# LOW SENSITIVITY MICROPOWER OMNIPOLAR HALL-EFFECT SWITCH

## Description

The AH1815 is a low-sensitivity, micro-power Omnipolar Hall effect switch IC, designed for portable and battery powered consumer equipment for home appliance and industrial applications such as smart-meter magnetic-tamper detection. Based on two sensitive Hall effect plates and a chopper-stabilized architecture, the AH1815 provides a reliable solution over the whole operating range. To support portable and battery powered equipment, the design has been optimized to operate over the supply range of 2.5V to 5.5V and consumes only 24µW with a supply of 3V.

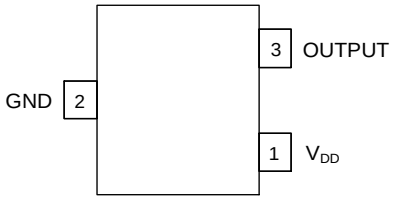
The single open drain output can switch on with either a north or south pole of sufficient strength. When the magnetic flux density (B) perpendicular to the package is larger than operating point (Bop) the output is switched on (pulled low). The output is turned off when B becomes lower than the releasing point (Brp). The output will remain off when there is no magnetic field.

## Features

- Omnipolar (North or South pole) Operation
- Low Sensitivity
- Single Open Drain Output
- Micropower Operation
- 2.5V to 5.5V Operating Range
- Chopper Stabilized Design Provides
  - Superior Temperature Stability
  - Minimal Switch Point Drift
  - Enhanced Immunity to Stress
- Good RF Noise Immunity
- -40°C to +125°C Operating Temperature
- ESD (HBM) > 6KV
- Small Low Profile SOT553 and Industry Standard SC59 and SIP-3 Packages
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

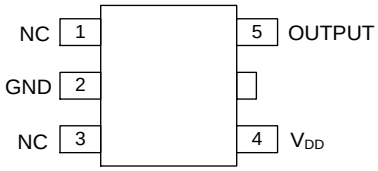
## Pin Assignments

**(Top View)**



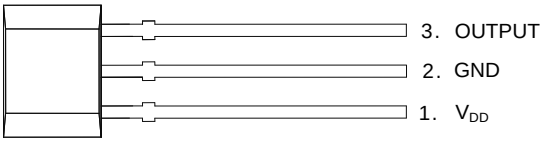

**SC59**

**(Top View)**




**SOT553**

**(Front View)**



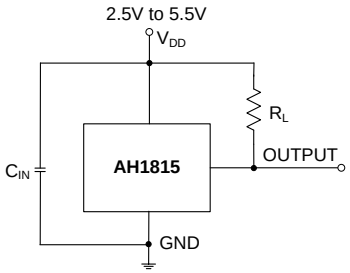

**SIP-3**

## Applications

- Doors, Lids, Covers and Tray Position Detect Switches
- Display Switch for Portable PCs and Tablets
- On/Off Switch for PDAs and Digital Cameras
- Liquid Level Detection for Coffee Machines
- Smart Meters
- Position, Proximity and Level Detection Contactless Switch in Battery Powered Consumer, Home Appliances and Industrial Applications

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See http://www.diodes.com/quality/lead_free.html for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

## Typical Applications Circuit (Note 4)




Note: 4. $C_{IN}$ is for power stabilization and to strengthen the noise immunity, the recommended capacitance is 10nF to 100nF.
$R_L$ is the pull-up resistor, the recommended resistance is 10kΩ to 100kΩ.

## Pin Descriptions

**Packages: SC59 and SIP-3**

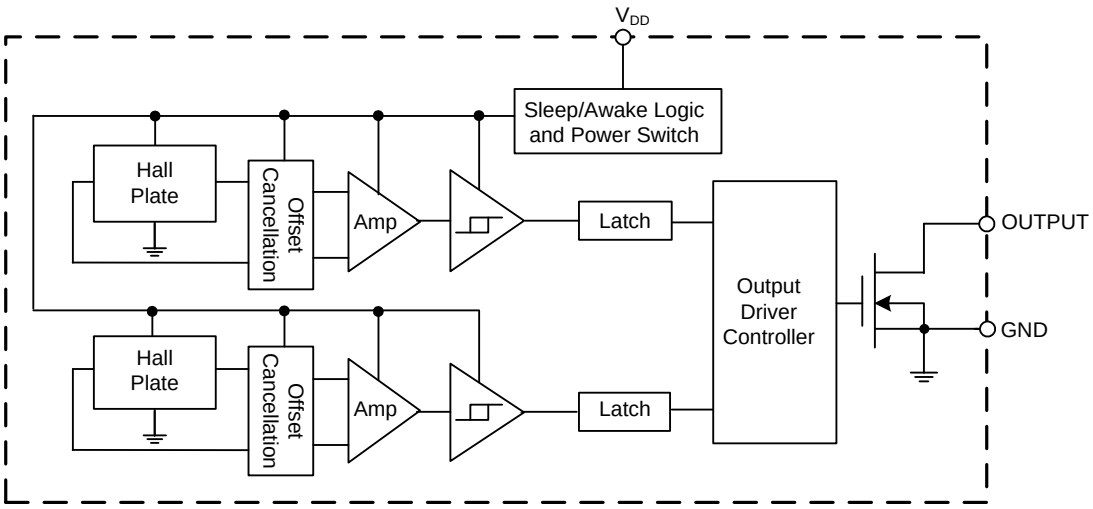
| Pin Number | Pin Name | Function |
|---|---|---|
| 1 | $V_{DD}$ | Power Supply Input |
| 2 | GND | Ground |
| 3 | OUTPUT | Output |

**Package: SOT553**

| Pin Number | Pin Name | Function |
|---|---|---|
| 1 | NC | No Connection (Note 5) |
| 2 | GND | Ground |
| 3 | NC | No Connection (Note 5) |
| 4 | $V_{DD}$ | Power Supply Input |
| 5 | OUTPUT | Output |

Note: 5. NC is “No Connection” pin and is not connected internally. This pin can be left open or tied to ground.

## Functional Block Diagram



## Absolute Maximum Ratings (Note 6) (@$T_A$ = +25°C, unless otherwise specified.)

| Symbol | Parameter | | Values | Unit |
|---|---|---|---|---|
| $V_{DD}$ | Supply Voltage (Note 7) | | 7 | V |
| $V_{OUT}$ | Output Pin Voltage (Note 7) | | 7 | V |
| $V_{DD\ REV}$ | Reverse Supply Voltage | | -0.3 | V |
| $V_{OUT\_REV}$ | Reverse Output Pin Voltage | | -0.3 | V |
| $I_{OUTPUT}$ | Output Current (Source and Sink) | | 2.5 | mA |
| B | Magnetic Flux Density | | Unlimited | |
| $P_D$ | Package Power Dissipation | SC59 and SOT553 | 230 | mW |
| | | SIP-3 | 230 | mW |
| $T_{STG}$ | Storage Temperature Range | | -65 to +150 | °C |
| $T_J$ | Maximum Junction Temperature | | +150 | °C |
| ESD HBM | Human Body Model ESD capability | | 6 | kV |

Notes: 6. Stresses greater than the 'Absolute Maximum Ratings' specified above may cause permanent damage to the device. These are stress ratings only; functional operation of the device at these or any other conditions exceeding those indicated in this specification is not implied. Device reliability may be affected by exposure to absolute maximum rating conditions for extended periods of time.
7. The absolute maximum $V_{DD}$ of 7V is a transient stress rating and is not meant as a functional operating condition. It is not recommended to operate the device at the absolute maximum rated conditions for any period of time.

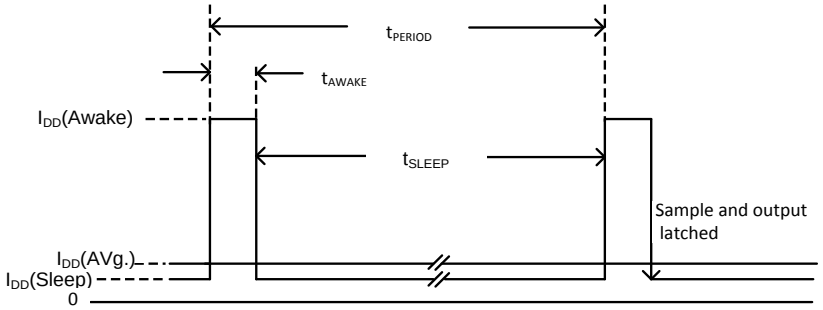
## Recommended Operating Conditions (@$T_A$ = +25°C, unless otherwise specified.)

| Symbol | Characteristic | Conditions | Rating | Unit |
|---|---|---|---|---|
| $V_{DD}$ | Supply Voltage | Operating | 2.5 to 5.5 | V |
| $V_{OUT\_MAX}$ | Maximum Output Pin Voltage | Operating | 5.5 | V |
| $T_A$ | Operating Temperature Range | Operating | -40 to +125 | °C |

## Electrical Characteristics (@$T_A$ = +25°C, $V_{DD}$ = 3V, unless otherwise specified.)

| Symbol | Characteristic | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{OUT\_ON}$ | Output On Voltage | $I_{OUT}$ = 1mA | — | 0.1 | 0.3 | V |
| $I_{OFF}$ | Output Leakage Current | $V_{OUT}$ = 5.5V, Output off | — | < 0.1 | 1 | µA |
| $I_{DD}$ (Awake) | Supply Current | During awake period, $T_A$ = +25°C, $V_{DD}$ = 3V | — | 3 | 6 | mA |
| | | During awake period, $T_A$ = -40°C to +125°C, $V_{DD}$ = 2.5V to 5.5V | — | 3 | 12 | mA |
| $I_{DD}$ (Sleep) | | During sleep period, $T_A$ = +25°C, $V_{DD}$ = 3V | — | 5 | 10 | µA |
| $I_{DD}$ (Sleep) | | During sleep period, $T_A$ = -40°C to +125°C, $V_{DD}$ = 2.5V to 5.5V | — | — | 28 | µA |
| $I_{DD}$ (Avg.) | Average Supply Current | $T_A$ = +25°C, $V_{DD}$ = 3V | — | 8 | 16 | µA |
| | | $T_A$ = -40°C to +125°C, $V_{DD}$ = 2.5V to 5.5V | — | — | 40 | µA |
| $t_{AWAKE}$ | Awake Time | (Note 8) | — | 75 | 125 | µs |
| $t_{PERIOD}$ | Period | (Note 8) | — | 75 | 125 | ms |
| D.C. | Duty Cycle | — | — | 0.1 | — | % |

Note: 8. When power is initially turned on, the operating $V_{DD}$ must be within its correct operating range (2.5V to 5.5V) to guarantee the output sampling. The output state is valid after the second operating cycle (typical 150ms).

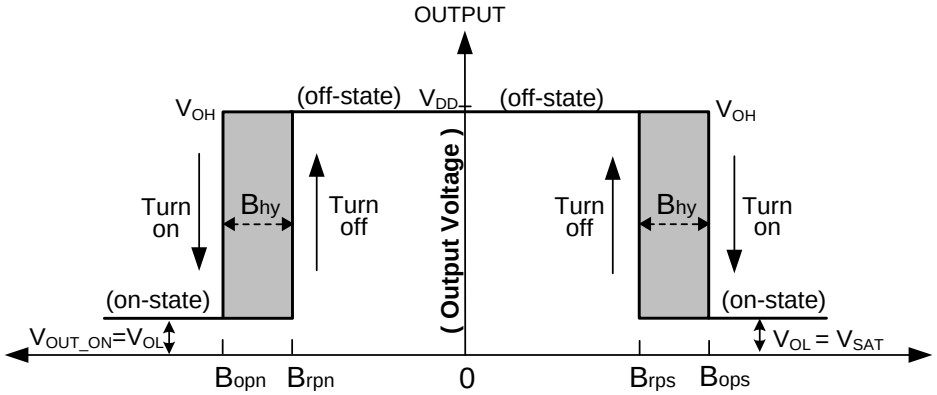


## Magnetic Characteristics (Notes 9 & 10) (@$T_A$ = -40°C to +125°C, $V_{DD}$ = 2.5V to 5.5V, unless otherwise specified.)

(1mT=10 Gauss)

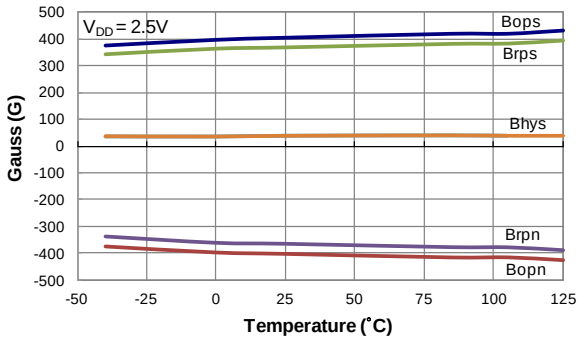
| Symbol | Characteristic | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Bops (South Pole to Part Marking Side) | Operating Points | $V_{DD}$ = 2.5V to 5.5V, $T_A$ = -40°C to +125°C, | 255 | 395 | 540 | Gauss |
| Bopn (North Pole to Part Marking Side) | | | -540 | -395 | -255 | |
| Brps (South Pole to Part Marking Side) | Releasing Points | $V_{DD}$ = 2.5V to 5.5V, $T_A$ = -40°C to +125°C, | 230 | 355 | 490 | |
| Brpn (North Pole to Part Marking Side) | | | -490 | -355 | -230 | |
| Bhy (\|Bopx\|-\|Brpx\|) | — | Hysteresis (Note 11) | — | 40 | — | |

Notes:
9. Typical data is at $T_A$ = +25°C, $V_{DD}$ = 3V, and for design information only.
10. Maximum and minimum parameters values over the operating temperature range are not tested in production, they are guaranteed by design, characterization and process control. The magnetic characteristics may vary with supply voltage, operating temperature and after soldering.
11. Maximum and minimum hysteresis is guaranteed by design and characterization.

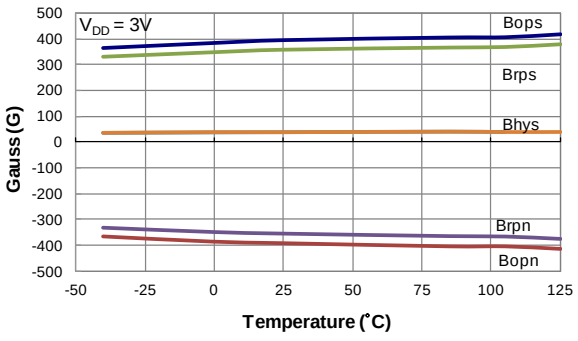


## Typical Operating Characteristics

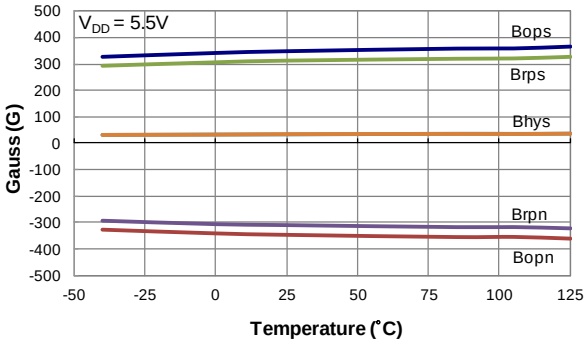
### Magnetic Operating Switch Points – Bop and Brp



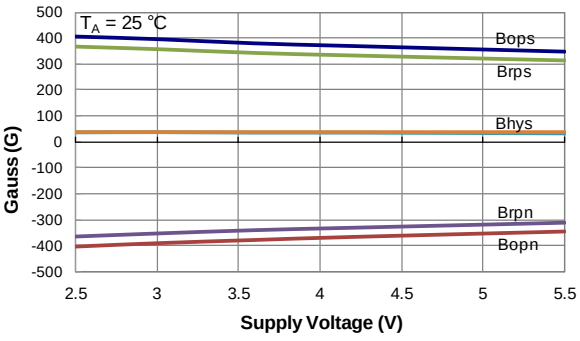

Switch Points vs Temperature




Switch Points vs Temperature

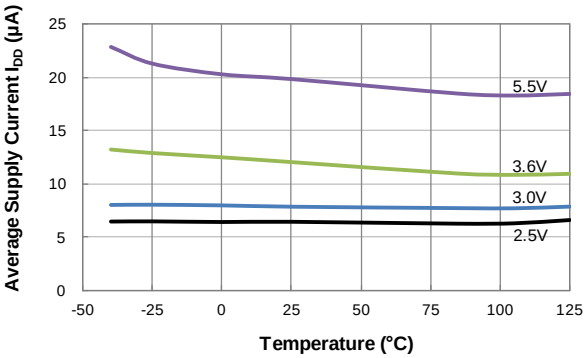



Switch Points vs Temperature

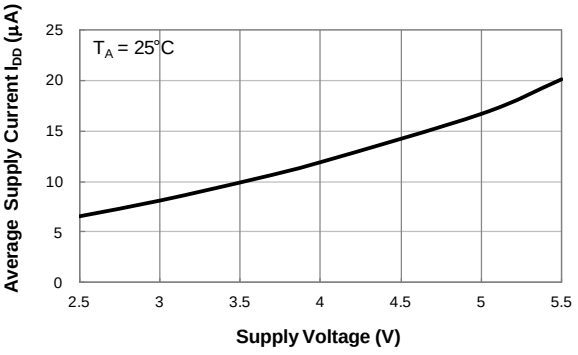



Switch Points vs Supply Voltage

### Average Supply Current




Average Supply Current vs Temperature

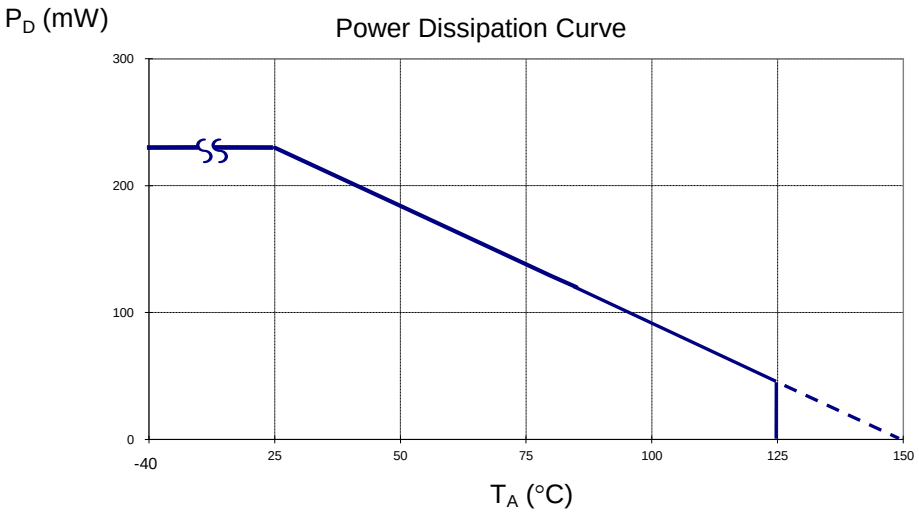



Average Supply Current vs Supply Voltage

## Thermal Performance Characteristics

**(1) Package Types: SC59, SOT553 and SIP-3**

| $T_A$ (°C) | 25 | 50 | 60 | 70 | 80 | 85 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $P_D$ (mW) | 230 | 184 | 166 | 147 | 129 | 120 | 110 | 92 | 74 | 55 | 37 | 18 | 0 |




## Ordering Information

**AH1815 - X - X**

| Package | Packing |
|---|---|
| W : SC59<br>Z : SOT553<br>P : SIP-3 | 7 : Tape & Reel<br>A : Ammo Box (Note 12)<br>B : Bulk (Note 13) |

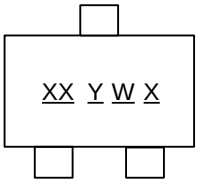
| Device | Package Code | Packaging | Bulk | | 7" Tape and Reel | | Ammo Box | |
|---|---|---|---|---|---|---|---|---|
| | | | Quantity | Part Number Suffix | Quantity | Part Number Suffix | Quantity | Part Number Suffix |
| AH1815-P-A | P | SIP-3 | NA | NA | NA | NA | 4,000/Box | -A |
| AH1815-P-B | P | SIP-3 | 1000 | -B | NA | NA | NA | NA |
| AH1815-W-7 | W | SC59 | NA | NA | 3,000/Tape & Reel | -7 | NA | NA |
| AH1815-Z-7 | Z | SOT553 | NA | NA | 3,000/Tape & Reel | -7 | NA | NA |

Notes: 12. Ammo Box is for SIP-3 Spread Lead.
13. Bulk is for SIP-3 Straight Lead.

## Marking Information

**(1) Package Type: SC59**

**( Top View )**

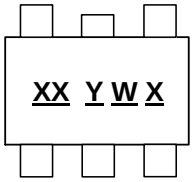



XX : Identification Code
Y : Year 0 to 9
W : Week : A to Z : 1 to 26 week;
a to z : 27 to 52 week; z represents
52 and 53 week
X : Internal Code

| Part Number | Package | Identification Code |
|---|---|---|
| AH1815 | SC59 | AG |

**(2) Package Type: SOT553**

**( Top View )**

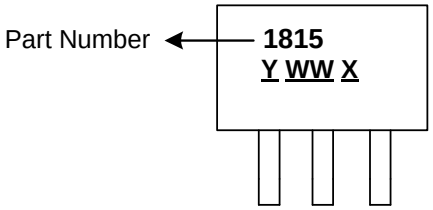



XX : Identification Code
Y : Year : 0 to 9
W : Week : A to Z : 1~26 week;
a to z : 27~52 week; z represents
52 and 53 week
X : Internal code

| Part Number | Package | Identification Code |
|---|---|---|
| AH1815 | SOT553 | AG |

**(3) Package Type: SIP-3**

**(Front View)**

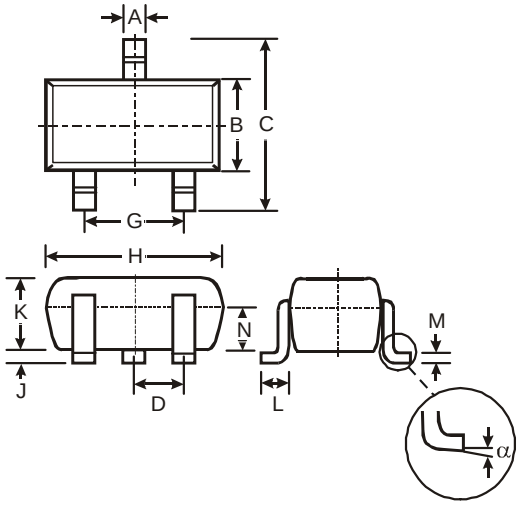



Y : Year : 0 to 9
WW : Week : 01~52, "52" represents
52 and 53 week
X : Internal Code

## Package Outline Dimensions (All dimensions in mm.)

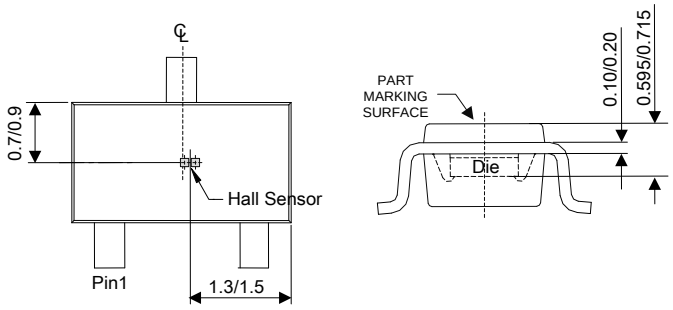
Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for the latest version.

**(1) Package Type: SC59**




| SC59 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 0.35 | 0.50 | 0.38 |
| **B** | 1.50 | 1.70 | 1.60 |
| **C** | 2.70 | 3.00 | 2.80 |
| **D** | - | - | 0.95 |
| **G** | - | - | 1.90 |
| **H** | 2.90 | 3.10 | 3.00 |
| **J** | 0.013 | 0.10 | 0.05 |
| **K** | 1.00 | 1.30 | 1.10 |
| **L** | 0.35 | 0.55 | 0.40 |
| **M** | 0.10 | 0.20 | 0.15 |
| **N** | 0.70 | 0.80 | 0.75 |
| **α** | 0° | 8° | - |
| **All Dimensions in mm** | | | |

Min/Max

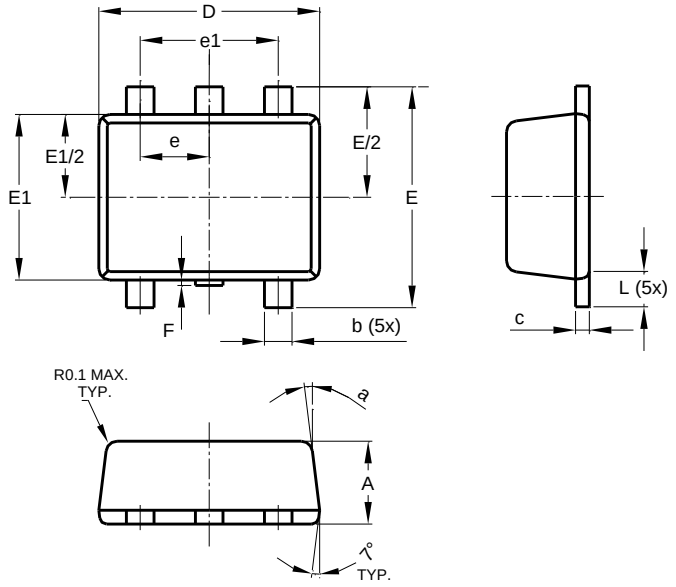



**Sensor Location**

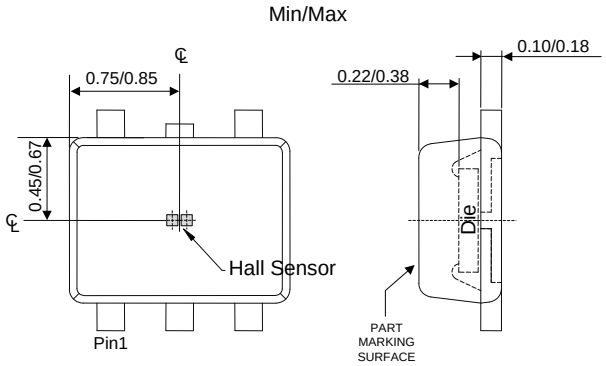
## Package Outline Dimensions (cont.) (All dimensions in mm.)

Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for the latest version.

**(2) Package Type: SOT553**




| SOT553 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 0.55 | 0.62 | 0.60 |
| **b** | 0.15 | 0.30 | 0.20 |
| **c** | 0.10 | 0.18 | 0.15 |
| **D** | 1.50 | 1.70 | 1.60 |
| **E** | 1.55 | 1.70 | 1.60 |
| **E1** | 1.10 | 1.25 | 1.20 |
| **e** | 0.50 BSC | | |
| **e1** | 1.00 BSC | | |
| **F** | 0.00 | 0.10 | — |
| **L** | 0.10 | 0.30 | 0.20 |
| **a** | 6° | 8° | 7° |
| **All Dimensions in mm** | | | |

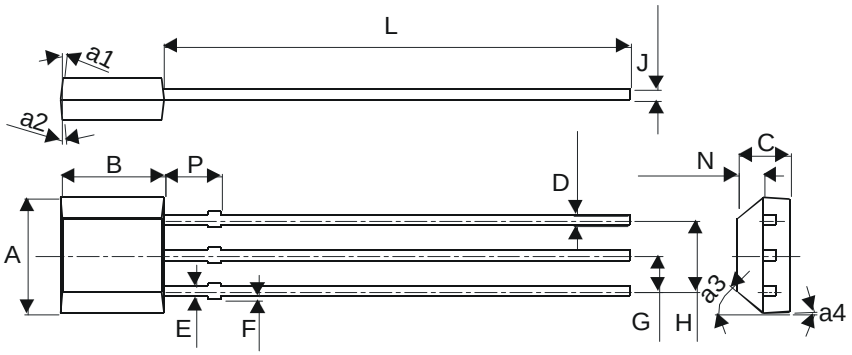



**Sensor Location**

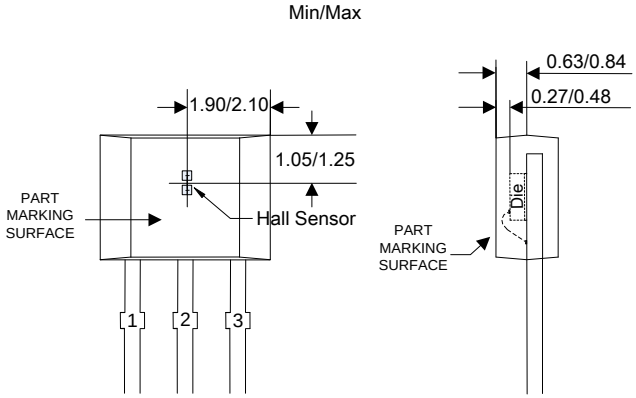
## Package Outline Dimensions (cont.) (All dimensions in mm.)

Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for the latest version.

**(3) Package Type: SIP-3 (Bulk Pack)**




| SIP-3 (Bulk Pack) | | |
|---|---|---|
| **Dim** | **Min** | **Max** |
| **A** | 3.9 | 4.3 |
| **a1** | 5° Typ | |
| **a2** | 5° Typ | |
| **a3** | 45° Typ | |
| **a4** | 3° Typ | |
| **B** | 2.8 | 3.2 |
| **C** | 1.40 | 1.60 |
| **D** | 0.33 | 0.432 |
| **E** | 0.40 | 0.508 |
| **F** | 0 | 0.2 |
| **G** | 1.24 | 1.30 |
| **H** | 2.51 | 2.57 |
| **J** | 0.35 | 0.43 |
| **L** | 14.0 | 15.0 |
| **N** | 0.63 | 0.84 |
| **P** | 1.55 | - |
| **All Dimensions in mm** | | |

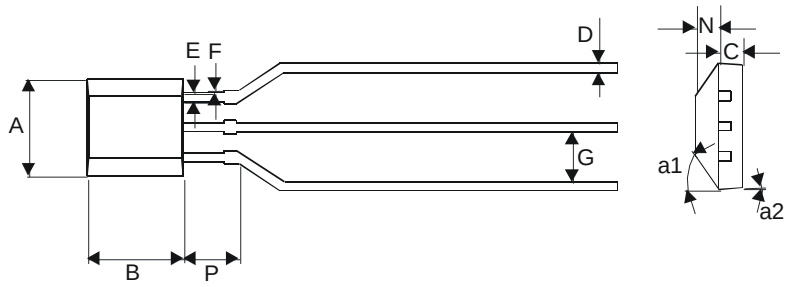



**Sensor Location**

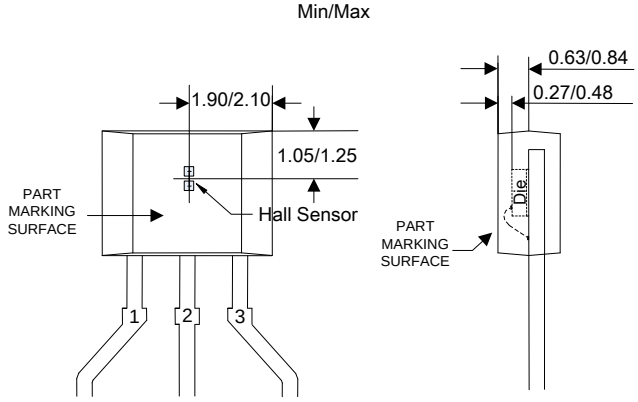
## Package Outline Dimensions (cont.) (All dimensions in mm.)

Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for the latest version.

**(4) Package Type: SIP-3 (Ammo Pack)**




| SIP-3 (Ammo Pack) | | |
|---|---|---|
| **Dim** | **Min** | **Max** |
| **A** | 3.9 | 4.3 |
| **a1** | 45° Typ | |
| **a2** | 3° Typ | |
| **B** | 2.8 | 3.2 |
| **C** | 1.40 | 1.60 |
| **D** | 0.35 | 0.41 |
| **E** | 0.43 | 0.48 |
| **F** | 0 | 0.2 |
| **G** | 2.4 | 2.9 |
| **N** | 0.63 | 0.84 |
| **P** | 1.55 | - |
| **All Dimensions in mm** | | |

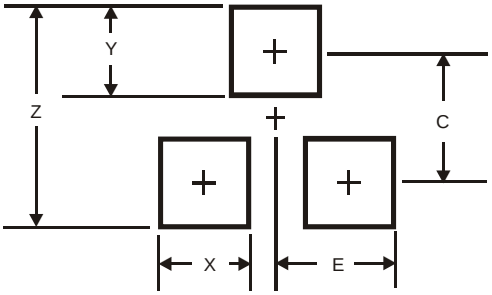



**Sensor Location**

## Suggested Pad Layout

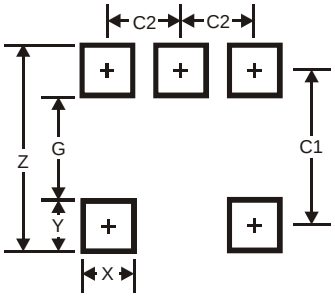
Please see AP02001 at http://www.diodes.com/datasheets/ap02001.pdf for the latest version.

**(1) Package Type: SC59**




| Dimensions | Value (in mm) |
|---|---|
| Z | 3.4 |
| X | 0.8 |
| Y | 1.0 |
| C | 2.4 |
| E | 1.35 |

**(2) Package Type: SOT553**




| Dimensions | Value (in mm) |
|---|---|
| Z | 2.2 |
| G | 1.2 |
| X | 0.375 |
| Y | 0.5 |
| C1 | 1.7 |
| C2 | 0.5 |

**IMPORTANT NOTICE**

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