QUICK REFERENCE · TK119

INA219 Current Monitor

A 100 mΩ shunt in the positive wire, and a chip that reports current, voltage and power over I²C.

In the + wire only, and 26 V at most

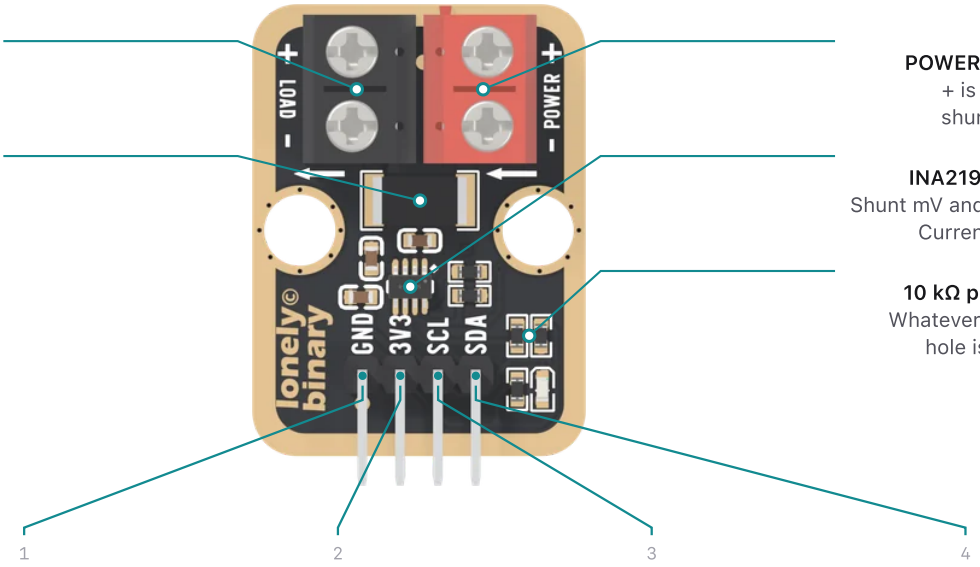
A tenth of an ohm across a supply is nearly a short circuit, and both – screws are the header's GND, so **the block goes in the positive wire and nowhere else**. Nothing on POWER or LOAD may go above 26 V, the chip's absolute maximum.

Pins, and which to wire

Drawn from above, terminals at the top. The supply goes into **POWER**, the load hangs off **LOAD**, and current flows the way the printed arrows point. On the header **SCL comes before SDA**, the reverse of most I²C boards.

LOAD: out to the load
+ is where the volts are read; – is ground.

100 mΩ shunt, 1 %, 2 W
0.1 mA a count; about 1 W of heat at 3.2 A.



POWER: the supply in
+ is one end of the shunt; – is ground.

INA219: two voltages
Shunt mV and LOAD + volts. Current is arithmetic.

10 kΩ pull-ups to 3V3
Whatever feeds the 3V3 hole is the bus level.

Front	GND	3V3	SCL	SDA
I²C	GND	3V3	SCL	SDA

It measures millivolts, not amps

The chip measures two voltages: across the shunt, and at LOAD +. Current is the first divided by a resistance the sketch sets, so a wrong shunt value scales the current and leaves both voltages right. This block is 0.1 Ω.

Four ranges, one step

Narrowest, /1

0.4 A full scale, gain /1

±40 mV across the shunt. Zero error up to ±1 mA; one count 0.1 mA.

/4

1.6 A full scale, gain /4

±160 mV across the shunt. Zero error up to ±1.5 mA; one count 0.1 mA.

Widest, /8, the default

3.2 A full scale, gain /8

±320 mV across the shunt. Zero error up to ±2 mA; one count 0.1 mA.

Every range counts in 0.1 mA. A narrow one halves the zero error, which matters at small currents, and stops at its own full scale: above it the reading pins and does not move. Pick the widest the load can reach, starts included.

Arithmetic on TI's INA219 datasheet (SBOS448G), A grade, maximum offset, and a 100 mΩ 1 % shunt; not measurements. Worst case at 1 A on /8 is under 2 %, at 1 mA the zero error is as large as the reading. The sketch compiles for an ESP32-S3; the block has not been bench-tested for this sheet.

The first reading, on an ESP32-S3

Arduino IDE · Board: ESP32S3 Dev Module · USB CDC On Boot: Enabled · Library: Adafruit INA219

```
#include <Wire.h>
#include <Adafruit_INA219.h>

const int SDA_PIN = 8, SCL_PIN = 9;
Adafruit_INA219 ina(0x40);   // both pads open

// The current with nothing in LOAD, in mA. Read it once.
const float ZERO_MA = 0.0;

void setup() {
  Serial.begin(115200);
  delay(500);
  Wire.begin(SDA_PIN, SCL_PIN);
  if (!ina.begin(&Wire)) {
    Serial.println("No INA219 at 0x40: is SCL the third pin?");
    while (true) delay(1000);
  }
  ina.setCalibration_32V_2A();   // up to 3.2 A, 0.1 mA a count
  Serial.println("shunt_mV  bus_V  mA  mW  supply_V");
}

void loop() {
  float shunt = ina.getShuntVoltage_mV();   // measured
  float bus = ina.getBusVoltage_V();        // measured, LOAD +
  float ma = ina.getCurrent_mA() - ZERO_MA; // worked out
  float mw = ina.getPower_mW();             // worked out
  float supply = bus + shunt / 1000;        // at POWER +
  Serial.printf("%.2f  %.3f  %.1f  %.0f  %.3f\n",
                shunt, bus, ma, mw, supply);
  delay(500);
}
```

```
shunt_mV bus_V mA mW supply_V
```

Twice a second at 115200. With nothing in LOAD the mA column sits within a milliamp or two of zero: note it and put it in ZERO_MA.

Wiring

	FRONT	ESP32-S3	ARDUINO UNO
1	**GND**	GND	GND
2	**3V3**	3V3	5V
3	**SCL**	GPIO 9	A5
4	**SDA**	GPIO 8	A4

Header first, then the rail: supply + to POWER +, supply – to POWER –, LOAD + and LOAD – to the load. On an Uno, feed the 3V3 hole from 5V: its Wire library pulls the lines toward 5 V, past what a 3.3 V-fed chip's SCL takes.

The 3V3 hole sets the bus

The hole is printed 3V3 and takes 3 to 5.5 V: it is the chip's own supply, separate from the rail being measured. The two 10 kΩ pull-ups end there, so whatever feeds it is the level SCL and SDA rest at. Feed it from your board's logic rail: 3V3 on an ESP32 or a Pico, 5V on an Uno. Bridging A0 on the back moves the block to 0x41, A1 to 0x44, both to 0x45.

When it does not work

No INA219 at 0x40

SCL and SDA are swapped: SCL is the third pin. Then check the red LED for GND and 3V3.

The current reads zero

The rail misses the shunt: supply not in POWER, or a screw clamped on insulation.

The voltage is below the supply

Correct: it is read at LOAD +, after the shunt. Add shunt mV back for the supply's.

The current is negative

POWER and LOAD are swapped. Current flows POWER to LOAD, with the arrows. Swap both pairs.

The current is off by a ratio

The sketch has the wrong shunt. The Adafruit calibrations assume 0.1 Ω, which is right.

The numbers jump about

One 532 µs conversion per reading. Average in the chip or the sketch for a steady number.

Specifications

Chip	TI INA219AIDCNR, A grade	**Shunt**	100 mΩ, 1 %, 2 W, in the + wire
Rail	0 to 26 V, POWER to LOAD	**Current**	±0.4 to ±3.2 A, four ranges
One count	0.1 mA; zero error 1 to 2 mA	**Supply**	3 to 5.5 V on the 3V3 hole
I²C	0x40; 0x41, 0x44, 0x45 by pad	**Board**	22.4 × 30.4 mm, all fitted