

NCS2005

Operational Amplifier, Low Power, 8 MHz GBW, Rail-to-Rail Input-Output

The NCS2005 provides high performance in a wide range of applications. The NCS2005 offers beyond rail-to-rail input range, full rail-to-rail output swing, large capacitive load driving ability, and low distortion. The inputs can be driven by voltages that exceed both power supply rails, thus eliminating concerns over exceeding the common-mode voltage range. The rail-to-rail output swing capability provides the maximum possible dynamic range at the output. This is particularly important when operating on low supply voltages.

Operating on supplies of 2.2 V to 32 V, the NCS2005 is excellent for a very wide range of applications in low power systems. With a supply current of 1.3 mA, the 8 MHz gain-bandwidth of this device supports applications where faster speeds are required. Placing the amplifier right at the signal source reduces board size and simplifies signal routing. The NCS2005 is available in a space-saving 5-pin SOT-23 package.

Features

- Wide Power Supply Range: 2.2 V to 32 V
- Common Mode Voltage Range Wider than Rail-to-Rail:
 $V_{CM} = -0.1 \text{ V to } 5.1 \text{ V @ } V_S = 5 \text{ V}$
- Wide Gain-bandwidth: 8 MHz typical
- Low Supply Current: 1.3 mA typical
- Stable with a 1 nF Capacitor Load with a Phase Margin over 25° @ $V_S = 10 \text{ V}$
- Available in a Space-saving 5-pin SOT23 Package
- These devices are Pb-free, Halogen free/BFR Free and are RoHS Compliant

Typical Applications

- Active Filters
- Voltage Referenced Buffers
- Sensors and Instrumentation
- Microphone Amplifiers
- ASIC Input Drivers
- Portable Communications
- PCMCIA Cards



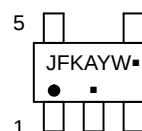
ON Semiconductor®

www.onsemi.com



SOT23-5
SN SUFFIX
CASE 483

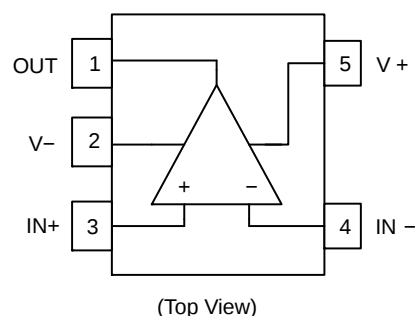
MARKING DIAGRAM



JFK = Specific Device Code
A = Assembly Location
Y = Year
W = Work Week
▪ = Pb-Free Package

(Note: Microdot may be in either location)

PIN DIAGRAM



(Top View)

ORDERING INFORMATION

Device	Package	Shipping†
NCS2005SN1T1G	SOT-23 (Pb-Free)	3000 / Tape & Reel

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

Table 1. PIN DESCRIPTION

Pin	Name	Type	Description
1	OUT	Output	Amplifier output
2	V-	Power	Negative power supply
3	IN+	Input	Non-inverting input of amplifier
4	IN-	Input	Inverting input of amplifier
5	V+	Power	Positive power supply

Table 2. ABSOLUTE MAXIMUM RATINGS (Note 1)

rating	Symbol	Value	Units
Supply Voltage Range (V+ – V-)	V_S	0 to 35	V
Input Voltage Range	V_{CM}	(V-) – 0.3 V to (V+) + 0.3 V	V
Differential Input Voltage Range	V_{diff}	0 to 15	V
Input Pin Current	I_{IN}	±10	mA
Output Pin Current (Note 2)	I_{OUT}	±20	mA
Supply Current	I_S	25	mA
Maximum Junction Temperature (Note 3)	$T_{J(max)}$	+150	°C
Storage Temperature Range	T_{stg}	-65 to +150	°C
ESD Capability (Note 4) Human Body Model Charged Device Model	HBM CDM	4000 400	V
Moisture Sensitivity Level (Note 5)	MSL	Level 1	

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 and APPLICATION INFORMATION for Safe Operating Area.
2. Applies to both single supply and split supply operation. Continuous short circuit operation at elevated ambient temperature can result in exceeding the maximum allowed junction temperature of 150°C.
3. The maximum power dissipation is a function of $T_{J(MAX)}$, T_{JA} , and T_A . The maximum allowable dissipation at any ambient temperature is $P_d = (T_{J(max)} - T_A)/T_{JA}$. All numbers apply for packages soldered directly to a PC board.
4. This device series incorporates ESD protection and is tested by the following methods:
ESD Human Body Model tested per JESD22-A114
ESD Charged Device Model tested per ANSI/ESD S5.3.1-2009
5. Moisture Sensitivity Level tested per IPC/JEDEC standard: J-STD-020A

Table 3. THERMAL CHARACTERISTICS

Parameter	Symbol	Package	Single Layer Board	Multi Layer Board	Units
Thermal Resistance Junction-to-Ambient (Note 6)	θ_{JA}	SOT-23-5	408 (Note 6)	355 (Note 7)	°C/W

6. Values based on a 1S standard PCB according to JEDEC51-3 with 1.0 oz copper and a 300 mm² copper area
7. Values based on a 1S2P standard PCB according to JEDEC51-7 with 1.0 oz copper and a 100 mm² copper area

Table 4. OPERATING RANGES

Parameter	Symbol	Min	Max	Units
Power Supply Voltage	V_S	2.2	32	V
Common Mode Input Voltage	V_{CM}	(V-) – 0.1	(V+) + 0.1	V
Ambient Temperature	T_A	-40	125	°C

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

Table 5. ELECTRICAL CHARACTERISTICS AT 10 V SUPPLY Unless otherwise noted, values are referenced to $T_A = 25^\circ\text{C}$, $V_+ = 10\text{ V}$, $V_- = 0\text{ V}$, $V_{CM} = V_+/2$, and $R_L > 1\text{ M}\Omega$ to $V_+/2$. **Boldface** limits apply from $T_A = -40^\circ\text{C}$ to 125°C . (Notes 8, 9)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Units
-----------	-----------------	--------	-----	-----	-----	-------

SUPPLY CHARACTERISTICS

Quiescent Supply Current	No load	I_S		1.30	1.5	mA
					1.7	
Power Supply Rejection Ratio	$V_S = 2.7\text{ V to }30\text{ V}$	PSRR		113		dB
			70			

INPUT CHARACTERISTICS

Input Offset Voltage		V _{OS}		0.2	6	mV
					6	
Input Offset Voltage Drift		ΔV/ΔT		1		μV/°C
Input Bias Current	V _{CM} = 0 V	I _{IB}		50	200	nA
					200	
	V _{CM} = 10 V			50	200	
					200	
Input Offset Current	V _{CM} = 0 V	I _{OS}		2	70	nA
					80	
	V _{CM} = 10 V			2	70	
					80	
Input Resistance		R _{IN}		95		MΩ
Input Capacitance		C _{IN}		3		pF
Common Mode Rejection Ratio	V _{CM} = V– to V+	CMRR	73	84		dB

OUTPUT CHARACTERISTICS

High-level output voltage	$I_L = 10\text{ mA}$	V_{OH}	9.65	9.80		V
Low-Level Output Voltage	$I_L = 10\text{ mA}$	V_{OL}		176	300	mV
Output Current Capability	Sourcing current	I_{OUT}		12		mA
	Sinking current			20		

DYNAMIC PERFORMANCE

Open Loop Voltage Gain	$R_L = 10\text{ k}\Omega$	A_{VOL}	83	107		dB
Gain-Bandwidth Product	$R_L = 10\text{ k}\Omega$	GBWP		8.5		MHz
Gain Margin	$R_L = 10\text{ k}\Omega$	A_M		5.5		dB
Phase Margin	$R_L = 10\text{ k}\Omega$	ψ_M		65		$^\circ$
Slew Rate	$R_L = 10\text{ k}\Omega$	SR		2.8		$\text{V}/\mu\text{s}$
Total Harmonic Distortion Plus Noise	$f_{IN} = 1\text{ kHz}$, $A_V = 2$, $R_L = 2\text{ k}\Omega$	THD+n		0.0015		%

NOISE PERFORMANCE

Voltage Noise Density	$f = 1\text{ kHz}$	e_N		45		$\text{nV}/\sqrt{\text{Hz}}$
-----------------------	--------------------	-------	--	----	--	------------------------------

8. Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.

9. Performance guaranteed over the indicated operating temperature range by design and/or characterization tested at $T_J = T_A = 25^\circ\text{C}$.

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

Table 6. ELECTRICAL CHARACTERISTICS AT 5 V SUPPLY Unless otherwise noted, values are referenced to $T_A = 25^\circ\text{C}$, $V_+ = 5\text{ V}$, $V_- = 0\text{ V}$, $V_{CM} = V_+/2$, and $R_L \geq 1\text{ M}\Omega$ to $V_+/2$. **Boldface** limits apply from $T_A = -40^\circ\text{C}$ to 125°C , unless otherwise noted. (Notes 10, 11)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Units
-----------	-----------------	--------	-----	-----	-----	-------

SUPPLY CHARACTERISTICS

Quiescent Supply Current	No load	I_S		1.25		mA
Power Supply Rejection Ratio	$V_S = 2.7\text{ V to }30\text{ V}$	PSRR		113		dB
			70			

INPUT CHARACTERISTICS

Input Offset Voltage		V_{OS}		0.2	6	mV
					6	
Input Offset Voltage Drift		$\Delta V/\Delta T$		1		$\mu\text{V}/^\circ\text{C}$
Input Bias Current	$V_{CM} = 0\text{ V}$	I_{IB}		55		nA
	$V_{CM} = 5\text{ V}$			55		
Input Offset Current	$V_{CM} = 0\text{ V}$	I_{OS}		2		nA
	$V_{CM} = 5\text{ V}$			2		
Input Resistance		R_{IN}		45		$\text{M}\Omega$
Input Capacitance		C_{IN}		3		pF
Common Mode Rejection Ratio	$V_{CM} = V_- \text{ to } V_+$	CMRR	68	90		dB

OUTPUT CHARACTERISTICS

High-level Output Voltage	$I_L = 5\text{ mA}$	V_{OH}	4.75	4.83		V
Low-level Output Voltage	$I_L = 5\text{ mA}$	V_{OL}		130	200	mV
Output Current Capability	Sourcing current	I_{OUT}		12		mA
	Sinking current			20		

DYNAMIC PERFORMANCE

Open Loop Voltage Gain	$R_L = 10\text{ k}\Omega$	A_{VOL}	83	100		dB
Gain-Bandwidth Product	$R_L = 10\text{ k}\Omega$	GBWP		8.5		MHz
Gain Margin	$R_L = 10\text{ k}\Omega$	A_M		5.5		dB
Phase Margin	$R_L = 10\text{ k}\Omega$	ψ_M		65		$^\circ$
Slew Rate	$R_L = 10\text{ k}\Omega$	SR		2.7		$\text{V}/\mu\text{s}$
Total Harmonic Distortion Plus Noise	$f_{IN} = 1\text{ kHz}$, $A_V = 2$, $R_L = 2\text{ k}\Omega$	THD+n		0.002		%

NOISE PERFORMANCE

Voltage Noise Density	$f = 1\text{ kHz}$	e_N		45		$\text{nV}/\sqrt{\text{Hz}}$
-----------------------	--------------------	-------	--	----	--	------------------------------

10. Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.

11. Performance guaranteed over the indicated operating temperature range by design and/or characterization tested at $T_J = T_A = 25^\circ\text{C}$.

Table 7. ELECTRICAL CHARACTERISTICS AT 2.7 V SUPPLY Unless otherwise noted, values are referenced to $T_A = 25^\circ\text{C}$, $V_+ = 2.7\text{ V}$, $V_- = 0\text{ V}$, $V_{CM} = V_+/2$, and $R_L \geq 1\text{ M}\Omega$ to $V_+/2$. **Boldface** limits apply from $T_A = -40^\circ\text{C}$ to 125°C , unless otherwise noted. (Notes 12, 13)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Units
-----------	-----------------	--------	-----	-----	-----	-------

SUPPLY CHARACTERISTICS

Quiescent Supply Current	No load	I_S		1.25		mA
Power Supply Rejection Ratio	$V_S = 2.7\text{ V}$ to 30 V	PSRR	70	113		dB

INPUT CHARACTERISTICS

Input Offset Voltage		V_{OS}		0.2	6	mV
					6	
Input Offset Voltage Drift		$\Delta V/\Delta T$		1		$\mu\text{V}/^\circ\text{C}$
Input Bias Current	$V_{CM} = 0\text{ V}$	I_{IB}		45		nA
	$V_{CM} = 2.7\text{ V}$			45		
Input Offset Current	$V_{CM} = 0\text{ V}$	I_{OS}		2		nA
	$V_{CM} = 2.7\text{ V}$			2		
Input Resistance		R_{IN}		90		$\text{M}\Omega$
Input Capacitance		C_{IN}		3		pF
Common Mode Rejection Ratio	$V_{CM} = V_-$ to V_+	CMRR	58	96		dB

OUTPUT CHARACTERISTICS

High-Level Output Voltage	$I_L = 2.7\text{ mA}$	V_{OH}	2.50	2.60		V
Low-Level Output Voltage	$I_L = 2.7\text{ mA}$	V_{OL}		100	130	mV
Output Current Capability	Sourcing current	I_{OUT}		12		mA
	Sinking current			20		

DYNAMIC PERFORMANCE

Open Loop Voltage Gain	$R_L = 10\text{ k}\Omega$	A_{VOL}	73	114		dB
Gain-Bandwidth Product	$R_L = 10\text{ k}\Omega$	GBWP		8.5		MHz
Gain Margin	$R_L = 10\text{ k}\Omega$	A_M		6		dB
Phase Margin	$R_L = 10\text{ k}\Omega$	ψ_M		60		$^\circ$
Slew Rate	$R_L = 10\text{ k}\Omega$	SR		2.6		$\text{V}/\mu\text{s}$
Total Harmonic Distortion Plus Noise	$f_{IN} = 1\text{ kHz}$, $A_V = 2$, $R_L = 2\text{ k}\Omega$	THD+n		0.05		%

NOISE PERFORMANCE

Voltage Noise Density	$f = 1\text{ kHz}$	e_N		45		$\text{nV}/\sqrt{\text{Hz}}$
-----------------------	--------------------	-------	--	----	--	------------------------------

12. Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.

13. Performance guaranteed over the indicated operating temperature range by design and/or characterization tested at $T_J = T_A = 25^\circ\text{C}$.

TYPICAL CHARACTERISTICS

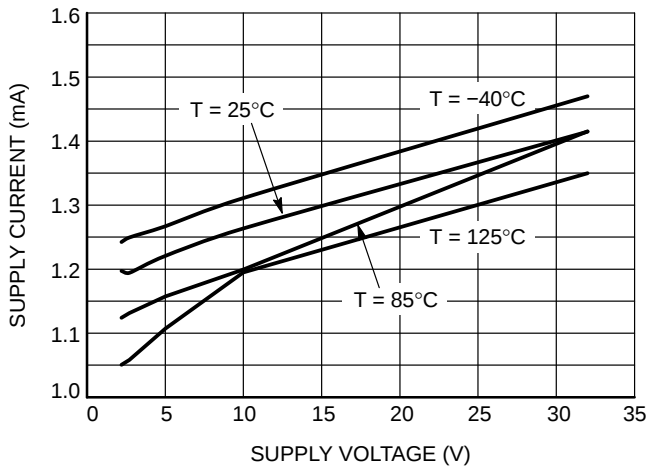


Figure 1. Quiescent Current Per Channel vs. Supply Voltage

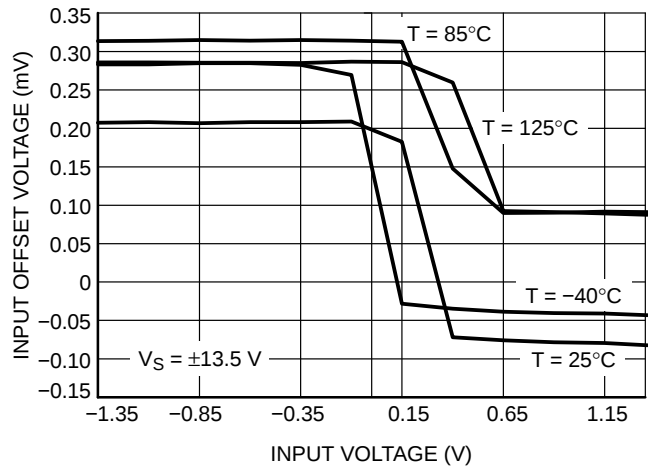


Figure 2. Input Offset Voltage vs. Common Mode Input Voltage

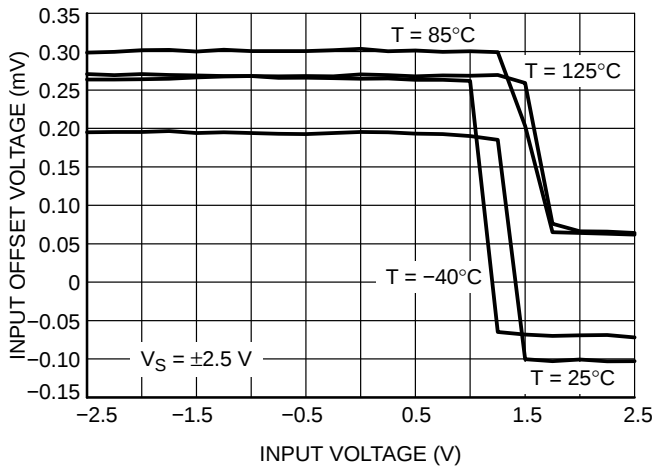


Figure 3. Input Offset Voltage vs. Common Mode Input Voltage

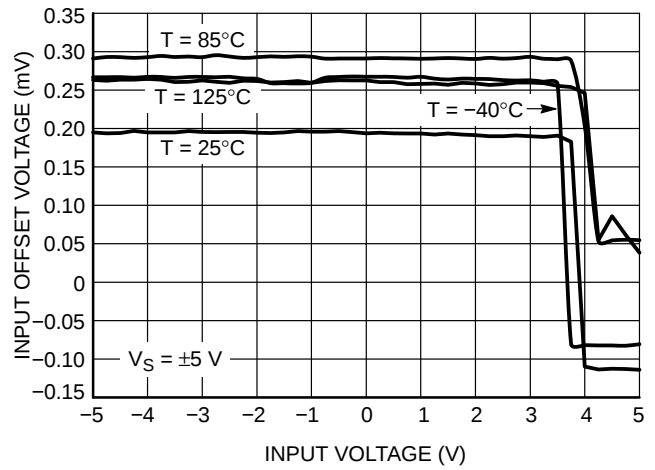


Figure 4. Input Offset Voltage vs. Common Mode Voltage

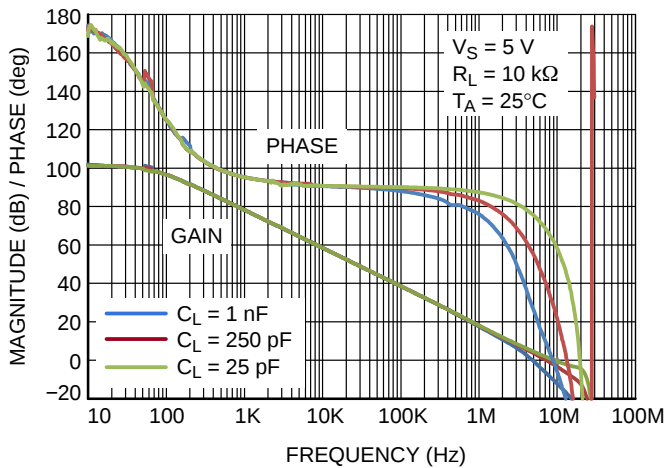


Figure 5. Gain and Phase vs. Frequency

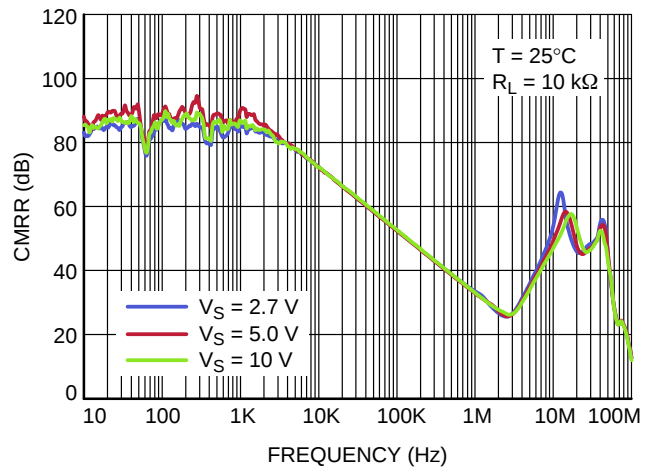


Figure 6. CMRR vs. Frequency

TYPICAL CHARACTERISTICS

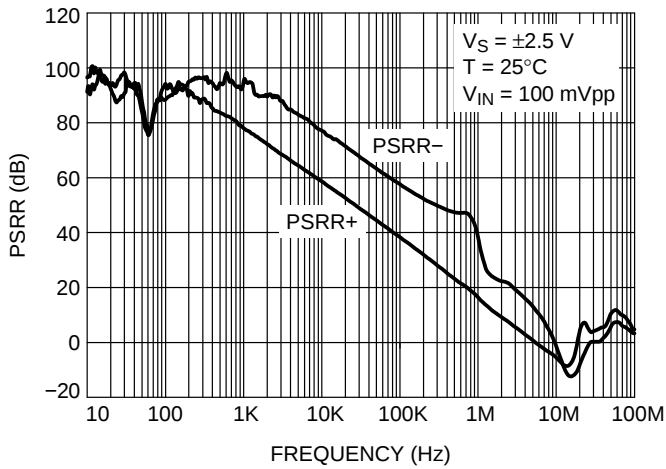


Figure 7. PSRR vs. Frequency

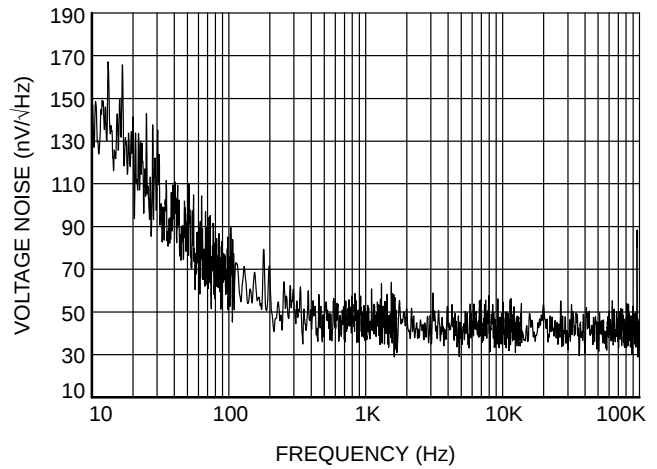


Figure 8. Input Voltage Noise vs. Frequency

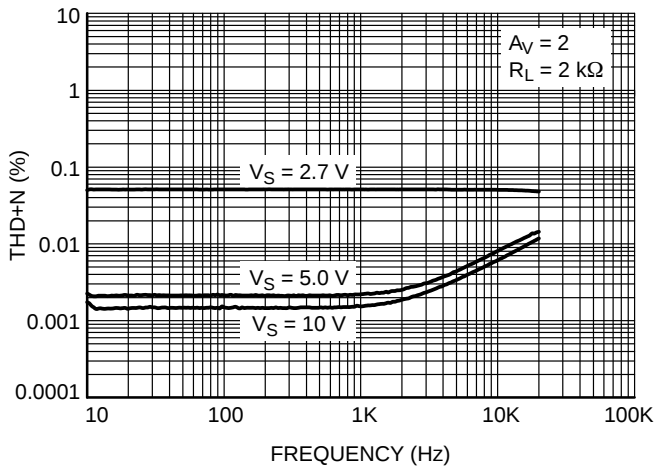
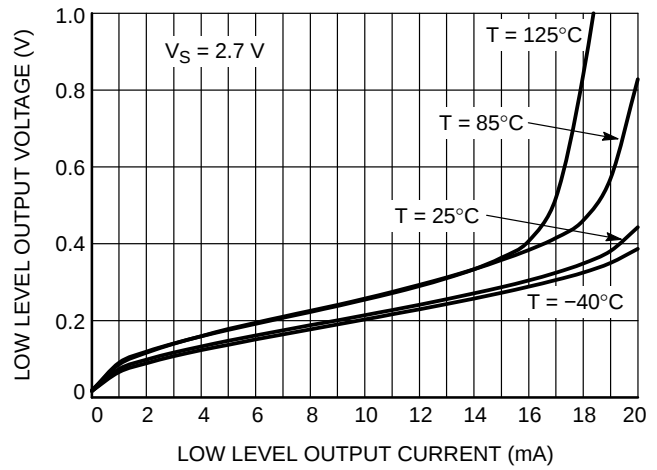
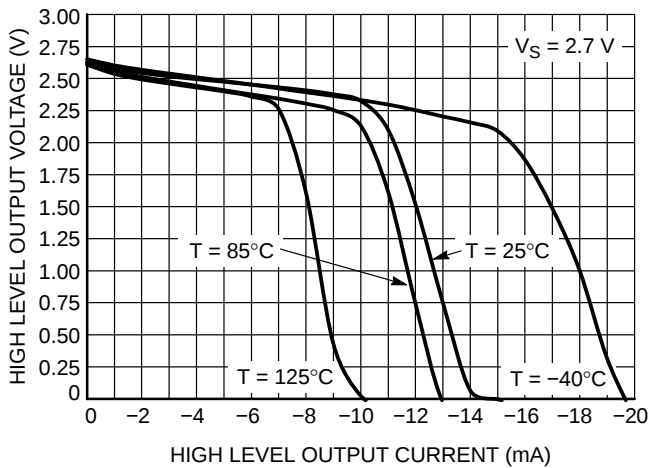
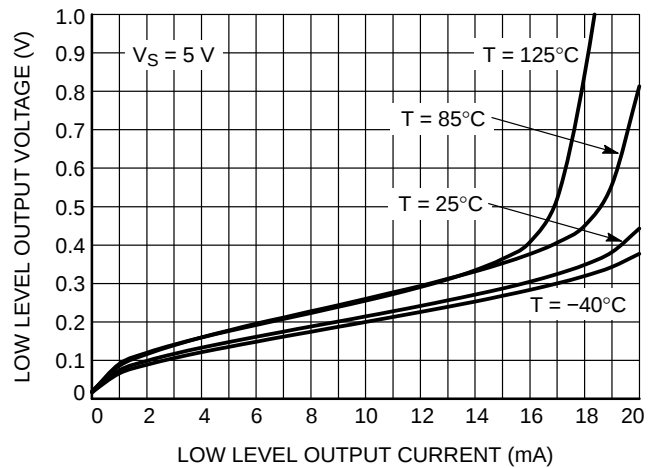


Figure 9. THD+N vs. Frequency

Figure 10. Low Level Output Voltage vs. Output Current @ $V_S = 2.7\text{ V}$ Figure 11. High Level Output Voltage vs. Output Current @ $V_S = 2.7\text{ V}$ Figure 12. Low Level Output Voltage vs. Output Current @ $V_S = 5\text{ V}$

TYPICAL CHARACTERISTICS

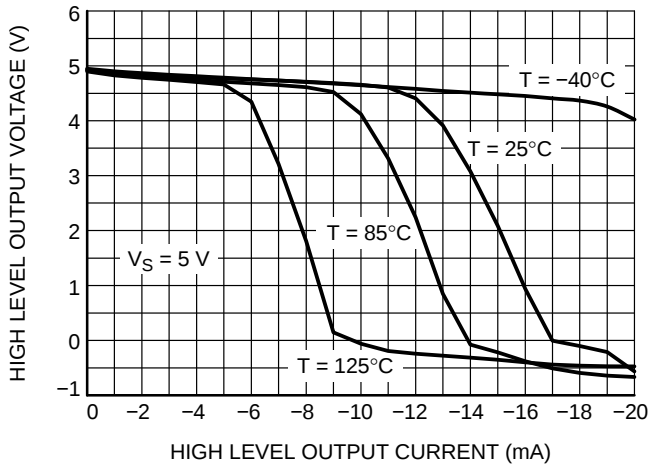


Figure 13. Low Level Output Voltage vs. Output Current

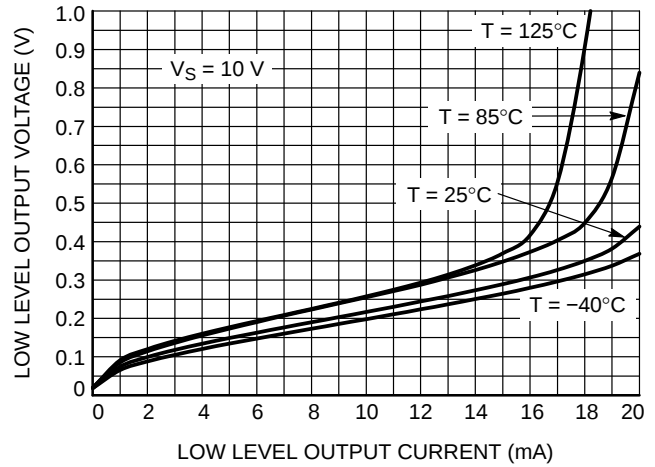


Figure 14. High Level Output Voltage vs. Output Current

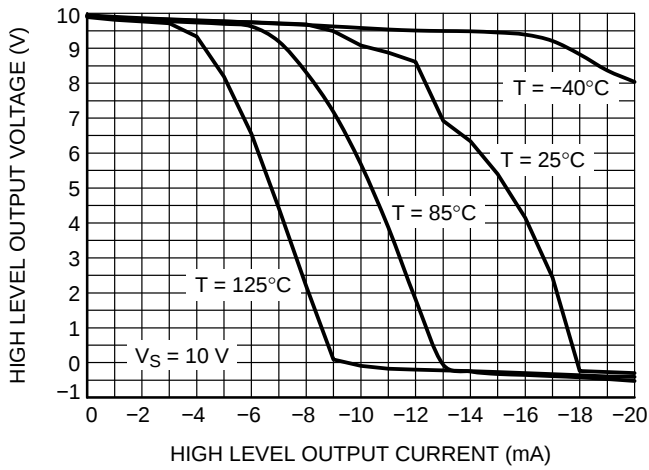


Figure 15. Low Level Output Voltage vs. Output Current

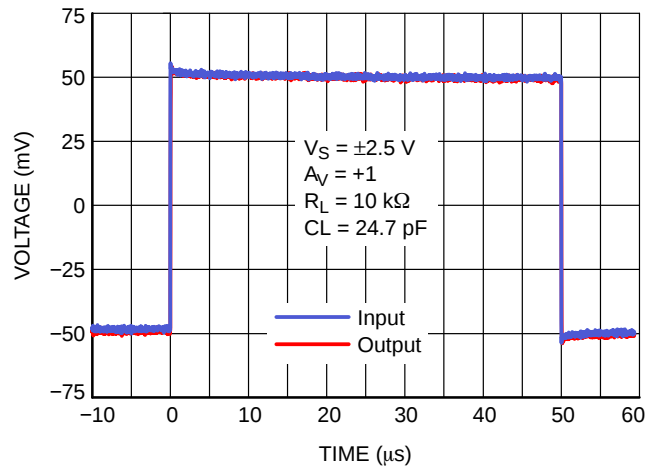


Figure 16. Non-inverting Small Signal Transient Response

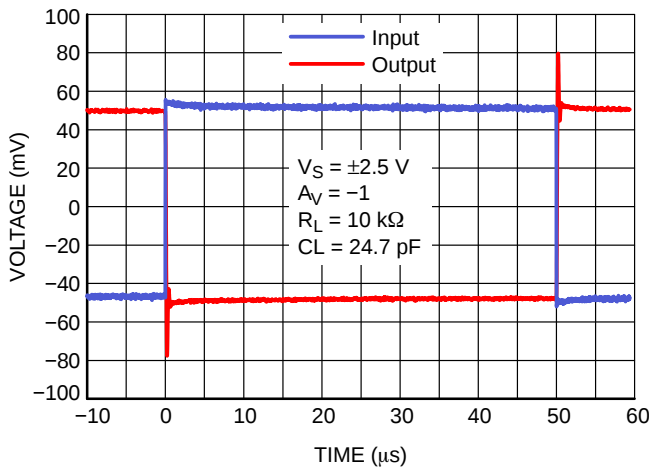


Figure 17. Inverting Small Signal Transient Response

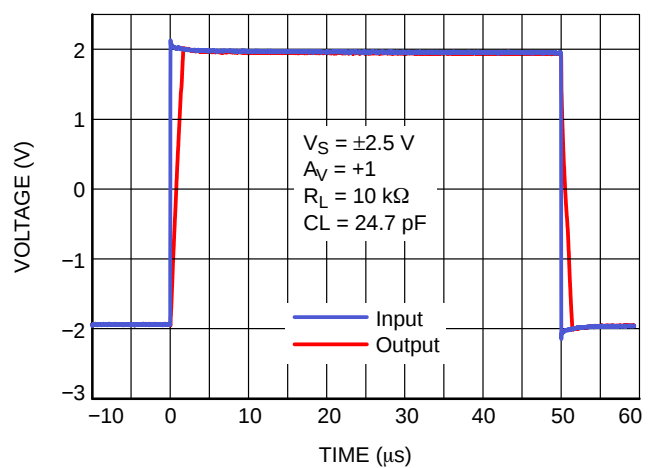


Figure 18. Non-Inverting Large Signal Transient Response

TYPICAL CHARACTERISTICS

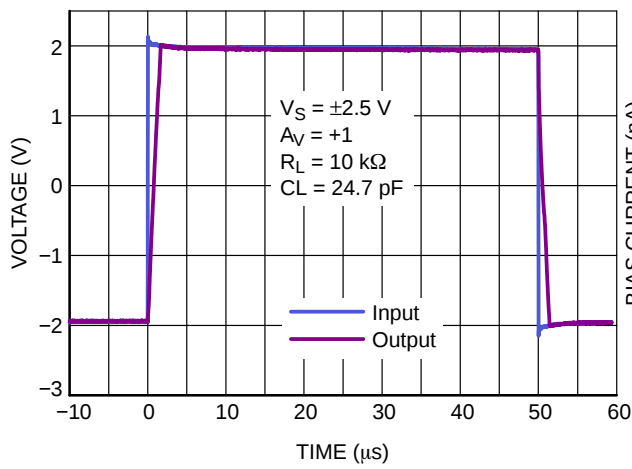


Figure 19. Inverting Large Signal Transient Response

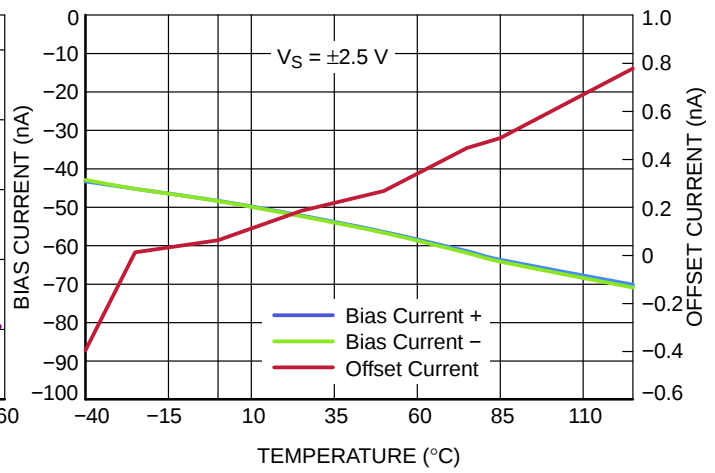
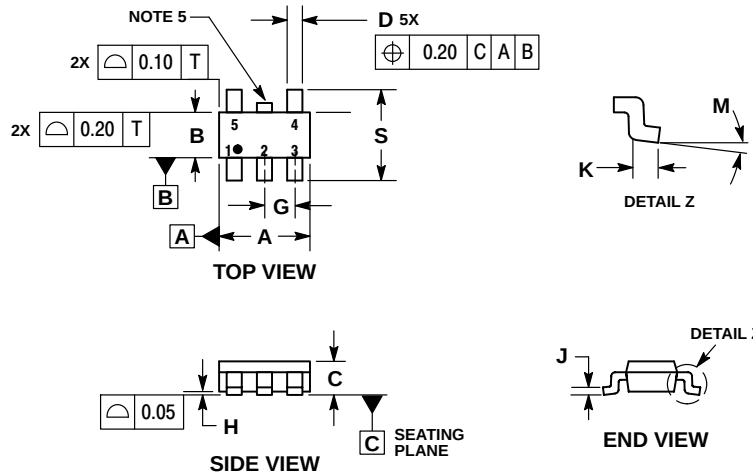


Figure 20. Input Bias and Offset Current vs. Temperature

PACKAGE DIMENSIONS

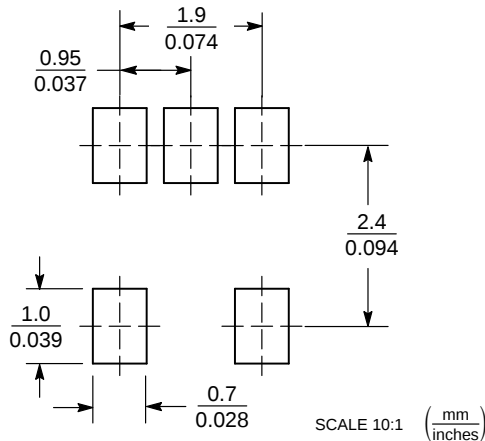
TSOP-5
CASE 483
ISSUE L

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE, DIMENSION A.
5. OPTIONAL CONSTRUCTION: AN ADDITIONAL TRIMMED LEAD IS ALLOWED IN THIS LOCATION. TRIMMED LEAD NOT TO EXTEND MORE THAN 0.2 FROM BODY.

DIM	MILLIMETERS	
	MIN	MAX
A	3.00	BSC
B	1.50	BSC
C	0.90	1.10
D	0.25	0.50
G	0.95	BSC
H	0.01	0.10
J	0.10	0.26
K	0.20	0.60
M	0°	10°
S	2.50	3.00

SOLDERING FOOTPRINT*



*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

ON Semiconductor and the are registered trademarks of Semiconductor Components Industries, LLC (SCILLC) or its subsidiaries in the United States and/or other countries. SCILLC owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of SCILLC's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marketing.pdf. SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative



**Стандарт
Электрон
Связь**

Мы молодая и активно развивающаяся компания в области поставок электронных компонентов. Мы поставляем электронные компоненты отечественного и импортного производства напрямую от производителей и с крупнейших складов мира.

Благодаря сотрудничеству с мировыми поставщиками мы осуществляем комплексные и плановые поставки широчайшего спектра электронных компонентов.

Собственная эффективная логистика и склад в обеспечивает надежную поставку продукции в точно указанные сроки по всей России.

Мы осуществляем техническую поддержку нашим клиентам и предпродажную проверку качества продукции. На все поставляемые продукты мы предоставляем гарантию .

Осуществляем поставки продукции под контролем ВП МО РФ на предприятия военно-промышленного комплекса России , а также работаем в рамках 275 ФЗ с открытием отдельных счетов в уполномоченном банке. Система менеджмента качества компании соответствует требованиям ГОСТ ISO 9001.

Минимальные сроки поставки, гибкие цены, неограниченный ассортимент и индивидуальный подход к клиентам являются основой для выстраивания долгосрочного и эффективного сотрудничества с предприятиями радиоэлектронной промышленности, предприятиями ВПК и научно-исследовательскими институтами России.

С нами вы становитесь еще успешнее!

Наши контакты:

Телефон: +7 812 627 14 35

Электронная почта: sales@st-electron.ru

Адрес: 198099, Санкт-Петербург,
Промышленная ул, дом № 19, литера Н,
помещение 100-Н Офис 331