





## Common Sense Amplifier, Frequently Asked Questions (FAQ)



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### Summary

The following questions are typical questions that ON Semiconductor's application support team answers on the topic of current sense amplifiers. If you have a question not addressed here, please do not hesitate to contact your local ON Semiconductor representative, or visit our [Technical Support](#) site to call or email us, or visit our [Design Support](#) site.

### APPLICATION NOTE

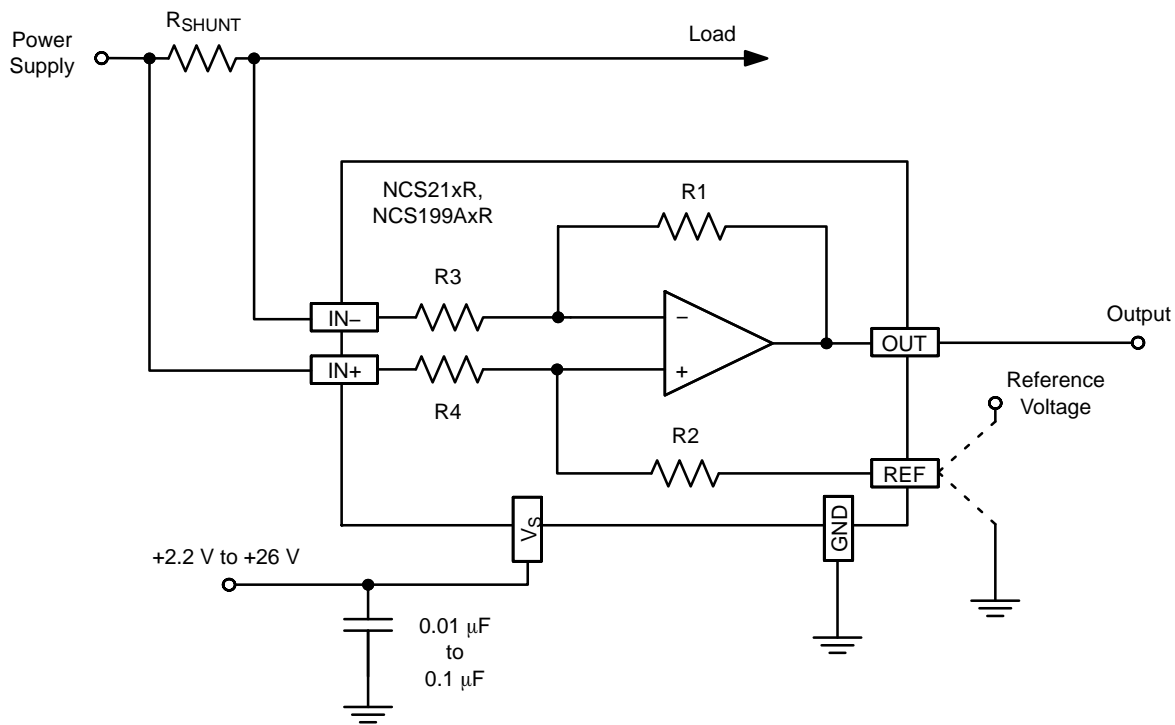


Figure 1. Example Application Schematic of a Current Sense Amplifier

## AND9750/D

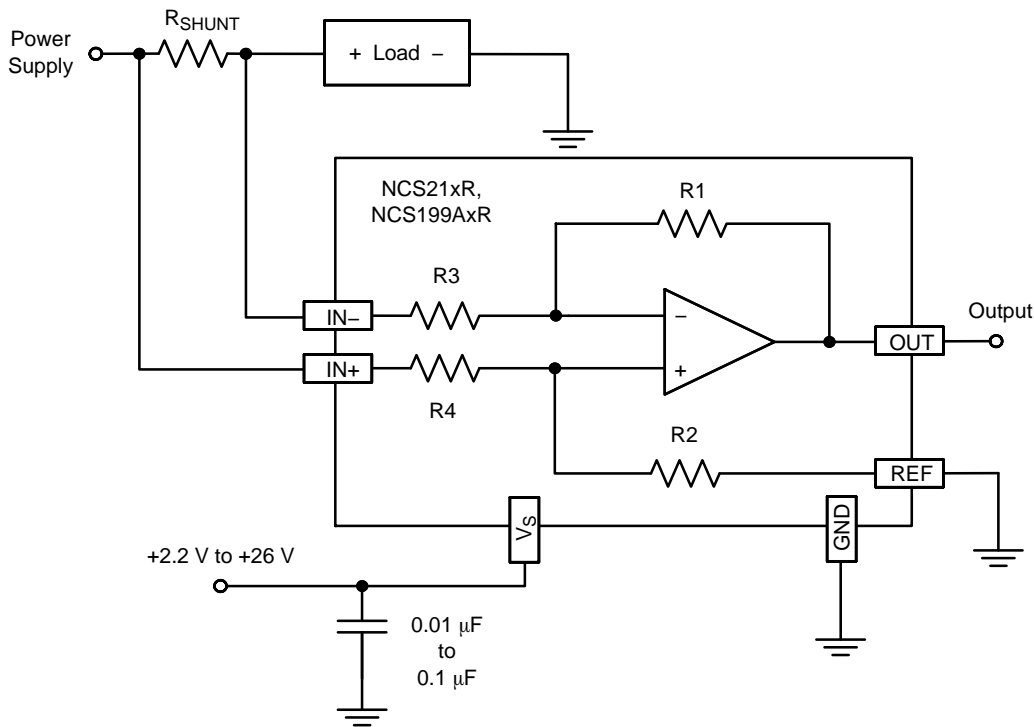


Figure 2. Example Application Schematic of a Current Sense Amplifier Configured for High-side Current Sensing

### FREQUENTLY ASKED QUESTIONS

#### What is a Current Sense Amplifier?

Current sense amplifiers such as the [NCS21xR](#) and [NCS199AxR](#) family of devices, (also called current shunt monitors or current shunt amplifiers) are amplifiers that feature internal precision resistors to create a full differential input. Current sense amplifiers also feature zero-drift architecture or low offset voltage and low offset drift over temperature. These devices measure small voltage drops across a shunt resistor that is connected to the inputs. These devices accurately amplify the 1 mV to 10 mV signal from the shunt, at various gains depending on the chosen device, up to a gain of 500. The output voltage is related to input current across the shunt resistor by:

$$I_{\text{SENSE}} = \frac{V_{\text{OUT}}}{\text{Gain} \cdot R_{\text{SENSE}}} \quad (\text{eq. 1})$$

where  $I_{\text{SENSE}}$  is the current flowing through the shunt resistor,  $V_{\text{OUT}}$  is the output voltage, Gain is the fixed internal gain of the amplifier, and  $R_{\text{SENSE}}$  is the sense (also called shunt) resistor.

#### What are the Common Current Sensing Circuit Configurations?

The common current sensing circuit configurations are:

- Low-side sensing,
- High-side sensing,
- Unidirectional sensing, and
- Bidirectional sensing.

The [NCS21xR](#) and [NCS199AxR](#) family of devices makes possible all of these configurations.

#### What is Low-side Current Sensing?

Low-side current sensing places the low side of the load at one end of the shunt or sense resistor, the other side of the sense resistor is connected to ground. The common mode voltage for low-side sensing will be close to 0 V. Low-side has the advantage of being simple to implement and inexpensive. However, it has the disadvantage of not being able to detect load high-side shorts, and the ground path is disturbed since the low side of the load is connected to ground through the sense resistor. See Figure 3 and take note of the position of the load.

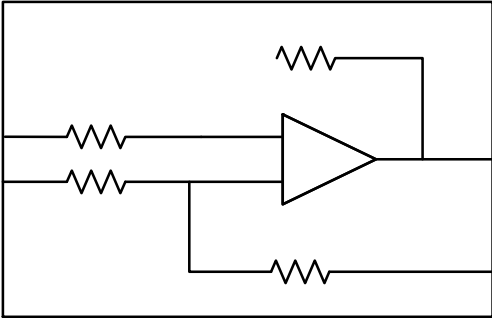


Figure 3. Low-side Current Sensing Example

What is Unidirectional Current Sensing?

