

ISB Series Current Sense Transducer

Application Information

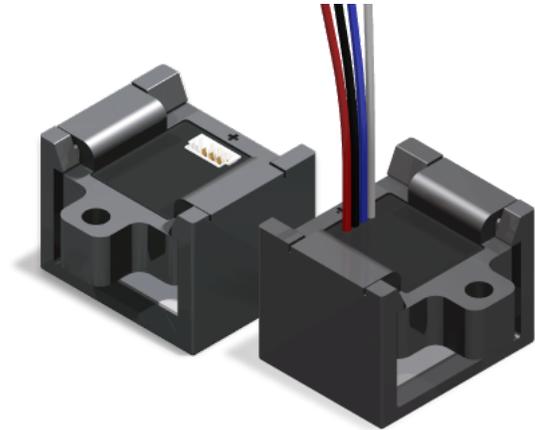
1 Scope

This application note provides background information on the **ISB current sensors** and information on how to use the low cost current sensor in busbar applications. The ISB series features high creepage, high isolation, low cost, fast response and high bandwidth. The technology is easy to install in challenging mechanical applications with tight dimensions.

2 Introduction

The ISB current sensors are custom ASIC based hall effect devices designed to operate without the need for the core and winding commonly used in current sensors. The current sensors can be applied in a wide range of busbar applications with currents ranging from 75 A up to over 670 A. The devices feature low insertion loss, high isolation, fast response, wide bandwidth, small size and easy assembly to a busbar. Factory programmable features include output type and customizable current range.

The simplified design consists of a PCB assembly, shield and a mechanical package to integrate the component parts. Thus enabling a lower cost than traditional current sensors while offering performance between typical open loop and closed loop designs.



3 Bus Bar Sizing

The ISB is designed to fit a busbar with a maximum thickness of $\frac{1}{4}$ inch and can be used to measure currents up to 670 A. The thickness of the busbars is variable with a maximum thickness of $\frac{1}{4}$ inch for each with no loss in accuracy. There are limits on the minimum width of the busbar for each size. As a general rule of thumb, a minimum width of $\frac{1}{2}$ inch is recommended. Customers are advised to provide the actual busbar dimensions for the calibration process. **Please ask an ICE engineer for more details.**

4 Shielding

ICE accomplishes two objectives by adding a U-shaped shield to the design. First, the magnetic flux density is concentrated within the shield. Due to the smaller magnetic resistance, (μ r from air is smaller than the μ r of the shielding material) a higher magnetic flux density is generated in the gap of the shield. Simulations show that the magnetic flux

density is increased with the shield when the same current is applied. This helps the current sensors to measure low current levels when compared to the overall current range of the sensors. Secondly, the shield helps protect the sensor from stray EMI fields. Our tests show that by maintaining a distance of 12.7 mm from adjacent high current paths the specified accuracy can be maintained.

5 Connection

The ISB series has two options for connection to the circuit. The first option is by a 1.00 mm pitch shrouded header connector; **JST #BM04B-SRSS-TB**, which requires **JST #SHR-04V-S-B** and **#SSH-003T-P0.2** (Contact) x4 mating connector. The creepage distance using the connector is 8.5 mm.

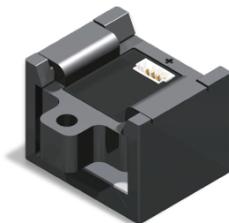


Figure 1: Connector Version (ISB-A-800 Series)

The second option uses stranded #22 AWG UL3239 rated lead wires with a voltage rating of 3 kV. The standard length of the lead wire is 150 mm providing a much higher creepage distance of 158.5 mm.

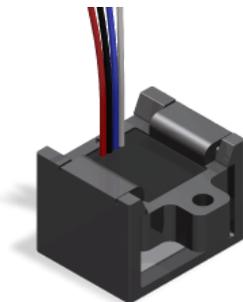


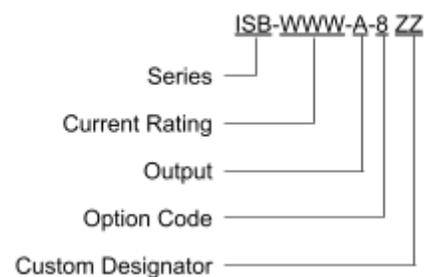
Figure 2: Lead-Wire Version (ISB-A-802 Series)

Note: Custom lead wire length can be provided as a custom part number.

6 Linear and Extended Ranges

The current sensors are specified with two current ranges; I_P and I_{PE} . The I_P or linear current range is the range in which the current sensor measurements are within the specified linearity and accuracy. In many applications there is a nominal current to be measured more accurately and a higher current to be measured in startup or in failure situations. I_{PE} extends the current range when accuracy is not as important but some resolution at higher currents is needed.

7 Part Number

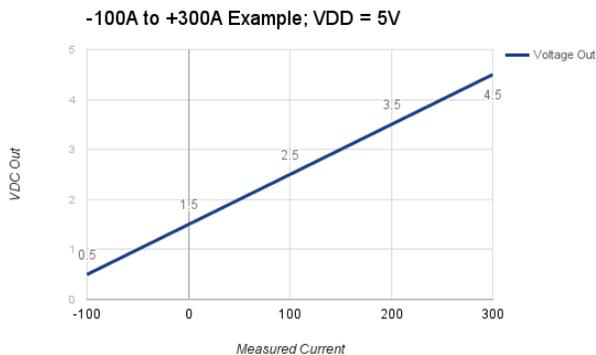


7.1 Current Rating - W

The ISB comes in six (6) standard current ratings. The current ranges from positive to the negative value of the rated current. As an example, the **ISB-425-A-800**'s current ranges from +425 A to -425 A.

The ISB series can be factory programmed for a custom current range. Any symmetrical or unsymmetrical current range between +670 A and -670 A can be factory programmed as long as zero

current is equal to or greater than 10% of V_{DD} . An example shown below is -100 A to + 300 A where -100 A equals 10% of V_{DD} and +300 A equals +90% of V_{DD} .



7.2 Output - A

The ISB series has an Analog (A) output which is ratiometric with a full scale range from 10% to 95% of V_{DD} . An example is the **ISB-425-A-800** with a precise 5VDC V_{DD} . The analog output will be 0.5 V at -425 A and 4.5 V at +425 A. For PWM output requirements, please ask an ICE engineer for availability.

7.3 Option Code - 8

Option code 8 features a 3 μs response time, a reference output and an excellent thermal stability. For more robust absolute maximum ratings and temperature output requirements, please ask an ICE engineer for availability.

7.4 Custom Code - Z

A custom code is assigned for any custom programming different from the standard part numbers. Examples include custom current ranges or custom lead lengths.

8 Busbar Attachment

As shown in **Figure 3**, the upper half of the ISB current sensor is attached to the busbar using standard hardware. The lower half of the housing is then clipped to the upper half for a secure connection. The lower housing also serves as protection for the shield.

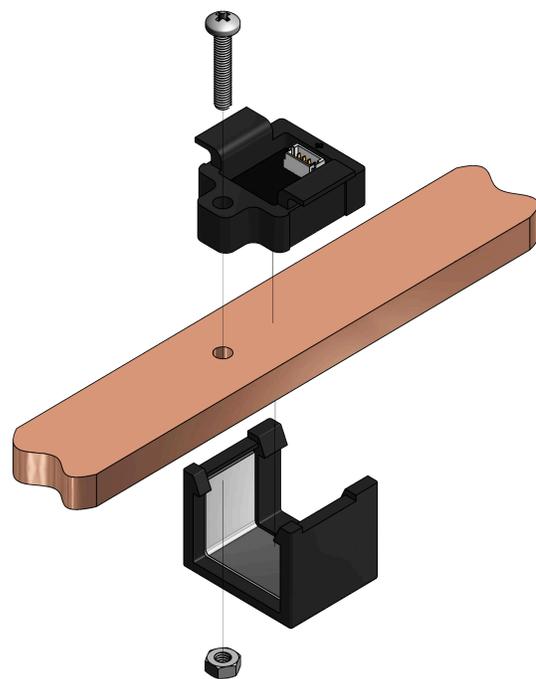


Figure 3: Busbar Attachment

9 Reference Output

The ISB series is available with a reference output that simplifies the driving of an op-amp circuit. The reference output is ratiometric to V_{DD} and provides a voltage that is 50% of V_{DD} .

10 High Current Application Example

In order to measure high currents without the need for a very wide shield, another option is to split the busbar so that only a fraction of the total current is measured by the sensor (**Figure 4**). With this configuration, the shield can be made much smaller and lower cost.

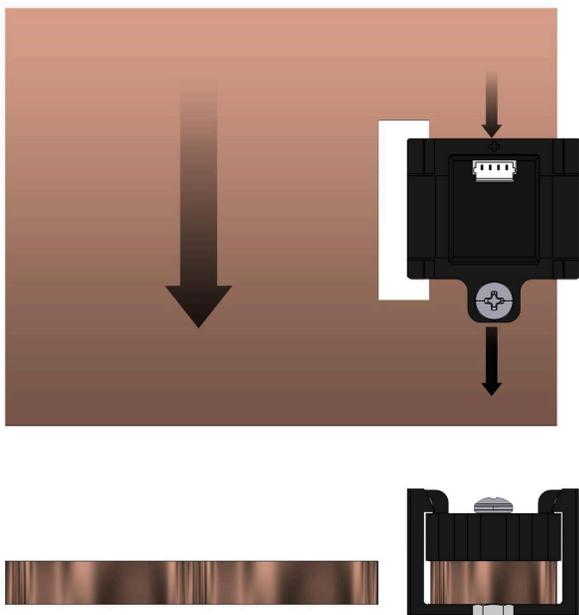


Figure 4: Busbar splitting for high current application.

Considering an application with a current of 1,600 A flowing in a busbar of 88 mm (width). A straightforward solution would be to add a current sensor around the entire busbar resulting in a larger current sensor. Another approach is to divide a portion of the busbar into two by adding a slot and then measure the current passing through the smaller section. The total current can be determined based on the ratio of the cross-sectional area of the measured section to the total cross-sectional area of the two sections. As shown in **Figure 5**, a solution can be achieved by adding an 8 mm slot that is 20 mm from one side of the busbar. The resulting current in the 20 mm section is only 400 A ($\frac{1}{4}$ of the total busbar cross section). The ISB current sensor can be applied to the 20 mm section of the busbar and can be scaled to measure the 1,600 A flowing in the busbar.

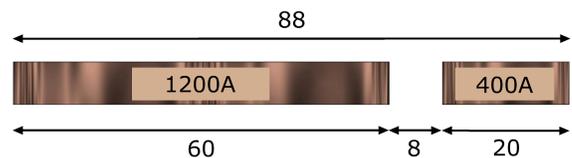


Figure 5: Division of current through busbar splitting.

NOTE: We recommend mounting the sensors with non-magnetic screws for maximum accuracy. We recommend stainless steel, brass, bronze, copper or aluminum.

For more details about our ISB Current Sensors, please visit:

<https://www.icecomponents.com/product-category/programmable-hall-effect-current-sensors/>

For Connector version, please visit:

<https://www.icecomponents.com/product/isb-a-800-series/>

For Lead-Wire version, please visit:

<https://www.icecomponents.com/product/isb-a-802-series/>

To directly purchase, you may visit:

<https://www.mouser.com/new/ice-components/ice-components-isb-transducers/>

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