $T_A=25^{\circ}C$ , unless otherwise specified.

For SOT-23-3 and DFN-2x2-3 Packages

| Parameter       | Symbol    | Conditions   | Min | Typ | Max | Unit  |
|-----------------|-----------|--|-----|-----|-----|-------|
| Operating Point | $B_{OPS}$ | South pole to branded side<br>$B > B_{OPS}$ , $V_{OUT} = \text{low (output on)}$   | 20  | 30  | 40  | Gauss |
|                 | $B_{OPN}$ | North pole to branded side<br>$B > B_{OPN}$ , $V_{OUT} = \text{low (output on)}$   | -40 | -30 | -20 | Gauss |
| Releasing Point | $B_{RPS}$ | South pole to branded side<br>$B < B_{RPS}$ , $V_{OUT} = \text{high (output off)}$ | 5   | 20  | 32  | Gauss |
|                 | $B_{RPN}$ | North pole to branded side<br>$B < B_{RPN}$ , $V_{OUT} = \text{high (output off)}$ | -32 | -20 | -5  | Gauss |
| Hysteresis      | $B_{HYS}$ | $ B_{OPX} - B_{RPX} $ (Note4)  |     | 10  |     | Gauss |

Note 3: The specifications stated here are guaranteed by design. 1 Gauss=0.1mT

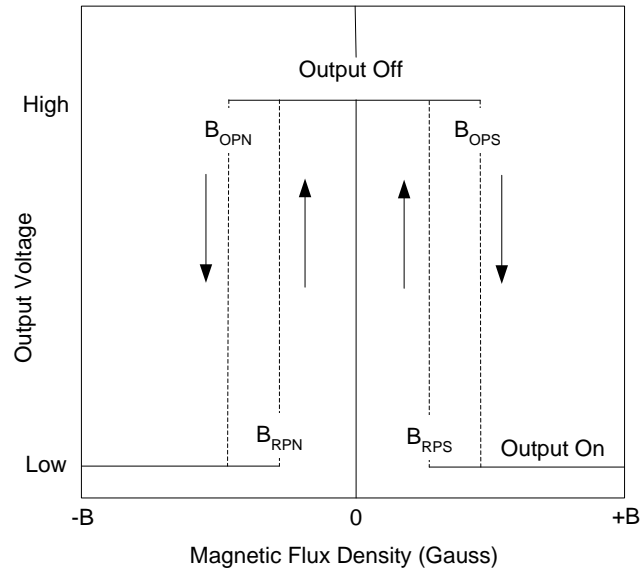
 Note 4:  $B_{OPX}$ =operating point (output turns on);  $B_{RPX}$ =releasing point (output turns off)


Figure 4. Output Voltage vs. Magnetic Flux Density

**High Sensitivity Micropower Omnipolar Hall-Effect Switch**

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**Test Conditions**

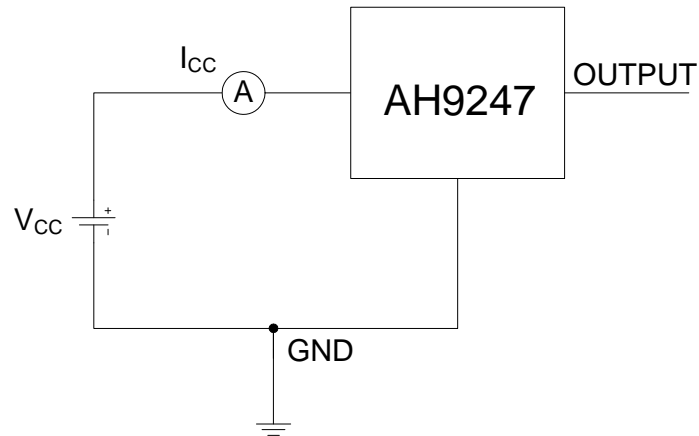


Figure 5. Average Supply Current (Note 5, Note 6)

Note 5:  $I_{CC}$  represents the average supply current. OUTPUT is open during measurement.

Note 6: The device is put under magnetic field with  $B < B_{RP}$ .

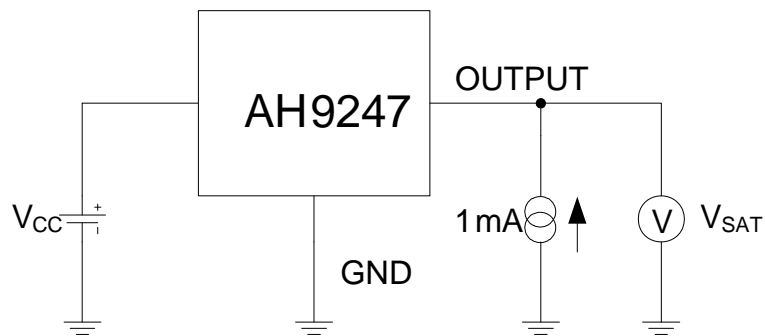


Figure 6. Output Saturation Voltage (Note 7, Note 8)

Note 7: The output saturation voltage  $V_{SAT}$  is measured at  $V_{CC}=2.5V$  and  $V_{CC}=5.5V$

Note 8: The device is put under magnetic field with  $B > B_{OP}$

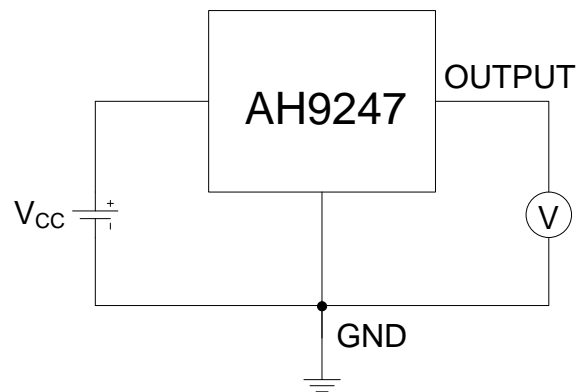
**Test Conditions (Continued)**

Figure 7. Magnetic Thresholds (Note 9, Note10)

Note 9:  $B_{OP}$  is determined by putting the device under magnetic field swept from  $B_{RP(min)}$  to  $B_{OP(max)}$  until the output is switched on.

Note 10:  $B_{RP}$  is determined by putting the device under magnetic field swept from  $B_{OP(max)}$  to  $B_{RP(min)}$  until the output is switched off.



Typical Performance Characteristics

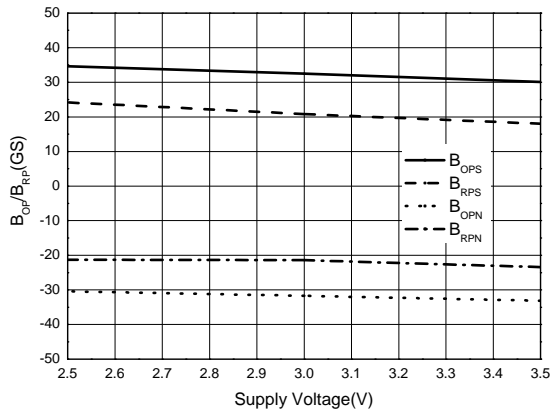


Figure 8. B<sub>OP</sub>/B<sub>RP</sub> vs. Supply Voltage

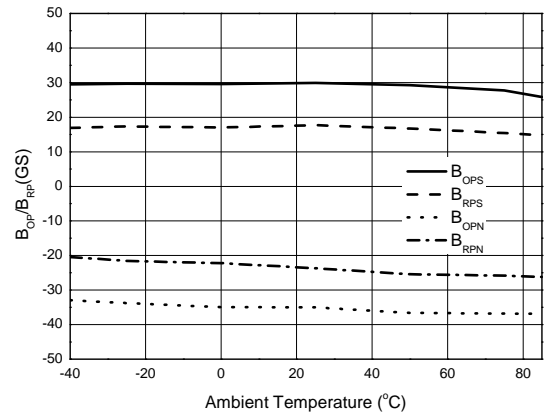


Figure 9. B<sub>OP</sub>/B<sub>RP</sub> vs. Ambient Temperature

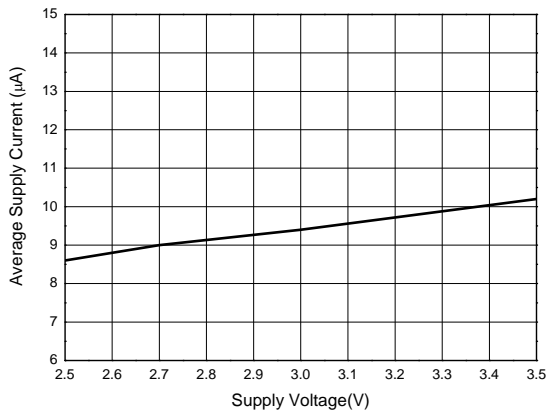


Figure 10. Average Supply Current vs. Supply Voltage

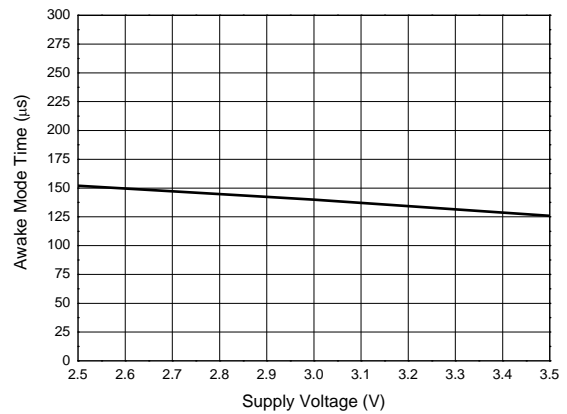


Figure 11. Awake Mode Time vs. Supply Voltage

**High Sensitivity Micropower Omnipolar Hall-Effect Switch**

**AH9247**

**Typical Performance Characteristics (Characteristic)**

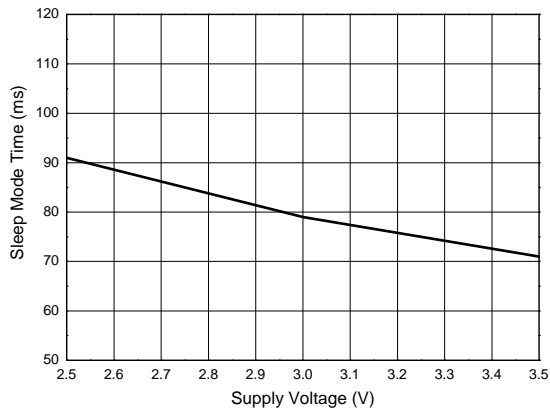


Figure 12. Sleep Mode Time vs. Supply Voltage

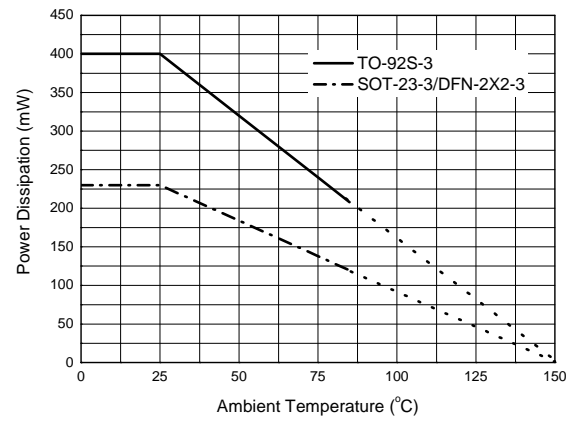


Figure 13. Power Dissipation vs. Ambient Temperature

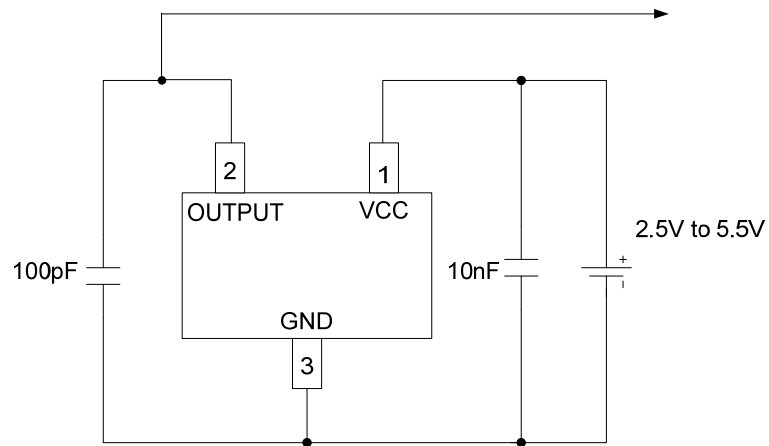
**High Sensitivity Micropower Omnipolar Hall-Effect Switch****AH9247****Typical Application**

Figure 14. Typical Application Circuit of AH9247

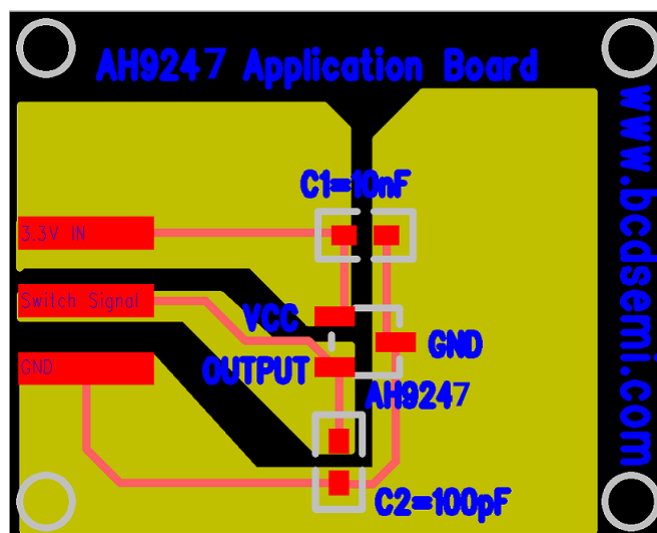


Figure 15. Typical Layout Pattern of AH9247 (Note 11)

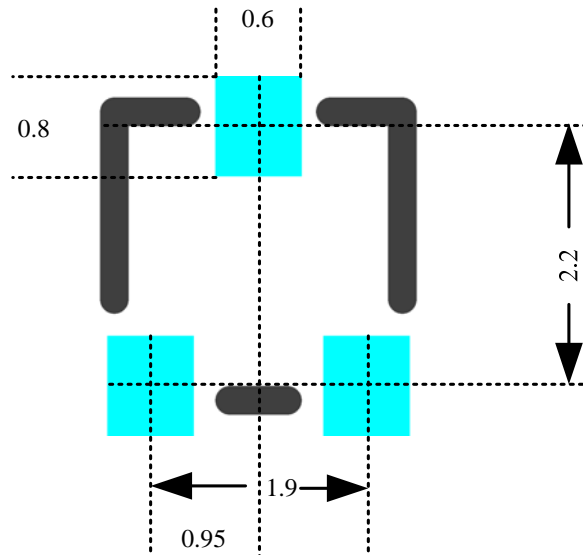
**Typical Application (Continued)**


Figure 16. AH9247 Layout Pattern Mechanical Dimensions (Unit: mm)

**Note 11:**

The AH9247 is an ultra-sensitive Hall-effect switch with digital latched output. It is very sensitive for the magnetic field. As a result, extreme care is required with respect to the pattern layout when designing application circuits. (Figure 15. is a typical application reference, Figure 16. is AH9247 layout pattern mechanical dimensions.)

**\*1. Ground and VCC Wiring Layout**

Insert a capacitor (recommended value: 10nF or larger) as near as possible to the space between the VCC pin and GND pin.

**\*2. Positioning the External Components**

The external components such as C2 (recommended

value: 100pF) that are connected to ground must be connected with lines that are as short as possible. External components connected between IC pins must be placed as near to the pins as possible.

**\*3. Pad Layout Around Hall Switch**

Place some large current lines and some elements that have magnetism, such as speaker and DC Fan, as far to the Hall switch as possible.

**\*4. GND Pattern**

If possible, GND pattern is as large as possible so that the power dissipation from the NB inner case or solder machine can dissipate quickly.

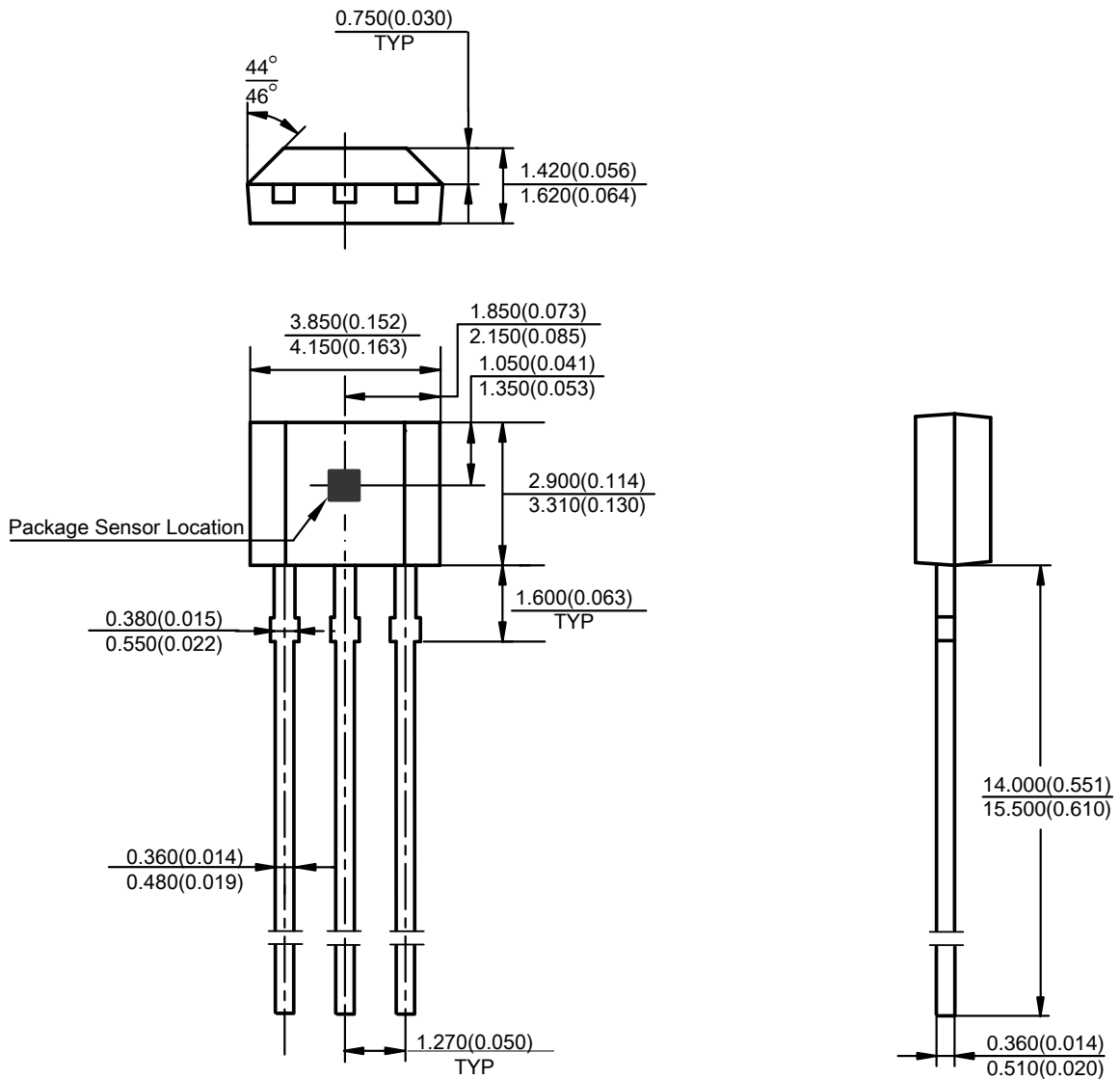
**High Sensitivity Micropower Omnipolar Hall-Effect Switch**

**AH9247**

**Mechanical Dimensions**

**TO-92S-3**

**Unit: mm(inch)**



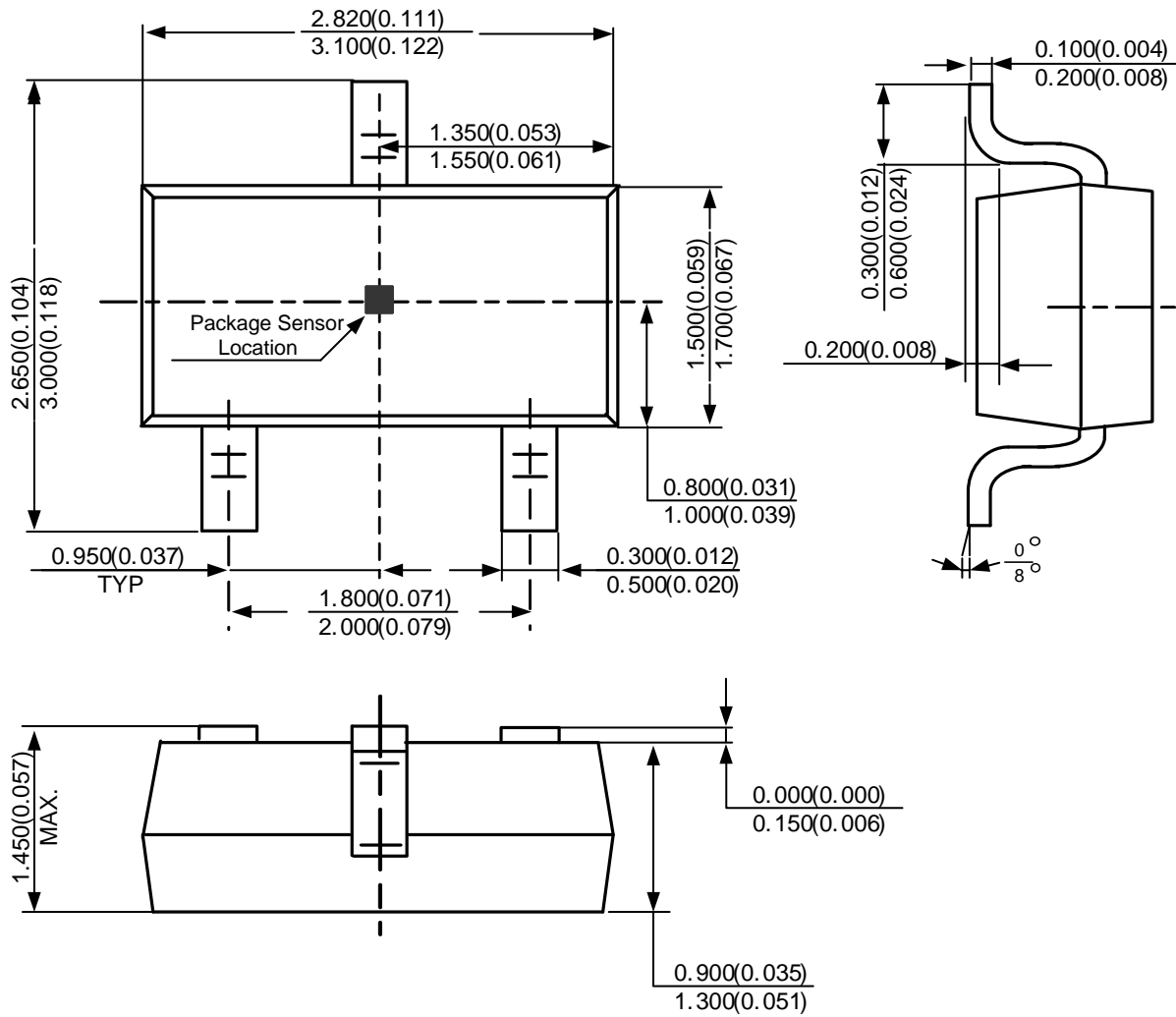
**High Sensitivity Micropower Omnipolar Hall-Effect Switch**

**AH9247**

**Mechanical Dimensions (Continued)**

**SOT-23-3**

**Unit: mm(inch)**



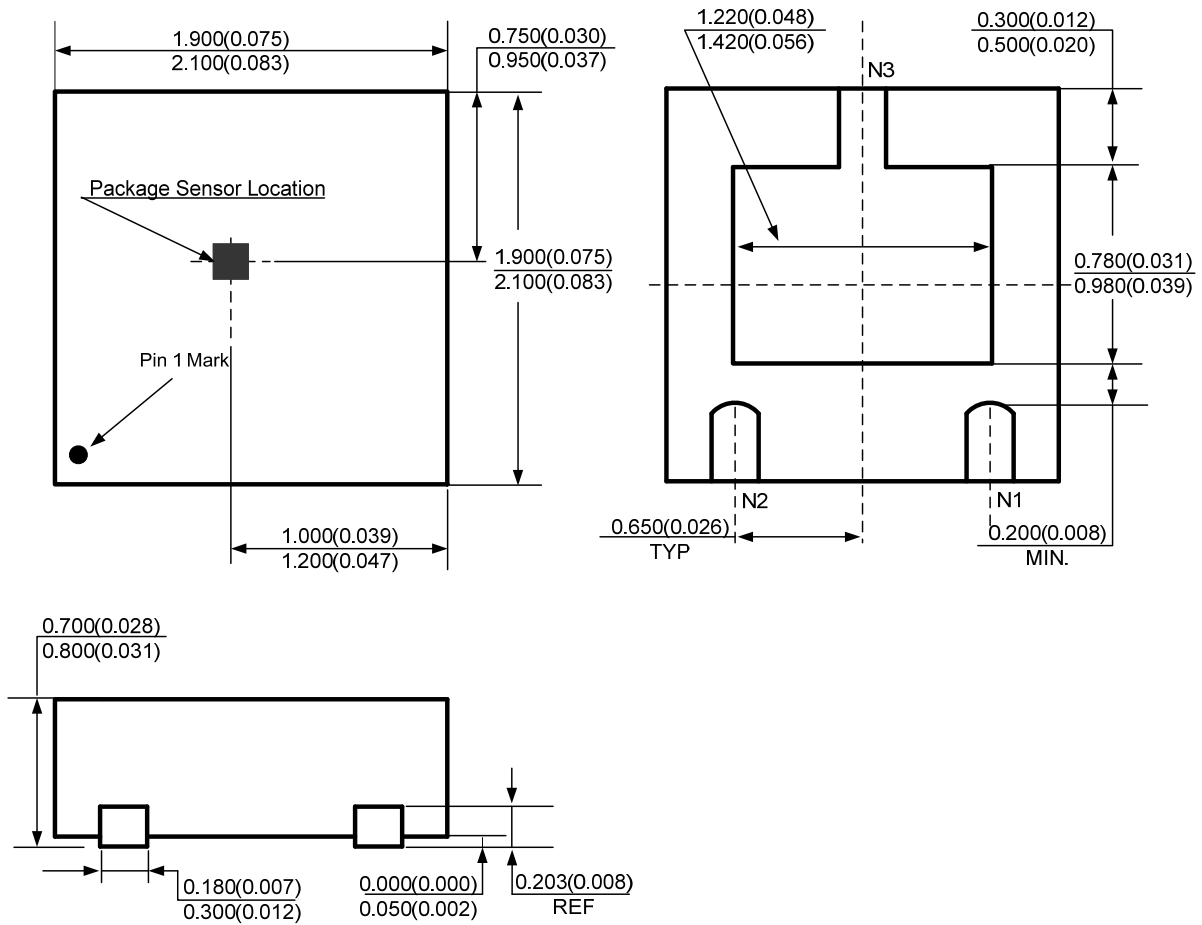
**High Sensitivity Micropower Omnipolar Hall-Effect Switch**

**AH9247**

**Mechanical Dimensions (Continued)**

**DFN-2x2-3**

**Unit: mm(inch)**





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