# EQ-433L

Shipped in packet-tape reel(5000pcs/Reel)

EQ-433L is composed of an InAs Quantum Well Hall Element and a signal processing IC chip in a package
Notice:It is requested to read and accept "IMPORTANT NOTICE" written on the back of the front cover of this catalogue.

## ●Features

- Analog output which proportional to the magnetic field strength and pole.
- Magnetic sensitivity 20mV/mT(typ.)
- Supply voltage from 3.0V to 5.5V at single power supply
- Operating temperature range -40℃～100℃
- Ratio-metric analog output
- 3pin surface mount plastic package
- Quick response  2 $\mu$s
  (when the rise-up time of magnetic field is rather than 1$\mu$s)
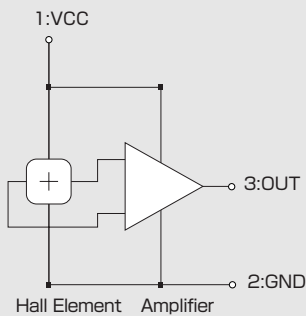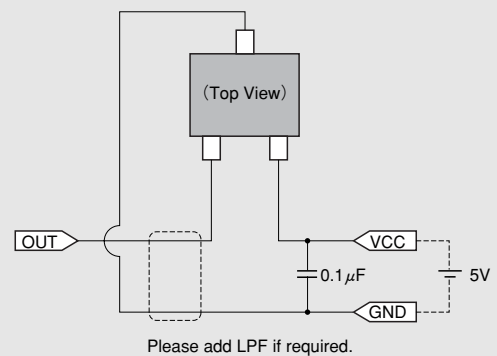- Low output noise voltage 2mVp-p



## ●Operational Characteristics
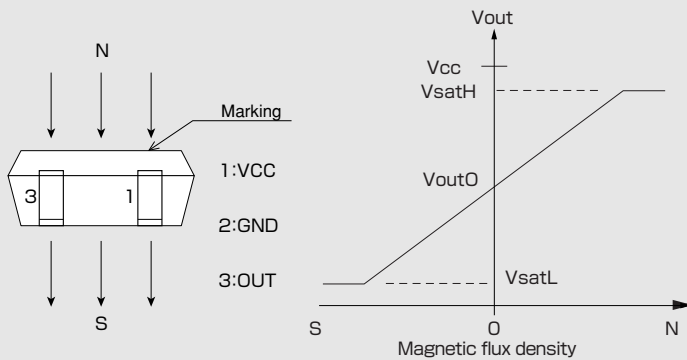


1:VCC
2:GND
3:OUT

## ●Pin and functions
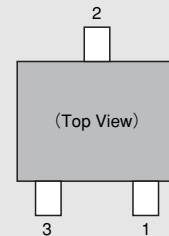


| Pin　No. | Pin name | Function |
|---|---|---|
| 1 | VCC | Power supply |
| 2 | GND | Ground |
| 3 | OUT | Output |

## ●Functional Block Diagram



Hall Element   Amplifier

## ●Application Circuit



Please add LPF if required.

## ●Absolute Maximum Ratings（Ta=25℃）

| parameter | symbol | specification | unit |
|---|---|---|---|
| Supply voltage | $V_{CC}$ | −0.3 ～ 6 | V |
| output current | Iout | ±1.2[*] | mA |
| operating ambient temperature | Topr | −40 ～ 100 | ℃ |
| Storage ambient temperature | Tstg | −40 ～ 125 | ℃ |

（*）Vcc＝5V

## ●Recommend operating conditions

| parameter | symbol | min | typ | max | unit |
|---|---|---|---|---|---|
| Supply voltage | Vcc | 3.0 | 5.0 | 5.5 | V |
| output current | IOUT | −1.0 | | 1.0 | mA |
| output load | CL | | | 1000 | pF |

● Electric characteristics (TA=25℃, Vcc=5V)

| Parameter | Symbol | Conditions | min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Current consumption | $I_{CC}$ | B=0mT with no load | | 9 | 12 | mA |
| Output saturation voltage at High Level[*1] | $V_{SATH}$ | $I_{OUT}=-1mA$ | $V_{CC}-0.3$ | | $V_{CC}$ | V |
| Output saturation voltage at Low Level[*1] | $V_{SATL}$ | $I_{OUT}=1mA$ | 0 | | 0.3 | V |
| B a n d w i d t h [*2] | $f_T$ | −3dB  $C_L$=1000pF | | 90 | | kHz |
| R e s p o n s e  t i m e [*2] | $t_{RES}$ | Rise time : 10% of Input MFD to 90% of output voltage. Fall time: 90% of Input MFD to 10% of output voltage. (under input/output MFD step is 1 to 2μs) $C_L$=1000pF | | 2 | | μs |
| Output rise time [*2] | $t_{RISE}$ | 10% to 90% of output voltage under input/output MFD step is 1 to 2μs. $C_L$=1000pF | | 4 | | μs |
| Output fall time [*2] | $t_{FALL}$ | 90% to 10% of output voltage under input/output MFD step is 1 to 2μs $C_L$=1000pF | | | | μs |
| Output delay time [*2] | $t_{REAC}$ | Rise time : 10% of Input MFD to 10% of output voltage. Fall time: 90% of Input MFD to 90% of output voltage. (under input/output MFD step is 1 to 2μs) $C_L$=1000pF | | 0.3 | | μs |
| Output noise voltage [*2] | $V_{Np-p}$ | | | 2 | | mVp-p |

(*1&2) Design target at 25℃                                  ※1mT = 10Gauss

● Magnetic characteristics (TA=25℃, Vcc=5V)

| Parameter | Symbol | Conditions | min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Sensitivity[*3] | $V_h$ | B=0、±41mT with no load | 17 | 20 | 23 | mV/mT |
| Quiescent voltage | $V_{OUT0}$ | B=0mT | 2.45 | 2.5 | 2.55 | V |
| Linearity[*4] | $\rho$ | B=0mT ($I_{OUT}$=0mA) B=±50mT ($I_{OUT}$=±1mA) | −0.5 | | 0.5 | %F.S. |

(*3) See Characteristic Definitions section
(*4) See Characteristic Definitions section            ※1mT = 10Gauss

● Ratio-metric characteristics (TA=25℃)

| Parameter | Symbol | Conditions | min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Error in Ratiometric of Magnetic sensitivity[*5] | $V_{h-R}$ | B=0、±41mT with no load | −3 | | 3 | % |
| Error in Ratiometric of Quiescent voltage[*5] | $V_{OUT0-R}$ | B=0mT | −3 | | 3 | % |

(*5) See Characteristic Definitions section            ※1mT = 10Gauss

● Characteristic Definitions

① Magnetic sensitivity $V_h$ (mV/mT)
Magnetic sensitivity is defined as the slope of the straight line obtained from three points, Quiescent voltage $V_{OUT0}$、$V_{OUT}$ (+B)、$V_{OUT}$ (−B) (B is described in measurement condition), by the least square approximation.

② Linearity $\rho$ (%F.S.)
Linearity is defined as the ratio of a error voltage against FULLSCALE. Where error voltage is calculate as the difference from the straight line obtained from three points, Quiescent voltage $V_{OUT0}$、$V_{OUT}$ (+B)、$V_{OUT}$ (−B) (B and Output current are described in measurement condition shown below), by the least square approximation.
〈Condition〉:0mT applied、$I_{OUT}$ = 0mA
+BmT applied : $I_{OUT}=+1.0mA$〈Draw out from output〉
−BmT applied : $I_{OUT}=-1.0mA$〈Draw in to output〉

$$\rho=\frac{V_{out}(B)-\{V_h\times B+V_{int}\}}{V_{out}(+B)-V_{out}(-B)}\times100$$

Where FULLSCALE(F.S.) is defied as $V_{OUT}$ (+B)、$V_{OUT}$ (−B), Vint is y-intercepts of the line obtained in the Definition of Magnetic sensitivity.

③ Error in Ratiometric of Magnetic sensitivity and Error in Ratiometric of quiescent voltage
Error in ratiometric is defined as the ratio of the variation of sensitivity and quiescent voltage at 3V and 5V as following equations..

$$V_{h-R}=\frac{\frac{V_h(V_{CC}=3V)}{V_h(V_{CC}=5V)}-\frac{3}{5}}{\frac{3}{5}}\times100 \quad V_{OUT0-R}=\frac{\frac{V_{OUT0}(V_{CC}=3V)}{V_{OUT0}(V_{CC}=5V)}-\frac{3}{5}}{\frac{3}{5}}\times100$$

④ Response time  $t_{RES}$ (μs)
Response time is defined as the time from the 90% reach point of input magnetic field rise up to the 90% reach point of output voltage rise up

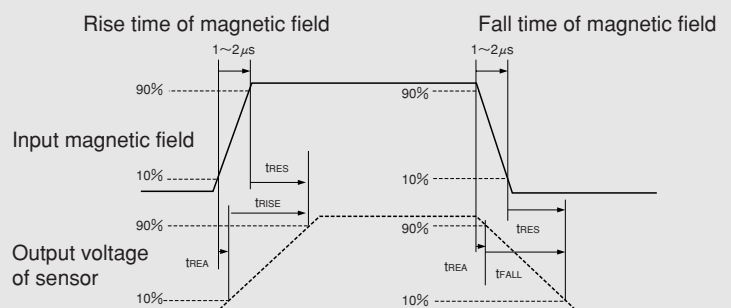⑤ Output rise time, Output fall time  $t_{RISE}$、$t_{FALL}$ (μs)
Output rise up time is defined as the time from the 10% point to the 90% point of output voltage under a pulse like magnetic field input shown below.
Output fall down time is defined as the time from the 90% point to the 10% point of output voltage under a pulse like magnetic field input shown below.

⑥ Output delay time  $t_{REAC}$ (μs)
Output delay time is defined as the time from the 10% point in rise up(90% point in fall down) of input magnetic field to the 10% point in rise up(90% point in fall down) of output voltage under a pulse like magnetic field input shown below..

〈Relations of the input Magnetic field and $t_{RES}$、$t_{RISE}$、$t_{FALL}$、$t_{REAC}$〉
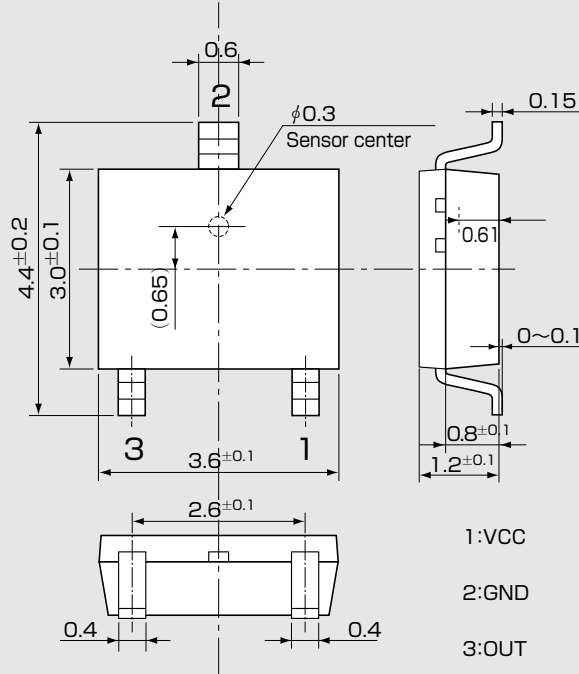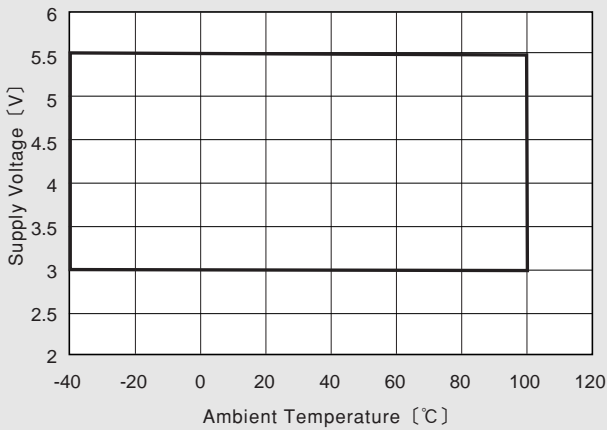
## ●Package (Unit:mm)

1:VCC

2:GND

3:OUT

※The sensor senter is located within the φ0.3mm circle.
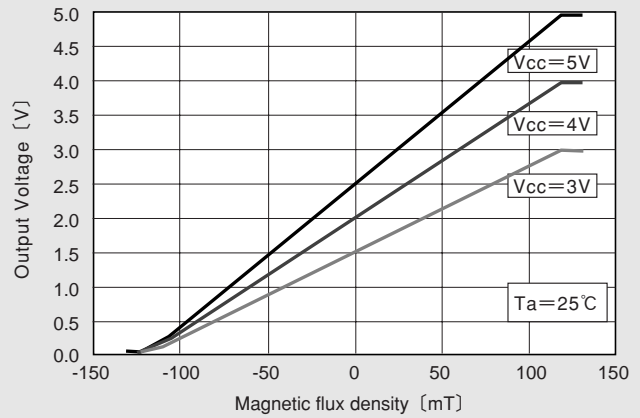
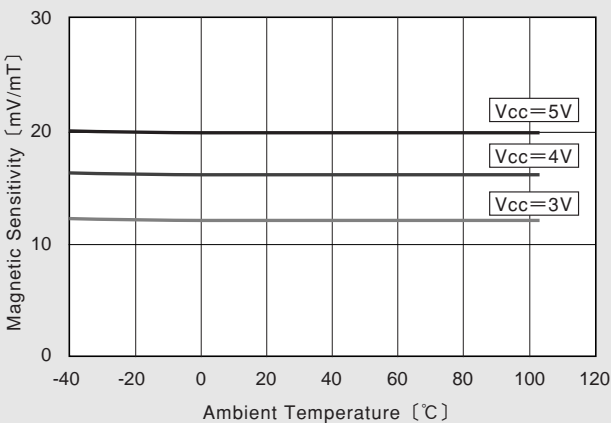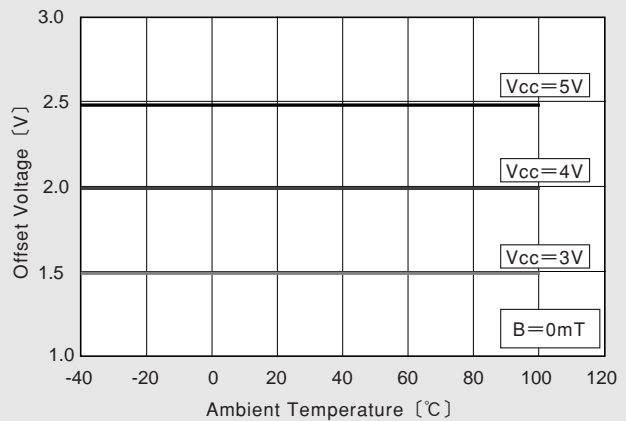## ●(For reference only)Land Pattern (Unit:mm)
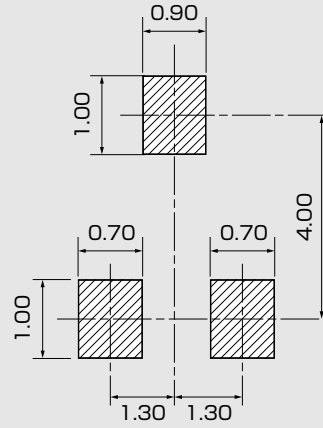
## ●Supply Voltage

## ●Operational Characteristics

## ●Temperature dependence of VH

## ●(For reference only) Temperature dependence of Vout0

## IMPORTANT NOTICE

August 18, 2011

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