# onse i-

#### **PIN FUNCTION DESCRIPTION**





# **PIN DESCRIPTION**

Pin Name	Туре	Description
IN+	Input	This pin is connected to the positive side of the sense resistor or current shunt.
IN–	Input	This pin is connected to the negative side of the sense resistor or current shunt.
OUT	Output	The output pin provides a low impedance voltage output.
V <sub>S</sub>	Supply	This is the positive supply pin that provides power to the internal circuitry. An external bypass capacitor of 0.1 F is recommended to be placed as close as possible to this pin.
GND	Supply	This is the negative supply rail of the circuit.

#### **MAXIMUM RATINGS**

Parameter		Symbol	Rating	Unit
Supply Voltage (Note 1)		VS	-0.3 to 5.5	V
	Differential (V <sub>IN+</sub> )–(V <sub>IN</sub> ) (Note 2)	V <sub>IN+</sub> , V <sub>IN-</sub>	42	Analog
Analog Inputs	Common–Mode (Note 2)		-0.3 to +42	Inputs
Output		V <sub>OUT</sub>	GND-0.3 to (V <sub>s</sub> ) +0.3	V
Maximum Output Current Input Current into Any Pin Maximum Junction Temperature Storage Temperature Range ESD Capability, Human Body Model (Note 3) Charged Device Model (Note 3) Latch-up Current (Note 4)		I <sub>OUT</sub>	8	mA
		I <sub>IN</sub>	10	mA
		T <sub>J(max)</sub>	+150	С
		T <sub>STG</sub>	-65 to +150	С
		НВМ	2000	V
		CDM	1000	V
			100	mA

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected. 1. Refer to ELECTRICAL CHARACTERISTICS, RECOMMENDED OPERATING RANGES and/or APPLICATION INFORMATION for safe

operating parameters.

2. Input voltage at any pin may exceed the voltage shown if current at that pin is limited to 10 mA

3. This device series incorporates ESD protection and is tested by the following methods: ESD Human Body Model tested per JEDEC standard JS-001-2017

ESD Charged Device Model tested per JEDEC standard JS-002-2014

4. Latch-up Current tested per JEDEC standard: JESD78E

#### THERMAL CHARACTERISTICS

Parameter	Symbol	Package	Value	Unit
Thermal Resistance, Junction-to-Air (Notes 5, 6)	$\theta_{JA}$	TSOP-5 / SOT23-5	208	C/W
		Micro8 / MSOP-8	162	

5. Refer to ELECTRICAL CHARACTERISTICS, RECOMMENDED OPERATING RANGES and/or APPLICATION INFORMATION for safe operating parameters

Values based on copper area of 645 mm<sup>2</sup> (or 1 in<sup>2</sup>) of 1 oz copper thickness and FR4 PCB substrate

**ELECTRICAL CHARACTERISTICS** (continued) At  $T_A = +25$  C,  $V_{SENSE} = (V_{IN+}) - (V_{IN-})$ ;  $V_S = 5$  V,  $V_{IN+} = 12$  V, unless otherwise noted. **Boldface** limits apply over the specified temperature range,  $T_A = -40$  C to 125 C unless otherwise noted, guaranteed by characterization and/or design.

Parameter	Symbol	Conditions	Min	Тур	Max	Unit			
OUTPUT									
Gain	G	G 20	-	20	-	V/V			
		G 50	-	50	-	1			
		G 100	-	100	-				
		G 200	-	200	-	1			
Gain Error		T <sub>A</sub> = 25 C	-	0.1	-	%			
		$T_A = -40 \text{ C to } +125 \text{ C}$	-	-	±0.4	1			
Gain Error vs Temperature		$T_A = -40 \text{ C to } +125 \text{ C}$	-	1.5	±20	ppm/ C			
Nonlinearity Error			-	0.01	-	%			
Maximum Capacitive Load	CL	No sustained oscillation	-	1	-	nF			
Settling Time to 1%			-	5	-	μs			

#### **VOLTAGE OUTPUT**

Output Voltage High, Swing from V <sub>S</sub> Supply Rail	V <sub>S</sub> – V <sub>OH</sub>	$V_{S}$ = 5.5 V $R_{L}$ = 10 k $\Omega$ to GND, $T_{A}$ = 25 C	-	0.02	-	V
		$V_S = 5.5 V$ $R_L = 10 k$ to GND, $T_A$				

NCS21673, NCV21673, NCS21674, NCV21674  $\textbf{TYPICAL CHARACTERISTICS} \text{ (At } T_A = +25 \text{ C}, \text{ } V_{SENSE} = (V_{IN+}) - (V_{IN-}), \text{ } V_S = 5.0 \text{ } V, \text{ } V_{IN} + = 12 \text{ } V, \text{ and all gains unless} \text{ } V_{IN+} = 12 \text{ } V, \text{ } V, \text{ } V_{IN+} = 12 \text{ } V, \text{ } V, \text{ } V_{IN+} =$ otherwise noted.) Figure 3a. Input Offset Voltage Distribution, Figure 3b. Input Offset Voltage Distribution, G20 G50 Figure 3d. Input Offset Voltage Distribution, Figure 3c. Input Offset Voltage Distribution, G100 G200 150 100 50 0 -50 G20 G50 G100 G200 -100

Figure 4. Input Offset vs. Temperature

50

Temp(C)

75

100

125

150

Offset Voltage (V)

-150

-50

-25

0

25

Figure 5a. Common Mode Rejection Ratio Distribution, G20

**TYPICAL CHARACTERISTICS** (At  $T_A = +25$  C,  $V_{SENSE} = (V_{IN+}) - (V_{IN-})$ ,  $V_S = 5.0$  V,  $V_{IN}+ = 12$  V, and all gains unless otherwise noted.) (continued)



Figure 5b. Common Mode Rejection Ratio Distribution, G50



Figure 5d. Common Mode Rejection Ratio Distribution, G200



Figure 7a. Gain Error Distribution, G20



Figure 5c. Common Mode Rejection Ratio Distribution, G100



Figure 6. Common Mode Rejection Ratio vs Temperature



Figure 7b. Gain Error Distribution, G50

**TYPICAL CHARACTERISTICS** (At  $T_A = +25$  C,  $V_{SENSE} = (V_{IN+}) - (V_{IN-})$ ,  $V_S = 5.0$  V,  $V_{IN}+ = 12$  V, and all gains unless otherwise noted.) (continued)

**TYPICAL CHARACTERISTICS** (At  $T_A = +25$  C,  $V_{SENSE} = (V_{IN+}) - (V_{IN-})$ ,  $V_S = 5.0$  V,  $V_{IN}+ = 12$  V, and all gains unless otherwise noted.) (continued)



TYPICAL CHARACTERISTICS (At T<sub>A</sub> = +25

**TYPICAL CHARACTERISTICS** (At  $T_A = +25$  C,  $V_{SENSE} = (V_{IN+}) - (V_{IN-})$ ,  $V_S = 5.0$  V,  $V_{IN+} = 12$  V, and all gains unless

# **APPLICATION INFORMATION**

# **Current Sensing Techniques**

NCS(V)21673 and NCS(V)21674 are current sense amplifiers featuring a wide common mode voltage range that spans from 0.1 V to 40 V independent of the supply voltage. These amplifiers can be configured for low side and high side current sensing.

### **Unidirectional Operation**

In unidirectional current sensing, the measured load current always flows in the same direction. Common applications for unidirectional operation include power supplies and load current monitoring. In this configuration, the IN+ pin should be connected to the high side of the sense resistor, while the IN pin should be connected to the low side of the sense resistor.

# Input Filtering

As shunt resistors decrease in value, shunt inductance can significantly affect frequency response. At values below 1 m, the shunt inductance causes a zero in the transfer function that often results in corner frequencies in the low 100's of kHz. This inductance increases the amplitude of high frequency spike transient events on the current sensing line that can overload the front end of any shunt current sensing IC. This problem must be solved by external filtering at the input of the amplifier. Note that all current sensing IC's are vulnerable to this problem, regardless of manufacturer claims. Filtering is required at the input of the device to resolve this problem, even if the spike frequencies are above the rated 3 dB bandwidth of the device.



Also note that when powered, the shunt input pins will

exhibit the specified and well matched bias current. The shunt input pins support the rated common mode voltage

when the power is not applied

VIN terminal to the output which forms a divider with the 400 k $\Omega$ . Vout under unpowered conditions will be:

$$Vout = \frac{VIN_{(Rload)}}{400K + (Rload)}$$
(eq. 3)

Load resistance to ground should be added to keep Vout within required system limits under this condition.

#### **ORDERING INFORMATION**

Device	Channels	Package	Gain	OPN	Marking	Shipping <sup>†</sup>			
INDUSTRIAL AN	NDUSTRIAL AND CONSUMER								
NCS21673	Single		20	NCS21672SN2C020T1C	AE2	Tane and Reel			

NCS21673	Single	TSOP-5	20	NCS21673SN2G020T1G	AE2	Tape and Reel
			50	NCS21673SN2G050T1G**	AE3	30007 Keel
			100	NCS21673SN2G100T1G**	AE4	
			200	NCS21673SN2G200T1G**	AE5	
NCS21674	Dual	Micro8	20	NCS21674DMG020R2G**	G020	Tape and Reel
			50	NCS21674DMG050R2G	G050	4000 / Reel
			100	NCS21674DMG100R2G	G100	
			200	NCS21674DMG200R2G	G200	

#### AUTOMOTIVE QUALIFIED

NCV21673*	Single	TSOP-5	20	NCV21673SN2G020T1G	AE2	Tape and Reel
			50	NCV21673SN2G050T1G**	AE3	3000 / Reel
			100	NCV21673SN2G100T1G**	AE4	
			200	NCV21673SN2G200T1G**	AE5	
NCV21674*	Dual	Micro8	20	NCV21674DMG020R2G**	G020	Tape and Reel
			50	NCV21674DMG050R2G	G050	4000 / Reel
			100	NCV21674DMG100R2G	G100	
			200	NCV21674DMG200R2G	G200	

+For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

\*NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC–Q100 Qualified and PPAP Capable

\*\*In Development / Consult Sales



Y

.

#### TSOP-5 3.00x1.50x0.95, 0.95P **CASE 483** ISSUE P

DATE 01 APR 2024







- \*This information is generic. Please refer to device data sheet for actual part marking. Pb–Free indicator, "G" or microdot "■", may or may not be present. Some products may not follow the Generic Marking.



Micro8 CASE 846A-02 ISSUE K

DATE 16 JUL 2020









3: S 1.  $\bullet$  A 3.  $\bullet$  A 4.  $\bullet$  - A 5.  $\bullet$  - A 6.  $\bullet$  - A 7. - A 8. - A

onsemi, , and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "onsemi" or its affiliates and/or subsidiaries in the United States and/or other countries. onsemi owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of onsemi's product/patent coverage may be accessed at <a href="http://www.onsemi.com/site/pdf/Patent-Marking.pdf">www.onsemi.com/site/pdf/Patent-Marking.pdf</a>. Onsemi reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and onsemi makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or incruit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using onsemi