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EM6011
Hall Effect Latch

1. General Description

The EM6011 is a Hall effect latch which detects magnetic field. The output is switched according to the magnetic field applied to the device.

2. Features

- ☐ Supply Voltage: 3.8 to 24V
- ☐ Operation Temperature: −40 to 150ºC
- ☐ Sensitivity: ±2.0mT(Typ.), ±3.0mT(Max.)
- ☐ Output: N-MOS Open Drain Output
- ☐ Reverse Battery Protection
- ☐ Package: 3-pin SOP Type
  (Small Package size, RoHS Compliant, Halogen free)

3. Table of Contents

4. Block Diagram and Functions

4.1. Block Diagram

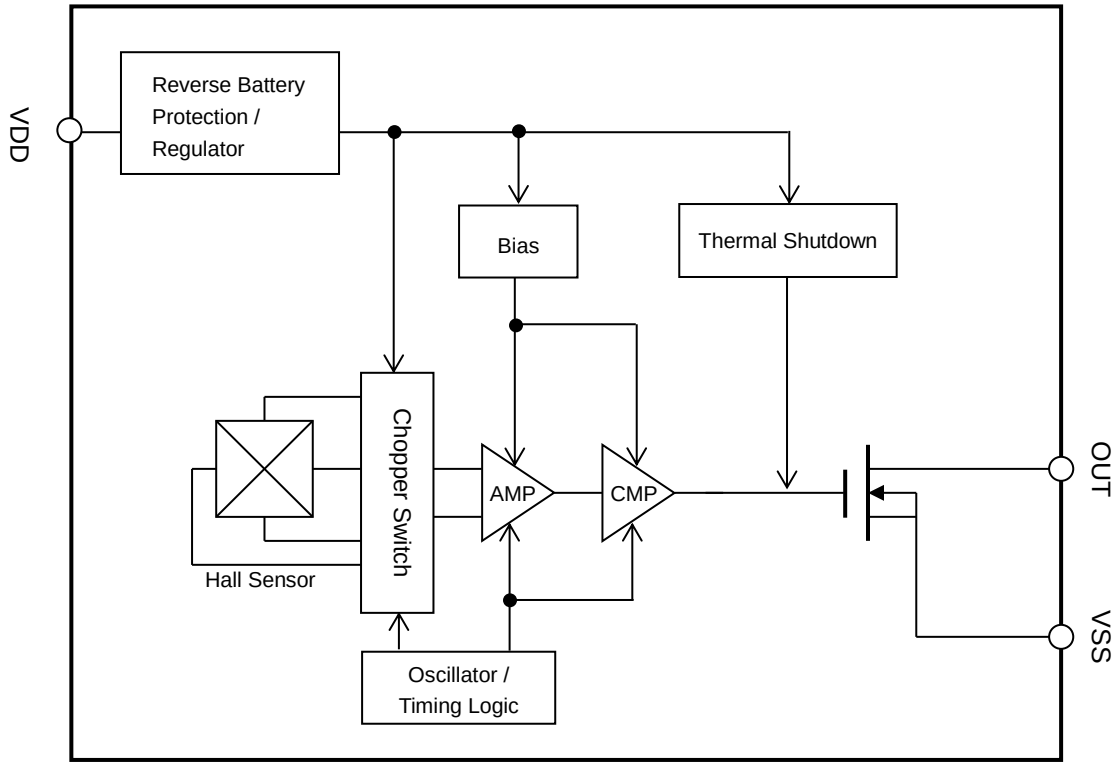


Figure 1. EM6011 Block Diagram

4.2. Functions

Table 1. Circuit configuration

Block Name	Function
Hall Sensor	Hall element fabricated by CMOS process.
Chopper Switch	Hall sensor drive switch. Perform chopping in order to cancel the offset of Hall sensor.
Reverse Battery Protection	To protect the IC from reverse-voltage (VDD pin)
Regulator	Generate internal operating voltage.
Bias	Generate bias current to internal circuits.
AMP	Amplify Hall sensor output voltage with summation and subtraction circuit.
CMP	Hysteresis comparator.
Oscillator	Generate operational clock.
Timing Logic	Generate timing signal for internal circuits.
Thermal Shutdown	Turn the output off when a measured temperature is beyond the specific value.

5. Pin Configurations and Functions

5.1. Pin Configurations

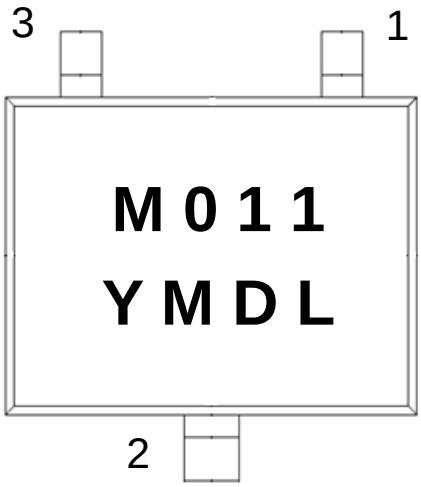


Figure 2. Pin Layout

5.2. Functions

Table 2. Description of pin name and function

Pin No.	Pin Name	I/O	Function	Description
1	VDD	–	Power Supply pin	
2	VSS	–	Ground pin (GND)	
3	OUT	O	Output pin	Open Drain

6. Absolute Maximum Ratings

Table 3. Absolute maximum ratings

Parameter	Symbol	Min.	Max.	Unit	Description
Supply voltage	V_{DD}	−30	30	V	VSS = 0V
Output voltage	V_{OUT}	−0.3	30	V	OUT pin (VSS= 0V)
Output current	I_{SINK}	−50	50	mA	OUT pin
Operating ambient temperature	Ta	−40	150	ºC	
Storage temperature	T_{STG}	−65	170	ºC	

Operation at or beyond these limits may result in permanent damage to the device. Normal operation is not guaranteed at these extremes.

7. Recommended Operating Conditions

Table 4. Recommended operating conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Description
Supply voltage	V_{DD}	3.8	12	24	V	(*1)
Output Voltage	V_{OUT}	0		24	V	
Output current	I_{SINK}	0		35	mA	
Output Load carrying capacity	C_L			100	pF	

*1. Supply voltage refers to the following.

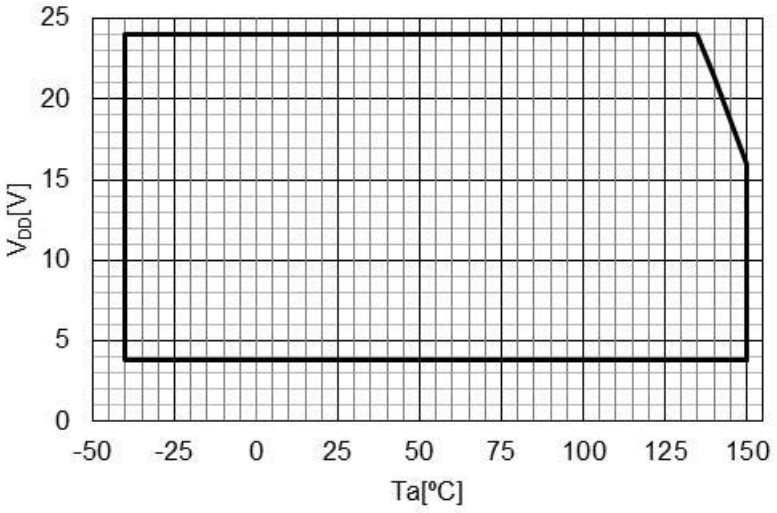


Figure 3. Supply Voltage

8. Electrical Characteristics

Table 5. Electrical characteristics at V_{DD} = 3.8 to 24V, Ta = −40 to 150ºC (Typ. Ta = 25ºC, V_{DD} = 12V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition, Note	Description
Supply current	I_{DD}		3	5	mA	Output “off” , ”on”	
Output leakage current	I_{LEAK}		0	10	μA	Output “off”	
Output saturation voltage	V_{SAT}			0.4	V	Output “on” I_{SINK}= 20mA	
Output rise time	Tr			1	μs	V_{DD} = 12V R_L = 820Ω, C_L = 20pF V_{OUT} = 10%V_{DD}~90%V_{DD}	
Output fall time	Tf			1	μs	V_{DD} = 12V R_L = 820Ω, C_L = 20pF V_{OUT} = 90%V_{DD}~10%V_{DD}	
Revers supply current	IR_{DD}			−0.1	mA	V_{DD} = −30V	
Output Refresh Period	To		8.3		μs		
Output Hi-Z releasing voltage	V_{RE}		2.9		V	When power is on, output is released Hi-Z.	(*2)
Thermal-shutdown operating temp.	TSD_{ON}	185	205	225	°C	Tj of Internal temp. sensor	(*3)
Thermal-shutdown releasing temp.	TSD_{OFF}	175	195	215	°C	Tj of Internal temp. sensor	(*3)

*2. Output waveform in power on

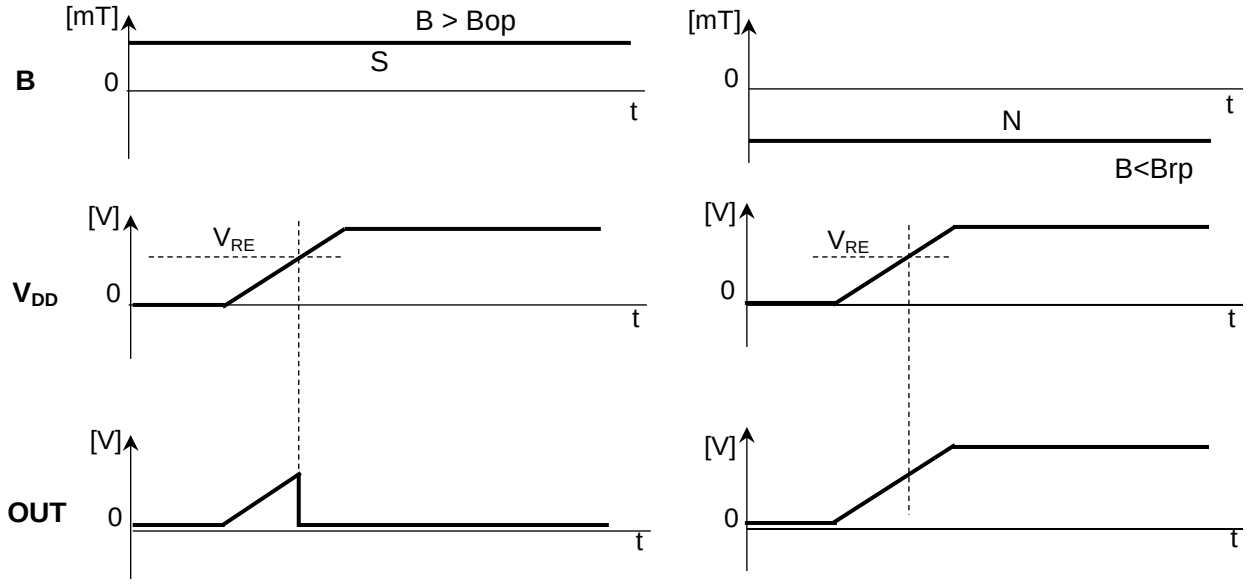


Figure 4. Output waveform in power on

*3. When Tj is beyond TSD_{ON}, the output turns off. And the output current is shut off.
When Tj is below TSD_{OFF}, the output operates by magnetic field again.

9. Magnetic Characteristics

Table 6. Magnetic characteristics at V_{DD} = 3.8 to 24V, Ta = –40 to 150ºC (Typ. Ta = 25ºC, V_{DD} = 12V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Description
Operate point	Bop	1.0	2.0	3.0	mT	
Release point	Brp	–3.0	–2.0	–1.0	mT	
Hysteresis	Bh	2.3	4.0	5.7	mT	Bh = Bop – Brp
Magnetic offset	Boff	–0.6	0.0	+0.6	mT	Boff = (Bop + Brp) / 2

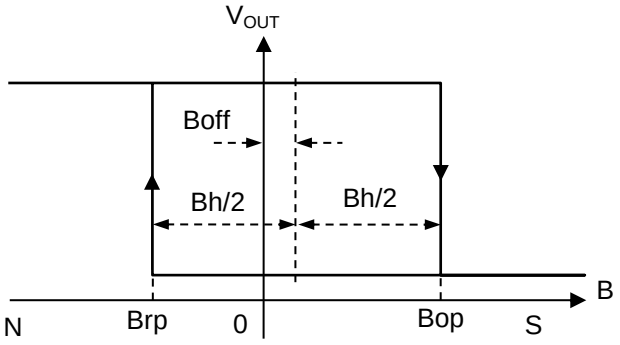


Figure 5. Magnetic Characteristics

10. Operating Characteristics

10.1. Definition of Magnetic Field

The OUT signal switches ‘L’ (ON) when the magnetic field perpendicular to the marking side of the package exceeds Bop. When the magnetic field is reduced below Brp, the OUT goes ‘H’ (OFF). In case of the magnetic field strength is greater than Brp, and smaller than Bop, OUT keeps its status.

Figure 6. Definition of magnetic field

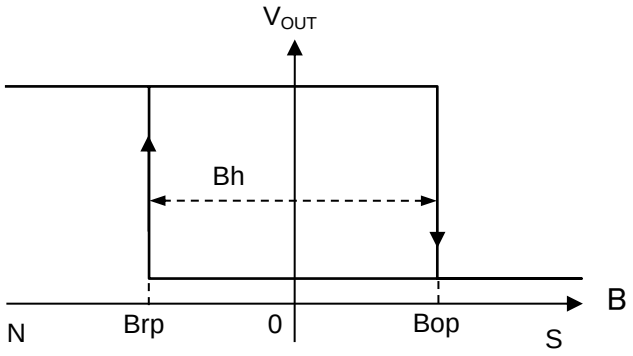


Figure 7. Switching behavior of OUT signal when magnetic field is applied

11. Recommended External Circuit

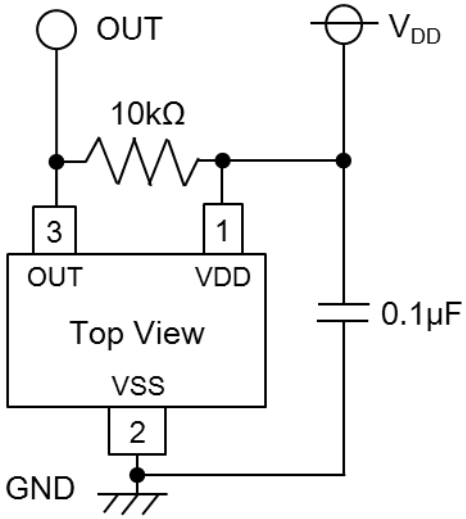
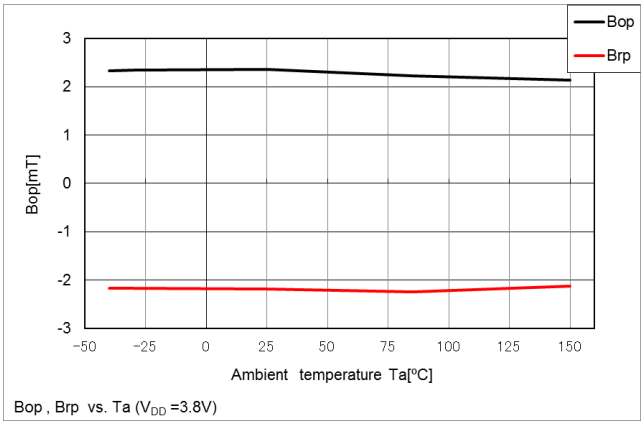
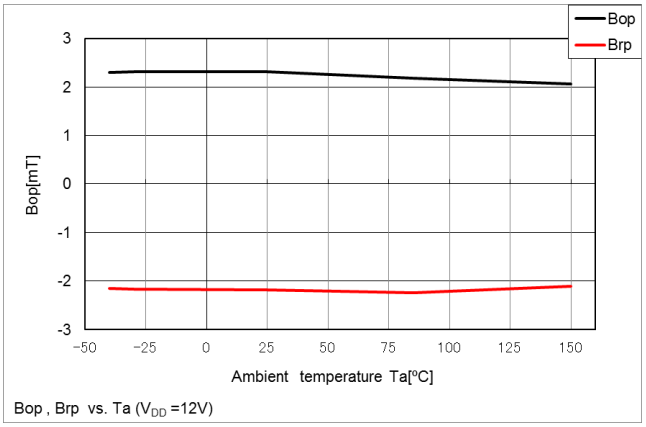


Figure 8. Recommended External Circuit

12. Typical Characteristics Data (for reference)





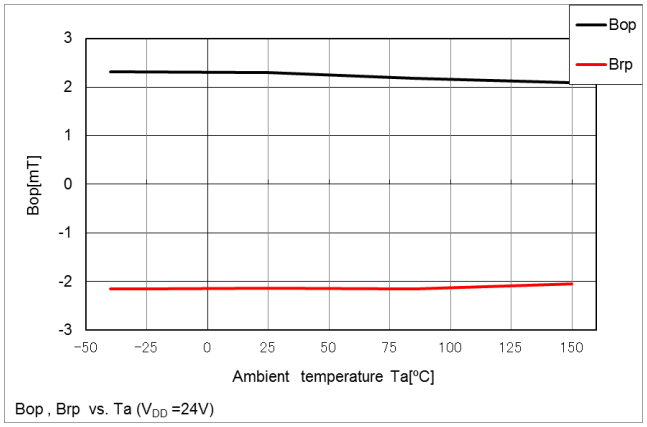


Figure 9. Temperature Dependence of Bop, Brp

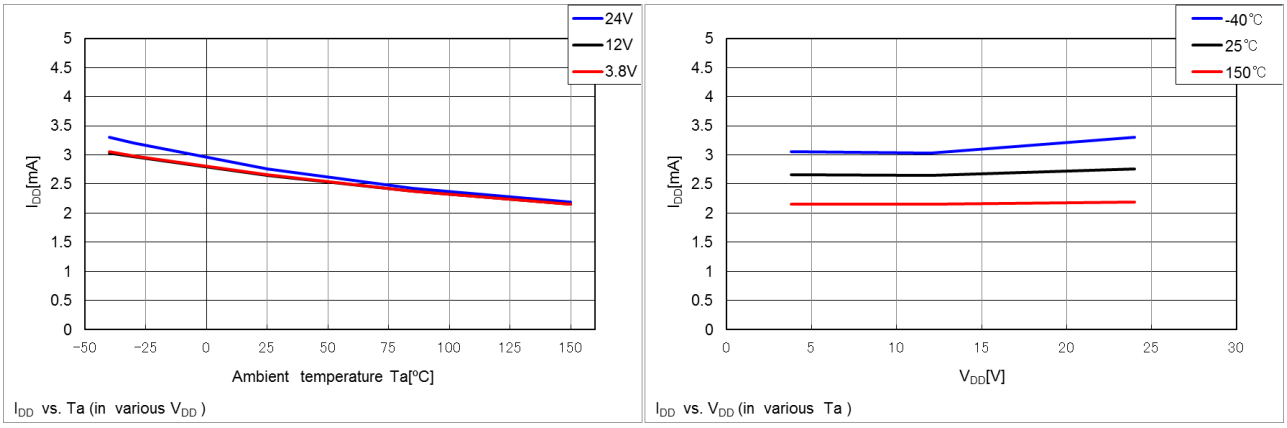


Figure 10. Temperature Dependence of Current Consumption

13. Package

13.1.Outline Dimensions

3-pin SOP (Unit: mm)

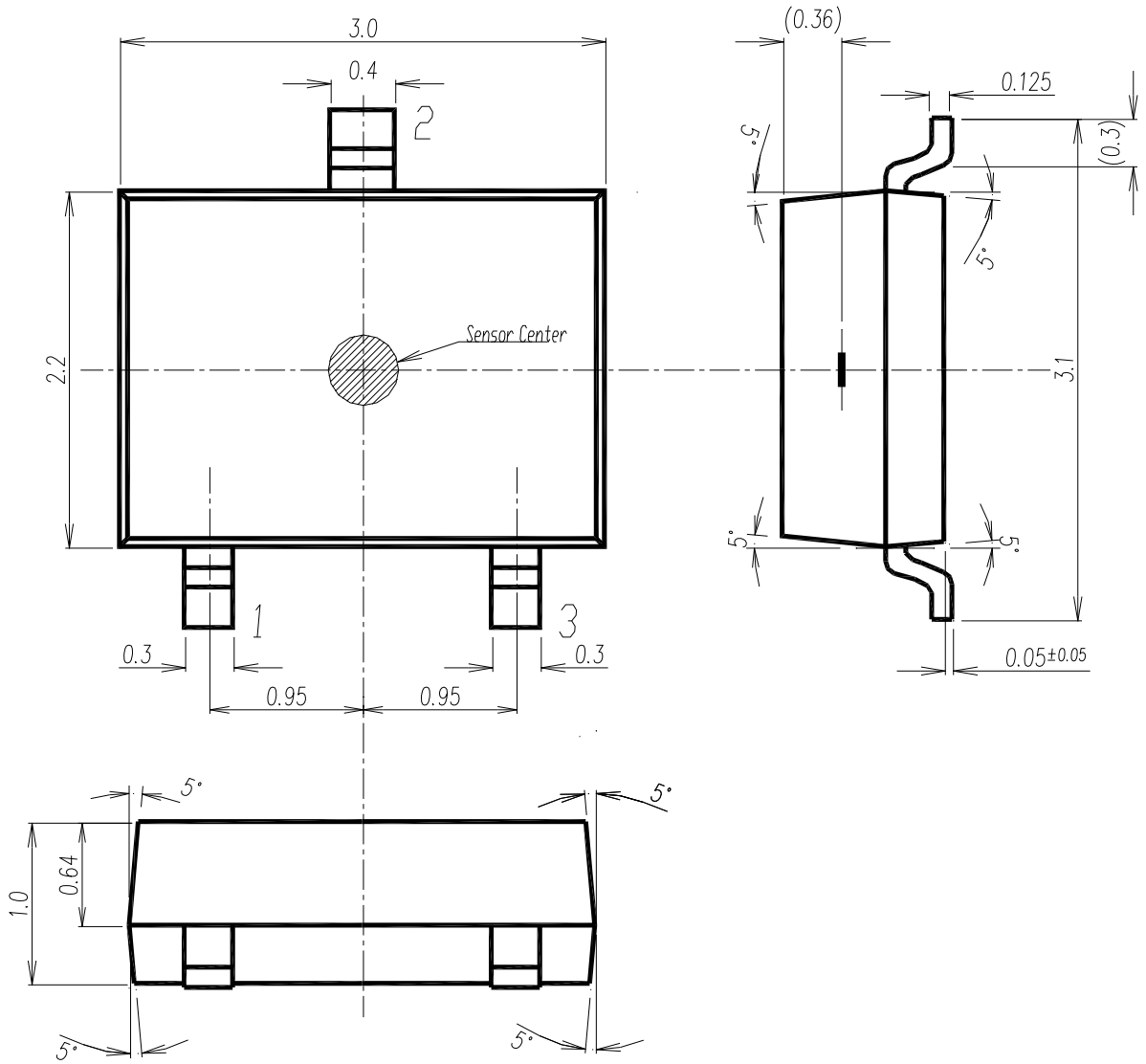


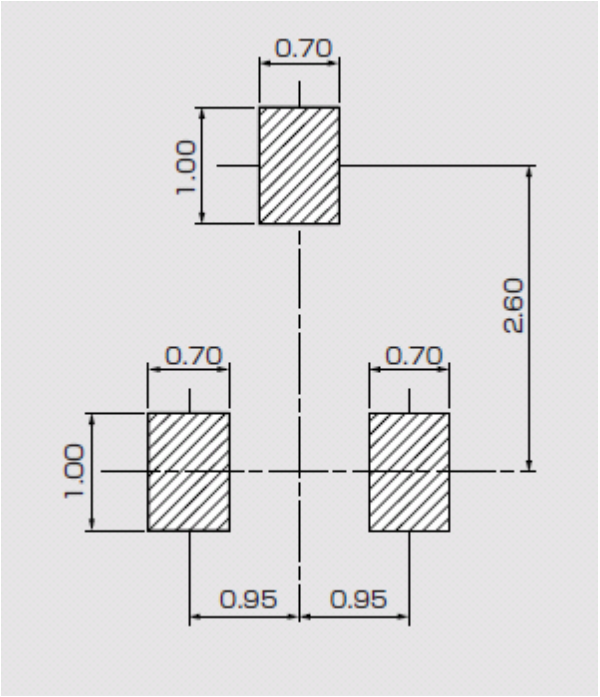
Figure 11. Outline Dimensions

* The center of the sensitive are is located within a φ0.3mm circle.
* The tolerances of dimensions with no mentions is ±0.1mm.
* Lead flatness: The standoff differences among terminals are Max. 0.1mm.
* The sensor part is located at 0.36mm (Typ.) deep from the marked surface.

13.2.Material of Terminals

Material:	Cu alloy
Plating:	Sn−2.0Bi
Thickness:	10μm (Typ.)

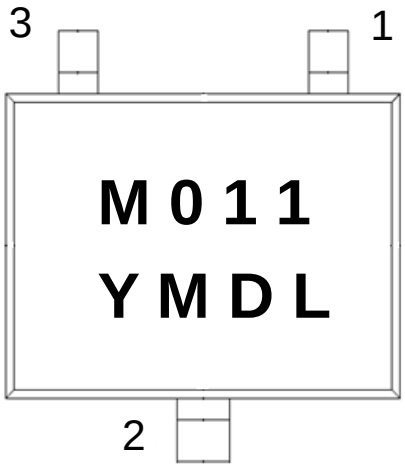
13.3.Land Pattern



(Unit: mm)

Figure 12. Land Pattern

13.4.Marking



Marking is performed by laser.

Product name M011(EM6011)
Date code YMDL
Y: Manufactured Year
M: Manufactured Month
D: Manufactured Day
L: Lot Number

Figure 13. Marking

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