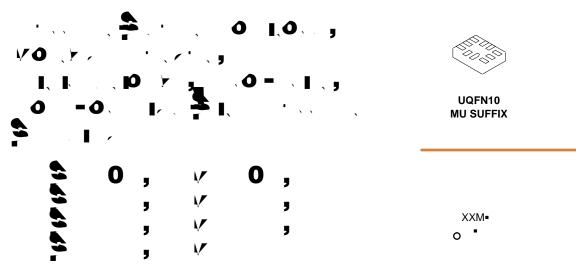
semi



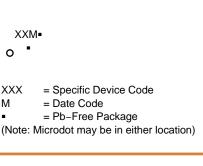
The NCS210R, NCS211R, NCS213R and NCS214R are voltage output, current shunt monitors (also called current sense amplifiers) which can measure voltage across shunts at common-mode voltages from -0.3 V to 26 V, independent of supply voltage. The low offset of the zero-drift architecture enables current sensing across the shunt with maximum voltage drop as low as 10 mV full-scale. These devices can operate from a single +2.2 V to +26 V power supply, drawing a maximum of 80 µA of supply current, and are specified over the extended operating temperature range (-40°C to +125°C). Available in the SC70-6 and UQFN10 packages.

Features

- Wide Common Mode Input Range: -0.3 V to 26 V
- Supply Voltage Range: 2.2 V to 26 V
- Low Offset Voltage: ±35 μV max
- Low Offset Drift: ±0.5 μV/°C
- Low Gain Error: ±1% max
- Low Gain Error Drift: ±10 ppm/°C max
- Rail-to-Rail Output Capability
- Low Current Consumption: 40 μA typ, 80 μA max
- NCV Prefix for Automotive and Other Applications Requiring Unique Site Qualified and PPAP Capable

Typical Applications

- Current Sensing (High–Side/Low–Side)
- Automotive
- Telecom
- Power Management
- Battery Charging and Discharging



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ORDERING INFORMATION

See detailed ordering, marking and shipping information on page 2 of this data sheet.

$\mathsf{NCS210R}, \mathsf{NCV210R}, \mathsf{NCS211R}, \mathsf{NCV211R}, \mathsf{NCS213R}, \mathsf{NCV213R}, \mathsf{NCS214R}, \mathsf{NCV214R}$

Table 1. MAXIMUM RATINGS

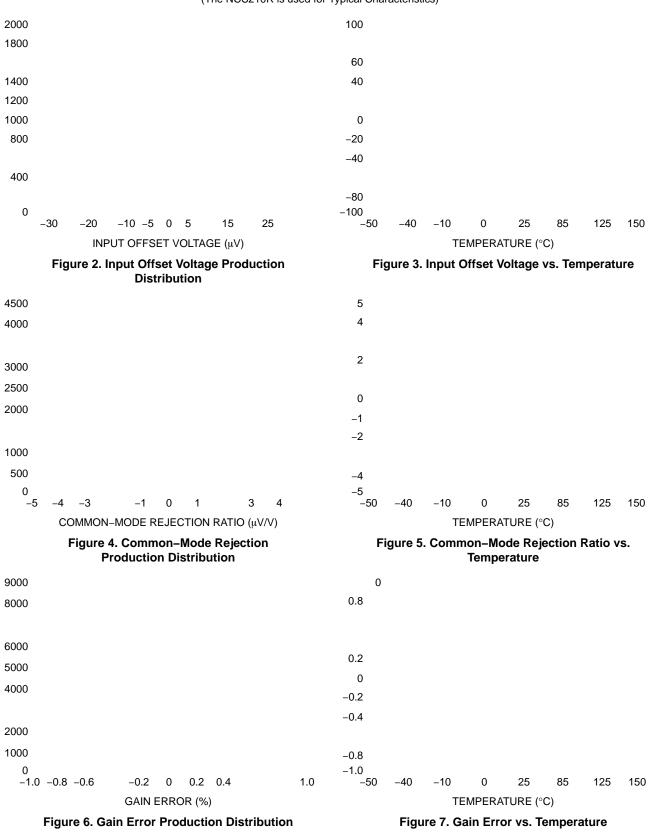
Parameter Supply Voltage (Note 1)		Symbol	Value	Unit V	
		V _S	+30		
Analog Input Voltage	Differential (V _{IN+})–(V _{IN-})	V _{IN+} , V _{IN-}	-30 to +30	V	
	Common-Mode (Note 2)	1 Г	(GND-0.3) to +30		
REF Pin Input Voltage		V _{REF}	(GND-0.3) to (V _s +0.3)	V	
Output Voltage (Note 2)		V _{OUT}	(GND-0.3) to (V _s +0.3)	V	
Input Current into Any Pin (Note 2)			±5	mA	
Maximum Junction Temperature		T _{J(max)}	+150	°C	
Storage Temperature Range		T _{STG}	-65 to +150	°C	
ESD Capability, Human Body Model (Note 3)		НВМ	±2000	V	
Charged Device Model (Note 3)		CDM	CDM ±2000		
Latch–Up Current (Note 4)		I _{LU}	±100	mA	

Stresses

Table 4. ELECTRICAL CHARACTERISTICSAt $T_A = +25^{\circ}C$, $V_{SENSE} = V_{IN+} - V_{IN-}$;NCS210R, NCS213R and NCS214R: $V_S = +5 V$, $V_{IN+} = 12 V$, and $V_{REF} = V_S/2$, unless otherwise noted.NCS211R: $V_S = +12 V$, $V_{IN+} = 12 V$, and $V_{REF} = V_S/2$, unless otherwise noted.Boldface limits apply over the specified temperature range of $T_A = -40^{\circ}C$ to 125°C, guaranteed by characterization and/or design.

Symbol	Parameter	Test Conditions	Min	Тур	Мах	Unit
INPUT		-				
V _{CM}	Common-Mode Input Voltage Range		-0.3		26	V





TYPICAL CHARACTERISTICS ($T_A = 25^{\circ}C$, $V_S = 5 V$, V_{IN} + = 12 V and $V_{REF} = V_S/2$ unless otherwise noted.) (The NCS210R is used for Typical Characteristics)

TYPICAL CHARACTERISTICS (T_A = 25°C, V_S = 5 V, V_{IN}+ = 12 V and V_{REF} = V_S/2 unless otherwise noted.) (The NCS210R is used for Typical Characteristics)



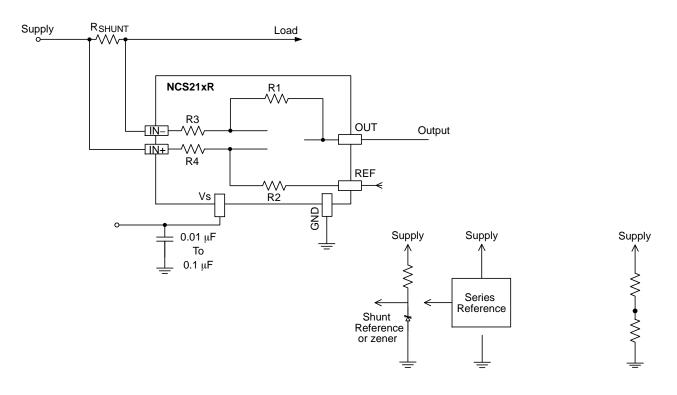


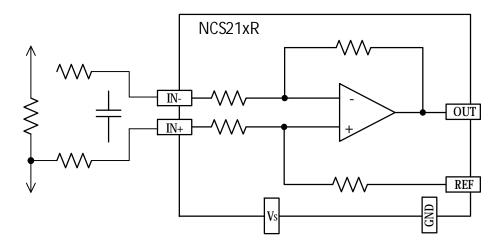
TYPICAL CHARACTERISTICS ($T_A = 25^{\circ}C$, $V_S = 5$ V, V_{IN} + = 12 V and $V_{REF} = V_S/2$ unless otherwise noted.)

Basic Connections

Current Sensing Techniques

The NCS21xR current-sense amplifiers can be configured for both low-side and high-side current sensing. Low-side sensing appears to have the advantage of being straightforward, inexpensive, and can be implemented with a simple op amp circuit. However, the NCS21xR series of devices provides the full differential input necessary to get accurate shunt connections, while also providing a built-in gain network with precision difficult to obtain with external resistors. While at times the application requires low-side sensing, only high-side sensing can detect a short from the positive supply line to ground. Furthermore, high-side sensing avoids adding resistance to the ground path of the load







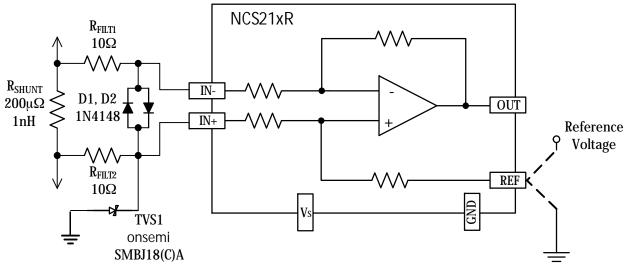


Figure 34. Single TVS transient common-mode protection

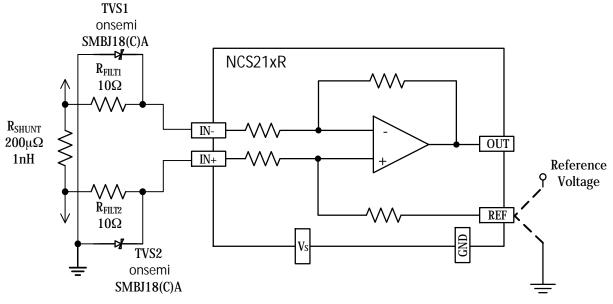


Figure 35. Dual TVS Transient Common-mode Protection

Use Zener diodes or unidirectional TVS diodes with clamping voltage ratings up to a maximum of 30 volts. Select TVS diodes with the lowest voltage rating possible for use in the system. There is a wide range between standoff voltage and maximum clamping voltage in TVS diodes. Most diodes rated at a standoff voltage of 18 V have a maximum clamping voltage of 29.2 V. Refer to the TVS data sheet and the parameters of your power supply to make the selection. In general, higher power TVS diodes demonstrate a sharper clamping knee; providing a tighter relationship between rated breakdown and maximum clamping voltage.

Selecting the Shunt Resistor

The desired accuracy of the current measurement determines the precision, shunt size, and the resistor value. The larger the resistor value, the more accurate the measurement possible, but a large resistor value also results in greater current loss.

For the most accurate measurements, use four terminal current sense resistors, as shown in Figure 36. It provides two terminals for the current path in the application circuit, and a second pair for the voltage detection path of the sense amplifier. This technique is also known as *Kelvin Sensing*. This insures that the voltage measured by the sense amplifier is the actual voltage across the resistor and does not include the small resistance of a combined connection. When using non–Kelvin shunts, follow manufacturer recommendations on how to lay out the sensing traces closely.



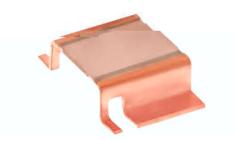
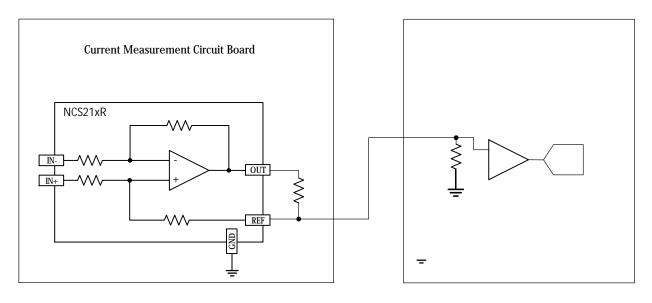


Figure 36. Surface Mount Kelvin Shunt

Current Output Configuration

In applications where the readout boards are remotely located, the voltage output of the NCS21xR can be converted to a precision current output. The precision output current measurements are read more accurately as it overcomes the errors due to ground drops between the boards.

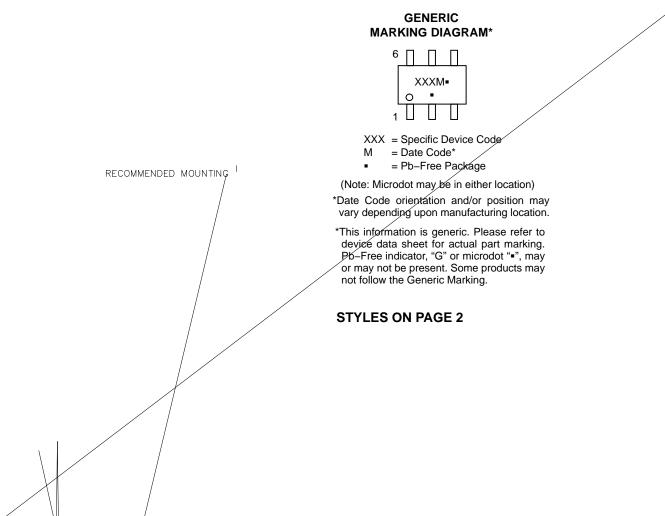




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DATE 18 APR 2024

_ BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.7



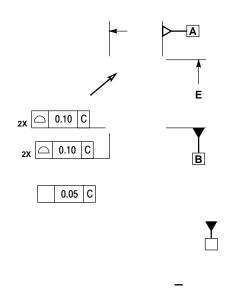
STYLE 1: PIN 1. EMITTER 2 2. BASE 2 3. COLLECTOR 1 4. EMITTER 1 5. BASE 1 6. COLLECTOR 2

STYLE 2: CANCELLED

STYLE 3: CANCELLED

UQFN10 1.4x1.8, 0.4P CASE 488AT ISSUE A

DATE 01 AUG 2007



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