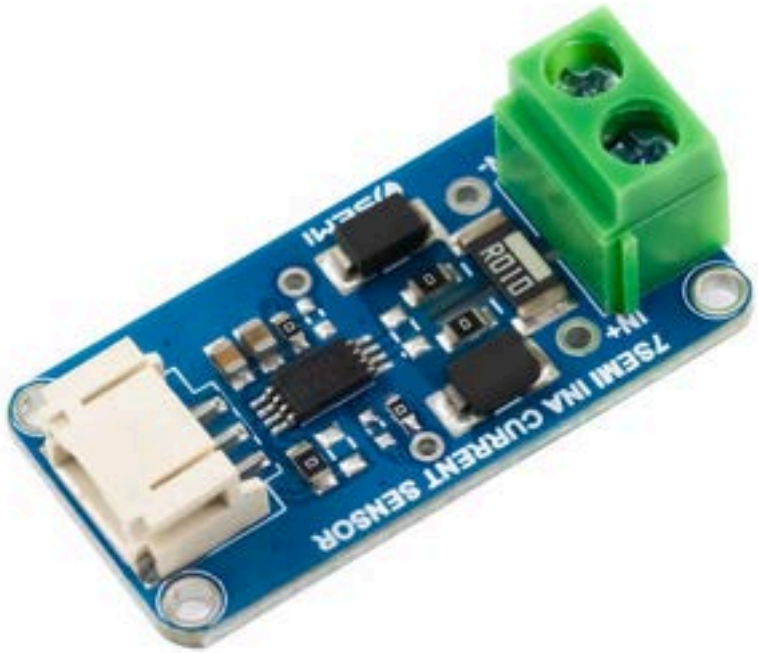
7Semi INA240 Current Sense Module – User Guide and Interfacing manual



The INA240 is a precision, voltage-output current-sense amplifier designed for accurate current measurement in electrically noisy PWM-controlled systems. It measures the small differential voltage developed across a shunt resistor and converts it into an amplified analog output suitable for a microcontroller, ADC, or control circuit.

The INA240 operates from a single 2.7V to 5.5V power supply and draws a maximum supply current of 2.4mA. 7Semi offers four fixed-gain variants to meet different current-sensing requirements.

Variant of INA240	Gain	Product SKU No
INA240A1	20V/V	ES-12190
INA240A2	50V/V	ES-12189
INA240A3	100V/V	ES-12188
INA240A4	200V/V	ES-12187

Features

- Supports bidirectional current sensing across a wide common-mode voltage range of −4V to +80V.
- Available in multiple gain variants: INA240A1 – 20V/V, INA240A2 – 50V/V, INA240A3 – 100V/V, and INA240A4 – 200V/V.
- Features an onboard 10mΩ shunt resistor for accurate current measurement with minimal load-voltage drop.
- Supports high-side, low-side, and inline current sensing.
- Module operating temperature range: −40°C to +80°C

Application of INA240

- Used in motor drives for accurate phase-current monitoring and control.
- Suitable for measuring current in solenoid and valve-control systems.
- Enables reliable current monitoring in power supplies and power-management circuits.
- Provides precise current feedback for industrial automation and actuator control.

General Specifications

Parameter	Value
Category of product	Current sense module
Communication interface	Analog output
Supply voltage required (Vs)	Up to 6V DC max (Typ 5V)
Common-mode voltage	–4 V to 80V DC
Operational temperature	-40°C to +80°C
Shunt resistor value	10mΩ 3W (For all INA240 variants)
Product Dimension	36mm x 18mm x 13.99mm

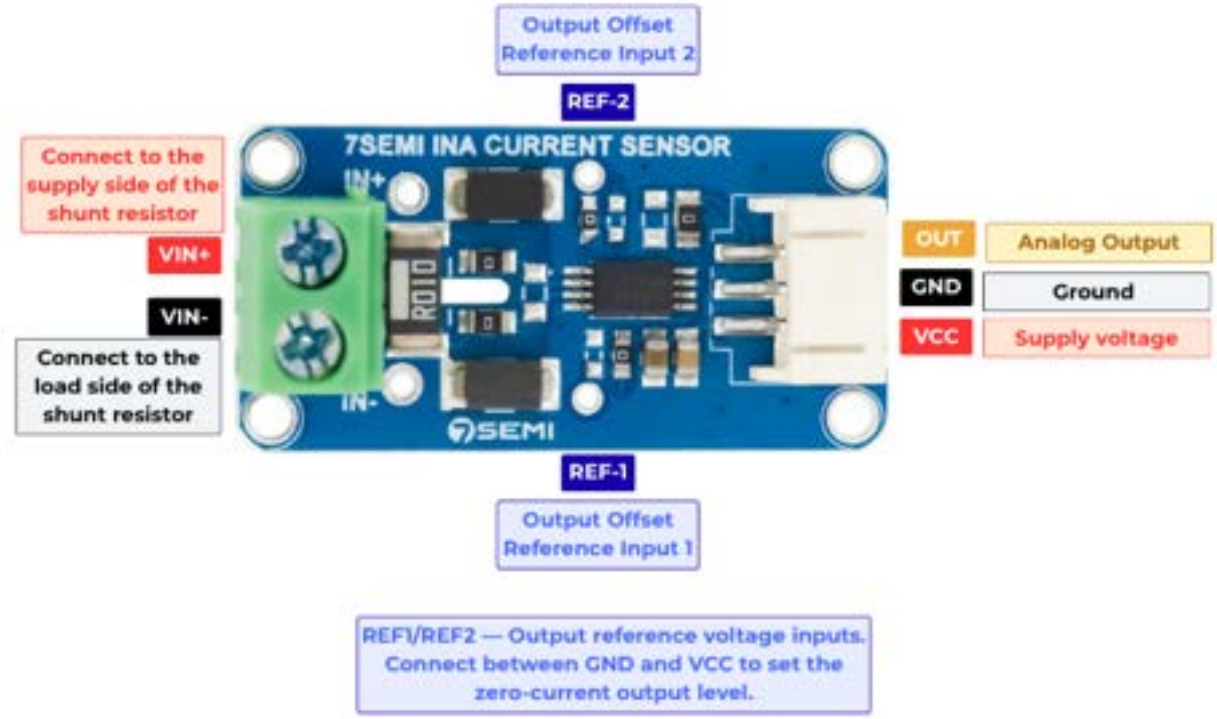
Max Current sense for different Gain

- Maximum Current for INA240 Gain Variants at 5V Supply
- Shunt resistor used for all variants: 10mΩ ±1%, 3W

Parameters	INA240A1	INA240A2	INA240A3	INA240A4
Gain	20V/V	50V/V	100V/V	200V/V
Shunt Resistor	10mΩ	10mΩ	10mΩ	10mΩ
Shunt resistor power	3W	3W	3W	3W
Voltage Supply (Vs)	5V	5V	5V	5V
Voltage across shunt	0.25V	0.10V	0.05V	0.025V
Shunt power	6.25W	1W	0.25W	0.0625W
Current sense range	**17A**	**10A**	**5A**	**2.5A**

Since the shunt resistor is rated for 3W, the maximum supported current is limited to 17A.These calculations are done by taking Vs = 5V into account and the maximum current value will be different as per Vs .If you are providing proper 5V supply to the INA240 board then you can go with the above values for your application.

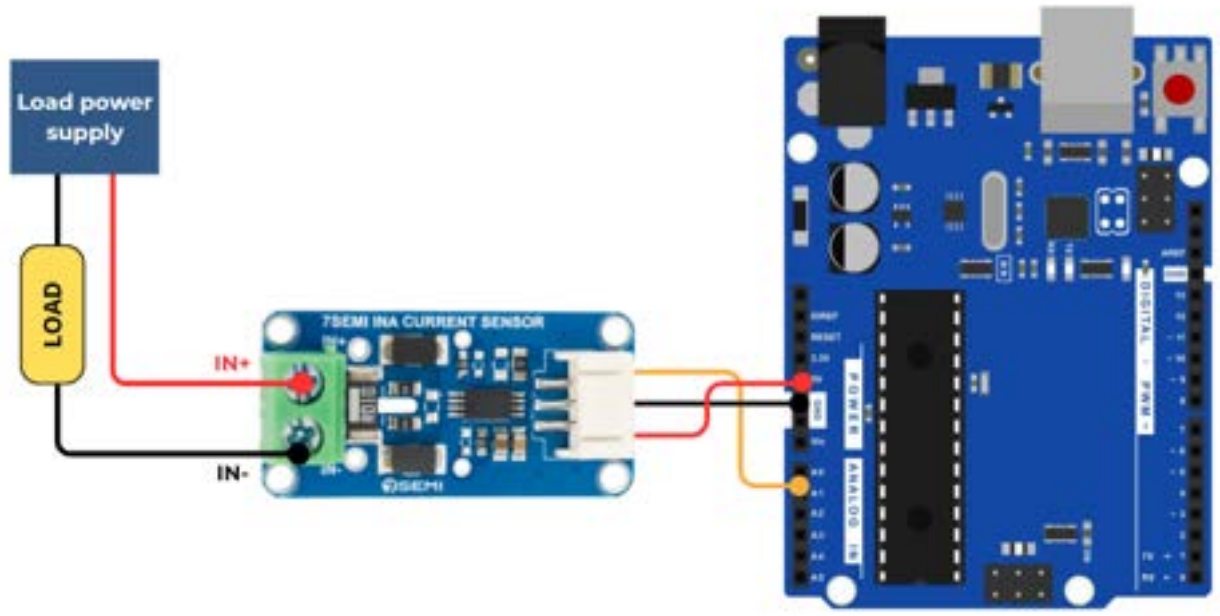
Pinout Description of IN240



- The VIN+ terminal connects to the supply side, while VIN− connects to the load side, allowing current to flow through the onboard shunt resistor.
- VCC powers the board with 3.3V or 5V, and GND connects to the controller ground.
- The OUT pin provides an analog voltage proportional to the measured current and connects to a microcontroller's ADC input.
- REF-1 and REF-2 set the zero-current output level and can be connected between GND and VCC for bidirectional current measurement.

This sensor gives Analog Output from its 'OUT' pin. In order to make current measurements we need to convert this analog value to digital. Using Arduino's ADC pins we can convert the analog values from the sensor to digital.

Hardware connection



Connections of INA240 current sensor with Arduino Uno/ Nano

Connect the load power supply positive terminal to **IN+** and connect **IN−** to one side of the load. Connect the other side of the load to the power supply negative terminal so the sensor remains in series with the load.

- Connect the sensor's **VCC** pin to Arduino **5V**,
- **GND** to Arduino **GND**,
- **OUT** to the Arduino analog input (any pin from A0 To A5)

The Arduino reads the voltage at A0 to calculate the current flowing through the load. Follow the sample code provided at the link below to interface the INA240 module with your microcontroller and measure current accurately. The example includes the required setup, output-voltage reading, and current calculation steps.

Sample code link:- [INA240 current sensor code]

Output

Connect the current sensor with your Arduino board as per the connection diagram given. Before connecting any kind of load you should see all the readings as 0.00 as shown in the image below

```
Sensor Value: 0.00      Voltage: 0.0000 V       Shunt Voltage: 0.0000 V Current: 0.0000 A
-------------------------------------------------------------------------------------------
Sensor Value: 0.00      Voltage: 0.0000 V       Shunt Voltage: 0.0000 V Current: 0.0000 A
```

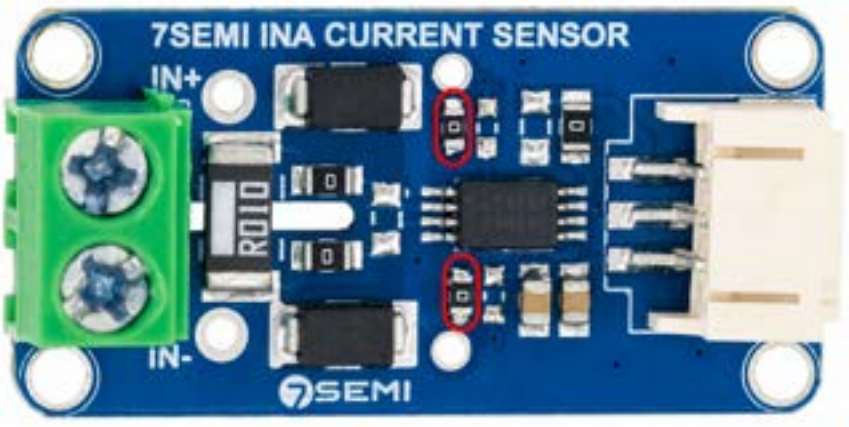
Now connect your load as per the connection diagram given and you should see this kind of output

```
Sensor Value: 149.00    Voltage: 0.4802 V       Shunt Voltage: 0.0096 V Current: 0.9604 A
-------------------------------------------------------------------------------------------
Sensor Value: 151.00    Voltage: 0.4866 V       Shunt Voltage: 0.0097 V Current: 0.9732 A
-------------------------------------------------------------------------------------------
Sensor Value: 151.00    Voltage: 0.4866 V       Shunt Voltage: 0.0097 V Current: 0.9732 A
```

Output Reference Modes

The INA240 module provides configurable output-reference modes through the REF1 and REF2 solder bridges. The selected reference mode determines the analog output voltage at zero current and allows the module to be configured for unidirectional or bidirectional current measurement.

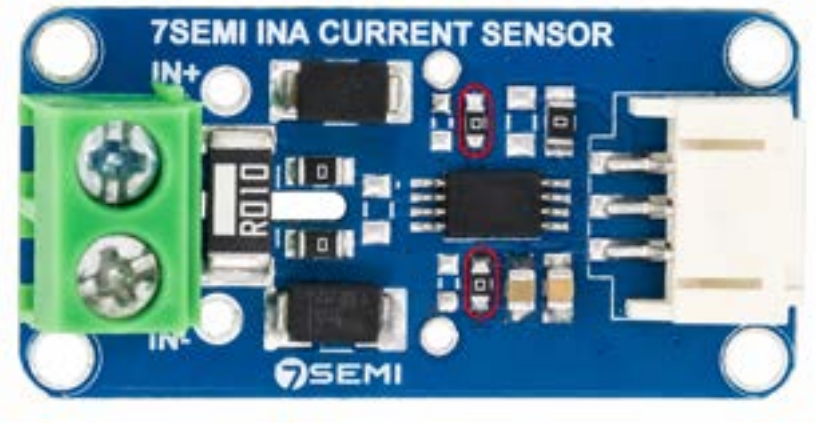
Ground-Referenced Output



For ground-referenced operation, short the **REF1–GND** and **REF2–GND** bridges while keeping the REF1–VCC and REF2–VCC bridges open. At zero

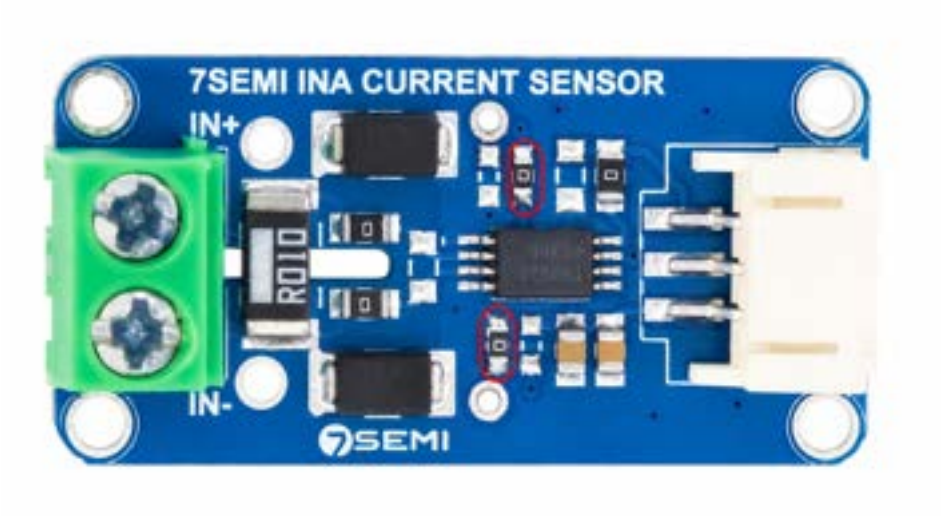
current, the output remains near 0 V and increases as current flows from VIN+ to VIN−. This mode is recommended for unidirectional current measurement.

Supply-Referenced Output



For supply-referenced operation, short the **REF1–VCC** and **REF2–VCC** bridges while keeping the REF1–GND and REF2–GND bridges open. At zero current, the output remains near VCC and decreases as current flows from VIN− to VIN+. This mode is suitable for measuring current in the reverse direction.

Mid-Supply Output



For bidirectional current measurement, short **REF1–VCC** and **REF2–GND**, or interchange the two reference connections. This sets the zero-current output

to approximately VCC/2. With a 5 V supply, the output is approximately 2.5 V at zero current. The output rises above 2.5 V when current flows from VIN+ to VIN− and falls below 2.5 V when current flows in the opposite direction.

External Reference Output

For a custom zero-current output level, leave all four reference solder bridges open and apply a suitable external reference voltage to REF1 and REF2. Connecting both reference inputs to the same external voltage sets the zero-current output to that voltage. This mode is useful when the module output must be matched to a specific microcontroller or ADC input range.

Important: Never short the VCC and GND bridges of the same REF input simultaneously, as this will directly short VCC to GND. The voltage applied to REF1 and REF2 must always remain between GND and VCC.