

ON Semiconductor

Is Now

onsemi™

To learn more about onsemi™, please visit our website at
www.onsemi.com

onsemi and **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** product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **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 circuit, 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** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** 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. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** 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 **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner. Other names and brands may be claimed as the property of others.

NCS2551

500 MHz Voltage Feedback Op Amp

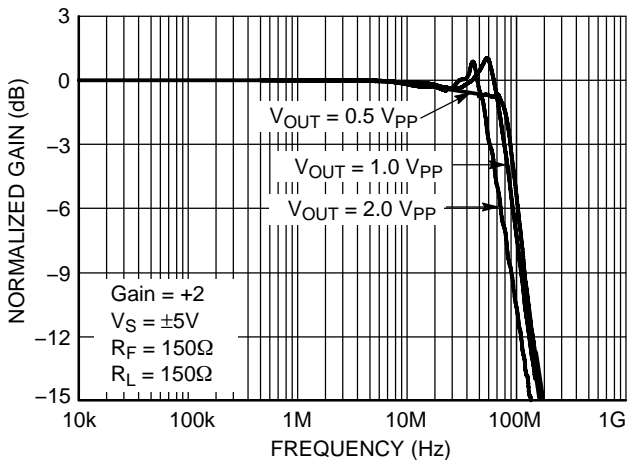
NCS2551 is a 500 MHz voltage feedback monolithic operational amplifier featuring high slew rate and low differential gain and phase error. The voltage feedback architecture allows for a superior bandwidth and low power consumption.

Features

- -3.0 dB Small Signal BW ($A_V = +2.0$, $V_O = 0.5 V_{p-p}$) 500 MHz Typ
- Slew Rate 1400 V/ μ s
- Supply Current 5.5 mA
- Input Referred Voltage Noise 6.0 nV/ $\sqrt{\text{Hz}}$
- THD -62 dBc ($f = 5.0$ MHz, $V_O = 2.0 V_{p-p}$)
- Output Current 100 mA
- Pin Compatible with AD8055, TSH341
- This is a Pb-Free Device

Applications

- Line Drivers
- Radar/Communication Receivers

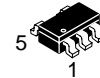


**Figure 1. Frequency Response:
Gain (dB) vs. Frequency $A_V = +2.0$**



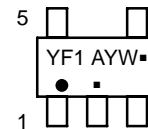
ON Semiconductor®

<http://onsemi.com>



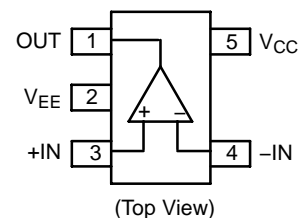
**SOT23-5
(TSOP-5)
SN SUFFIX
CASE 483**

MARKING DIAGRAM



YF1 = Specific Device Code
A = Assembly Location
Y = Year
W = Work Week
▪ = Pb-Free Package
(Note: Microdot may be in either location)

SOT23-5 PINOUT



ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 11 of this data sheet.

NCS2551

PIN FUNCTION DESCRIPTION

Pin (SOT23-5/SC70)	Symbol	Function	Equivalent Circuit
1	OUT	Output	
2	V_{EE}	Negative Power Supply	
3	+IN	Non-inverted Input	
4	-IN	Inverted Input	See Above
5	V_{CC}	Positive Power Supply	

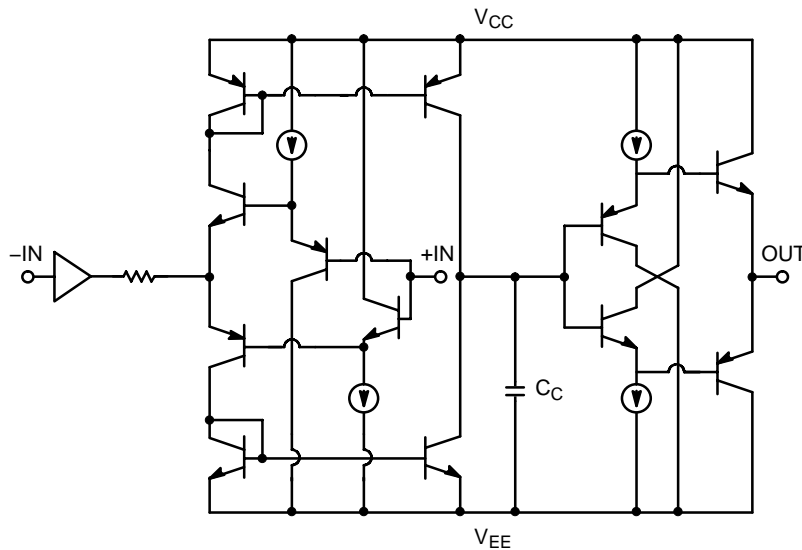


Figure 2. Simplified Device Schematic

ATTRIBUTES

Characteristics	Value
ESD	
Human Body Model	2.0 kV
Machine Model	200 V
Charged Device Model	1.0 kV
Moisture Sensitivity (Note 1)	Level 1
Flammability Rating Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in

1. For additional information, see Application Note AND8003/D.

MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit
Power Supply Voltage	V_S	11	Vdc
Input Voltage Range	V_I	$\leq V_S$	Vdc
Input Differential Voltage Range	V_{ID}	$\leq V_S$	Vdc
Output Current	I_O	100	mA
Maximum Junction Temperature (Note 2)	T_J	150	°C
Operating Ambient Temperature	T_A	-40 to +85	°C
Storage Temperature Range	T_{stg}	-60 to +150	°C
Power Dissipation	P_D	(See Graph)	mW
Thermal Resistance, Junction-to-Air	$R_{\theta JA}$	158	°C/W

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

2. Power dissipation must be considered to ensure maximum junction temperature (T_J) is not exceeded.

MAXIMUM POWER DISSIPATION

The maximum power that can be safely dissipated is limited by the associated rise in junction temperature. For the plastic packages, the maximum safe junction temperature is 150°C. If the maximum is exceeded momentarily, proper circuit operation will be restored as soon as the die temperature is reduced. Leaving the device in the “overheated” condition for an extended period can result in device damage.

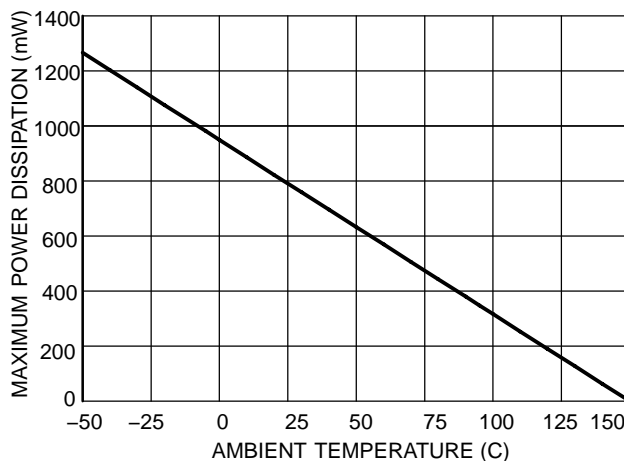


Figure 3. Power Dissipation vs. Temperature

NCS2551

AC ELECTRICAL CHARACTERISTICS ($V_{CC} = +5.0\text{ V}$, $V_{EE} = -5.0\text{ V}$, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$, $R_L = 150\ \Omega$ to GND, $R_F = 150\ \Omega$, $A_V = +2.0$, Enable is left open, unless otherwise specified).

Symbol	Characteristic	Conditions	Min	Typ	Max	Unit
--------	----------------	------------	-----	-----	-----	------

FREQUENCY DOMAIN PERFORMANCE

BW	Bandwidth 3.0 dB Small Signal 3.0 dB Large Signal	$A_V = +2.0$, $V_O = 0.5\text{ V}_{p-p}$ $A_V = +2.0$, $V_O = 2.0\text{ V}_{p-p}$		500 300		MHz
$GF_{0.1dB}$	0.1 dB Gain Flatness Bandwidth	$A_V = +2.0$		15		MHz
dG	Differential Gain	$A_V = +2.0$, $R_L = 150\ \Omega$, $f = 3.58\text{ MHz}$		0.06		%
dP	Differential Phase	$A_V = +2.0$, $R_L = 150\ \Omega$, $f = 3.58\text{ MHz}$		0.06		°

TIME DOMAIN RESPONSE

SR	Slew Rate	$A_V = +2.0$, $V_{step} = 2.0\text{ V}$		1400		V/ μs
t_s	Settling Time 0.1%	$A_V = +2.0$, $V_{step} = 2.0\text{ V}$		10		ns
t_r t_f	Rise and Fall Time	(10%–90%) $A_V = +2.0$, $V_{step} = 2.0\text{ V}$		2.4		ns

HARMONIC/NOISE PERFORMANCE

THD	Total Harmonic Distortion	$f = 5.0\text{ MHz}$, $V_O = 2.0\text{ V}_{p-p}$		-62		dB
HD2	2nd Harmonic Distortion	$f = 5.0\text{ MHz}$, $V_O = 2.0\text{ V}_{p-p}$		-68		dBc
HD3	3rd Harmonic Distortion	$f = 5.0\text{ MHz}$, $V_O = 2.0\text{ V}_{p-p}$		-63		dBc
IP3	Third-Order Intercept	$f = 10\text{ MHz}$, $V_O = 1.0\text{ V}_{p-p}$		40		dBm
SFDR	Spurious-Free Dynamic Range	$f = 5.0\text{ MHz}$, $V_O = 2.0\text{ V}_{p-p}$		63		dBc
e_N	Input Referred Voltage Noise	$f = 1.0\text{ MHz}$		6.0		nV/ $\sqrt{\text{Hz}}$
i_N	Input Referred Current Noise	$f = 1.0\text{ MHz}$		3.0		pA/ $\sqrt{\text{Hz}}$

NCS2551

DC ELECTRICAL CHARACTERISTICS ($V_{CC} = +5.0\text{ V}$, $V_{EE} = -5.0\text{ V}$, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$, $R_L = 150\ \Omega$ to GND, $R_F = 150\ \Omega$, $A_V = +2.0$, Enable is left open, unless otherwise specified).

Symbol	Characteristic	Conditions	Min	Typ	Max	Unit
--------	----------------	------------	-----	-----	-----	------

DC PERFORMANCE

V_{IO}	Input Offset Voltage		-10	0	+10	mV
$\Delta V_{IO}/\Delta T$	Input Offset Voltage Temperature Coefficient			6.0		$\mu\text{V}/^\circ\text{C}$
I_{IB}	Input Bias Current	$V_O = 0\text{ V}$		± 3.2	± 20	μA
$\Delta I_{IB}/\Delta T$	Input Bias Current Temperature Coefficient	$V_O = 0\text{ V}$		± 40		$\text{nA}/^\circ\text{C}$

INPUT CHARACTERISTICS

V_{CM}	Input Common Mode Voltage Range (Note 3)		± 3.0	± 4.0		V
CMRR	Common Mode Rejection Ratio	(See Graph)	40	50		dB
R_{IN}	Input Resistance			4.5		$\text{M}\Omega$
C_{IN}	Differential Input Capacitance			1.0		pF

OUTPUT CHARACTERISTICS

R_{OUT}	Output Resistance	Closed Loop Open Loop		0.1 17		Ω
V_O	Output Voltage Range		± 3.0	± 4.0		V
I_O	Output Current		± 50	± 100		mA

POWER SUPPLY

V_S	Operating Voltage Supply			10		V
I_S	Power Supply Current		2.0	5.5	10	mA
PSRR	Power Supply Rejection Ratio	(See Graph)	40	60		dB

3. Guaranteed by design and/or characterization.

NCS2551

AC ELECTRICAL CHARACTERISTICS ($V_{CC} = +2.5\text{ V}$, $V_{EE} = -2.5\text{ V}$, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$, $R_L = 150\ \Omega$ to GND, $R_F = 150\ \Omega$, $A_V = +2.0$, Enable is left open, unless otherwise specified).

Symbol	Characteristic	Conditions	Min	Typ	Max	Unit
--------	----------------	------------	-----	-----	-----	------

FREQUENCY DOMAIN PERFORMANCE

BW	Bandwidth 3.0 dB Small Signal 3.0 dB Large Signal	$A_V = +2.0$, $V_O = 0.5\text{ V}_{p-p}$ $A_V = +2.0$, $V_O = 1.0\text{ V}_{p-p}$		400 200		MHz
$GF_{0.1dB}$	0.1 dB Gain Flatness Bandwidth	$A_V = +2.0$		10		MHz
dG	Differential Gain	$A_V = +2.0$, $R_L = 150\ \Omega$, $f = 3.58\text{ MHz}$		0.07		%
dP	Differential Phase	$A_V = +2.0$, $R_L = 150\ \Omega$, $f = 3.58\text{ MHz}$		0.06		°

TIME DOMAIN RESPONSE

SR	Slew Rate	$A_V = +2.0$, $V_{step} = 1.0\text{ V}$		800		V/ μs
t_s	Settling Time 0.1%	$A_V = +2.0$, $V_{step} = 1.0\text{ V}$		10		ns
t_r , t_f	Rise and Fall Time	(10%–90%) $A_V = +2.0$, $V_{step} = 1.0\text{ V}$		2.2		ns

HARMONIC/NOISE PERFORMANCE

THD	Total Harmonic Distortion	$f = 5.0\text{ MHz}$, $V_O = 1.0\text{ V}_{p-p}$		-59		dB
HD2	2nd Harmonic Distortion	$f = 5.0\text{ MHz}$, $V_O = 1.0\text{ V}_{p-p}$		-60		dBc
HD3	3rd Harmonic Distortion	$f = 5.0\text{ MHz}$, $V_O = 1.0\text{ V}_{p-p}$		-67		dBc
IP3	Third-Order Intercept	$f = 10\text{ MHz}$, $V_O = 0.5\text{ V}_{p-p}$		35		dBm
SFDR	Spurious-Free Dynamic Range	$f = 5.0\text{ MHz}$, $V_O = 1.0\text{ V}_{p-p}$		60		dBc
e_N	Input Referred Voltage Noise	$f = 1.0\text{ MHz}$		6.0		nV/ $\sqrt{\text{Hz}}$
i_N	Input Referred Current Noise	$f = 1.0\text{ MHz}$		3.0		pA/ $\sqrt{\text{Hz}}$

NCS2551

DC ELECTRICAL CHARACTERISTICS ($V_{CC} = +2.5\text{ V}$, $V_{EE} = -2.5\text{ V}$, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$, $R_L = 150\ \Omega$ to GND, $R_F = 150\ \Omega$, $A_V = +2.0$, Enable is left open, unless otherwise specified).

Symbol	Characteristic	Conditions	Min	Typ	Max	Unit
--------	----------------	------------	-----	-----	-----	------

DC PERFORMANCE

V_{IO}	Input Offset Voltage		-10	0	+10	mV
$\Delta V_{IO}/\Delta T$	Input Offset Voltage Temperature Coefficient			6.0		$\mu\text{V}/^\circ\text{C}$
I_{IB}	Input Bias Current	$V_O = 0\text{ V}$		± 3.2	± 20	μA
$\Delta I_{IB}/\Delta T$	Input Bias Current Temperature Coefficient	$V_O = 0\text{ V}$		± 40		$\text{nA}/^\circ\text{C}$

INPUT CHARACTERISTICS

V_{CM}	Input Common Mode Voltage Range (Note 3)		± 0.9	± 1.5		V
CMRR	Common Mode Rejection Ratio	(See Graph)	40	50		dB
R_{IN}	Input Resistance			4.5		$\text{M}\Omega$
C_{IN}	Differential Input Capacitance			1.0		pF

OUTPUT CHARACTERISTICS

R_{OUT}	Output Resistance	Closed Loop Open Loop		0.1 17		Ω
V_O	Output Voltage Range		± 0.9	± 1.5		V
I_O	Output Current		± 50	± 100		mA

POWER SUPPLY

V_S	Operating Voltage Supply			5.0		V
I_S	Power Supply Current		2.0	5.2	10	mA
PSRR	Power Supply Rejection Ratio	(See Graph)	40	60		dB

4. Guaranteed by design and/or characterization.

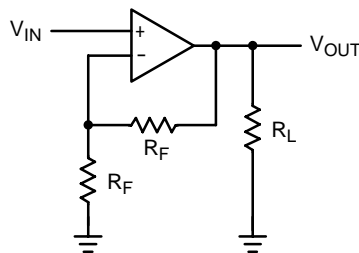


Figure 4. Typical Test Setup
($A_V = +2.0$, $R_F = 150\ \text{k}\Omega$, $R_L = 150\ \Omega$)

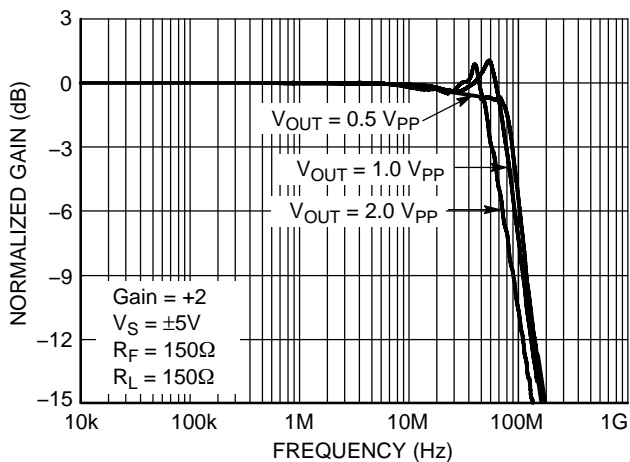


Figure 5. Frequency Response:
Gain (dB) vs. Frequency
 $A_v = +2.0$

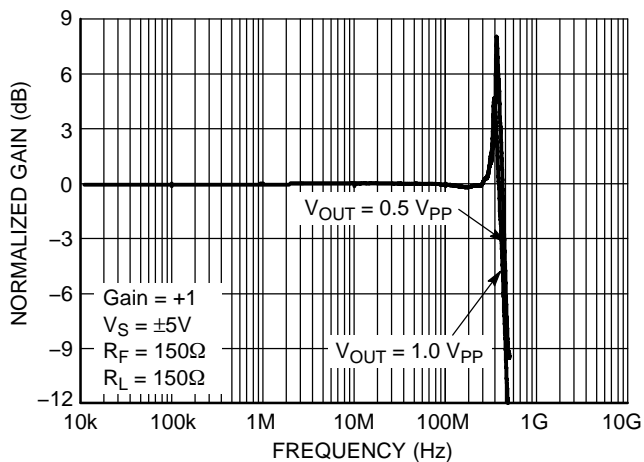


Figure 6. Frequency Response:
Gain (dB) vs. Frequency
 $A_v = +1.0$

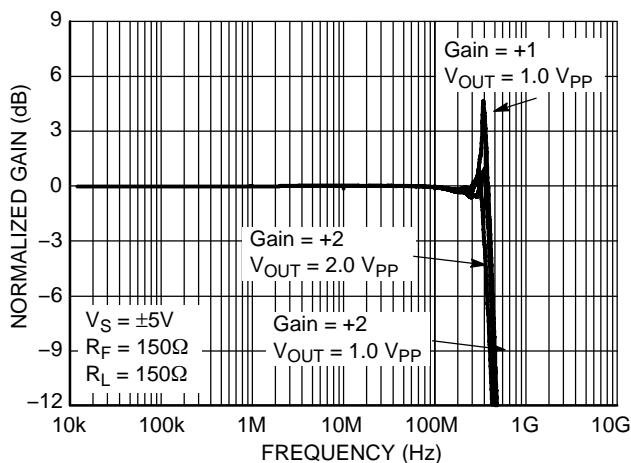


Figure 7. Large Signal Frequency Response
Gain (dB) vs. Frequency

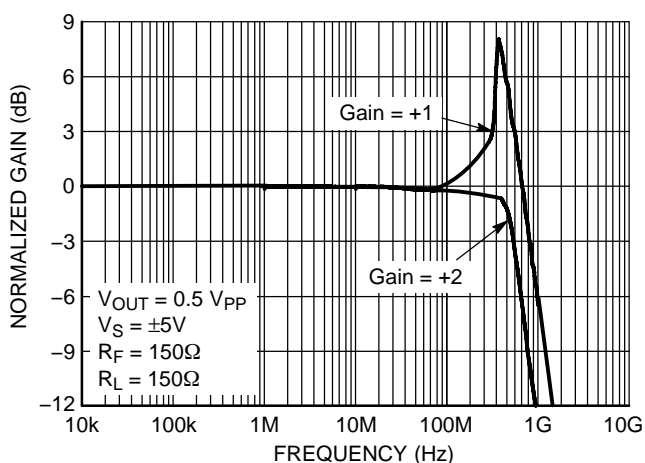


Figure 8. Small Signal Frequency Response
Gain (dB) vs. Frequency

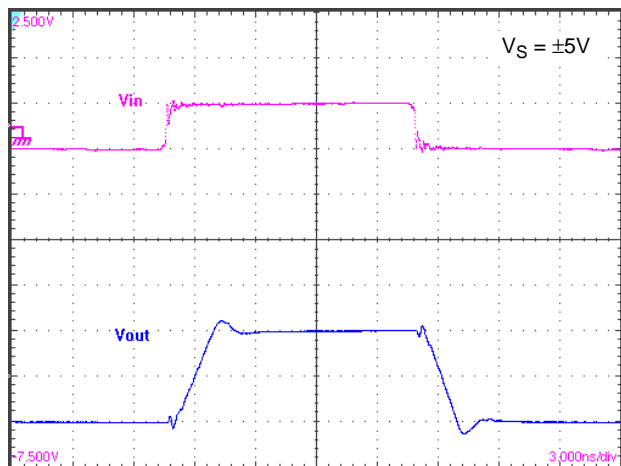


Figure 9. Small Signal Step Response
Vertical: 500 mV/div
Horizontal: 10 ns/div

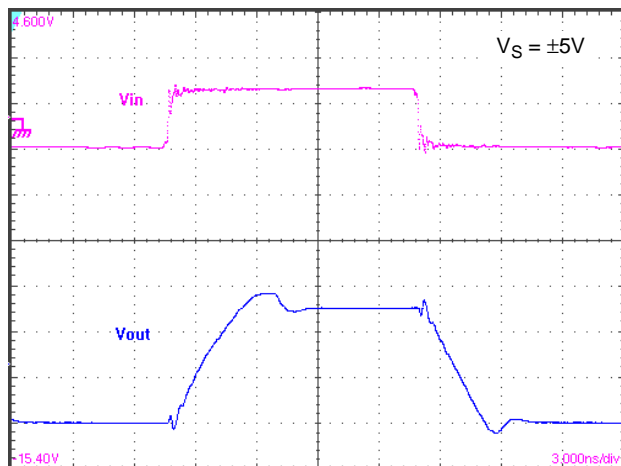


Figure 10. Large Signal Step Response
Vertical: 2V/div
Horizontal: 10 ns/div

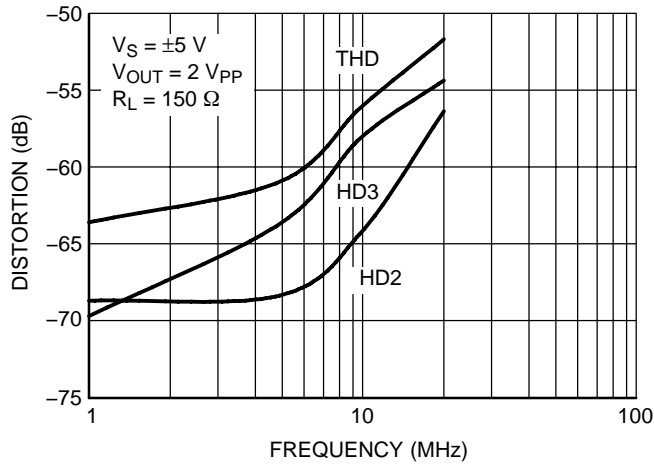


Figure 11. THD, HD2, HD3 vs. Frequency

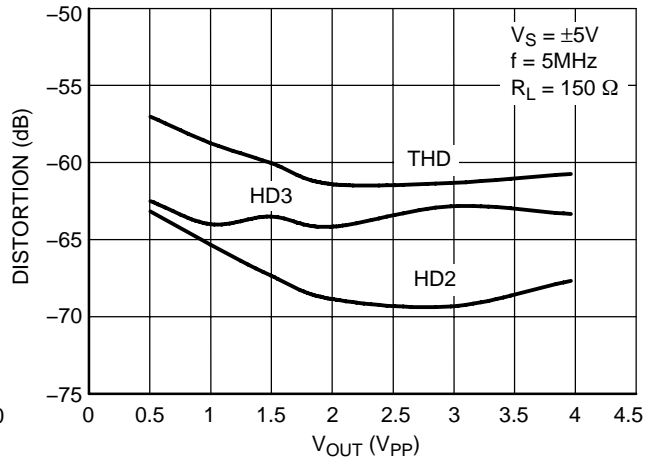


Figure 12. THD, HD2, HD3 vs. Output Voltage

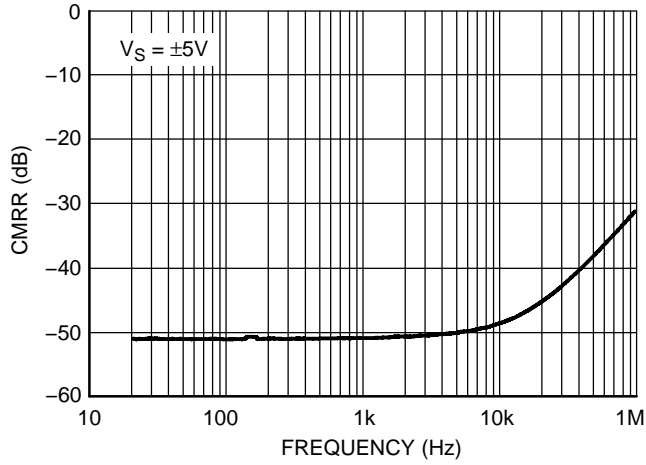


Figure 13. CMRR vs. Frequency

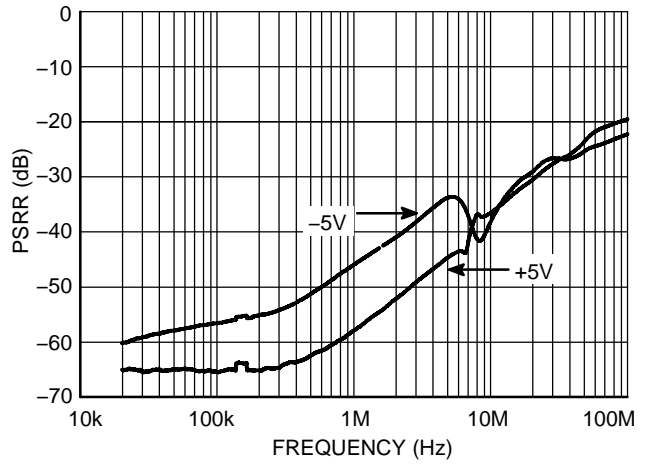


Figure 14. PSRR vs. Frequency

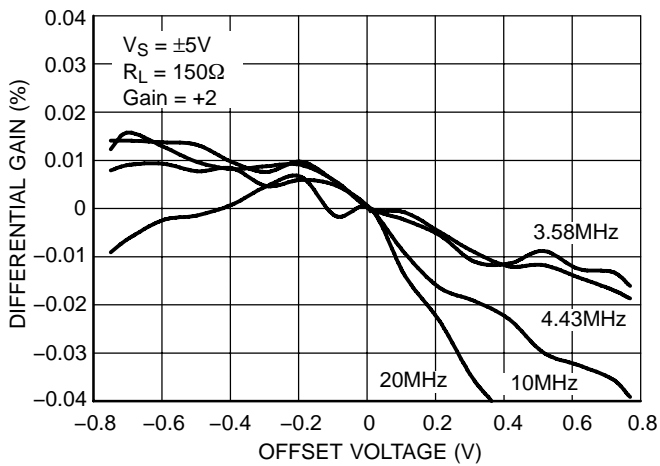


Figure 15. Differential Gain

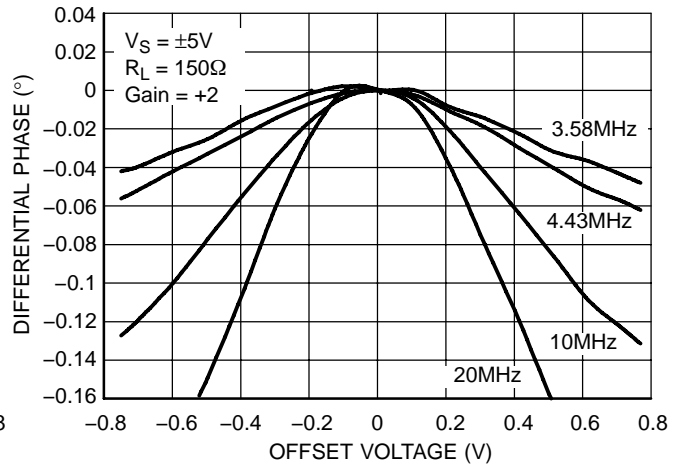


Figure 16. Differential Phase

NCS2551

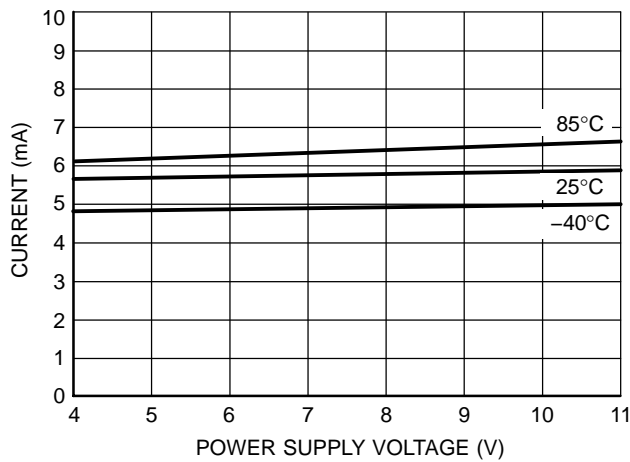


Figure 17. Supply Current vs. Power Supply

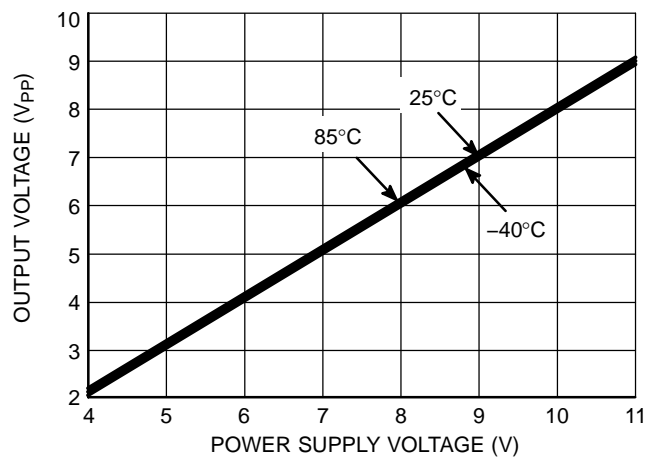


Figure 18. Output Voltage Swing vs. Supply Voltage

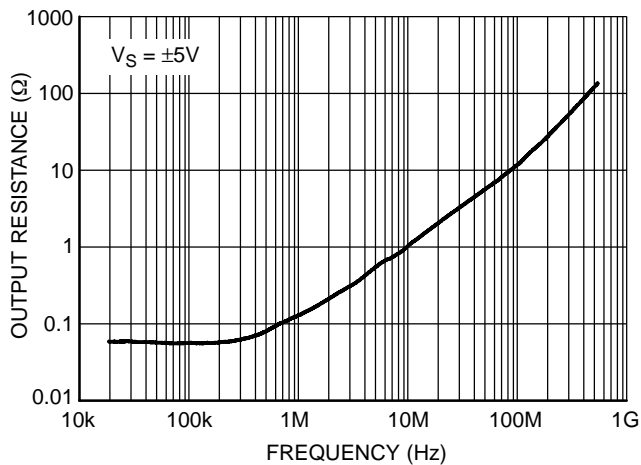


Figure 19. Closed Loop Output Resistance vs. Frequency

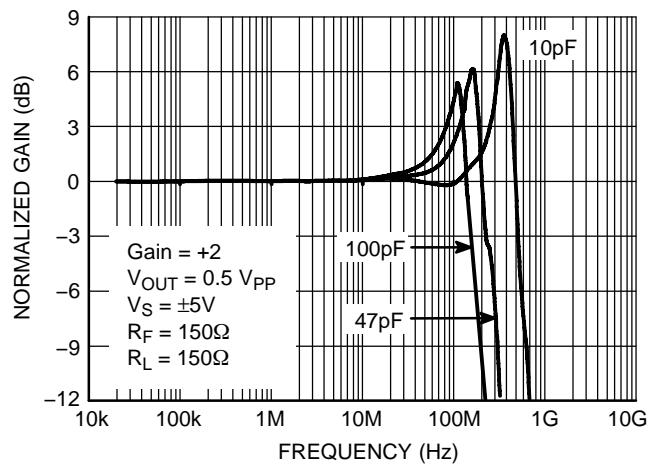


Figure 20. Frequency Response vs. Capacitive Load

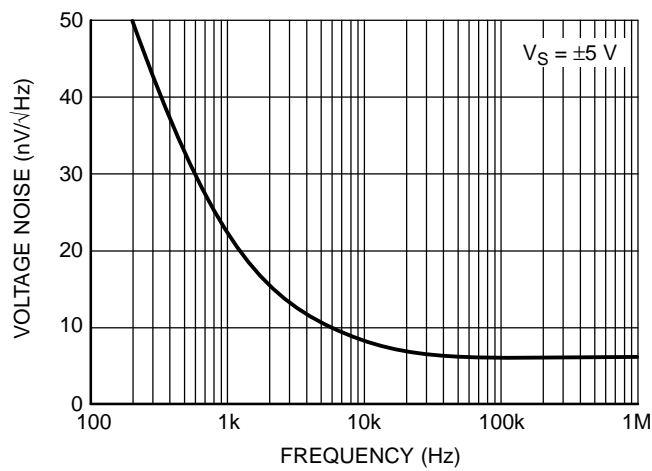


Figure 21. Input Referred Voltage Noise vs. Frequency

Printed Circuit Board Layout Techniques

Proper high speed PCB design rules should be used for all wideband amplifiers as the PCB parasitics can affect the overall performance. Most important are stray capacitances at the output and inverting input nodes as it can effect peaking and bandwidth. A space (3/16" is plenty) should be left around the signal lines to minimize coupling. Also, signal lines connecting the feedback and gain resistors should be short enough so that their associated inductance does not cause high frequency gain errors. Line lengths less than 1/4" are recommended.

Video Performance

This device designed to provide good performance with NTSC, PAL, and HDTV video signals. Best performance is obtained with back terminated loads as performance is degraded as the load is increased. The back termination reduces reflections from the transmission line and effectively masks transmission line and other parasitic capacitances from the amplifier output stage.

ESD Protection

All device pins have limited ESD protection using internal diodes to power supplies as specified in the attributes table (see Figure 22). These diodes provide moderate protection

to input overdrive voltages above the supplies. The ESD diodes can support high input currents with current limiting series resistors. Keep these resistor values as low as possible since high values degrade both noise performance and frequency response. Under closed-loop operation, the ESD diodes have no effect on circuit performance. However, under certain conditions the ESD diodes will be evident. If the device is driven into a slewing condition, the ESD diodes will clamp large differential voltages until the feedback loop restores closed-loop operation. Also, if the device is powered down and a large input signal is applied, the ESD diodes will conduct.

NOTE: Human Body Model for +IN and -IN pins are rated at 0.8kV while all other pins are rated at 2.0kV.

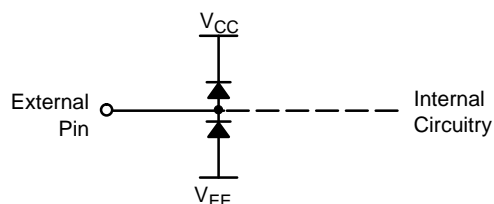


Figure 22. Internal ESD Protection

ORDERING INFORMATION

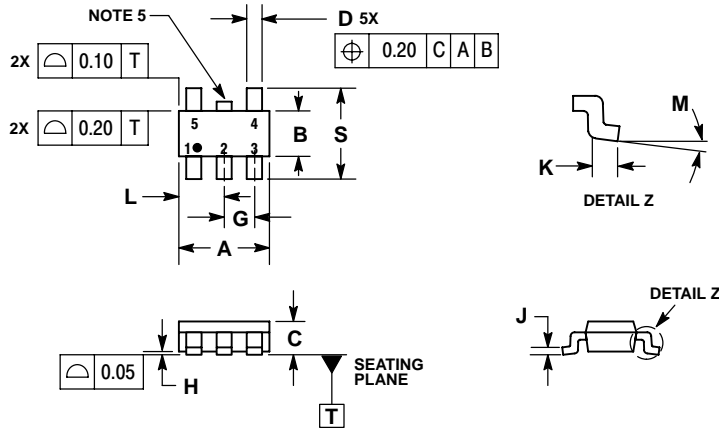
Device	Package	Shipping†
NCS2551SNT1G	SOT23-5 (TSOP-5) (Pb-Free)	3000/Tape & Reel

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

NCS2551

PACKAGE DIMENSIONS

TSOP-5 CASE 483-02 ISSUE F

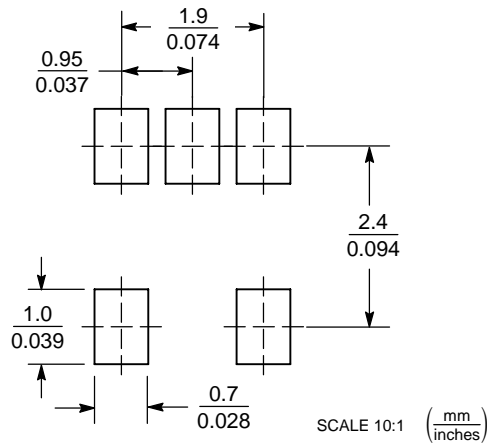


NOTES:

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.
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
L	1.25	1.55
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 are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). 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
P.O. Box 5163, Denver, Colorado 80217 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: 81-3-5773-3850

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

For additional information, please contact your local Sales Representative