

LOW SENSITIVITY MICROPOWER OMNIPOLAR HALL-EFFECT SWITCH

Description

The AH1809 is a low sensitivity micro power Omnipolar Hall Effect switch IC designed for battery powered consumer to home appliance and industrial equipment such smart e-meters. Based on two Hall Effect plates and a chopper stabilized architecture the AH1809 provides a reliable solution over the whole operating range. To support battery and low power applications the design has been optimized to operate over the supply range of 2.5V to 5.5V and consumes only 24 μ W with a supply of 3V.

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

The AH1809 is available in SC59, SOT553 and SIP-3L.

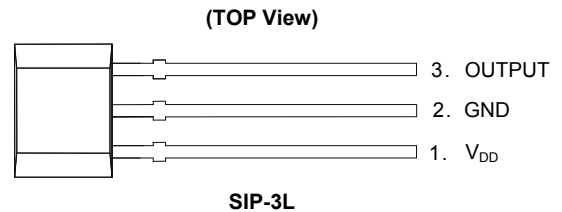
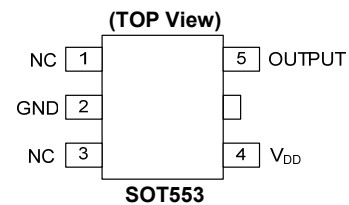
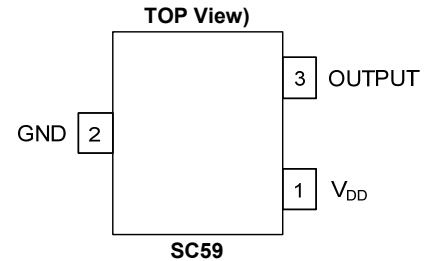
Features

- 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
- High ESD
- Small Low Profile SOT553 and Industry Standard SC59 and SIP-3L Packages
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

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.

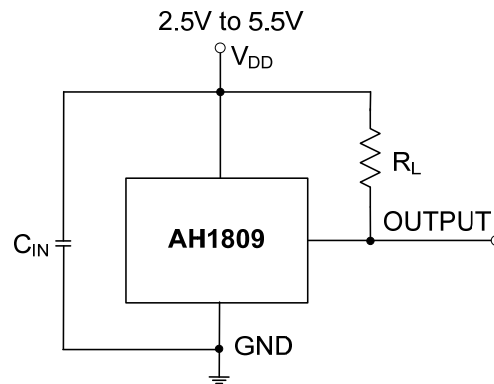
Pin Assignments



Applications

- Smart E-Meters
- Tamper Protection Switch
- Door, Lids and Tray Position Switch
- Proximity and Position Switches
- Level Detects
- On/Off Switch Digital Contact-Less Switch in Industrial and Consumer Products

Typical Applications Circuit



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

Pin Descriptions

Package: SC59 and SIP-3L

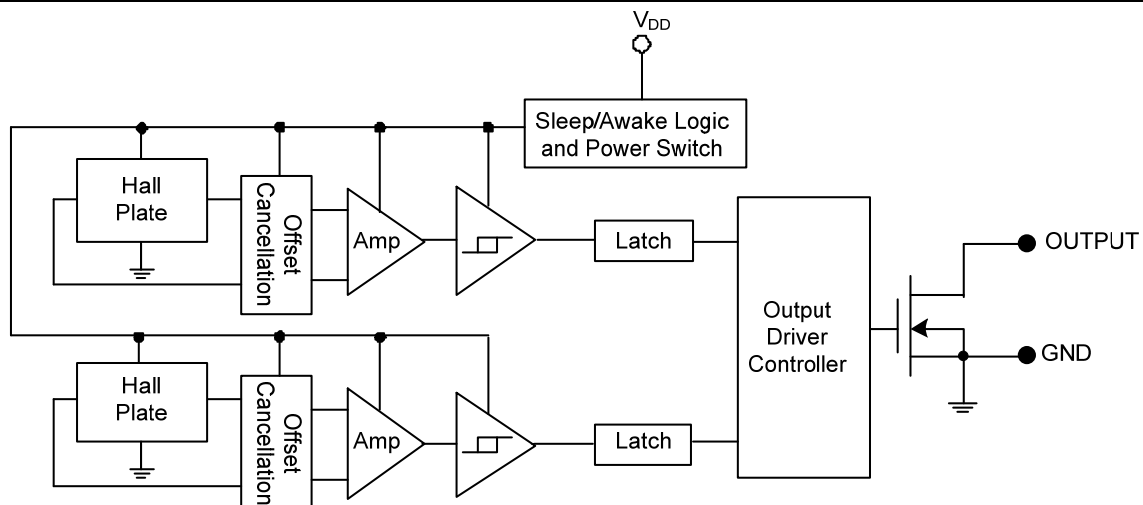
| Pin Number | Pin Name | Function |
|------------|-----------------|--------------------|
| 1 | V _{DD} | Power Supply Input |
| 2 | GND | Ground |
| 3 | OUTPUT | Output Pin |

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 | Rating | 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-3L | 230 |
| T _s | Storage Temperature Range | -65 to +150 | °C |
| T _J | Maximum Junction Temperature | +150 | °C |
| ESD HBM | Human Body Model ESD capability | 6 | kV |

- Notes:
- 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.
 - 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.

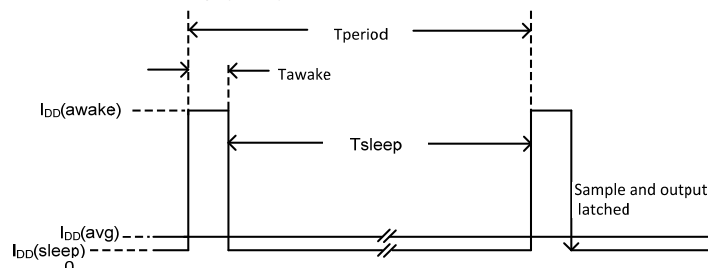
Recommended Operating Conditions (@T_A = +25°C, unless otherwise specified.)

| Symbol | Parameter | 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 | Parameter | Conditions | Min | Typ | Max | Unit |
|------------------------|--------------------------------------|------------------------------------------------------------------------------------------|-----|-------|-----|------|
| V _{OUT_ON} | Output On Voltage (V _{OL}) | 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 to +125°C, V _{DD} = 2.5V to 5.5V | — | — | 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 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 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:
- When power is initially turned on, the operating V_{DD} must be within its correct operating range (2.5V to 5.5V) to guaranteed the output sampling. The output state is valid after the second operating cycle (typical 150ms).

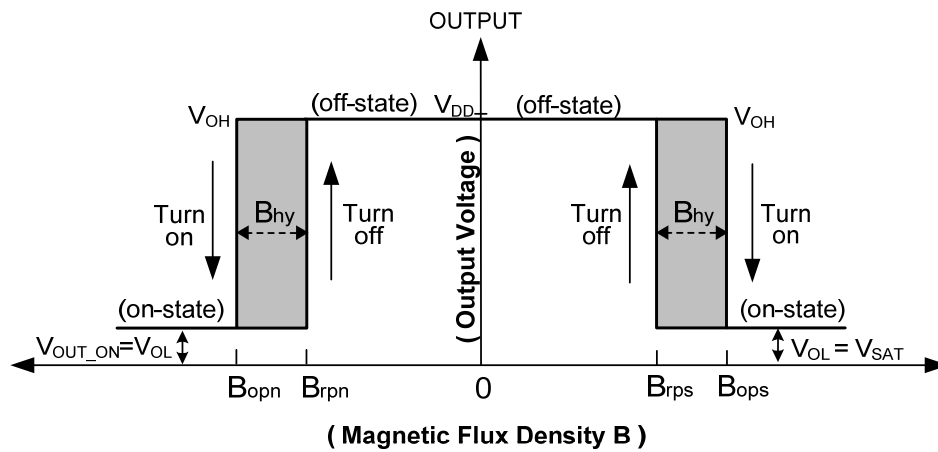


Magnetic Characteristics (Note 9 & 10) ($T_A = +25^\circ\text{C}$, $V_{DD} = 2.5\text{V to } 5.5\text{V}$, unless otherwise specified)

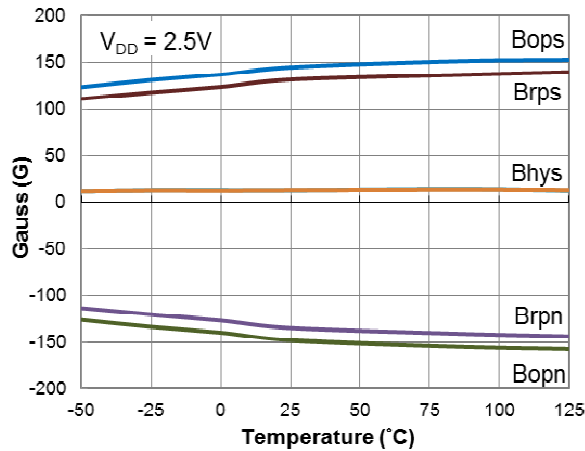
(1mT=10 Gauss)

| Symbol | Characteristics | Test Condition | Min | Typ | Max | Unit |
|----------------------------------------|----------------------|--------------------------------------------------|------|------|------|-------|
| Bops (south pole to part marking side) | Operation Point | $T_A = +25^\circ\text{C}$ | 100 | 130 | 165 | Gauss |
| | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | 90 | 130 | 185 | |
| Bopn (north pole to part marking side) | | $T_A = +25^\circ\text{C}$ | -165 | -130 | -100 | |
| | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | -185 | -130 | -90 | |
| Brps (south pole to part marking side) | Release Point | $T_A = +25^\circ\text{C}$ | 90 | 115 | 150 | |
| | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | 80 | 115 | 170 | |
| Brpn (north pole to part marking side) | | $T_A = +25^\circ\text{C}$ | -150 | -115 | -90 | |
| | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | -170 | -115 | -80 | |
| Bhy ($ B_{opx} - B_{rpx} $) | Hysteresis (Note 11) | $T_A = +25^\circ\text{C}$ | 10 | 15 | 20 | |
| | | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ | 5 | 15 | — | |

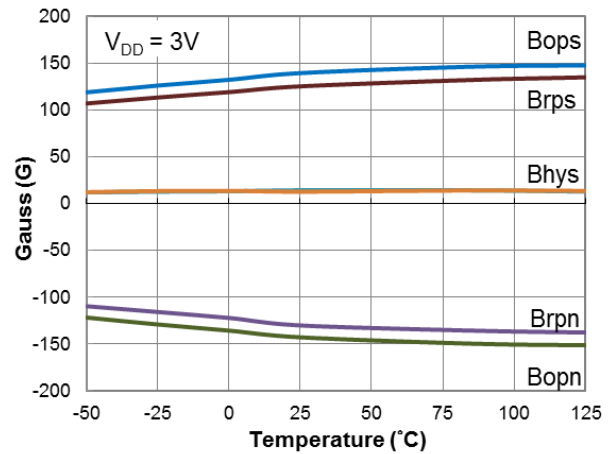
- Notes:
- Typical data is at $T_A = +25^\circ\text{C}$, $V_{DD} = 3\text{V}$.
 - Parameters values over operating temperature range are not tested in production, they are guaranteed by design, process control and characterization. The magnetic characteristics may vary with supply voltage, operating temperature and after soldering.
 - Maximum and minimum hysteresis is guaranteed by design and characterization.



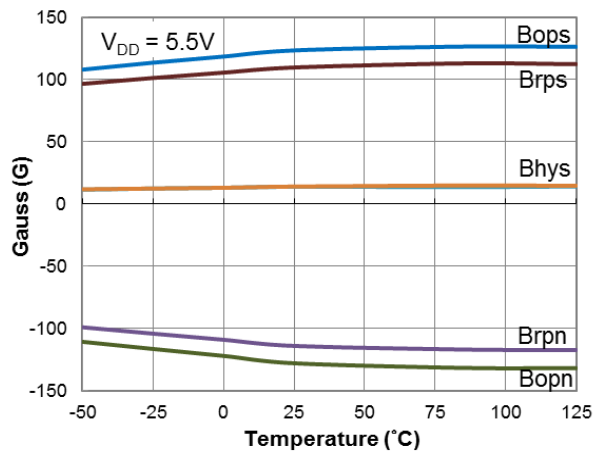
Typical Operating Characteristics



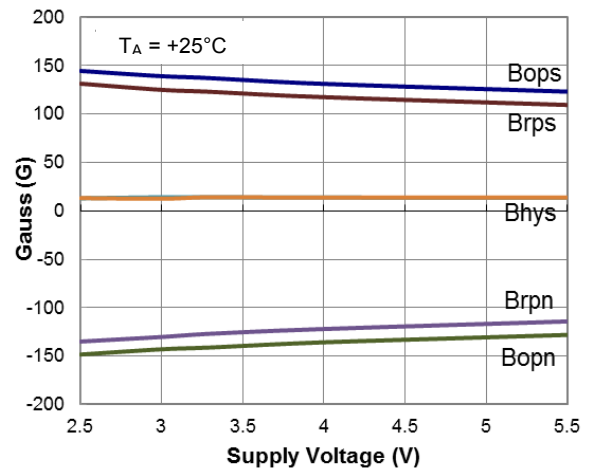
Switch Points vs Temperature



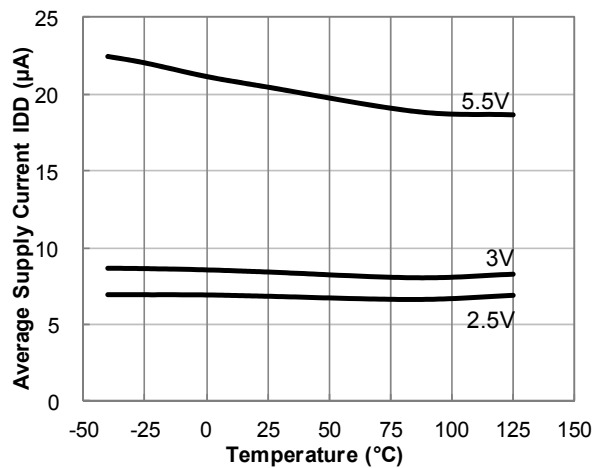
Switch Points vs Temperature



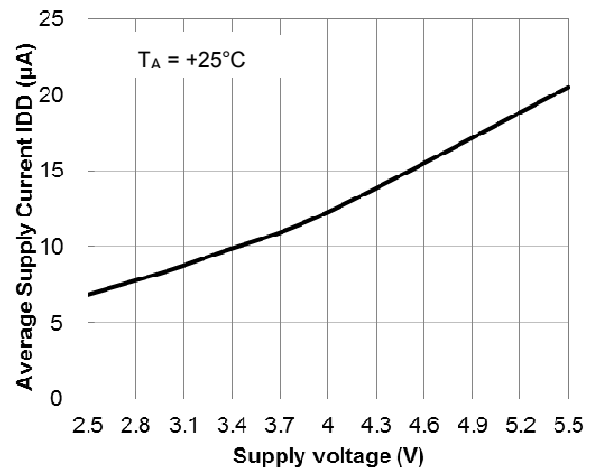
Switch Points vs Temperature



Switch Points vs Supply Voltage



Average Supply Current vs. Temperature

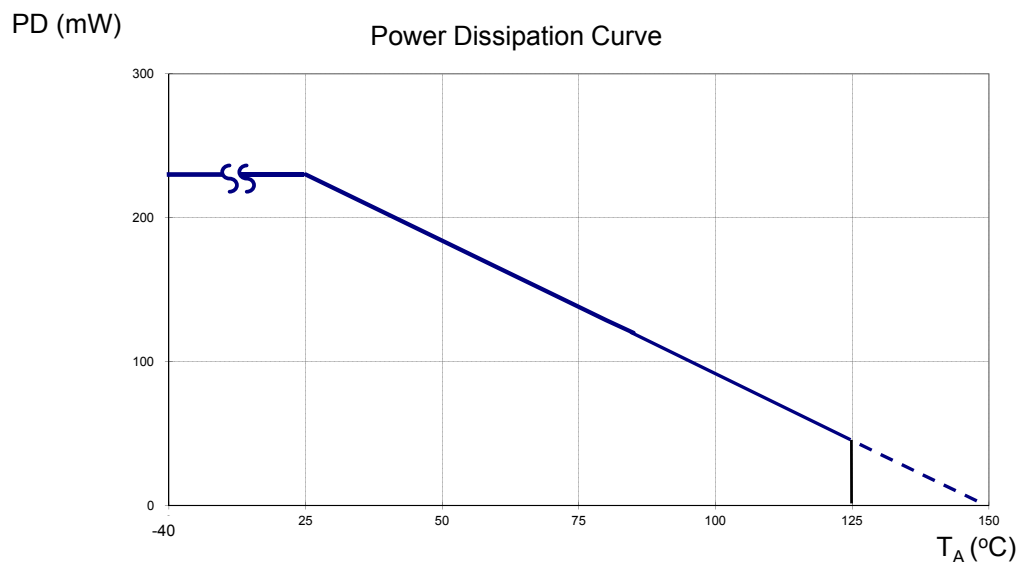


Average Supply Current vs. Supply Voltage

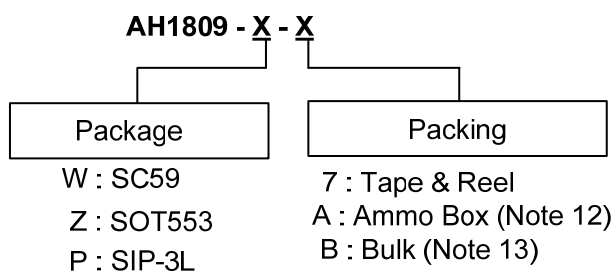
Thermal Performance Characteristics

(1) Package type: SC59, SOT553 and SIP-3L

| 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



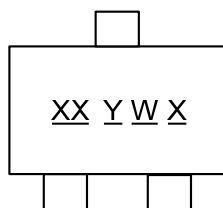
| Part Number | Package Code | Packaging | Bulk | | 7" Tape and Reel | | Ammo Box | |
|-------------|--------------|-----------|----------|--------------------|------------------|--------------------|----------|--------------------|
| | | | Quantity | Part Number Suffix | Quantity | Part Number Suffix | Quantity | Part Number Suffix |
| AH1809-W-7 | Z | SC59 | NA | NA | 3000/Tape & Reel | -7 | NA | NA |
| AH1809-Z-7 | Z | SOT553 | NA | NA | 3000/Tape & Reel | -7 | NA | NA |
| AH1809-P-B | P | SIP-3L | 1000 | -B | NA | NA | NA | NA |
| AH1809-P-A | P | SIP-3L | NA | NA | NA | NA | -A | 4000/Box |

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

Marking Information

(1) Package Type: SC59

(Top View)

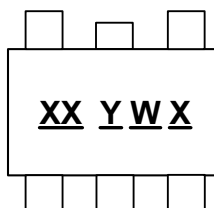


XX : Identification code
Y : Year 0 to 9
W : Week : A to Z : 1 to 26 week;
a to z : 27 to 52 week; z represents
52 and 53 week
X : Internal Code

| Part Number | Package | Identification Code |
|-------------|---------|---------------------|
| AH1809 | SC59 | F9 |

(2) Package Type: SOT553

(Top View)

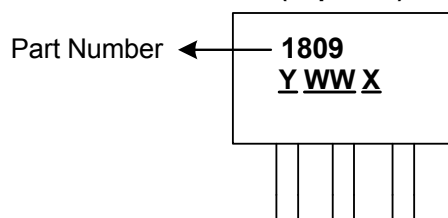


XX : Identification Code
Y : Year : 0 to 9
W : Week : A to Z : 1~26 week;
a to z : 27~52 week; z represents
52 and 53 week
X : Internal code

| Part Number | Package | Identification Code |
|-------------|---------|---------------------|
| AH1809 | SOT553 | H9 |

(3) Package Type: SIP-3L

(Top View)

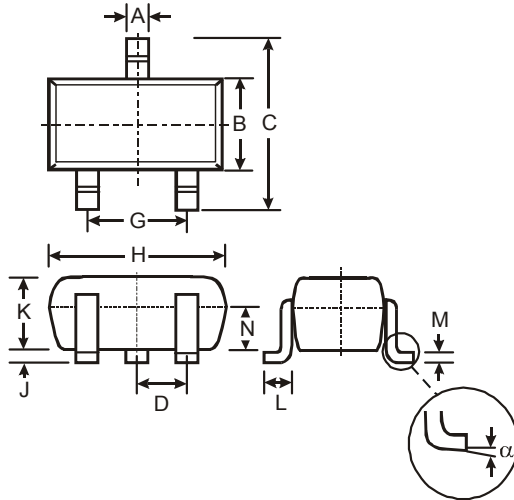


Y : Year : 0~9
WW : Week : 01~52, "52" represents
52 and 53 week
X : Internal Code

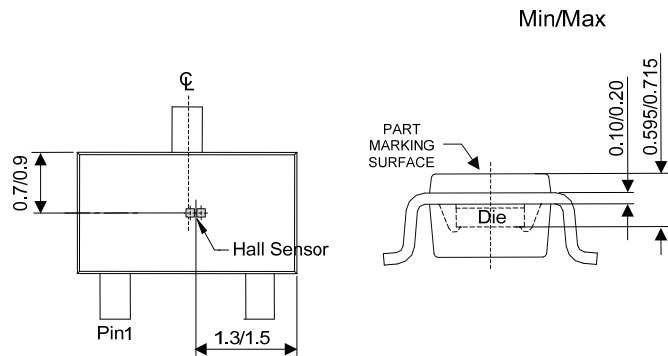
Package Outline Dimensions (All dimensions in mm.)

Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for 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 | | | |

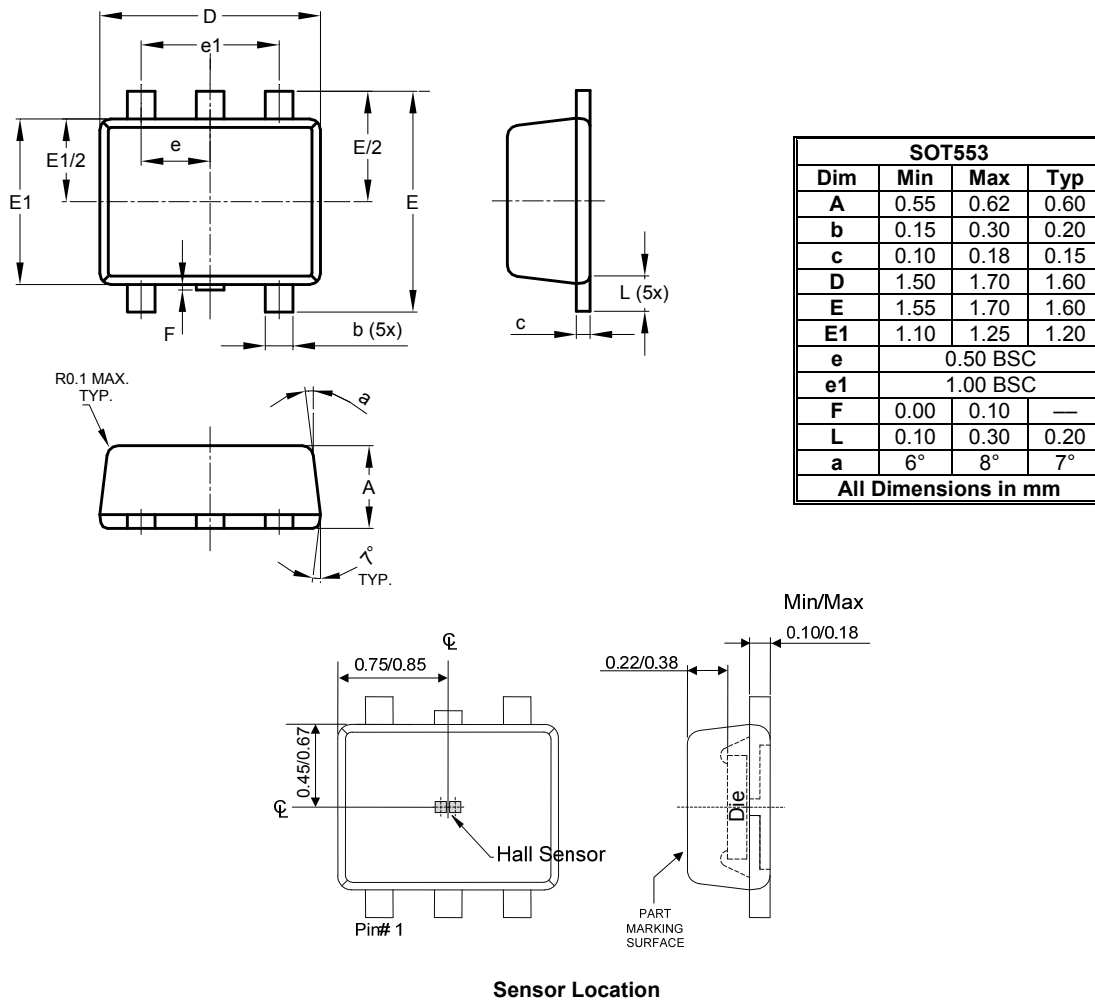


Sensor Location

Package Outline Dimensions (All dimensions in mm.)

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

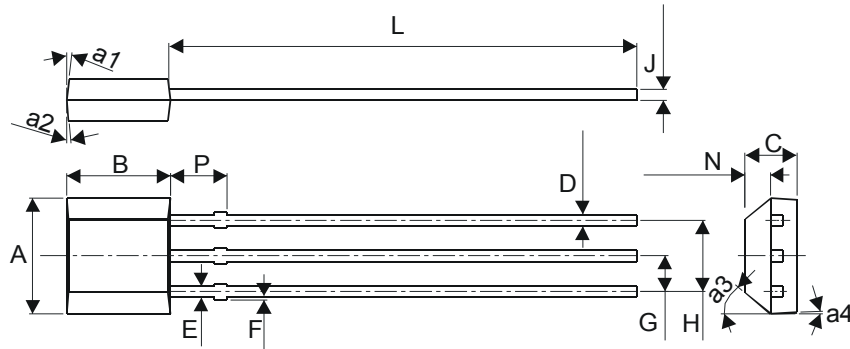
(2) Package Type: SOT553



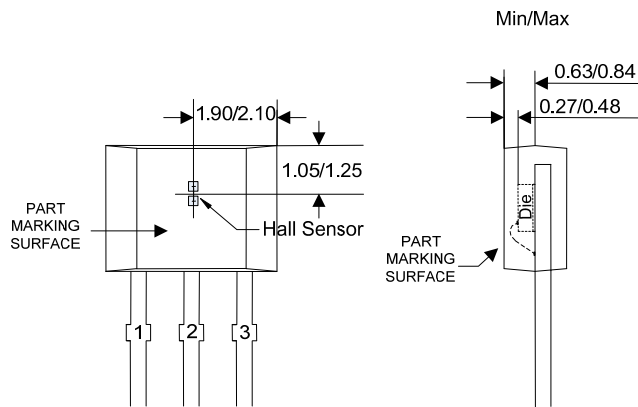
Package Outline Dimensions (cont.) (All dimensions in mm.)

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

(3) Package Type: SIP-3L for Bulk Pack



| SIP-3 for 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 | | |

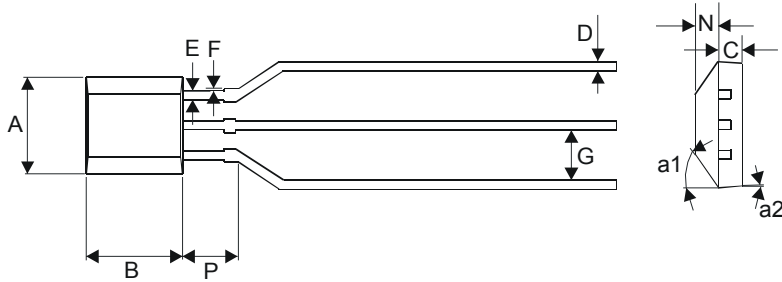


Sensor location

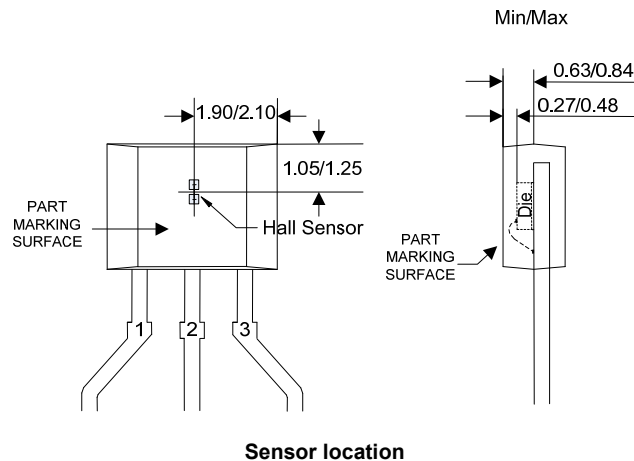
Package Outline Dimensions (cont.) (All dimensions in mm.)

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

(4) Package Type: SIP-3L for Ammo Pack



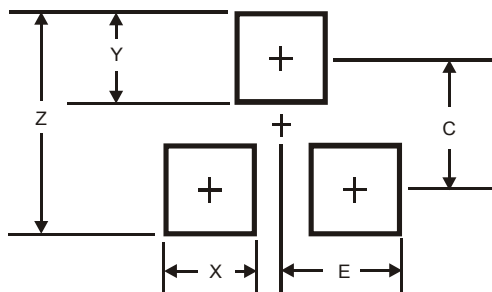
| SIP-3 for Ammo Pack only | | |
|-----------------------------|---------|------|
| Dim | Min | Max |
| A | 3.9 | 4.3 |
| a1 | 45° Typ | |
| a2 | 3° Typ | |
| B | 2.8 | 3.2 |
| C | 1.40 | 1.60 |
| D | 0.35 | 0.41 |
| E | 0.43 | 0.48 |
| F | 0 | 0.2 |
| G | 2.4 | 2.9 |
| N | 0.63 | 0.84 |
| P | 1.55 |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



Suggested Pad Layout

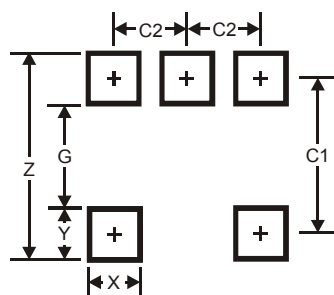
Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.

(1) Package Type: SC59



| Dimensions | Value (in mm) |
|------------|---------------|
| Z | 3.4 |
| X | 0.8 |
| Y | 1 |
| 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 |

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