

# TSH251

## Micropower CMOS Output Hall Effect Switch

### TO-92S



#### Pin Definition:

1. V<sub>CC</sub>
2. GND
3. Output

### TSOT-23



#### Pin Definition:

1. V<sub>CC</sub>
2. Output
3. GND

## Description

TSH251 Hall-effect sensor is a temperature stable, stress-resistant, Low Tolerance of Sensitivity micro-power switch. Superior high-temperature performance is made possible through a dynamic offset cancellation that utilizes chopper-stabilization. This method reduces the offset voltage normally caused by device over molding, temperature dependencies, and thermal stress. TSH251 is special made for low operation voltage at 1.65V, to active the chip which includes the following on a single silicon chip: voltage regulator, Hall voltage generator, small-signal amplifier, chopper stabilization, Schmitt trigger, CMOS output driver. Advanced CMOS wafer fabrication processing is used to take advantage of low-voltage requirements, component matching, very low input-offset errors, This device requires the presence of omni-polar magnetic fields for operation.

## Features

- CMOS Hall IC Technology
- Strong RF noise protection
- 1.65 to 3.5V for battery-powered applications
- Omni polar, output switches with absolute value of North or South pole from magnet
- Operation down to 1.65V, micropower consumption
- High Sensitivity for reed switch replacement applications
- Low sensitivity drift in crossing of Temp. range
- Ultra Low power consumption at 5μA (avg.)
- High ESD Protection, HBM > ±4KV( min )
- Totem-pole output

## Ordering Information

| Part No.     | Package | Packing          |
|--------------|---------|------------------|
| TSH251CT B0G | TO-92S  | 1kpcs / Bulk Bag |
| TSH251CX RFG | TSOT-23 | 3kpcs / 7" Reel  |

**Note:** "G" denote for Halogen Free Product

## Application

- Solid state switch, Water Meter, Floating Meter
- Handheld Wireless Handset Awake Switch (Flip Cell/PHS Phone/Note Book/Flip Video Set)
- Lid close sensor for battery powered devices
- Magnet proximity sensor for reed switch replacement in low duty cycle applications

## Absolute Maximum Ratings (T<sub>A</sub>=25°C unless otherwise noted)

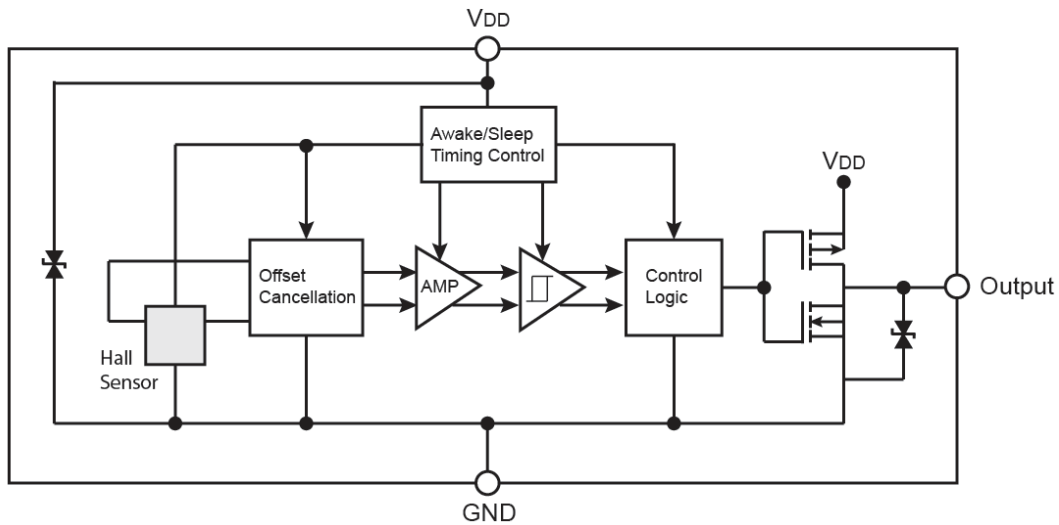
| Characteristics                          | Limit               | Value       | Unit  |
|------------------------------------------|---------------------|-------------|-------|
| Supply voltage                           | V <sub>DD</sub>     | 4.5         | V     |
| Output Voltage                           | V <sub>OUT</sub>    | 4.5         | V     |
| Reverse Voltage                          | V <sub>DD/OUT</sub> | -0.3        | V     |
| Magnetic flux density                    |                     | Unlimited   | Gauss |
| Output current                           | I <sub>OUT</sub>    | 1           | mA    |
| Operating temperature range              | T <sub>OPR</sub>    | -40 to +85  | °C    |
| Storage temperature range                | T <sub>STG</sub>    | -65 to +150 | °C    |
| Maximum Junction Temp                    | T <sub>J</sub>      | 150         | °C    |
| Thermal Resistance - Junction to Ambient | TO-92S              | 206         | °C/W  |
|                                          | TSOT-23             | 543         |       |
| Thermal Resistance - Junction to Case    | TO-92S              | 148         | °C/W  |
|                                          | TSOT-23             | 410         |       |
| Package Power Dissipation                | TO-92S              | 606         | mW    |
|                                          | TSOT-23             | 230         |       |

**Note:** Exceeding the absolute maximum ratings may cause permanent damage. Exposure to absolute maximum-rated conditions for extended periods may affect device reliability.

# TSH251

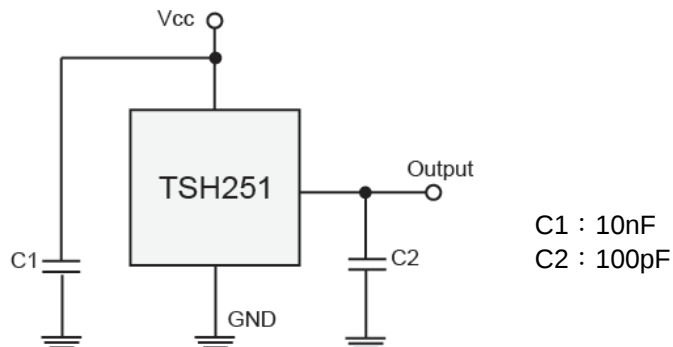
## Micropower CMOS Output Hall Effect Switch

### Block Diagram



**Note:** Static sensitive device; please observe ESD precautions. Reverse  $V_{DD}$  protection is not included. For reverse voltage protection, a 100 $\Omega$  resistor in series with  $V_{DD}$  is recommended.

### Typical Application Circuit



### Electrical Specifications (DC Operating Parameters: $T_A=+25^{\circ}\text{C}$ , $V_{DD}=1.8\text{V}$ )

| Parameters               | Test Conditions                       | Min          | Typ | Max | Units         |
|--------------------------|---------------------------------------|--------------|-----|-----|---------------|
| Supply Voltage           | Operating                             | 1.65         | --  | 3.5 | V             |
| Supply Current           | Awake State                           | --           | 1.4 | 3   | mA            |
|                          | Sleep State                           | --           | 3.6 | 7   | $\mu\text{A}$ |
|                          | Average                               | --           | 5   | 10  | $\mu\text{A}$ |
| Output Leakage Current   | Output off                            | --           | --  | 1   | $\mu\text{A}$ |
| Output High Voltage      | $I_{OUT}=0.5\text{mA}(\text{Source})$ | $V_{DD}-0.2$ | --  | --  | V             |
| Output Low Voltage       | $I_{OUT}=0.5\text{mA}(\text{Sink})$   | --           | --  | 0.2 | V             |
| Awake mode time          | Operating                             | --           | 40  | 80  | $\mu\text{s}$ |
| Sleep mode time          | Operating                             | --           | 40  | 80  | ms            |
| Duty Cycle               |                                       | --           | 0.1 | --  | %             |
| Electro-Static Discharge | HBM                                   | 4            | --  | --  | KV            |

### Magnetic Specifications (TSH251CT)

| Parameter       | Symbol           | Test Conditions                                                    | Min. | Typ. | Max. | Units |
|-----------------|------------------|--------------------------------------------------------------------|------|------|------|-------|
| Operating Point | B <sub>OPS</sub> | S pole to branded side, B > B <sub>OP</sub> , V <sub>OUT</sub> On  | --   | 30   | 55   | Gauss |
|                 | B <sub>OPN</sub> | N pole to branded side, B > B <sub>OP</sub> , V <sub>OUT</sub> On  | -55  | -30  | --   | Gauss |
| Release Point   | B <sub>RPS</sub> | S pole to branded side, B < B <sub>RP</sub> , V <sub>OUT</sub> Off | 10   | 20   | --   | Gauss |
|                 | B <sub>RPN</sub> | N pole to branded side, B < B <sub>RP</sub> , V <sub>OUT</sub> Off | --   | -20  | -10  | Gauss |
| Hysteresis      | B <sub>HYS</sub> | B <sub>OPX</sub> - B <sub>RPX</sub>                                | --   | 10   | --   | Gauss |

Note: 1G (Gauss) = 0.1mT (millitesta)

### Magnetic Specifications (TSH251CX)

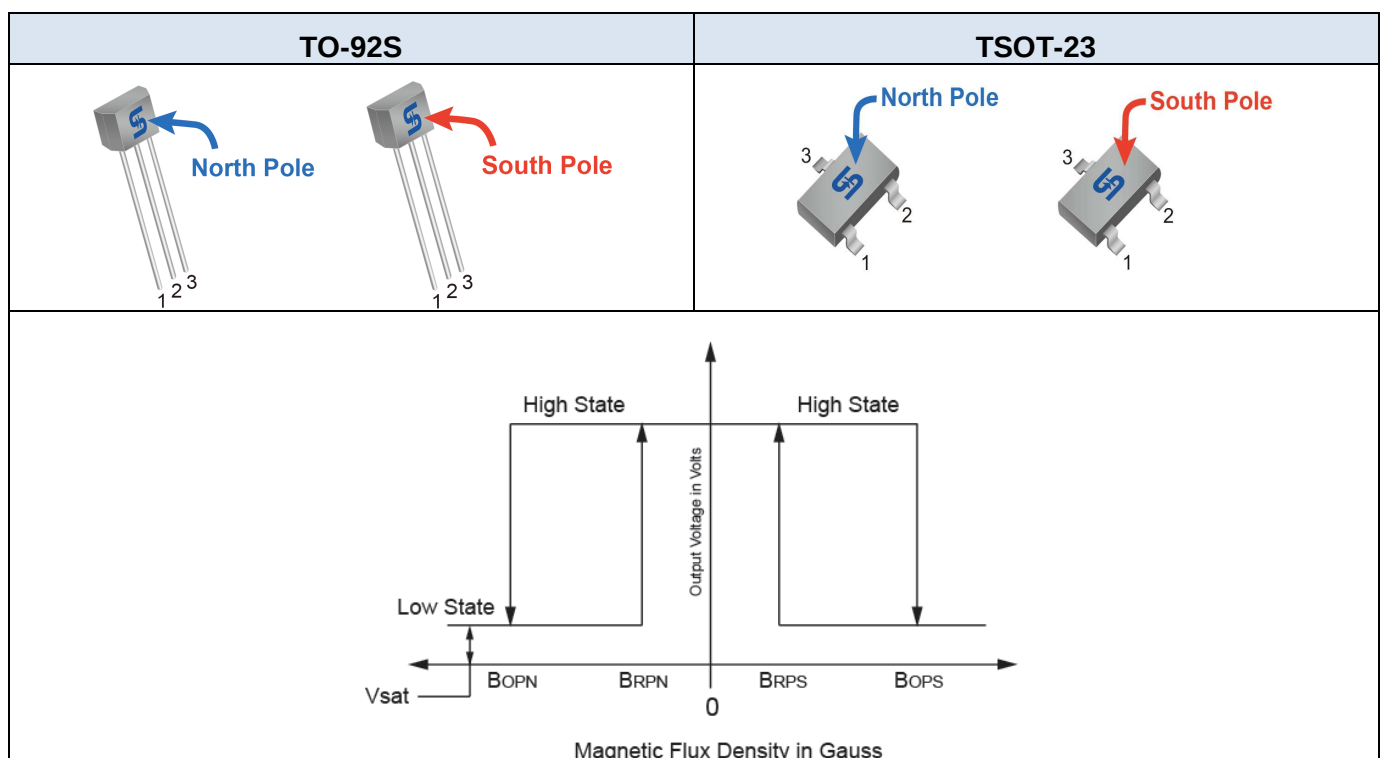
| Parameter       | Symbol           | Test Conditions                                                    | Min. | Typ. | Max. | Units |
|-----------------|------------------|--------------------------------------------------------------------|------|------|------|-------|
| Operating Point | B <sub>OPS</sub> | N pole to branded side, B > B <sub>OP</sub> , V <sub>OUT</sub> On  | --   | 30   | 55   | Gauss |
|                 | B <sub>OPN</sub> | S pole to branded side, B > B <sub>OP</sub> , V <sub>OUT</sub> On  | -55  | -30  | --   | Gauss |
| Release Point   | B <sub>RPS</sub> | N pole to branded side, B < B <sub>RP</sub> , V <sub>OUT</sub> Off | 10   | 20   | --   | Gauss |
|                 | B <sub>RPN</sub> | S pole to branded side, B < B <sub>RP</sub> , V <sub>OUT</sub> Off | --   | -20  | -10  | Gauss |
| Hysteresis      | B <sub>HYS</sub> | B <sub>OPX</sub> - B <sub>RPX</sub>                                | --   | 10   | --   | Gauss |

Note: 1G (Gauss) = 0.1mT (millitesta)

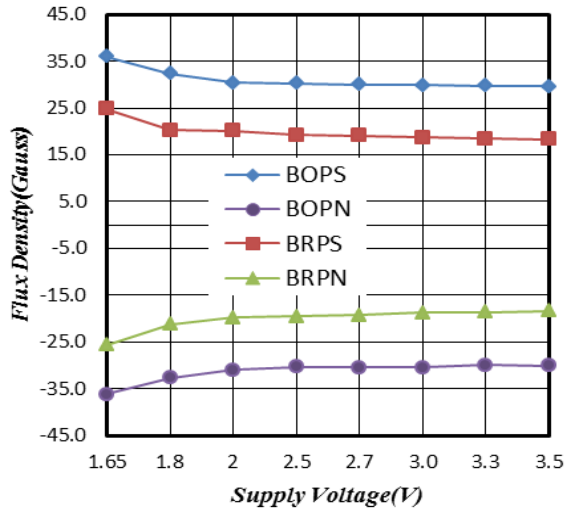
### Output Behavior versus Magnetic Pole

DC Operating Parameters: T<sub>A</sub> = -40 to 125°C, V<sub>CC</sub> = 1.8V ~ 6V

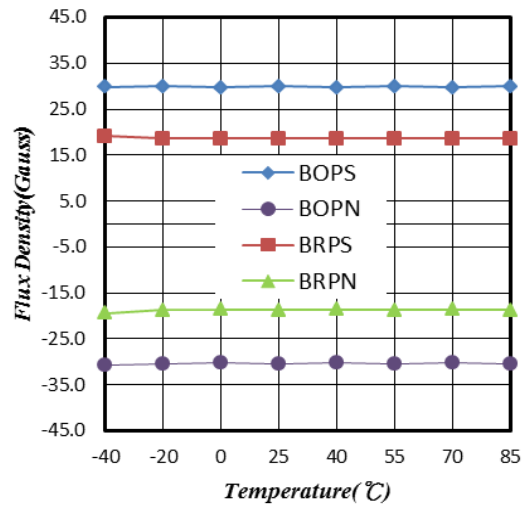
| Parameter                   | Test condition                      | OUT  |
|-----------------------------|-------------------------------------|------|
| South pole                  | B < B <sub>op</sub> [(-55) ~ (-10)] | Low  |
| Null or weak magnetic field | B = 0 or B < B <sub>RP</sub>        | High |
| North pole                  | B > B <sub>op</sub> (55 ~ 10)       | Low  |



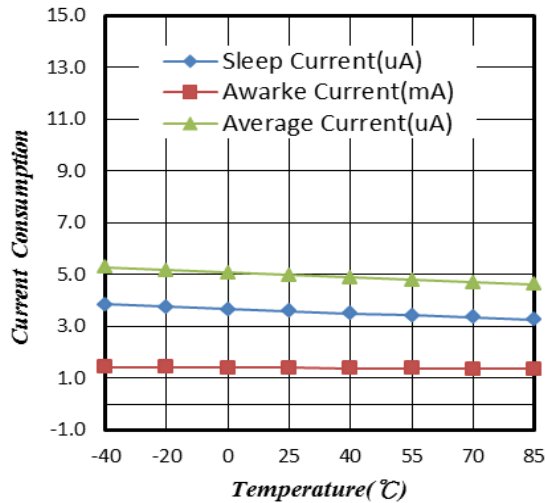
### Characteristic Performance



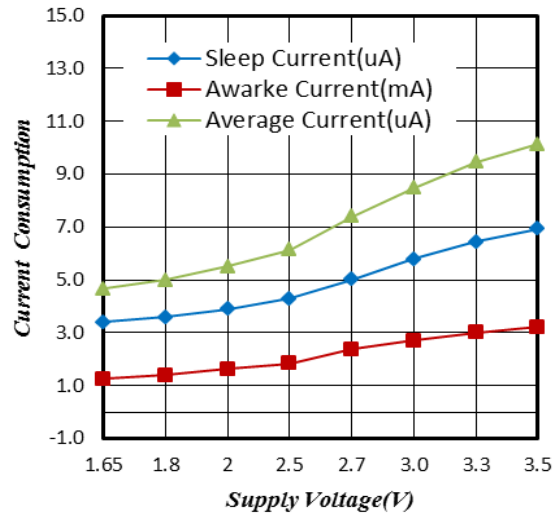
**Figure 1. Supply Voltage vs. Flux Density**



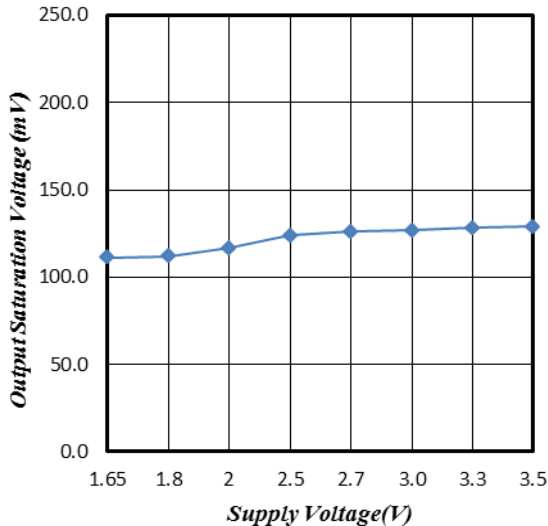
**Figure 2. Temperature vs. Flux Density**



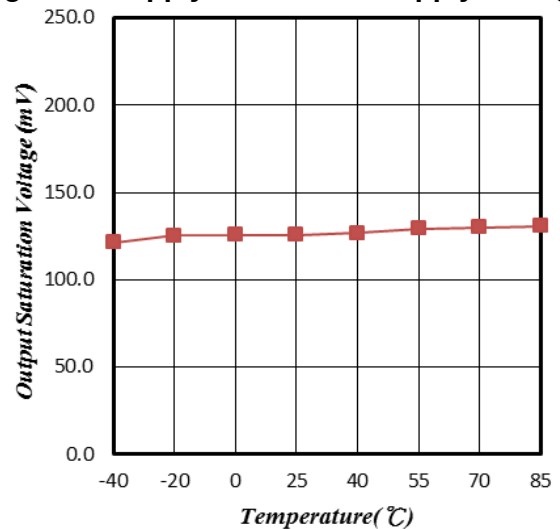
**Figure 3. Supply Current vs. Temperature**



**Figure 4. Supply Current vs. Supply Voltage**



**Figure 5. Output Saturation Voltage vs. Supply Voltage**



**Figure 6. Output Saturation Voltage vs. Temperature**

## Characteristic Performance

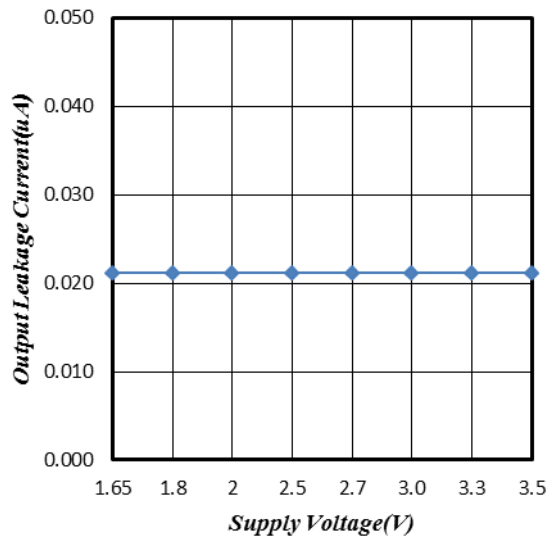


Figure 7. Output Leakage Current vs. Supply Voltage

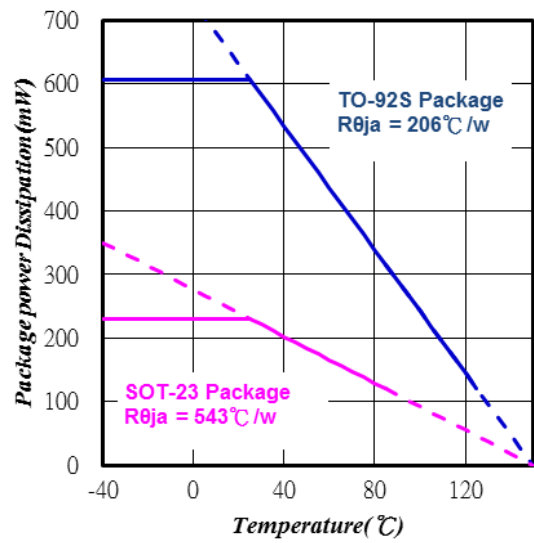
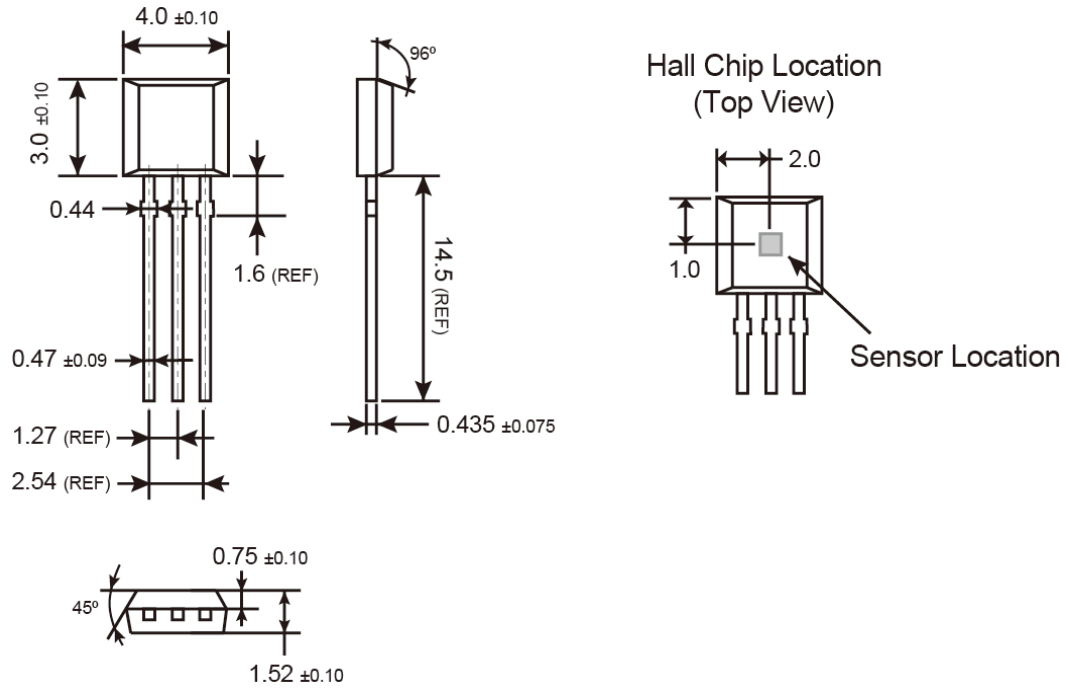


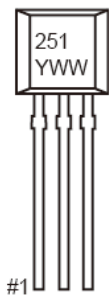
Figure 8. Power Dissipation vs. Temperature

## TO-92S Mechanical Drawing



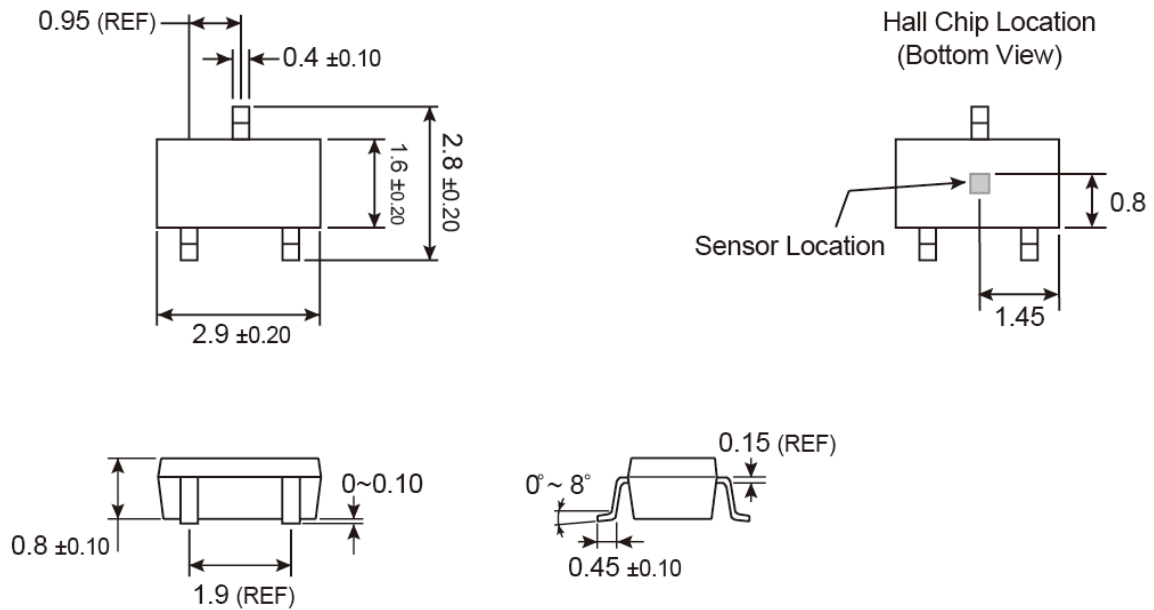
Unit: Millimeters

## Marking Diagram



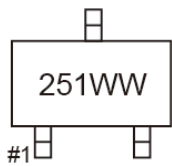
**251** = Device Code  
**Y** = Year Code (4=2014, 5=2015....)  
**WW** = Week Code (01~52)

## TSOT-23 Mechanical Drawing



Unit: Millimeters

## Marking Diagram



**251** = Device Code

**WW** = Week Code Table

|      |    |    |    |    |    |    |    |    |    |    |    |    |    |
|------|----|----|----|----|----|----|----|----|----|----|----|----|----|
| week | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 |
| code | QA | QB | QC | QD | QE | QF | QG | QH | QI | QJ | QK | QL | QM |
| week | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| code | QN | QO | QP | QQ | QR | QS | QT | QU | QV | QW | QX | QY | QZ |
| week | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |
| code | RA | RB | RC | RD | RE | RF | RG | RH | RI | RJ | RK | RL | RM |
| week | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 |
| code | RN | RO | RR | RO | RR | RS | RT | RU | RV | RW | RX | RY | RZ |

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## Micropower CMOS Output Hall Effect Switch

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