Document	853–0814
ECN No.	91253
Date of Issue	November 3, 1987
Status	Product Specification
RF Communications	

NE/SE5539

High frequency operational amplifier

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.

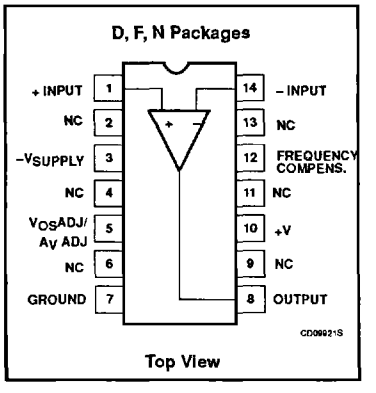
FEATURES

- Bandwidth
  - Unity gain – 350MHz
  - Full power – 48MHz
  - GBW – 1.2GHz at 17dB
- Slew rate: 600/Vμs
- A_{VOL}: 52dB typical
- Low noise – 4nV√Hz typical
- MIL–STD processing available

APPLICATIONS

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

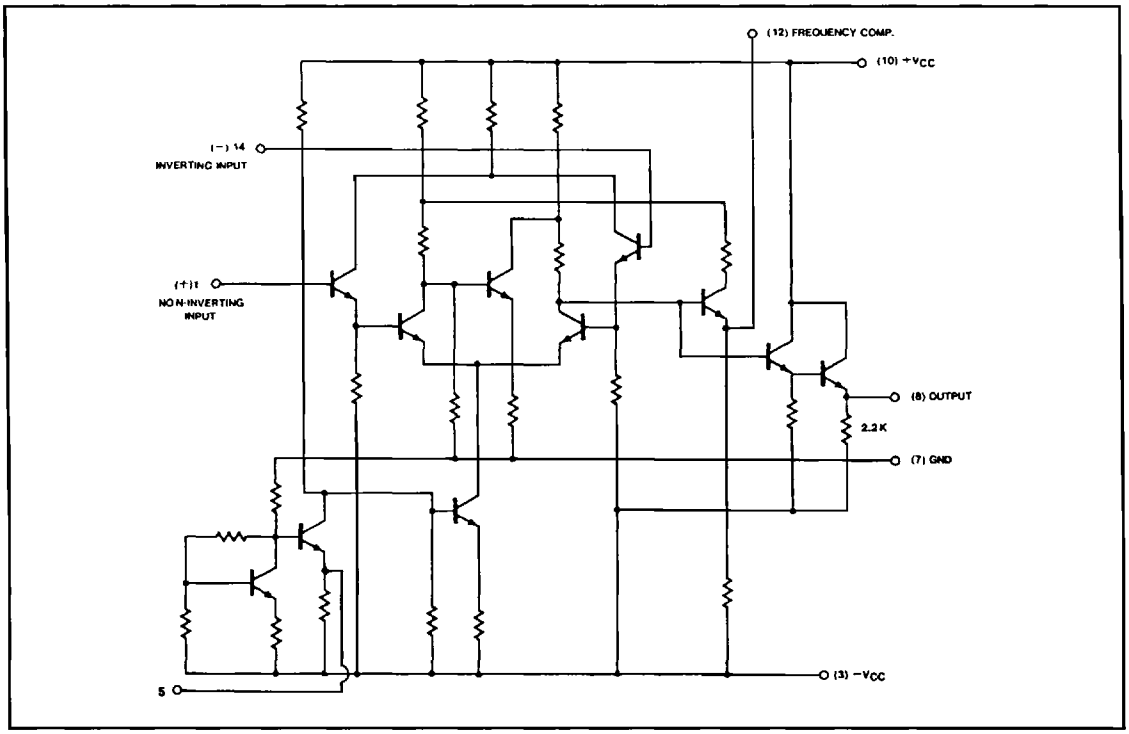
PIN CONFIGURATION



ORDERING INFORMATION

DESCRIPTION	TEMPERATURE RANGE	ORDER CODE
14–Pin Plastic DIP	0 to +70°C	NE5539N
14–Pin Plastic SO	0 to +70°C	NE5539D
14–Pin Cerdip	0 to +70°C	NE5539F
14–Pin Plastic DIP	–55 to +125°C	SE5539N
14–Pin Cerdip	–55 to +125°C	SE5539F

EQUIVALENT SCHEMATIC



ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	RATING	UNITS
V_{CC}	Supply voltage	±12	V
P_{DMAX}	Maximum power dissipation, T_A = 25°C (still-air)[2] F package N package D package	 1.17 1.45 0.99	 W W W
T_A	Operating temperature range NE SE	 0 to 70 −55 to +125	 °C °C
T_{STG}	Storage temperature range	−65 to +150	°C
T_J	Max junction temperature	150	°C
T_{SOLD}	Lead soldering temperature (10sec max)	+300	°C

NOTES:
1. Differential input voltage should not exceed 0.25V to prevent excesive input bias current and common-mode voltage 2.5V. These voltage limits may be exceeded if current is limited to less than 10mA.
2. *Derate above 25°C, at the following rates:*
   F package at 9.3mW/°C
   N package at 11.6mW/°C
   D package at 7.9mW/°C

DC ELECTRICAL CHARACTERISTICS $V_{CC} = \pm 8V$, $T_A = 25°C$; unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS		SE5539			NE5539			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{OUT}	Output voltage swing	$R_L = 150\Omega$ to GND and 470Ω to $-V_{CC}$	+Swing –Swing				+2.3 –1.7	+2.7 –2.2		V
V_{OUT}	Output voltage swing	$R_L = 25\Omega$ to GND Over temp	+Swing –Swing	+2.3 –1.5	+3.0 –2.1					V
		$R_L = 25\Omega$ to GND $T_A = 25°C$	+Swing –Swing	+2.5 –2.0	+3.1 –2.7					V
I_{CC+}	Positive supply current	$V_O = 0$, $R_1 = \infty$, Over temp			14	18		2.8	3.5	mA
		$V_O = 0$, $R_1 = \infty$, $T_A = 25°C$			14	17		14	18	mA
I_{CC-}	Negative supply current	$V_O = 0$, $R_1 = \infty$, Over temp			11	15		2.8	3.5	mA
		$V_O = 0$, $R_1 = \infty$, $T_A = 25°C$			11	14		11	15	mA
PSRR	Power supply rejection ratio	$\Delta V_{CC} = \pm 1V$, Over temp			300	1000				µV/V
		$\Delta V_{CC} = \pm 1V$, $T_A = 25°C$						200	1000	µV/V
A_{VOL}	Large signal voltage gain	$V_O = +2.3V, -1.7V$, $R_L = 150\Omega$ to GND, 470Ω to $-V_{CC}$					47	52	57	dB
A_{VOL}	Large signal voltage gain	$V_O = +2.3V, -1.7V$, $R_L = 2\Omega$ to GND, $T_A = 25°C$					47	52	57	dB
A_{VOL}	Large signal voltage gain	$V_O = +2.5V, -2.0V$, $R_L = 2\Omega$ to GND, Over temp		46		60				dB
		$V_O = +2.5V, -2.0V$, $R_L = 2\Omega$ to GND, $T_A = 25°C$		48	53	58				dB

DC ELECTRICAL CHARACTERISTICS $V_{CC} = \pm 6V$, $T_A = 25°C$; unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	SE5539			UNITS
			MIN	TYP	MAX	
V_{OS}	Input offset voltage	Over temp		2	5	mV
		$T_A = 25°C$		2	3	mV
I_{OS}	Input offset current	Over temp		0.1	3	µA
		$T_A = 25°C$		0.1	1	µA
I_B	Input bias current	Over temp		5	20	µA
		$T_A = 25°C$		4	10	µA
CMRR	Common-mode rejection ratio	$V_{CM} = \pm 1.3V$, $R_S = 100\Omega$	70	85		dB
I_{CC+}	Positive supply current	Over temp		11	14	mA
		$T_A = 25°C$		11	13	mA
I_{CC-}	Negative supply current	Over temp		8	11	mA
		$T_A = 25°C$		8	10	mA
PSRR	Power supply rejection ratio	$\Delta V_{CC} = \pm 1V$, Over temp		300	1000	µV/V
		$\Delta V_{CC} = \pm 1V$, $T_A = 25°C$				µV/V

DC ELECTRICAL CHARACTERISTICS $V_{CC} = \pm 6V$, $T_A = 25°C$; *unless otherwise specified.*

SYMBOL	PARAMETER	TEST CONDITIONS	SE5539			UNITS
			MIN	TYP	MAX	
V_{OUT}	Output voltage swing	$R_L = 150\Omega$ to GND, 390Ω to $-V_{CC}$, Over temp +Swing –Swing	 +1.4 –1.1	 +2.0 –1.7		V
		$R_L = 150\Omega$ to GND, 390Ω to $-V_{CC}$, $T_A = 25°C$ +Swing –Swing	 +1.5 –1.4	 +2.0 –1.8		mV

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

SYMBOL	PARAMETER	TEST CONDITIONS	SE5539			NE5539			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
BW	Gain bandwidth product	$A_{CL} = 7$, $V_O = 0.1\ V_{P-P}$		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/μs
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	$R_S = 50\Omega$, 1MHz		4			4		nV/√Hz
	Input noise current	1MHz		6			6		pA/√Hz

NOTES:
1. External compensation.

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

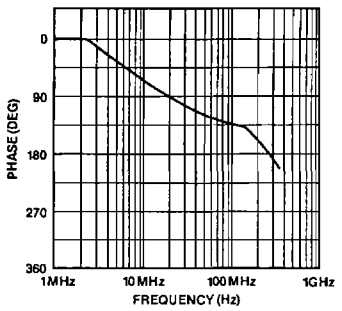
SYMBOL	PARAMETER	TEST CONDITIONS	SE5539			UNITS
			MIN	TYP	MAX	
BW	Gain bandwidth product	$A_{CL} = 7$		700		MHz
	Small signal bandwidth	$A_{CL} = 2$[1]		120		MHz
t_S	Settling time	$A_{CL} = 2$[1]		23		ns
SR	Slew rate	$A_{CL} = 2$[1]		330		V/μs
t_{PD}	Propagation delay	$A_{CL} = 2$[1]		4.5		ns
	Full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

NOTES:
1. External compensation.

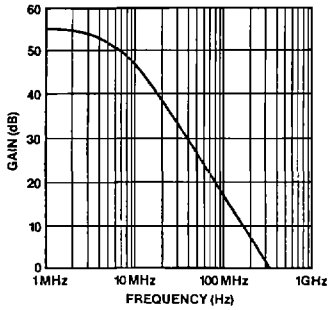
High frequency operational amplifier NE/SE5539

TYPICAL PERFORMANCE CURVES

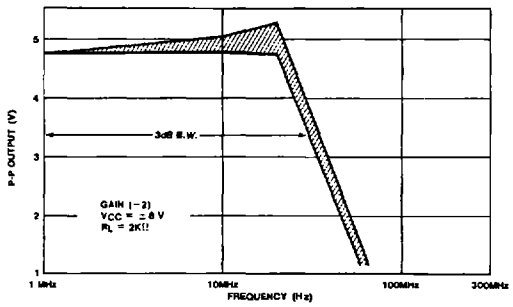
NE5539 Open-Loop Phase



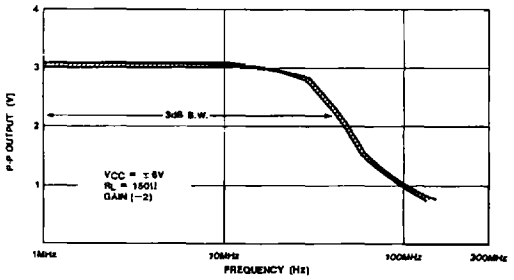
NE5539 Open-Loop Gain



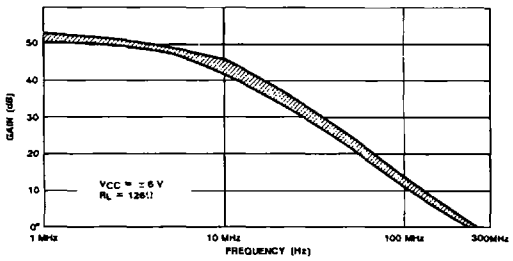
Power Bandwidth (SE)



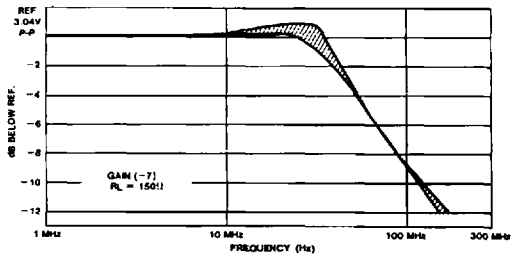
Power Bandwidth (NE)



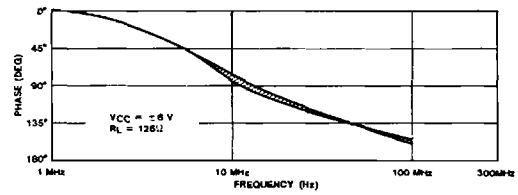
SE5539 Open-Loop Gain vs Frequency



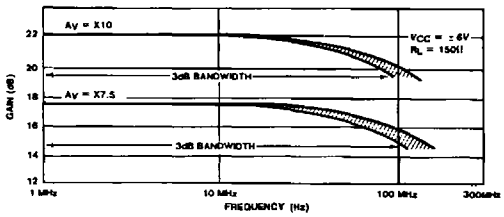
Power Bandwidth



SE5539 Open-Loop Phase vs Frequency



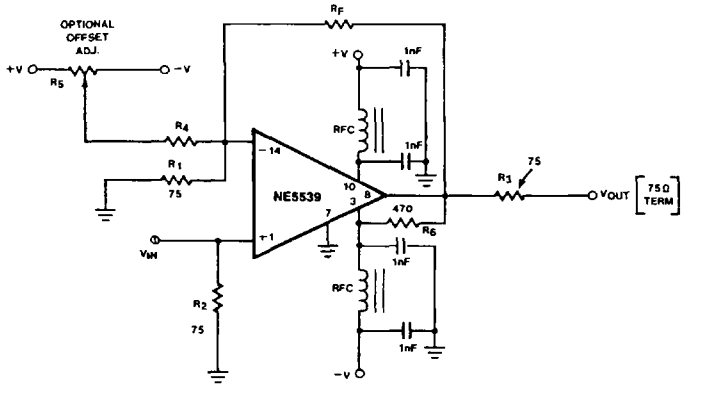
Gain Bandwidth Product vs Frequency



NOTE

Indicates typical distribution $-55°C \leq T_A \leq 125°C$

High frequency operational amplifier | NE/SE5539



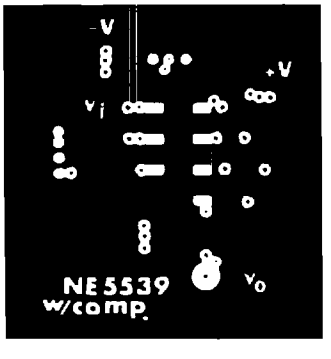
NOTES:

R_1 = 75Ω 5% CARBON
R_2 = 75Ω 5% CARBON
R_3 = 75Ω 5% CARBON
R_4 = 36k 5% CARBON

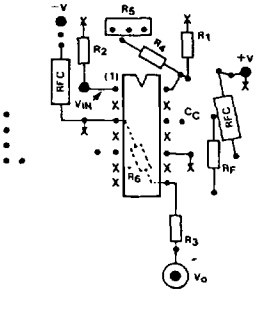
R_5 = 20k TRIMPOT (CERMET)
R_F = 1.5k (28dB GAIN)
R_6 = 470Ω 5% CARBON

RFC 3T # 26 BUSS WIRE ON FERROXCUBE VK 200 09/3B CORE
BYPASS CAPACITORS
1nF CERAMIC
(MEPCO OR EQUIV.)

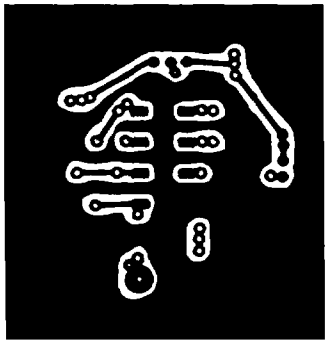
Top Plane Copper[1] (Component Side)



Component Side (Component Layout)



Bottom Plane Copper[1]



NOTE:
1. Bond edges of top and bottom ground plane copper.

Figure 1. 28dB Non-Inverting Amp Sample PC Layout

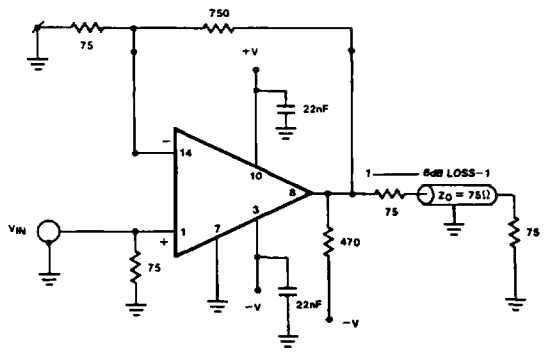


Figure 2. NE5539 Video Amplifier

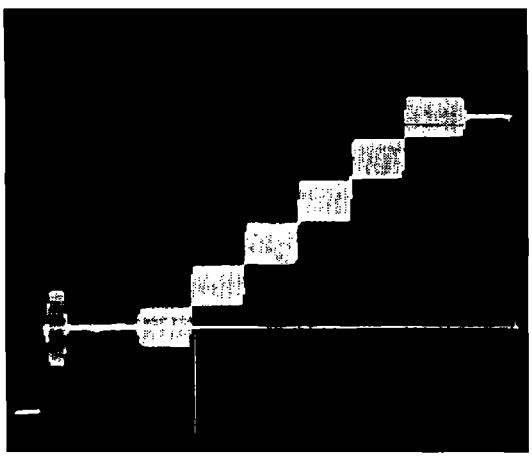


Figure 3. Input Signal

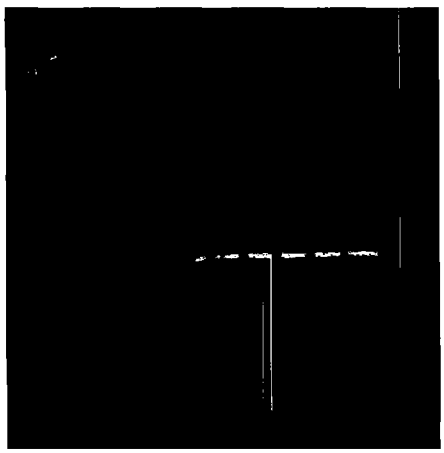


Figure 4. Differential Gain <0.5%

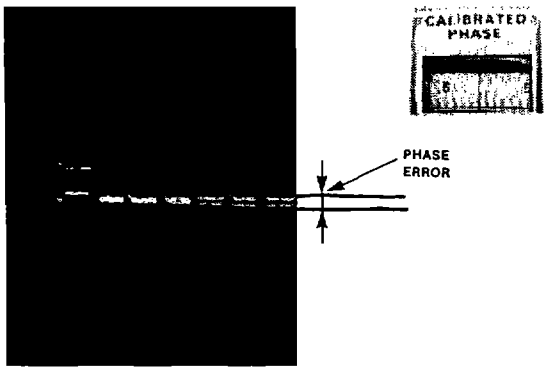


Figure 5. Differential Phase +0.1°

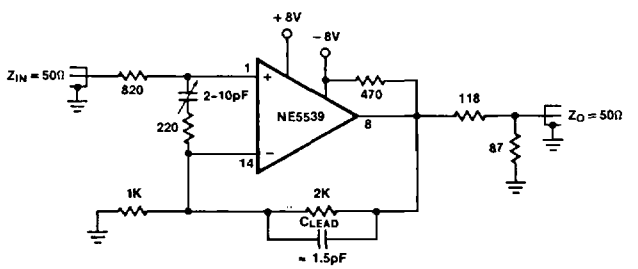


Figure 6. Non-Inverting Follower

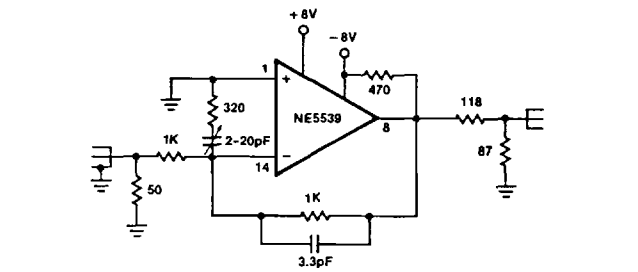


Figure 7. Inverting Follower