INA226 Voltage, Current and Power Monitor

Typical test circuit and commissioning guide for the VC Reader module listed by C.B.Electronics s.a.r.l.

OFFICIAL APPLICATION NOTE

Issued by C.B.Electronics s.a.r.l. for the INA226 VC Reader module.

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Application note
High-side DC voltage and current monitoring using I2C

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Purpose

This note presents a complete, representative test circuit for a breakout module based on the Texas Instruments INA226. It explains the monitored power path, I2C wiring, initial checks, calibration relationships, and practical limits.

Scope and module-specific verification

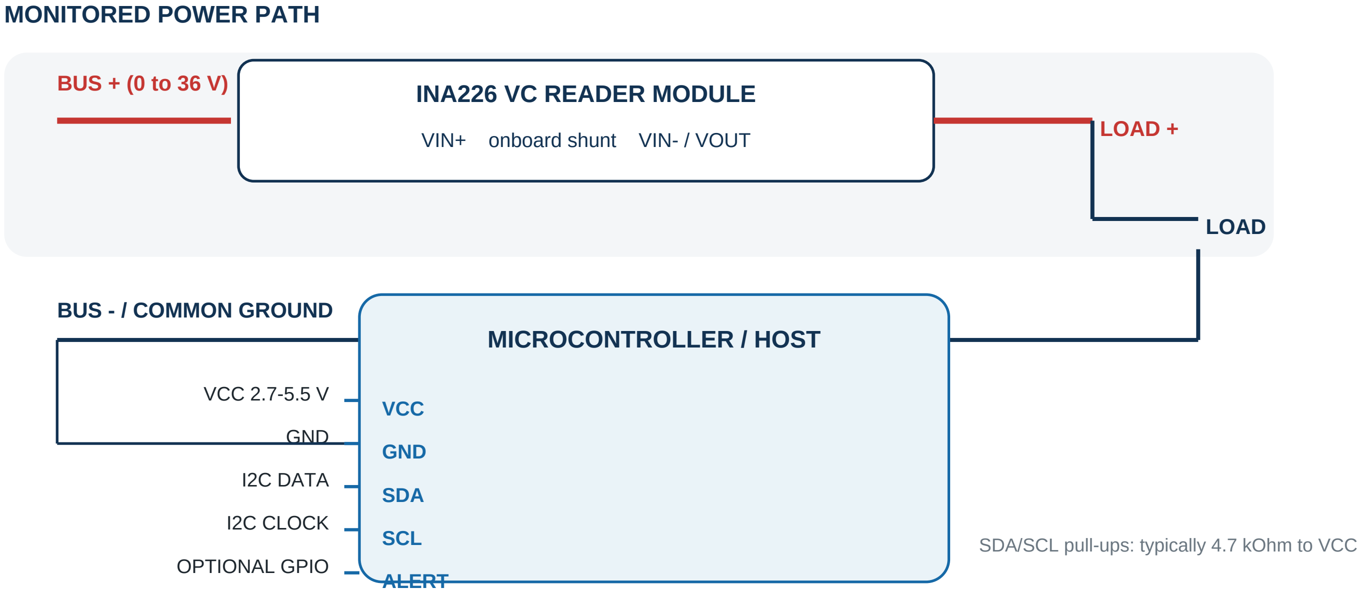
The referenced seller page identifies the product as a VC Reader using the INA226, but it does not expose a board schematic in machine-readable form. Terminal names, fitted shunt resistance, shunt power rating, pull-up resistors, and I2C address straps must therefore be verified on the physical board before high-current use.

Key operating limits

Parameter	INA226 value	Design implication
Logic supply	2.7 V to 5.5 V	Use 3.3 V with a 3.3 V-only host when pull-ups are fitted on the module.
Bus common-mode voltage	0 V to 36 V	The monitored DC source may differ from the logic supply, but grounds are common in this circuit.
Shunt full-scale range	approximately +/-81.92 mV	Maximum current depends on the fitted shunt resistance and its power rating.

1. Complete Typical High-Side Test Circuit

In normal high-side operation, only the positive conductor is routed through the shunt. The negative conductor remains the common return and is tied to the host ground.



Current direction for a positive reading	**DC supply + -> VIN+ -> onboard shunt -> VIN- / VOUT -> load +**

Module-internal functions

The shunt input pins IN+ and IN- measure the small differential voltage across the shunt. VBUS measures the load-side bus voltage. A 0.1 uF bypass capacitor should be present from VS to GND close to the IC. SDA and SCL are open-drain I2C lines and require pull-up resistors, commonly 4.7 kOhm to the module logic supply. ALERT is an optional open-drain output.

Important: some modules label their high-current terminals VIN/VOUT, V+/V-, or IN+/IN-. Confirm continuity and markings rather than relying on connector position.

2. Bench Wiring and Commissioning

Recommended low-energy first test

Use a current-limited 12 V DC bench supply and a resistive load. A 100 Ohm, 5 W resistor produces approximately 0.12 A and 1.44 W at 12 V. The resistor will become warm. Set the supply current limit near 0.25 A before energizing the circuit.

Module connection	Arduino Uno	Typical ESP32	Notes
VCC	5 V	3.3 V	Prefer 3.3 V for a 3.3 V-only I2C host.
GND	GND	GND	Tie to DC supply negative for this non-isolated test.
SDA	A4	GPIO 21 normally	Confirm board-specific I2C mapping.
SCL	A5	GPIO 22 normally	Confirm board-specific I2C mapping.
ALERT	Optional GPIO	Optional GPIO	May be left unconnected when unused.

Commissioning sequence

1. With power removed, read the shunt marking and record the resistance. Typical markings include R002 = 0.002 Ohm, R005 = 0.005 Ohm, R010 = 0.010 Ohm, and R100 = 0.100 Ohm.

2. Check for continuity through the high-current path. Do not use a solderless breadboard for that path.

3. Wire VCC, GND, SDA, and SCL. Inspect whether the module already has I2C pull-ups.

4. Wire supply positive to VIN+, module VIN- or VOUT to load positive, and connect the negative return directly.

5. Power the host first and run an I2C scan. The common default address is 0x40 when A0 and A1 are tied to GND.

6. Enable the DC source at a low current limit. Compare bus voltage and current with a trusted multimeter before increasing load.

Expected first-test result

For 12 V across a 100 Ohm load, expect approximately 12 V, 0.12 A, and 1.44 W, allowing for resistor tolerance, wiring loss, and instrument error.

3. Shunt Selection and Calibration

The INA226 reports bus voltage directly, but meaningful current and power registers require the correct shunt resistance and calibration value.

Range and dissipation relationships

Shunt-limited current: Imax = 0.08192 V / Rshunt
Shunt dissipation: Pshunt = I^2 x Rshunt
Calibration register: CAL = 0.00512 / (Current_LSB x Rshunt)
Power resolution: Power_LSB = 25 x Current_LSB

Shunt	Theoretical full-scale current	Dissipation at 10 A	Practical comment
2 mOhm	40.96 A	0.20 W	Connector and PCB limits will normally dominate.
5 mOhm	16.38 A	0.50 W	Verify shunt wattage and temperature rise.
10 mOhm	8.19 A	1.00 W	10 A exceeds the INA226 shunt-voltage range.
100 mOhm	0.819 A	10.00 W	Suitable only for substantially lower current.

Worked calibration example

For a 2 mOhm shunt and a selected Current_LSB of 0.5 mA/bit:

CAL = 0.00512 / (0.0005 x 0.002) = 5120 decimal = 0x1400
Power_LSB = 25 x 0.0005 = 0.0125 W/bit
Signed current range = 32768 x 0.0005 = 16.384 A

Selecting Current_LSB is a design choice. It must cover the required signed current range while preserving adequate resolution. Libraries often request maximum current and shunt resistance, then perform this calculation internally.

Measurement integrity

Use Kelvin connections from the INA226 input pins to the shunt pads. Keep the bypass capacitor close to VS and GND. Avoid routing high-current copper through breadboards or thin jumper wires. For pulsed loads, increase conversion averaging only after verifying that transient behavior is still captured.

4. Safety, Troubleshooting and References

Safety limits

• Do not exceed 36 V common-mode voltage at IN+, IN-, or VBUS.

• Do not use this non-isolated circuit on mains voltage or where galvanic isolation is required.

• The IC current range is not the module current rating. Respect the shunt, terminal, connector, copper, and thermal limits.

• Remove power before rewiring. Start with a current-limited source and a low-energy resistive load.

• A reversed monitored path normally produces negative current, but module-specific protection and layout must still be checked.

Troubleshooting

Symptom	Likely checks
No I2C response	Confirm VCC and common GND, scan all addresses, inspect SDA/SCL pull-ups, and verify that the IC is actually INA226.
Correct voltage, zero current	Check shunt continuity, calibration register, current path, and module terminal orientation.
Current has wrong sign	Swap VIN+ and VIN- sides of the monitored path or invert the sign in software only if the physical direction is intentional.
Current scale is wrong	Verify the printed shunt code and library shunt value. R002 and R020 differ by a factor of ten.
I2C instability with ESP32	Power the module at 3.3 V if onboard pull-ups connect to VCC; avoid pulling 3.3 V GPIOs to 5 V.

Primary references

1. Texas Instruments, *INA226 36-V, 16-Bit, Ultra-Precise I2C Output Current, Voltage, and Power Monitor With Alert*, datasheet SBOS547B, revised September 2024.
https://www.ti.com/lit/ds/symlink/ina226.pdf

2. Texas Instruments, INA226EVM evaluation module and user guides.
https://www.ti.com/tool/INA226EVM

3. C.B.Electronics s.a.r.l., INA226 VC Reader product page.
https://cb-electronics.com/products/vc-reader/

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