EQ-433L

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°C ~ 100°C
- Ratio-metric analog output
- 3pin surface mount plastic package
- Quick response 2 μs
  (when the rise-up time of magnetic field is rather than 1 μs)
- Low output noise voltage 2mVp-p

**Operational Characteristics**

- Magnetic flux density
  - Vout: Vcc, VisatH
  - VisatL: Vout0

**Pin and functions**

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Pin name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VCC</td>
<td>Power supply</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>3</td>
<td>OUT</td>
<td>Output</td>
</tr>
</tbody>
</table>

**Functional Block Diagram**

- 1: VCC
- 2: GND
- 3: OUT

**Absolute Maximum Ratings (Ta=25°C)**

<table>
<thead>
<tr>
<th>parameter</th>
<th>symbol</th>
<th>specification</th>
<th>unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>Vcc</td>
<td>–0.3 ~ 6</td>
<td>V</td>
</tr>
<tr>
<td>output current</td>
<td>Iout</td>
<td>±1.2%</td>
<td>mA</td>
</tr>
<tr>
<td>operating ambient temperature</td>
<td>Toper</td>
<td>–40 ~ 100</td>
<td>°C</td>
</tr>
<tr>
<td>Storage ambient temperature</td>
<td>Tstg</td>
<td>–40 ~ 125</td>
<td>°C</td>
</tr>
</tbody>
</table>

(※) Vcc=5V

**Application Circuit**

Please add LPF if required.

**Recommend operating conditions**

<table>
<thead>
<tr>
<th>parameter</th>
<th>symbol</th>
<th>min</th>
<th>typ</th>
<th>max</th>
<th>unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>Vcc</td>
<td>3.0</td>
<td>5.0</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>output current</td>
<td>Iout</td>
<td>–1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>mA</td>
</tr>
<tr>
<td>output load</td>
<td>CL</td>
<td>1000</td>
<td>1000</td>
<td>pF</td>
<td></td>
</tr>
</tbody>
</table>
● Electric characteristics (TA=25°C, Vcc=5V)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current consumption</td>
<td>Icc</td>
<td>B-0mT with no load</td>
<td>9</td>
<td>12</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Output saturation voltage at High Level[1]</td>
<td>VsatH</td>
<td>Iout=−1mA</td>
<td>Vcc-0.3</td>
<td>Vcc</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Output saturation voltage at Low Level[2]</td>
<td>VsatL</td>
<td>Iout=1mA</td>
<td>0</td>
<td>0.3</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Band width [2]</td>
<td>fT</td>
<td>−3dB Cref=1000pF</td>
<td>90</td>
<td>kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response time [2]</td>
<td>IRES</td>
<td>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) Cref=1000pF</td>
<td>2</td>
<td>μs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output rise time [2]</td>
<td>RISE</td>
<td>10% to 90% of output voltage under input/output MFD step is 1 to 2μs Cref=1000pF</td>
<td>4</td>
<td>μs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output fall time [2]</td>
<td>FALL</td>
<td>90% to 10% of output voltage under input/output MFD step is 1 to 2μs Cref=1000pF</td>
<td>0.3</td>
<td>μs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output noise voltage [2]</td>
<td>Vn-p</td>
<td>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) Cref=1000pF</td>
<td>2</td>
<td>mV/p-p</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[1,2] Design target at 25°C

1mT = 10Gauss

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>Vr</td>
<td>B-0.341mT with no load</td>
<td>17</td>
<td>20</td>
<td>23</td>
<td>kV/mT</td>
</tr>
<tr>
<td>Quiescent voltage</td>
<td>Vout</td>
<td>B=0mT</td>
<td>2.45</td>
<td>2.55</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Linearity[4]</td>
<td>ρ</td>
<td>B=0mT Iout=0mA</td>
<td>−0.5</td>
<td>0.5</td>
<td>% F.S.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>B=±500mT Iout=±1mA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(3) See Characteristic Definitions section

(4) See Characteristic Definitions section

● Characteristic Definitions

1. Magnetic sensitivity Vr (mV/mT)
   Magnetic sensitivity is defined as the slope of the straight line obtained from three points, Quiescent voltage Vout, Vout (+B), Vout (−B) (B is described in measurement condition), by the least square approximation.

2. Linearity ρ (% 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 Vout, Vout (+B), Vout (−B) (B and Output current are described in measurement condition shown below), by the least square approximation.
   \[ \rho = \frac{V_{out}(B) - \left| Vr \times B + V_{int} \right|}{V_{out}(+B) - V_{out}(-B)} \times 100 \]
   Where FULLSCALE/F.S. is defined as Vout (+B), Vout (−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.
   \[ \frac{V_r(V_{cc}=3V)}{V_r(V_{cc}=5V)} = \frac{3}{5} \times 100 \]
   \[ \frac{V_{out}(V_{cc}=3V)}{V_{out}(V_{cc}=5V)} = \frac{3}{5} \times 100 \]

● Ratio-metric characteristics (TA=25°C)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error in Ratiometric of Magnetic sensitivity[3]</td>
<td>Vhr</td>
<td>B-0.341mT with no load</td>
<td>−3</td>
<td>3</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Error in Ratiometric of Quiescent voltage[3]</td>
<td>Vout</td>
<td>B=0mT</td>
<td>−3</td>
<td>3</td>
<td>%</td>
<td></td>
</tr>
</tbody>
</table>

(3) See Characteristic Definitions section

1mT = 10Gauss

4. Response time TRIS (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 TRIS, TFALL (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 TREC (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 TRIS, TRIS, TFALL, TREAC)
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Package (Unit:mm)

- Sensor center
- 0.3

(For reference only) Land Pattern (Unit:mm)

1: VCC
2: GND
3: OUT

※ The sensor center is located within the ø0.3mm circle.

Supply Voltage

Ambient Temperature (°C)

Supply Voltage (V)

-40 -20 0 20 40 60 80 100 120

- 6 5.5 5 4.5 4 3.5 3 2.5 2

Operational Characteristics

Output Voltage (V)

-150 -100 -50 0 50 100 150

Magnetic flux density (mT)

-6 -5 -4 -3 -2 -1 0 1 2 3 4 5

Temperature dependence of VH

Ambient Temperature (°C)

Magnetic Sensitivity (mV/mT)

-40 -20 0 20 40 60 80 100 120

- 30 20 10 0

(For reference only) Temperature dependence of VoutO

Ambient Temperature (°C)

Offset Voltage (V)

-40 -20 0 20 40 60 80 100 120

- 3.0 2.5 2.0 1.5 1.0
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August 18, 2011