Signetics

NE/SE538
High Slew Rate Op Amp

Product Specification

Linear Products

DESCRIPTION

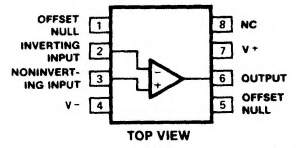
The NE/SE538 is a new generation operational amplifier featuring high slew rates combined with improved input characteristics. Internally-compensated for gains of 5 or larger, the SE538 offers guaranteed minimum slew rates of 40V/μs or larger. Industry standard pinout and internal compensation allow 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**
- **60V/μs 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

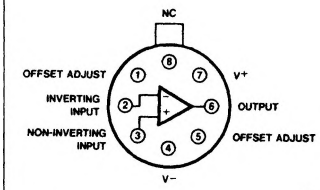
D, FE, N Packages



TOP VIEW

CD11720S

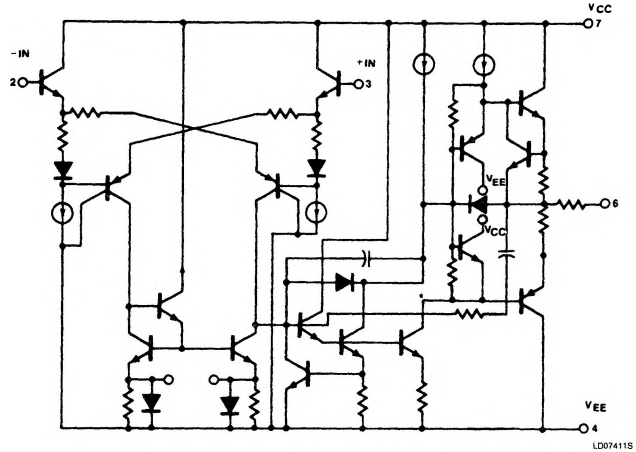
H Package[1]



CD11730S

NOTE:
1. Metal cans no longer available.

EQUIVALENT SCHEMATIC (EACH AMPLIFIER)



LD07411S

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 SE military grade NE commercial grade	 ±22 ±18	 V V
P_D	Maximum power dissipation, T_A=25°C (still air)[1] D package F package N package	 790 830 1200	 mW mW 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.

DC ELECTRICAL CHARACTERISTICS $T_A = 25°C$, $V_S = \pm 15V$, unless otherwise specified.

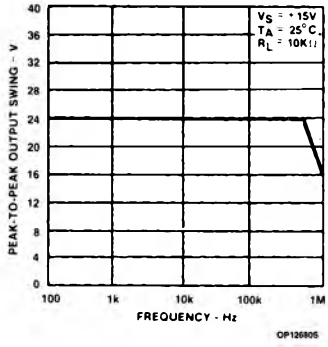
SYMBOL	PARAMETER	TEST CONDITIONS	SE538			NE538			UNIT
			Min	Typ	Max	Min	Typ	Max	
V_{OS}	Input offset voltage	$R_S \leq 10k\Omega$ $R_S \leq 10k\Omega$, over temp.		0.7	4.0 5.0		2.0	6.0 7.0	mV mV
ΔV_{OS}	Input offset voltage drift	$R_S = 0\Omega$, over temp.		4.0			6.0		µV/°C
I_{OS}	Input offset current	 Over temp.		5	20 40		15	40 80	nA nA
ΔI_{OS}	Input offset current	Over temp.		25			40		pA/°C
I_B	Input current	 Over temp.		45	80 200		65	150 200	nA nA
ΔI_B	Input current	Over temp.		50			80		pA/°C
V_{CM}	Input common-mode voltage range		± 12	± 13		± 12	± 13		V
CMRR	Common-mode rejection ratio	$R_S \leq 10k\Omega$, over temp.	70	90		70	90		dB
PSRR	Power supply rejection ratio	$R_S \leq 10k\Omega$, over temp.		30	150		30	150	µV/V
R_{IN}	Input resistance		3	10		1	6		MΩ
A_{VOL}	Large-signal voltage gain	$R_L \geq 2k\Omega$, , $V_{OUT} = \pm 10V$ Over temp., $R_L \geq 2k\Omega$, $V_{OUT} = \pm 10V$	50 25	200		50 25	200		V/mV V/mV
V_{OUT}	Output voltage swing	Over temp., $R_L \geq 2k\Omega$ Over temp., $R_L \geq 10k\Omega$	± 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 $T_A = 25°C$, unless otherwise specified.

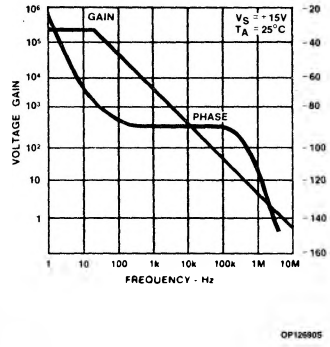
SYMBOL	PARAMETER	TEST CONDITIONS	SE538			NE538			UNIT
			Min	Typ	Max	Min	Typ	Max	
GBW	Gain bandwidth product (Gain +5, −4 minimum)			6			6		MHz
t_R	Transient response Small-signal rise time Small-signal overshoot			 0.25 6			 0.25 6		 µs %
t_S	Settling time	To 0.1%		1.2			1.2		µs
SR	Slew rate	Minimum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

TYPICAL PERFORMANCE CHARACTERISTICS

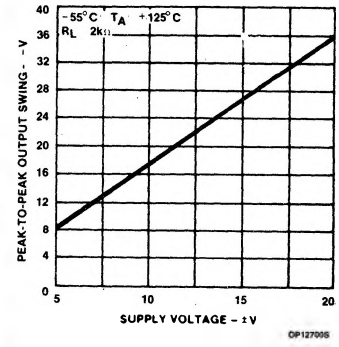
Output Voltage Swing as a Function of Frequency



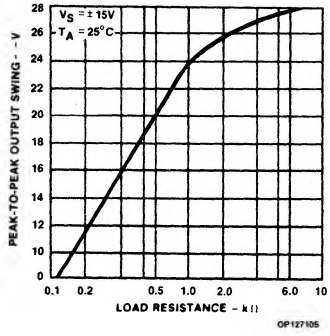
Open Loop Voltage Gain as a Function of Frequency



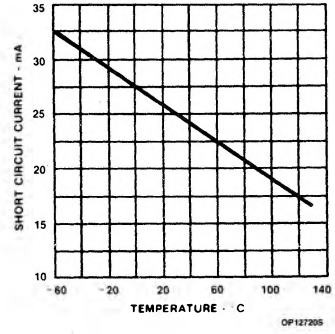
Output Voltage Swing as a Function of Supply Voltage



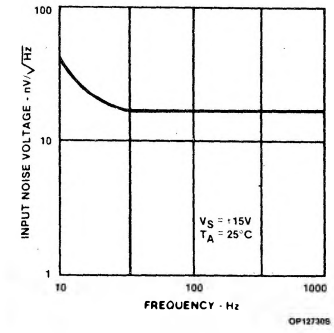
Output Voltage Swing as a Function of Load Resistance



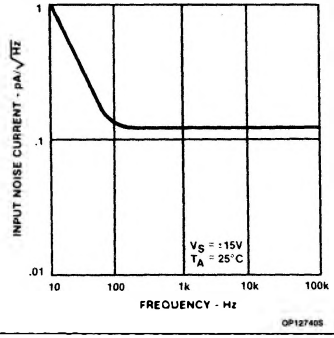
Output Short-Circuit Current as a Function of Ambient Temperature



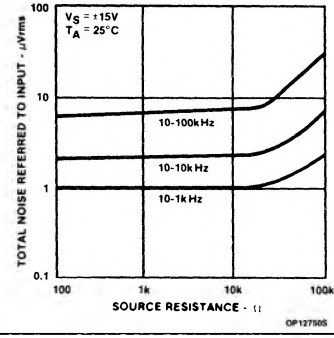
Input Noise Voltage as a Function of Frequency



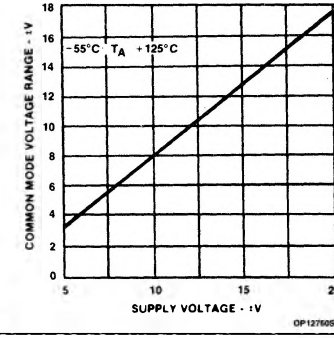
Input Noise Current as a Function of Frequency



Broadband Noise for Various Bandwidths

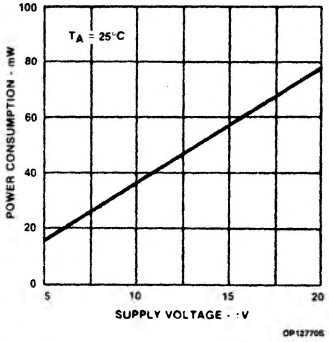


Input Common-Mode Voltage Range as a Function of Supply Voltage

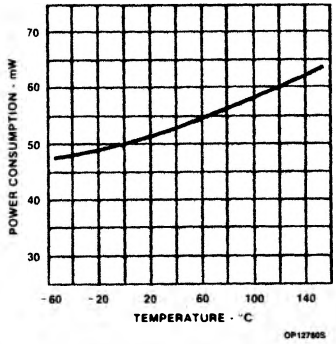


TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

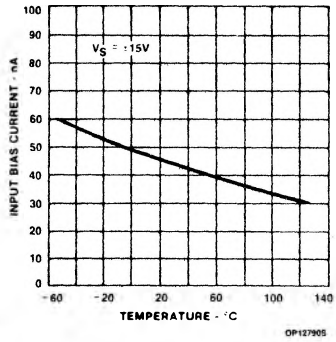
Power Consumption as a Function of Supply Voltage



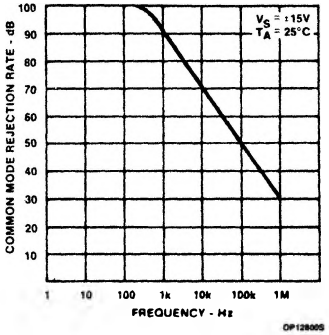
Power Consumption as a Function of Ambient Temperature



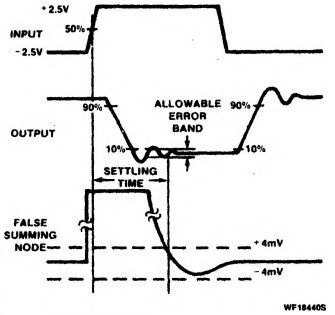
Input Bias Current as a Function of Ambient Temperature



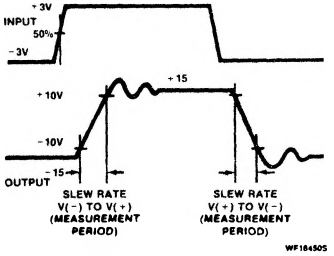
Common-Mode Rejection Ratio as a Function of Frequency



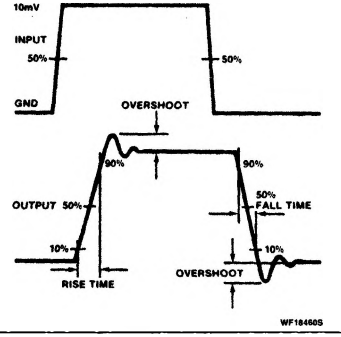
Settling Time Measurement Waveforms



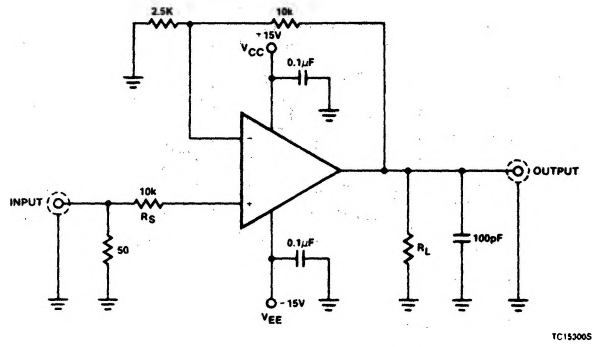
Slew Rate Measurement $V_{CC} = \pm 20V$



Small-Signal Transient Response Definitions

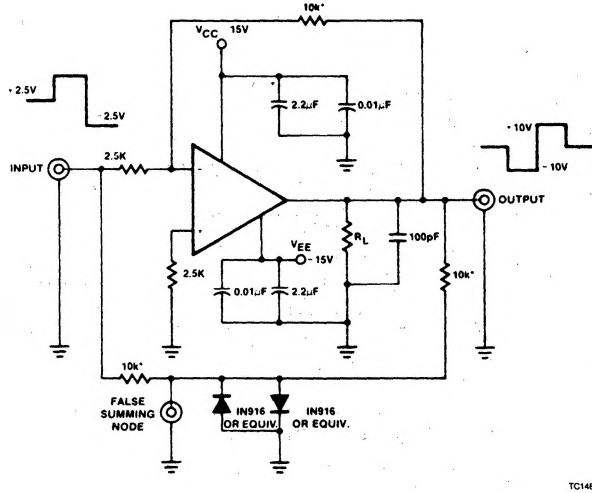


TEST LOAD CIRCUITS



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

Slew Rate and Small-Signal Transient Response Test Circuit



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 μA741 or μ748.

Equations:

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

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

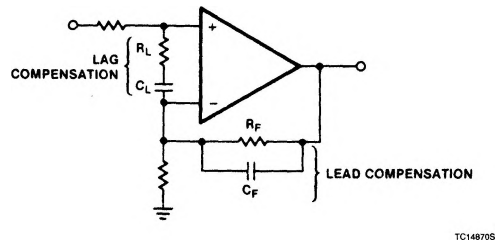


Figure 1. Non-Inverting Configuration

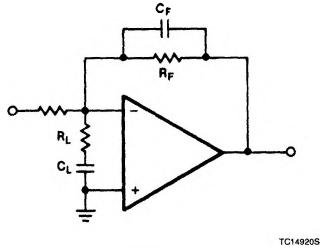


Figure 2. Inverting Configuration

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.

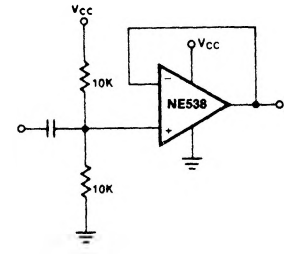


Figure 3. Voltage-Follower With Single Power Source

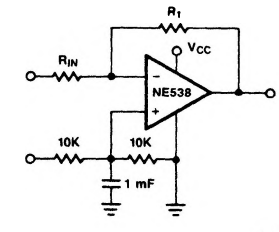


Figure 4. Inverting Amp With Single Power Supply

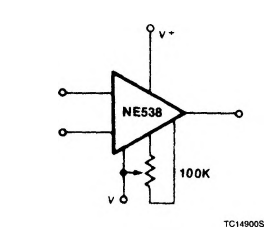
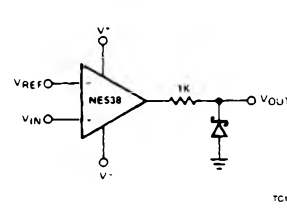


Figure 5. Offset Adjust Circuit



NOTE:
All resistor values are in ohms.

Figure 6. Voltage Comparator