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Overview

This Evaluation Board Includes

- Three AAL024-10ETDFN current sensors
- 1.565" x 2.915" (40 mm by 74 mm), 0.062" (1.6 mm) thick PCB
- Three current measurement configurations
- Sturdy screw connections for high current
- Up to 65 amps AC or DC noncontact current measurement

AAL024-10E Features

- Wheatstone bridge analog outputs
- High sensitivity: 3.6 mV/V/Oe typical
- Wide linear range: 1.5 to 10.5 Oe; 15 Oe saturation
- 2.2 kΩ bridge resistance/1.1 kΩ output impedance for easy interface
- Low offset: 4 mV/V max.
- Low hysteresis: 2% max. for excellent repeatability
- Wide bandwidth: 500 kHz
- −50 to 125°C
- Ultraminiature 2.5 mm x 2.5 mm TDFN6 package

Advantages of Sensing Current Over Trace

- Negligible insertion resistance
- Usable for a wide current range
- Inherent electrical isolation
- AC or DC operation

Additional Resources

- Buy Online: www.nve.com/webstore/catalog

Sensors Details

Omnipolar Response

AA-Series sensors are “omnipolar,” meaning the output voltage is positive for either field polarity. This produces an output analogous to half-wave rectification of the current being sensed, eliminating the need for rectification of AC inputs.

Bridge Offset

The sensors have a maximum offset of ±4 mV/V. This can be trimmed out with an external resistor if necessary.

Temperature Compensation

The Wheatstone bridge inherently compensates for temperature changes, but there is still some residual temperature coefficient. A constant-current rather than constant-voltage power supply reduces the temperature coefficient of the output considerably. The sensors can also be externally temperature compensated if necessary.

Ampere’s Law

For narrow traces, the magnetic field generated can be approximated by Ampere’s law:

\[ B = \frac{2I}{d} \]  
[“B” in Gauss, “I” in amps, and “d” in millimeters]

A more accurate calculation can be made by breaking the trace into a finite-element array of thin traces, and calculating the field from each array element.

We have a free, Web-based application with a finite-element model to estimate magnetic fields and sensor outputs in this application: www.nve.com/spec/calculators.php#tabs-Current-Sensing
The evaluation board demonstrates three current-trace configurations:

A. Single trace on top side of PCB
   This configuration will saturate the sensor at about seven amps. The 0.05-inch (1.25mm) wide, one-ounce trace can carry up to seven amps, coinciding with sensor saturation.

B. Five turns on top side of PCB
   Five traces provide approximately five times the field, but they must be narrower to fit under the sensor. The 0.0055-inch (0.14mm), one-ounce copper traces have a maximum current of approximately one amp.

C. Heavy, wide trace on bottom of PCB
   This is the highest-current configuration, with a one-inch (25mm) wide trace of one-ounce (35μm thick) copper that can carry up to 50 amps with a 50°C temperature rise, which coincides with the sensor saturation. Using a wide trace on the opposite side of the board from the sensor allows large currents to be detected without overheating the board trace or the sensor.

Typical characteristics of the three configurations are summarized in the following table:

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Typical Sensitivity</th>
<th>Linear Range</th>
<th>Sensor Saturation</th>
<th>Isolation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Trace on top of PCB</td>
<td>8.6 mV/V/A</td>
<td>0 – 4.5 A</td>
<td>7 A</td>
<td>&gt;300V</td>
</tr>
<tr>
<td>B. 5 turns on top of PCB</td>
<td>43 mV/V/A</td>
<td>0 – 0.75 A</td>
<td>1 A</td>
<td>&gt;300V</td>
</tr>
<tr>
<td>C. Wide trace under PCB</td>
<td>0.9 mV/V/A</td>
<td>0 – 50 A</td>
<td>55 A</td>
<td>&gt;6 kV</td>
</tr>
</tbody>
</table>
AAL024-10E Magnetometer Sensors (3 places)

Configuration B: 5 turns of 0.0055"-wide, 1 oz copper traces on top of PCB

Configuration A: 0.05"-wide, 1 oz copper trace on top side of PCB

Configuration C: 1"-wide, 1 oz copper trace on bottom-side of PCB

Sensor Power (0 - 12 V) (3 places)

Sensor Differential Outputs (45 mV/V full-scale; 540 mV full-scale at 12V; 3 places)

Connections for Current to Be Sensed

Current to Be Sensed