

NE/SE538

High Slew Rate Op Amp

Product Specification

DESCRIPTION

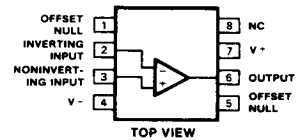
The NE/SE538 is a new generation operational amplifier featuring high slew rates combined with improved input characteristics. Internally-compensated for gains of 5 or larger, the SE538 offers guaranteed minimum slew rates of $40\text{V}/\mu\text{s}$ or larger. Industry standard pinout and internal compensation allow the user to upgrade system performance by directly replacing general purpose amplifiers, such as 748, 101A and 741.

FEATURES

- 2mV typical input offset voltage
- 80nA max input offset current
- Short-circuit protected
- Offset null capability
- Large common-mode and differential voltage ranges
- $60\text{V}/\mu\text{s}$ typical slew rate (gain of $+5$, -4 min)
- 6MHz typical gain bandwidth product (gain $+5$, -4 minimum)
- Internal frequency compensation (gain of $+5$, -4 minimum)
- Pinout: standard single op amp (748, 101A, 741, etc).

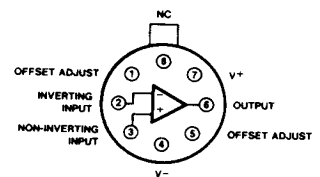
PIN CONFIGURATIONS

D, FE, N Packages



CD117205

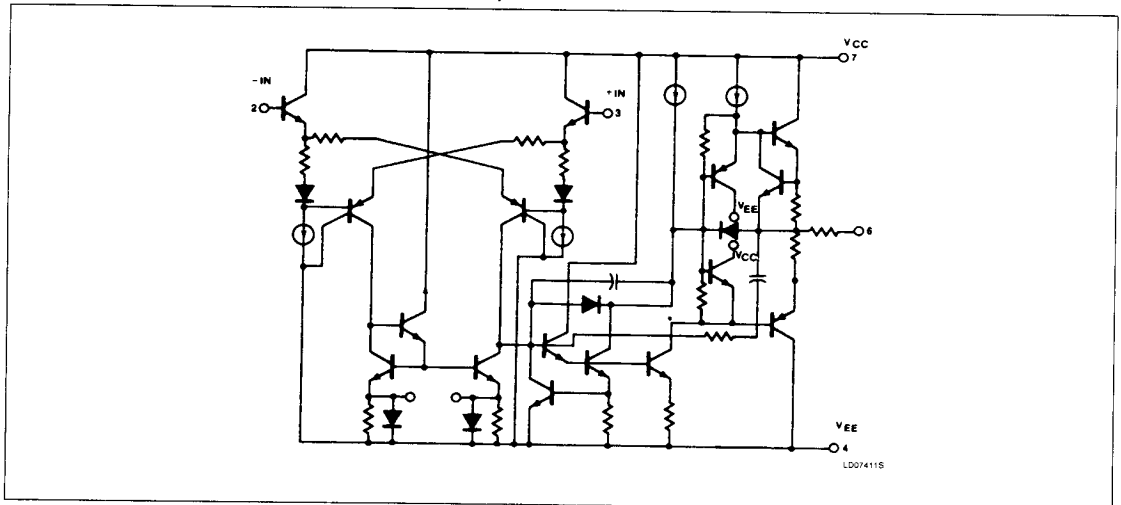
H Package¹



CD117305

NOTE:
1. Metal cans no longer available.

EQUIVALENT SCHEMATIC (EACH AMPLIFIER)



High Slew Rate Op Amp

NE/SE538

ORDERING INFORMATION

DESCRIPTION	TEMPERATURE RANGE	ORDER CODE
8-Pin Plastic SO	0 to +70°C	NE538D
8-Pin Plastic DIP	0 to +70°C	NE538N
8-Pin Ceramic DIP	0 to +70°C	NE538FE
8-Pin Plastic DIP	-55°C to +125°C	SE538N
8-Pin Ceramic DIP	-55°C to +125°C	SE538FE

ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	RATING	UNIT
V _{CC}	Supply voltage	± 22	V
	SE military grade NE commercial grade	± 18	V
P _D	Maximum power dissipation, T _A =25°C (still air) ¹		
	D package	790	mW
	F package	830	mW
	N package	1200	mW
V _{DIFF}	Differential input voltage	± 30	V
V _{IN}	Input voltage ²	± 15	V
T _A	Operating ambient temperature range		
	SE military grade NE commercial grade	-55 to +125 0 to 70	°C °C
	Output short-circuit ³	indefinite	
T _{STG}	Storage temperature range	-65 to +150	°C
T _{SOLD}	Lead soldering temperature (10sec max)	300	°C

NOTES:

1. Derate above 25°C, at the following rates:

D package at 6.3mW/°C

F package at 6.7mW/°C

N package at 9.6mW/°C

2. For supply voltages less than ± 15V, the absolute maximum input voltage is equal to the supply voltage.

3. Short-circuit may be to ground or either supply. Rating applies to 125°C case temperature or 75°C ambient temperature.

High Slew Rate Op Amp

NE/SE538

DC ELECTRICAL CHARACTERISTICS $T_A = 25^\circ\text{C}$, $V_S = \pm 15\text{V}$, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	SE538			NE538			UNIT
			Min	Typ	Max	Min	Typ	Max	
V_{OS}	Input offset voltage	$R_S \leq 10\text{k}\Omega$ $R_S \leq 10\text{k}\Omega$, over temp.		0.7	4.0 5.0		2.0	6.0 7.0	mV mV
ΔV_{OS}	Input offset voltage drift	$R_S = 0\Omega$, over temp.		4.0			6.0		$\mu\text{V}/^\circ\text{C}$
I_{OS}	Input offset current	Over temp.		5	20 40		15	40 80	nA nA
ΔI_{OS}	Input offset current	Over temp.		25			40		$\text{pA}/^\circ\text{C}$
I_B	Input current	Over temp.		45	80 200		65	150 200	nA nA
ΔI_B	Input current	Over temp.		50			80		$\text{pA}/^\circ\text{C}$
V_{CM}	Input common-mode voltage range		± 12	± 13		± 12	± 13		V
CMRR	Common-mode rejection ratio	$R_S \leq 10\text{k}\Omega$, over temp.	70	90		70	90		dB
PSRR	Power supply rejection ratio	$R_S \leq 10\text{k}\Omega$, over temp.		30	150		30	150	$\mu\text{V}/\text{V}$
R_{IN}	Input resistance		3	10		1	6		M Ω
A_{VOL}	Large-signal voltage gain	$R_L \geq 2\text{k}\Omega$, $V_{OUT} = \pm 10\text{V}$ Over temp., $R_L \geq 2\text{k}\Omega$, $V_{OUT} = \pm 10\text{V}$	50 25	200		50 25	200		V/mV V/mV
V_{OUT}	Output voltage swing	Over temp., $R_L \geq 2\text{k}\Omega$ Over temp., $R_L \geq 10\text{k}\Omega$	± 10 ± 12	± 13 ± 14		± 10 ± 12	± 13 ± 14		V V
I_{CC}	Supply current	Over temp.		2 2.2	3 3.6		2 2.2	3 3.6	mA mA
P_D	Power dissipation	Over temp.		60 66	90 108		60 66	90 108	mW mW
I_{SC}	Output short-circuit current		10	25	50	10	25	50	mA
R_{OUT}	Output resistance			100			100		Ω

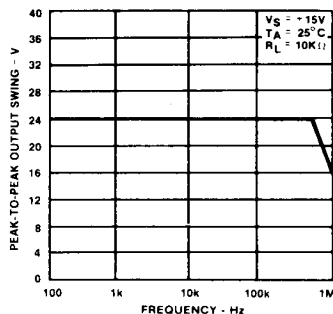
AC ELECTRICAL CHARACTERISTICS $T_A = 25^\circ\text{C}$, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	SE538			NE538			UNIT
			Min	Typ	Max	Min	Typ	Max	
GBW	Gain bandwidth product (Gain +5, -4 minimum)			6			6		MHz
t_R	Transient response Small-signal rise time Small-signal overshoot			0.25 6			0.25 6		μs %
t_S	Settling time	To 0.1%		1.2			1.2		μs
SR	Slew rate	Minimum gain = 5 Noninverting $R_L \geq 2\text{k}\Omega$	40	60			60		V/ μs
V_{NOISE}	Input noise voltage	$f = 1\text{kHz}$, $T_A = 25^\circ\text{C}$		30			30		nV/ $\sqrt{\text{Hz}}$

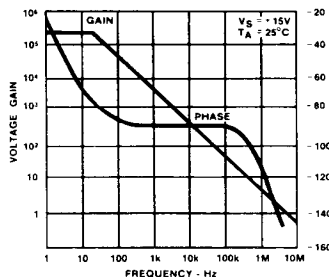
High Slew Rate Op Amp

NE/SE538

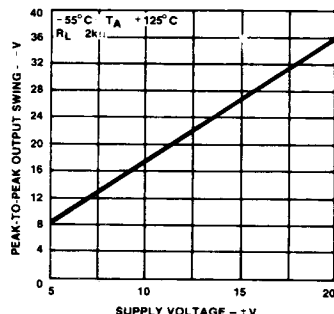
TYPICAL PERFORMANCE CHARACTERISTICS

Output Voltage Swing
as a Function of
Frequency

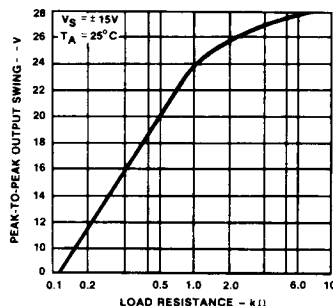
OP126805

Open Loop Voltage Gain
as a Function of
Frequency

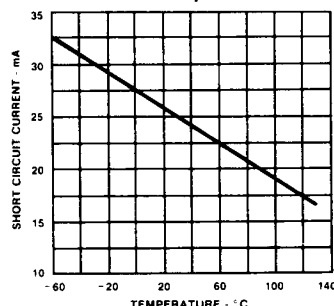
OP126905

Output Voltage Swing
as a Function of
Supply Voltage

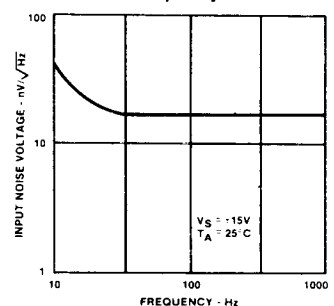
OP127005

Output Voltage Swing
as a Function of
Load Resistance

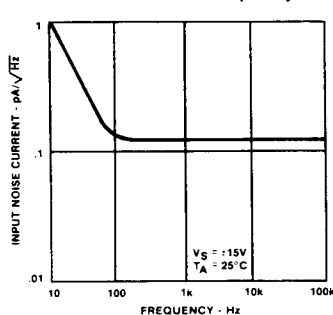
OP127105

Output Short-Circuit Current
as a Function of
Ambient Temperature

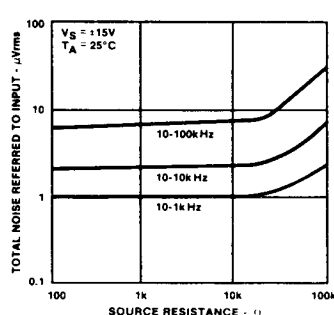
OP127205

Input Noise Voltage
as a Function of
Frequency

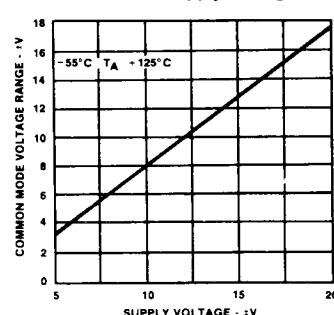
OP127305

Input Noise Current
as a Function of Frequency

OP127405

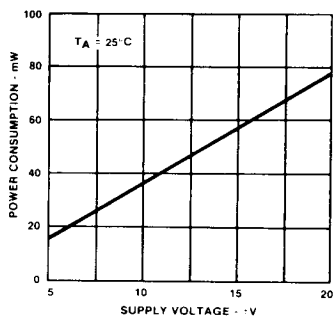
Broadband Noise for
Various Bandwidths

OP127505

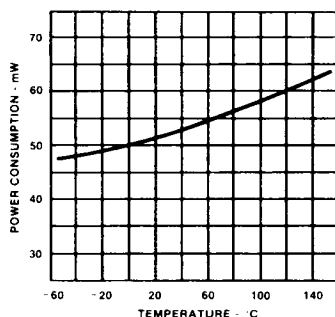
Input Common-Mode
Voltage Range as a
Function of Supply Voltage

OP127605

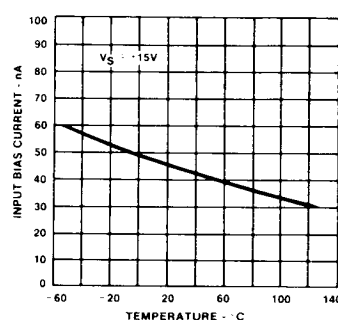
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

Power Consumption
as a Function of
Supply Voltage

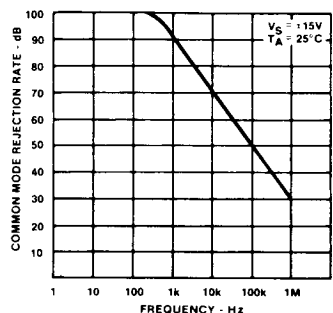
OP127705

Power Consumption
as a Function of
Ambient Temperature

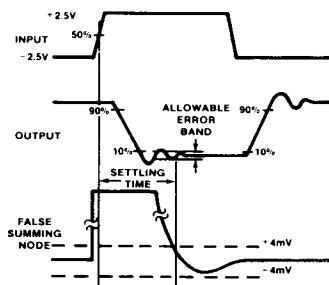
OP127805

Input Bias Current
as a Function of
Ambient Temperature

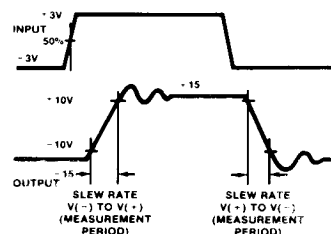
OP127905

Common-Mode Rejection
Ratio as a Function of
Frequency

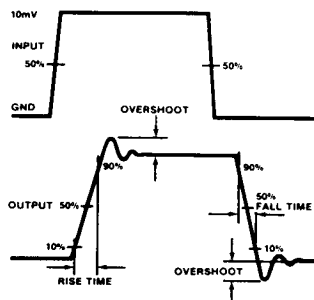
OP128005

Settling Time Measurement
Waveforms

WF184405

Slew Rate Measurement
 $V_{CC} = \pm 20\text{V}$ 

WF184505

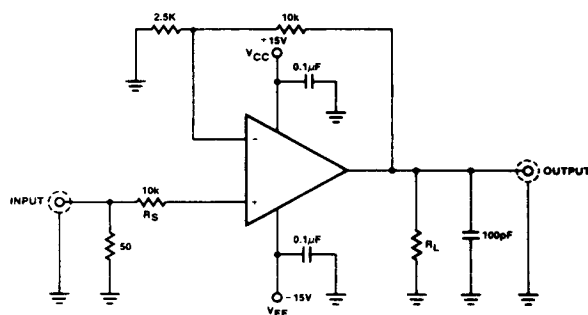
Small-Signal Transient
Response Definitions

WF184605

High Slew Rate Op Amp

NE/SE538

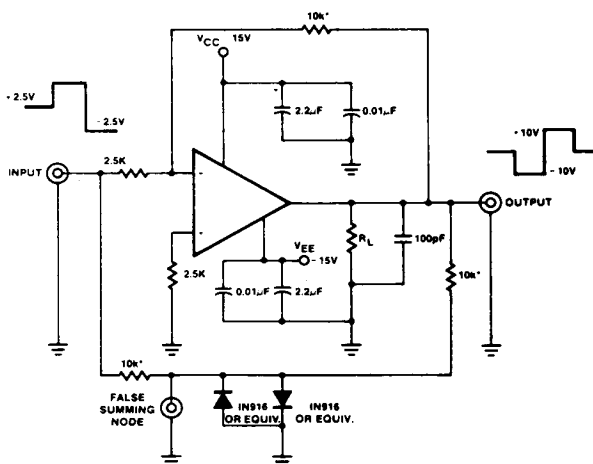
TEST LOAD CIRCUITS



TC153008

NOTES:

Pins not shown are not connected.
All resistor values are typical and in ohms.

Slew Rate and Small-Signal Transient Response Test Circuit

TC148818

NOTES:

*Match to within 0.01%.
Pins not shown are not connected.
All resistor values are typical and in ohms.

Settling Time Test Circuit

High Slew Rate Op Amp

NE/SE538

APPLICATIONS

The internal frequency compensation is designed for a minimum inverting gain of 4 and a minimum non-inverting gain of 5. Below these gains the NE538 will be unstable and will need external compensation (see Figures 1 and 2).

The higher slew rate of the NE538 has made this device quite appealing for high-speed designs, and the fact that it has a standard pinout will allow it to be used to upgrade existing systems that now use the μ A741 or μ 748.

Equations:

$$f_{LAG} = \frac{1}{10} \frac{(6\text{MHz})}{2\pi R_L C_L} = \frac{1}{2\pi R_L C_L}$$

$$f_{LEAD} = 6\text{MHz} = \frac{1}{2\pi R_F C_F}$$

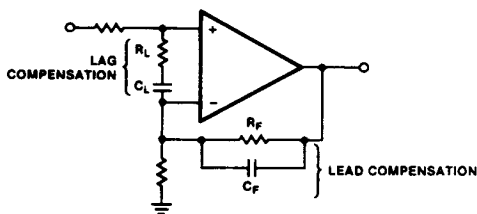


Figure 1. Non-Inverting Configuration

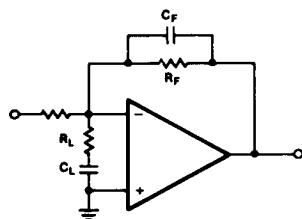


Figure 2. Inverting Configuration

VOLTAGE COMPARATOR

Inexpensive voltage comparators with only modest parameters are often needed. The op amp is often used in the configuration because the high gain provides good selectivity. Figure 6 shows a circuit usable with most any op amp. The zener is selected for the output voltage required (5.1 volt for TTL), and the resistor provides some current protection to the op amp output structure. V_{REF} can be any voltage within the wide common-mode range of the amplifier — another advantage of using op amps for comparators.

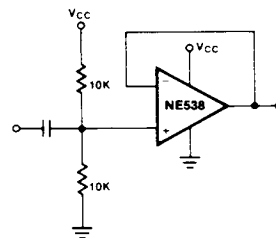


Figure 3. Voltage-Follower With Single Power Source

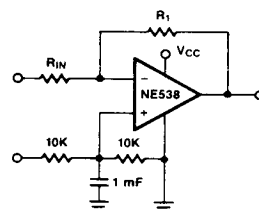


Figure 4. Inverting Amp With Single Power Supply

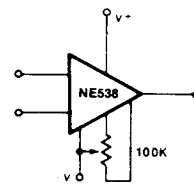
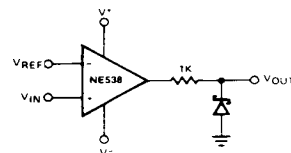


Figure 5. Offset Adjust Circuit



NOTE:
All resistor values are in ohms.

Figure 6. Voltage Comparator