

DATA SHEET

NE/SE5539

High frequency operational amplifier

Product data
Supersedes data of 2001 Aug 03
File under Integrated Circuits, IC11 Data Handbook

2002 Jan 25

High frequency operational amplifier

NE/SE5539

DESCRIPTION

The NE/SE5539 is a very wide bandwidth, high slew rate, monolithic operational amplifier for use in video amplifiers, RF amplifiers, and extremely high slew rate amplifiers.

Emitter-follower inputs provide a true differential input impedance device. Proper external compensation will allow design operation over a wide range of closed-loop gains, both inverting and non-inverting, to meet specific design requirements.

FEATURES

- Bandwidth
 - Unity gain: 350 MHz
 - Full power: 48 MHz
 - GBW: 1.2 GHz at 17 dB
- Slew rate: 600/V μ s
- A_{VOL}: 52 dB typical
- Low noise: 4 nV \sqrt Hz typical

PIN CONFIGURATION

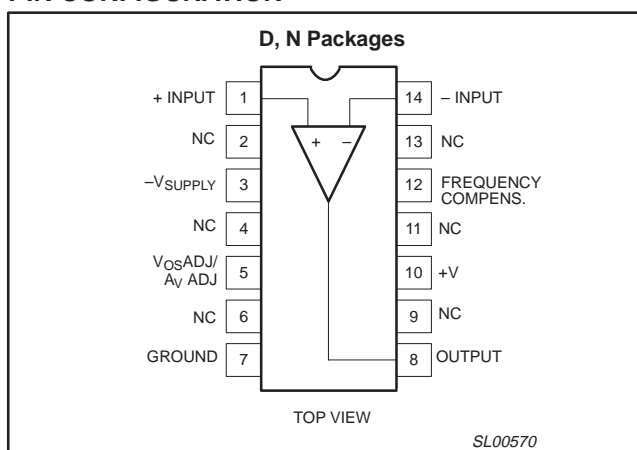


Figure 1. Pin Configuration

APPLICATIONS

- High speed datacom
- Video monitors & TV
- Satellite communications
- Image processing
- RF instrumentation & oscillators
- Magnetic storage

ORDERING INFORMATION

DESCRIPTION	TEMPERATURE RANGE	ORDER CODE	DWG #
14-Pin Plastic Dual In-Line Package (DIP)	0 °C to +70 °C	NE5539N	SOT27-1
14-Pin Plastic Small Outline (SO) package	0 °C to +70 °C	NE5539D	SOT108-1
14-Pin Plastic Dual In-Line Package (DIP)	-55 °C to +125 °C	SE5539N	SOT27-1

ABSOLUTE MAXIMUM RATINGS¹

SYMBOL	PARAMETER	RATING	UNITS
V _{CC}	Supply voltage	±12	V
P _{D(max)}	Maximum power dissipation; T _{amb} = 25 °C (still-air) ²		
	N package	1.45	W
	D package	0.99	W
T _{amb}	Operating temperature range		
	NE5539D, NE5539N	0 to +70	°C
	SE5539N	-55 to +125	°C
T _{stg}	Storage temperature range	-65 to +150	°C
T _j	Max junction temperature	+150	°C
T _{sld}	Lead soldering temperature (10 sec max)	+230	°C

NOTES:

1. Differential input voltage should not exceed 0.25 V to prevent excessive input bias current and common-mode voltage 2.5 V. These voltage limits may be exceeded if current is limited to less than 10 mA.
2. Derate above 25 °C, at the following rates:
 - N package at 11.6 mW/°C
 - D package at 7.9 mW/°C

High frequency operational amplifier

NE/SE5539

EQUIVALENT CIRCUIT

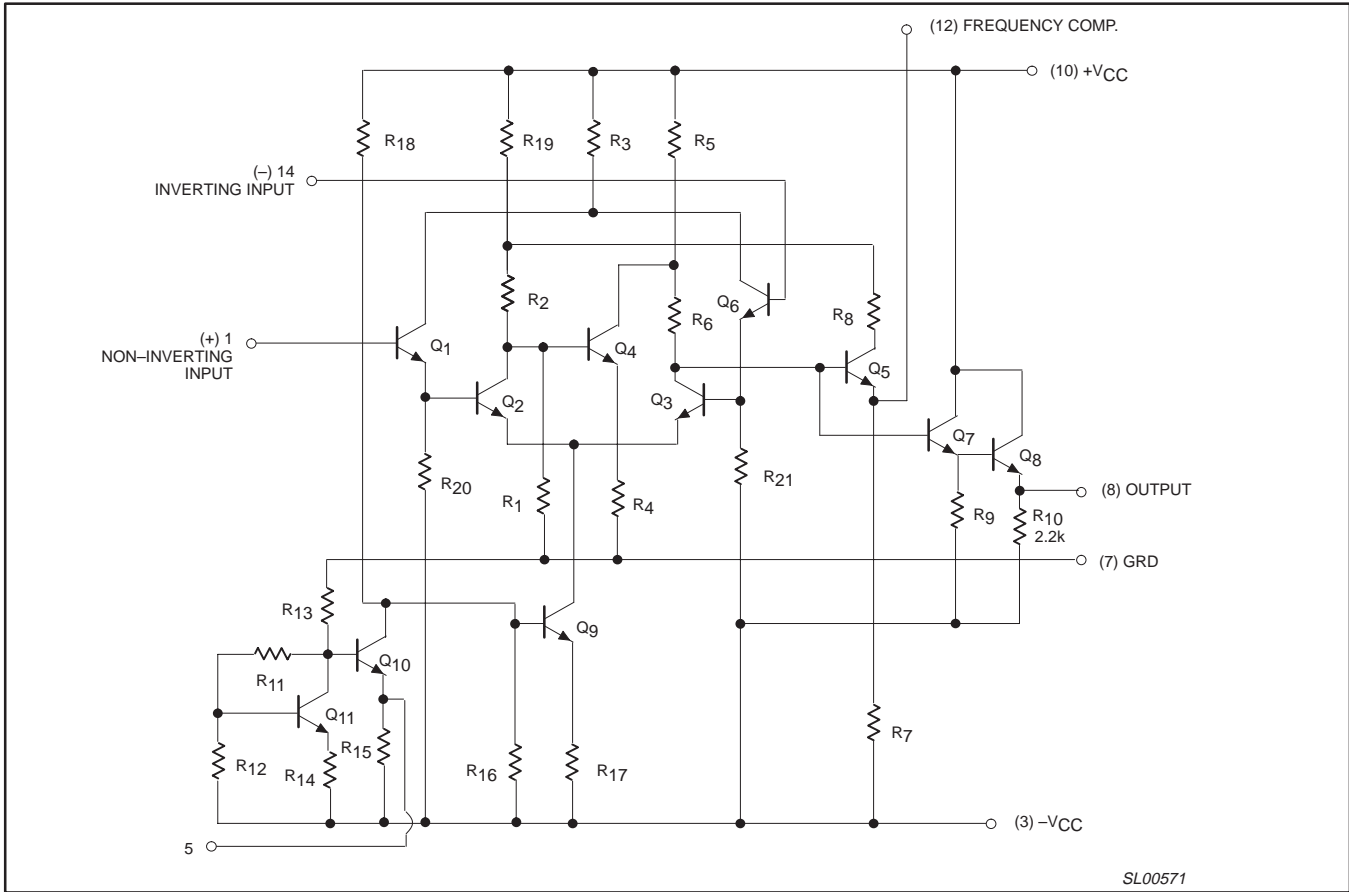


Figure 2. Equivalent Circuit

High frequency operational amplifier

NE/SE5539

DC ELECTRICAL CHARACTERISTICS $V_{CC} = \pm 8\text{ V}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$; unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	SE5539			NE5539			UNITS	
			MIN	TYP	MAX	MIN	TYP	MAX		
V_{OS}	Input offset voltage	$V_O = 0\text{ V}$; $R_S = 100\ \Omega$	Over temp.	2	5				mV	
			$T_{amb} = 25\text{ }^{\circ}\text{C}$	2	3		2.5	5		
$\Delta V_{OS}/\Delta T$				5			5		$\mu\text{V}/^{\circ}\text{C}$	
I_{OS}	Input offset current		Over temp.	0.1	3				μA	
			$T_{amb} = 25\text{ }^{\circ}\text{C}$	0.1	1			2		
$\Delta I_{OS}/\Delta T$				0.5			0.5		$\text{nA}/^{\circ}\text{C}$	
I_B	Input bias current		Over temp.	6	25				μA	
			$T_{amb} = 25\text{ }^{\circ}\text{C}$	5	13		5	20		
$\Delta I_B/\Delta T$				10			10		$\text{nA}/^{\circ}\text{C}$	
CMRR	Common mode rejection ratio	$F = 1\text{ kHz}$; $R_S = 100\ \Omega$; $V_{CM} \pm 1.7\text{ V}$	Over temp.	70	80		70	80	dB	
				70	80					
R_{IN}	Input impedance			100			100		$\text{k}\Omega$	
R_{OUT}	Output impedance			10			10		Ω	
V_{OUT}	Output voltage swing	$R_L = 150\ \Omega$ to GND and $470\ \Omega$ to $-V_{CC}$	+Swing				+2.3	+2.7	V	
			-Swing				-1.7	-2.2		
		$R_L = 25\ \Omega$ to GND Over temp.	+Swing	+2.3	+3.0					V
			-Swing	-1.5	-2.1					
		$R_L = 25\ \Omega$ to GND $T_{amb} = 25\text{ }^{\circ}\text{C}$	+Swing	+2.5	+3.1					V
			-Swing	-2.0	-2.7					
I_{CC+}	Positive supply current	$V_O = 0\text{ V}$, $R_1 = \infty$; Over temp.		14	18				mA	
			$V_O = 0\text{ V}$, $R_1 = \infty$; $T_{amb} = 25\text{ }^{\circ}\text{C}$		14	17		14		18
I_{CC-}	Negative supply current	$V_O = 0\text{ V}$, $R_1 = \infty$; Over temp.		11	15				mA	
			$V_O = 0\text{ V}$, $R_1 = \infty$; $T_{amb} = 25\text{ }^{\circ}\text{C}$		11	14		11		15
PSRR	Power supply rejection ratio	$\Delta V_{CC} = \pm 1\text{ V}$; Over temp.		300	1000				$\mu\text{V}/\text{V}$	
			$\Delta V_{CC} = \pm 1\text{ V}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$					200		1000
A_{VOL}	Large signal voltage gain	$V_O = +2.3\text{ V}$, -1.7 V ; $R_L = 150\ \Omega$ to GND, $470\ \Omega$ to $-V_{CC}$	Over temp.				47	52	57	dB
			$T_{amb} = 25\text{ }^{\circ}\text{C}$				47	52	57	
		$V_O = +2.5\text{ V}$, -2.0 V ; $R_L = 2\ \Omega$ to GND	Over temp.	46		60				dB
			$T_{amb} = 25\text{ }^{\circ}\text{C}$	48	53	58				

High frequency operational amplifier

NE/SE5539

DC ELECTRICAL CHARACTERISTICS $V_{CC} = \pm 6\text{ V}$, $T_{amb} = 25\text{ }^\circ\text{C}$; unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS		SE5539			UNITS	
				MIN	TYP	MAX		
V_{OS}	Input offset voltage			Over temp.	2	5	mV	
				$T_{amb} = 25\text{ }^\circ\text{C}$	2	3		
I_{OS}	Input offset current			Over temp.	0.1	3	μA	
				$T_{amb} = 25\text{ }^\circ\text{C}$	0.1	1		
I_B	Input bias current			Over temp.	5	20	μA	
				$T_{amb} = 25\text{ }^\circ\text{C}$	4	10		
CMRR	Common-mode rejection ratio	$V_{CM} = \pm 1.3\text{ V}$; $R_S = 100\ \Omega$		70	85		dB	
I_{CC+}	Positive supply current			Over temp.	11	14	mA	
				$T_{amb} = 25\text{ }^\circ\text{C}$	11	13		
I_{CC-}	Negative supply current			Over temp.	8	11	mA	
				$T_{amb} = 25\text{ }^\circ\text{C}$	8	10		
PSRR	Power supply rejection ratio	$\Delta V_{CC} = \pm 1\text{ V}$		Over temp.	300	1000	$\mu\text{V/V}$	
				$T_{amb} = 25\text{ }^\circ\text{C}$				
V_{OUT}	Output voltage swing	$R_L = 150\ \Omega$ to GND and $390\ \Omega$ to $-V_{CC}$		Over temp.	+Swing	+1.4	+2.0	V
					-Swing	-1.1	-1.7	
				$T_{amb} = 25\text{ }^\circ\text{C}$	+Swing	+1.5	+2.0	
					-Swing	-1.4	-1.8	

High frequency operational amplifier

NE/SE5539

AC ELECTRICAL CHARACTERISTICS

$V_{CC} = \pm 8\text{ V}$, $R_L = 150\ \Omega$ to GND and $470\ \Omega$ to $-V_{CC}$, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	SE5539			NE5539			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
BW	Gain bandwidth product	$A_{CL} = 7$, $V_O = 0.1\text{ V}_{P-P}$		1200			1200		MHz
	Small signal bandwidth	$A_{CL} = 2$, $R_L = 150\ \Omega^1$		110			110		MHz
t_S	Settling time	$A_{CL} = 2$, $R_L = 150\ \Omega^1$		15			15		ns
SR	Slew rate	$A_{CL} = 2$, $R_L = 150\ \Omega^1$		600			600		V/ μ s
t_{PD}	Propagation delay	$A_{CL} = 2$, $R_L = 150\ \Omega^1$		7			7		ns
	Full power response	$A_{CL} = 2$, $R_L = 150\ \Omega^1$		48			48		MHz
	Full power response	$A_V = 7$, $R_L = 150\ \Omega^1$		20			20		MHz
	Input noise voltage	$R_S = 50\ \Omega$, 1 MHz		4			4		nV/ $\sqrt{\text{Hz}}$
	Input noise current	1 MHz		6			6		pA/ $\sqrt{\text{Hz}}$

NOTE:

- External compensation.

AC ELECTRICAL CHARACTERISTICS

$V_{CC} = \pm 6\text{ V}$, $R_L = 150\ \Omega$ to GND and $390\ \Omega$ to $-V_{CC}$, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	SE5539			UNITS
			MIN	TYP	MAX	
BW	Gain bandwidth product	$A_{CL} = 7$		700		MHz
	Small signal bandwidth	$A_{CL} = 2^1$		120		
t_S	Settling time	$A_{CL} = 2^1$		23		ns
SR	Slew rate	$A_{CL} = 2^1$		330		V/ μ s
t_{PD}	Propagation delay	$A_{CL} = 2^1$		4.5		ns
	Full power response	$A_{CL} = 2^1$		20		MHz

NOTE:

- External compensation.

TYPICAL PERFORMANCE CURVES

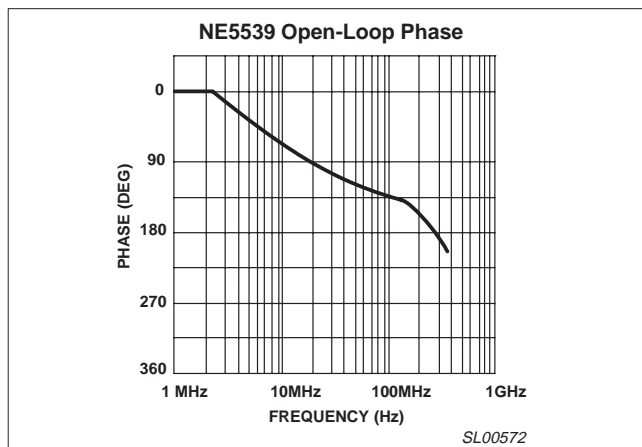


Figure 3. NE5539 Open-Loop Phase

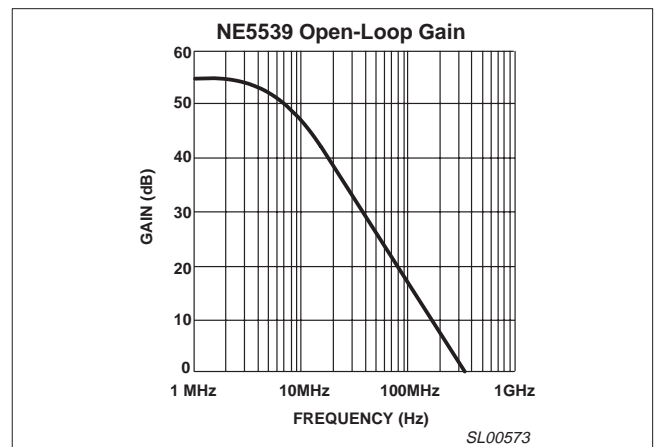
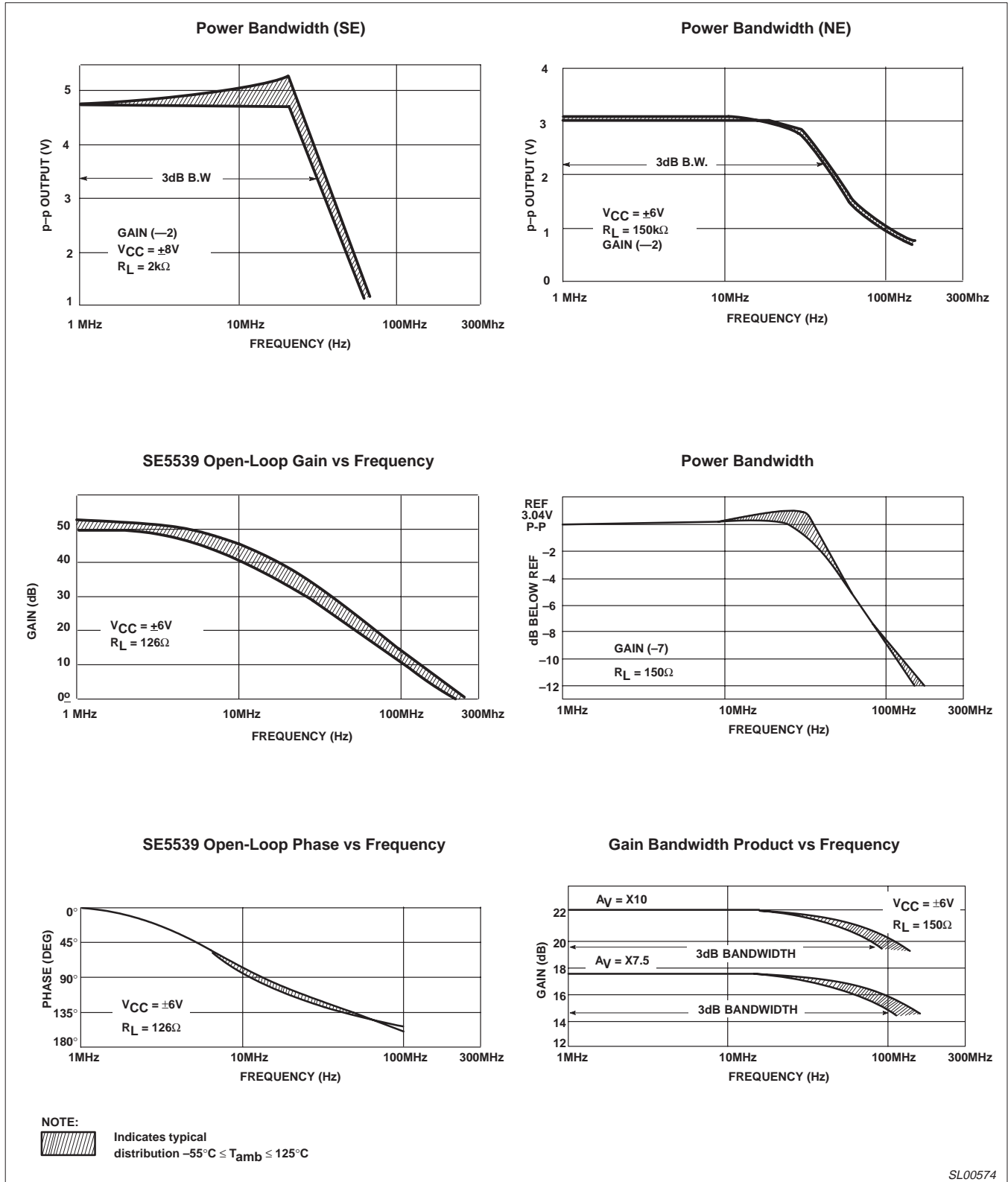


Figure 4. NE5539 Open-Loop Gain

High frequency operational amplifier

NE/SE5539

TYPICAL PERFORMANCE CURVES (Continued)



SL00574

Figure 5. Typical Performance Curves

High frequency operational amplifier

NE/SE5539

CIRCUIT LAYOUT CONSIDERATIONS

As may be expected for an ultra-high frequency, wide-gain bandwidth amplifier, the physical circuit is extremely critical.

Bread-boarding is not recommended. A double-sided copper-clad printed circuit board will result in more favorable system operation. An example utilizing a 28 dB non-inverting amp is shown in Figure 6.

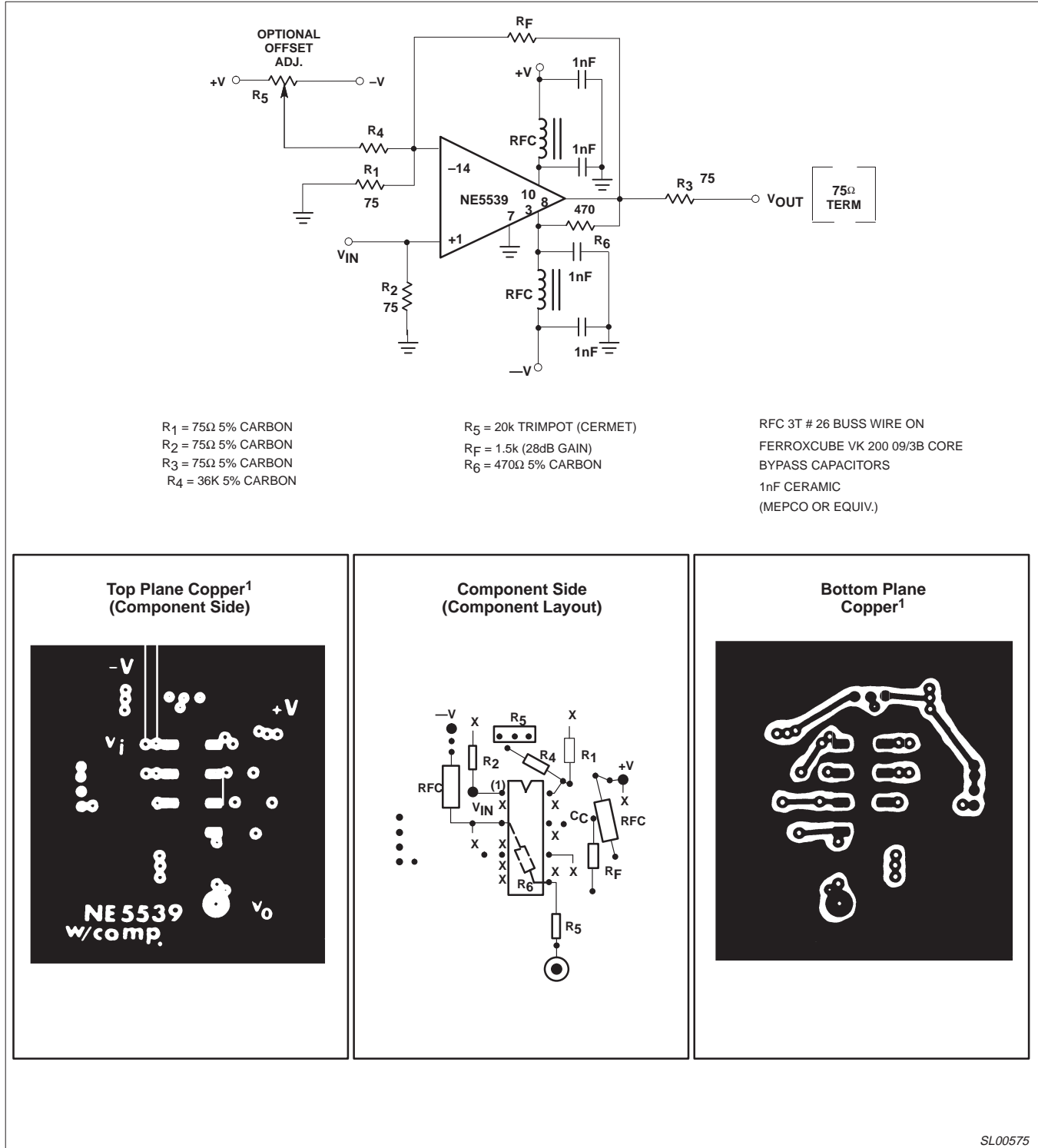


Figure 6. 28dB Non-Inverting Amp Sample PC Layout

High frequency operational amplifier

NE/SE5539

NE5539 COLOR VIDEO AMPLIFIER

The NE5539 wideband operational amplifier is easily adapted for use as a color video amplifier. A typical circuit is shown in Figure 7 along with vector-scope photographs showing the amplifier differential gain and phase response to a standard five-step modulated staircase linearity signal (Figures 8, 9 and 10). As can be seen in Figure 9, the gain varies less than 0.5% from the bottom to the top of the staircase. The maximum differential phase shown in Figure 10 is approximately $+0.1^\circ$.

The amplifier circuit was optimized for a 75Ω input and output termination impedance with a gain of approximately 10 (20 dB).

NOTE:

1. The input signal was 200 mV and the output 2 V. V_{CC} was ± 8 V.

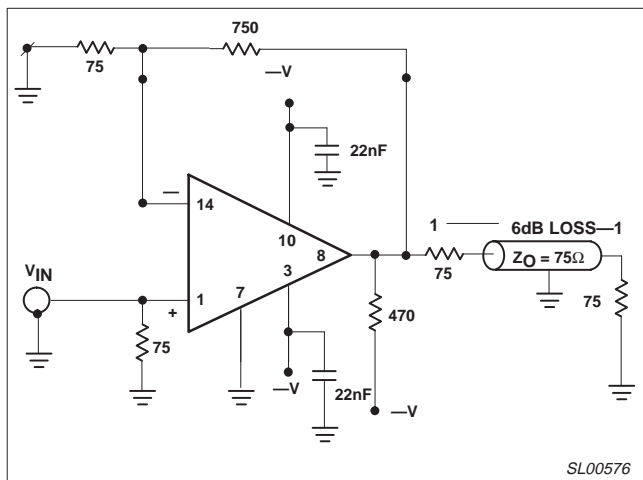


Figure 7. NE5539 Video Amplifier

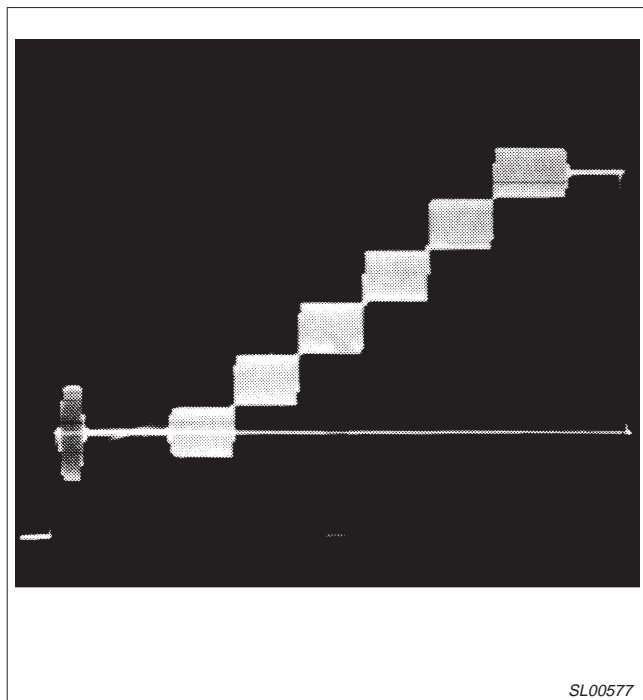


Figure 8. Input Signal

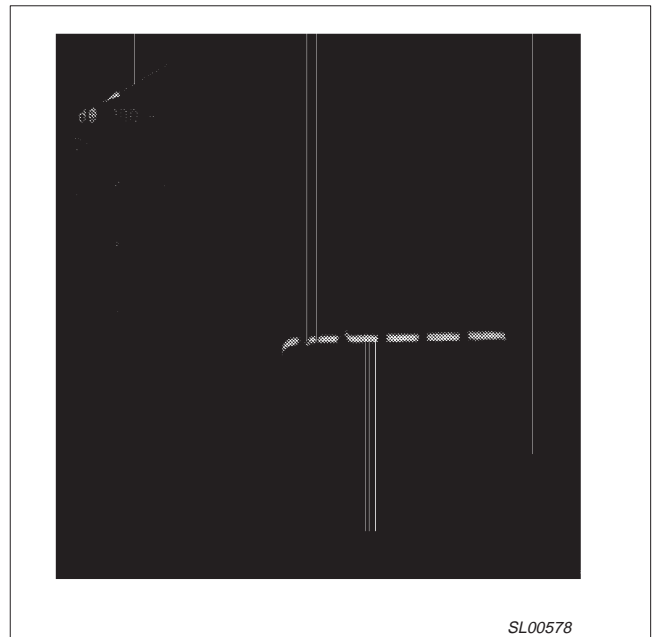


Figure 9. Differential Gain $<0.5\%$

NOTE:

Instruments used for these measurements were Tektronix 146 NTSC test signal generator, 520A NTSC vectorscope, and 1480 waveform monitor.

High frequency operational amplifier

NE/SE5539

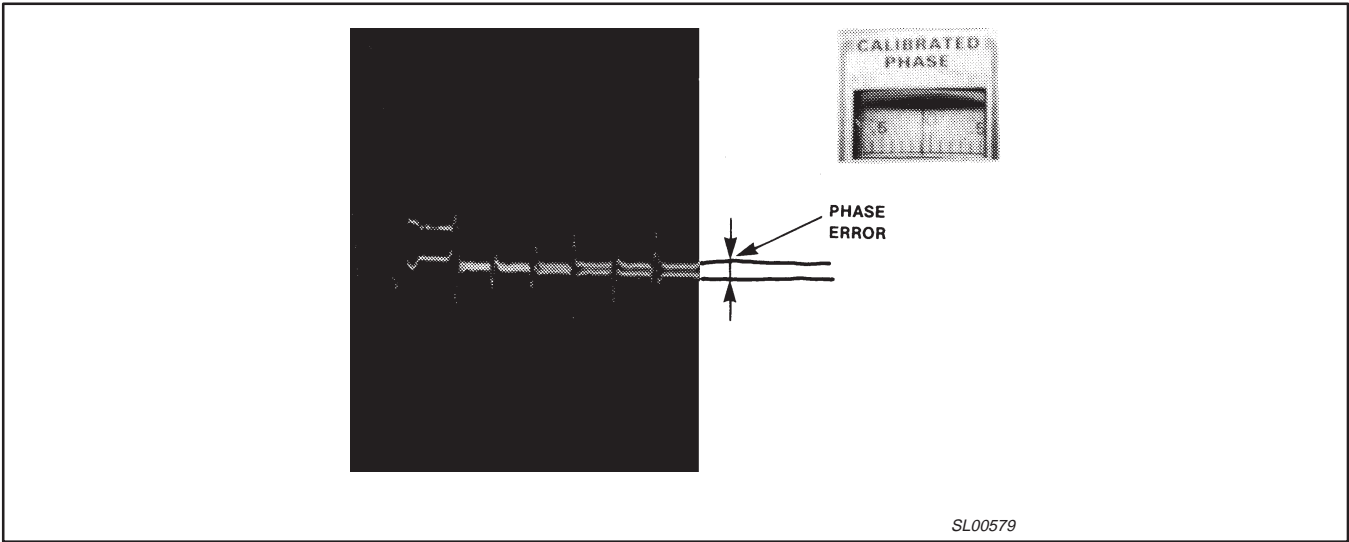


Figure 10. Differential Gain +0.1°

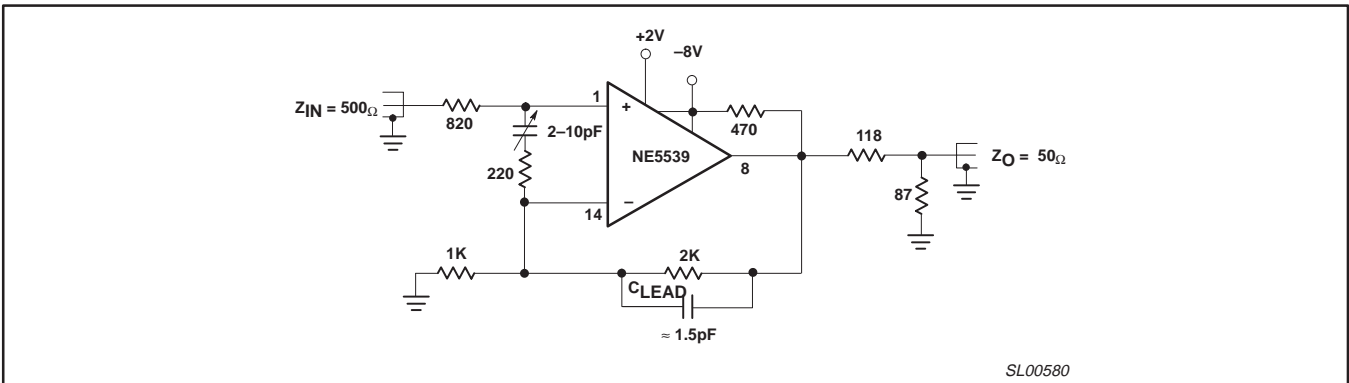


Figure 11. Non-Inverting Follower

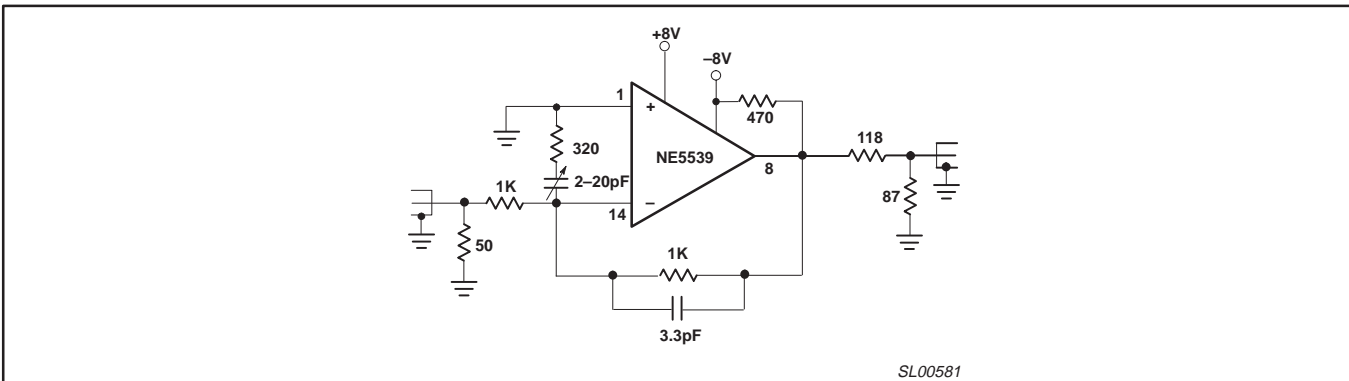


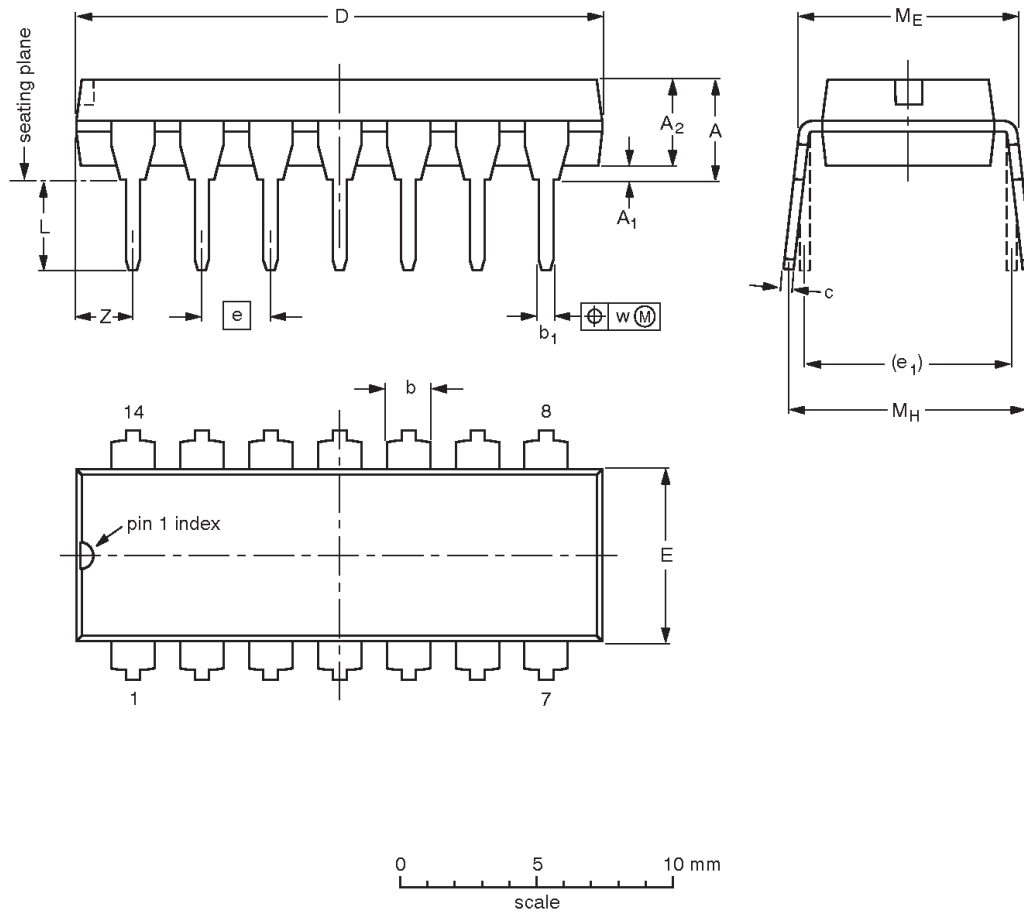
Figure 12. Inverting Follower

High frequency operational amplifier

NE/SE5539

DIP14: plastic dual in-line package; 14 leads (300 mil)

SOT27-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A ₁ min.	A ₂ max.	b	b ₁	c	D ⁽¹⁾	E ⁽¹⁾	e	e ₁	L	M _E	M _H	w	Z ⁽¹⁾ max.
mm	4.2	0.51	3.2	1.73 1.13	0.53 0.38	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.2
inches	0.17	0.020	0.13	0.068 0.044	0.021 0.015	0.014 0.009	0.77 0.73	0.26 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.087

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

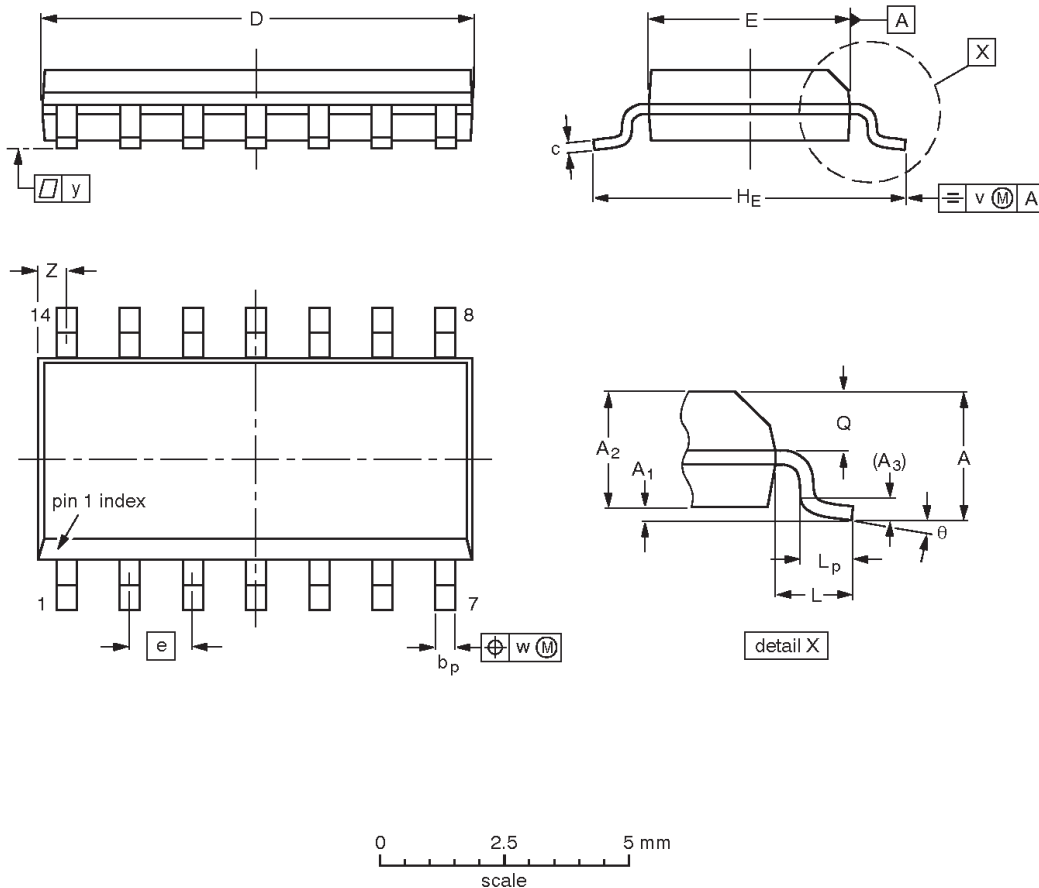
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT27-1	050G04	MO-001	SC-501-14			95-03-11 99-12-27

High frequency operational amplifier

NE/SE5539

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _E	L	L _p	Q	v	w	y	Z ⁽¹⁾	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	8.75 8.55	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.35 0.34	0.16 0.15	0.050	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT108-1	076E06	MS-012				97-05-22 99-12-27

High frequency operational amplifier

NE/SE5539

NOTES

High frequency operational amplifier

NE/SE5539

Data sheet status

Data sheet status ^[1]	Product status ^[2]	Definitions
Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
Product data	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Changes will be communicated according to the Customer Product/Process Change Notification (CPCN) procedure SNW-SQ-650A.

[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

Definitions

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

Application information — Applications that are described herein for any of these products are for illustrative purposes only. Philips Semiconductors make no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Disclaimers

Life support — These products are not designed for use in life support appliances, devices or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips Semiconductors customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips Semiconductors for any damages resulting from such application.

Right to make changes — Philips Semiconductors reserves the right to make changes, without notice, in the products, including circuits, standard cells, and/or software, described or contained herein in order to improve design and/or performance. Philips Semiconductors assumes no responsibility or liability for the use of any of these products, conveys no license or title under any patent, copyright, or mask work right to these products, and makes no representations or warranties that these products are free from patent, copyright, or mask work right infringement, unless otherwise specified.

Contact information

For additional information please visit
<http://www.semiconductors.philips.com>. Fax: +31 40 27 24825

© Koninklijke Philips Electronics N.V. 2002
 All rights reserved. Printed in U.S.A.

Date of release: 01-02

For sales offices addresses send e-mail to:
sales.addresses@www.semiconductors.philips.com

Document order number:

9397 750 09382

Let's make things better.