HIGH SLEW RATE OP AMP

SE/NE538

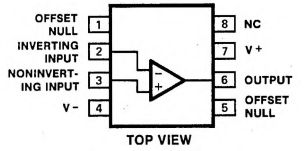
DESCRIPTION

The SE/NE538 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. Featuring 2mV max input offset voltage, the 538 is a single amplifier. Industry standard pin out and internal compensation allow the user to upgrade system performance by directly replacing general purpose amplifiers, such as 748, 101A and 741.

FEATURES

- **2mV input offset voltage**
- **80nA max input offset current**
- **Short circuit protected**
- **Offset null capability**
- **Large common mode and differential voltage ranges**
- **60V/μs slew rate (gain of +5, −4 min)**
- **6MHz gain bandwidth product (gain +5, −4 minimum)**
- **Internal frequency compensation (gain of +5, −4 minimum)**
- **Pin out: 538 same as 741 (single)**

FE,N PACKAGE

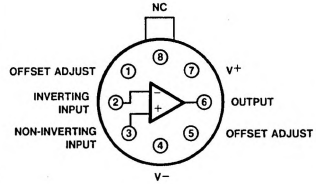


TOP VIEW

ORDER NUMBERS

SE538N, FE NE538N, FE

H PACKAGE*



ORDER NUMBERS

SE538H NE538H

ABSOLUTE MAXIMUM RATINGS[1,2,3]

	PARAMETER	RATING	UNIT
V_{CC}	Supply voltage		
	SE military grade	±22	V
	NE commercial grade	±18	V
P_D	Internal power dissipation FE package	1000	mW
P_D	Internal power dissipation[1] N package	500	mW
P_D	Internal power dissipation[1] H package	800	mW
	Differential input voltage	±30	V
	Input voltage[2]	±15	V
	Operating temperature range		
	SE military grade	-55 to +125	°C
	NE commercial grade	0 to 70	°C
	Output short circuit[3]	indefinite	
	Storage temperature range	-65 to +150	°C
	Lead temperature (solder, 60sec.)	300	°C

NOTES

1. Rating applies for thermal resistances of 240°C/W and 150°C/W junction to ambient for N and H packages. Maximum chip temperature is 150°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.

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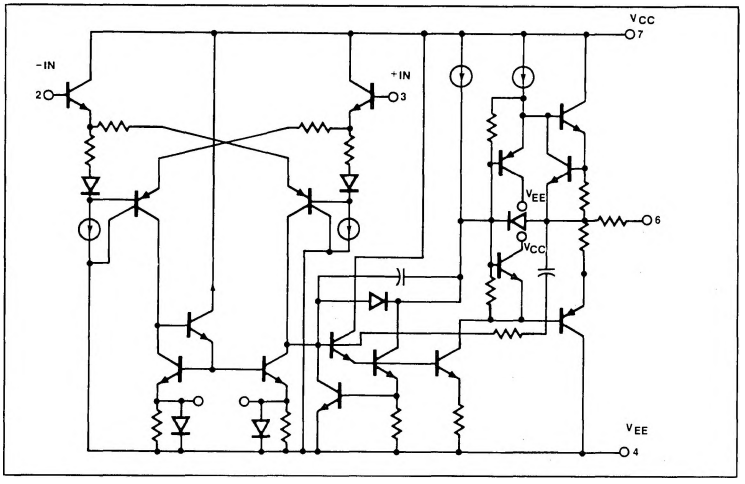
EQUIVALENT SCHEMATIC (EACH AMPLIFIER)



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

PARAMETER		TEST CONDITIONS	SE538			NE538			UNIT
			Min	Typ	Max	Min	Typ	Max	
V_{OS}	Input offset voltage	$R_S \leq 10k\Omega$		0.7	4.0		2.0	6.0	mV
		$R_S \leq 10k\Omega$, over temp.			5.0			7.0	mV
ΔV_{OS}	Input offset voltage drift	$R_S = 0\Omega$, over temp.		4.0			6.0		μV/°C
I_{OS}	Input offset current			5	20		15	40	nA
		Over temp.			40			80	nA
ΔI_{OS}	Input offset current	Over temp		25			40		pA/°C
I_B	Input current			45	80		65	150	nA
		Over temp.			200			200	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	$R_S \leq 10k\Omega$, over temp.		30	150		30	150	μV/V
R_{IN}	Input resistance		3	10		1	6		MΩ
A_{VOL}	Large signal voltage gain	$R_L \geq 2k\Omega$, $V_{OUT} = \pm 10V$	50	200		50	200		V/mV
		Over temp., $R_L \geq 2k\Omega$, $V_{OUT} = \pm 10V$	25			25			V/mV
V_{OUT}	Output voltage	Over temp., $R_L \geq 2k\Omega$	± 10	± 13		± 10	± 13		V
		Over temp., $R_L \geq 10k\Omega$	± 12	± 14		± 12	± 14		V
I_{CC}	Supply current	Per amplifier		2	3		2	3	mA
		Over temp., per amplifier		2.2	3.6		2.2	3.6	mA
P_D	Power dissipation	Per amplifier		60	90		60	90	mW
		Over temp., per amplifier		66	108		66	108	mW
I_{SC}	Output short circuit current		10	25	50	10	25	50	mA
R_{OUT}	Output resistance			100			100		Ω

NOTE
Temperature Range
SE Types $-55°C \leq T_A \leq 125°C$
NE Types $0°C \leq T_A \leq 70°C$

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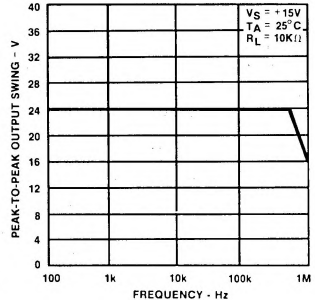
SE/NE538

AC ELECTRICAL CHARACTERISTICS $T_A = 25°C$ unless otherwise specified.

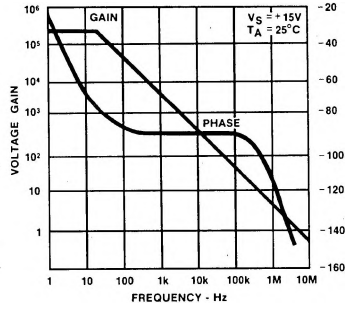
PARAMETER	TEST CONDITIONS	SE538/SE5538			SE538/NE5538			UNIT
		Min	Typ	Max	Min	Typ	Max	
Gain bandwidth product (Gain +5, -4 minimum)			6			6		MHz
Transient response Small signal rise time Small signal overshoot			 0.25 6			 0.25 6		 μs %
Settling time	To 0.1%		1.2			1.2		μs
Slew rate	Minimum gain = 5 Noninverting $R_L \geq 2k\Omega$	40	60			60		V/μs
Input noise voltage	f = 1kHz, $T_A = 25°C$		30			30		$nV/\sqrt{Hz}$

TYPICAL PERFORMANCE CHARACTERISTICS

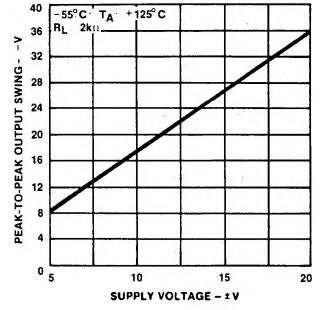
OUTPUT VOLTAGE SWING AS A FUNCTION OF FREQUENCY



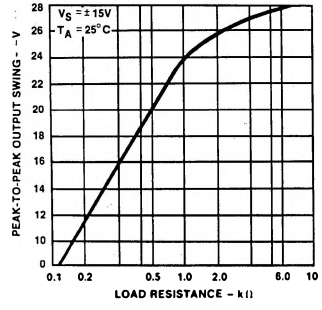
OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF FREQUENCY



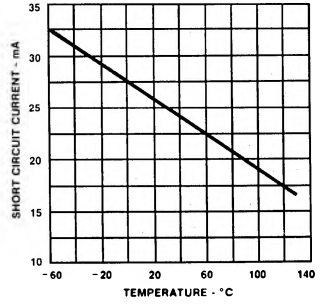
OUTPUT VOLTAGE SWING AS A FUNCTION OF SUPPLY VOLTAGE



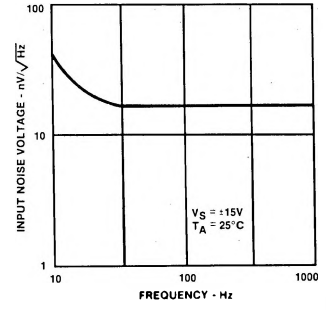
OUTPUT VOLTAGE SWING AS A FUNCTION OF LOAD RESISTANCE



OUTPUT SHORT-CIRCUIT CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE

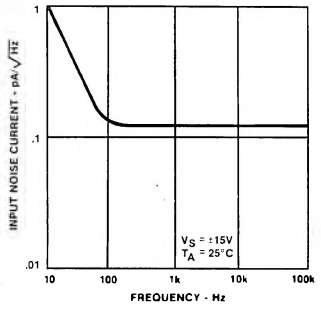


INPUT NOISE VOLTAGE AS A FUNCTION OF FREQUENCY

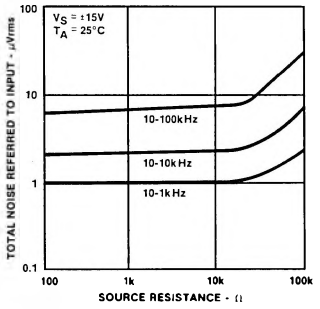


TYPICAL PERFORMANCE CHARACTERISTICS (Cont'd)

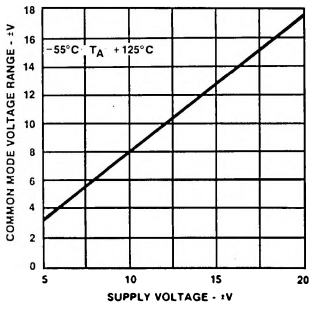
INPUT NOISE CURRENT AS A FUNCTION OF FREQUENCY



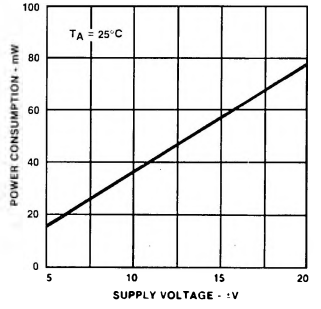
BROADBAND NOISE FOR VARIOUS BANDWIDTHS



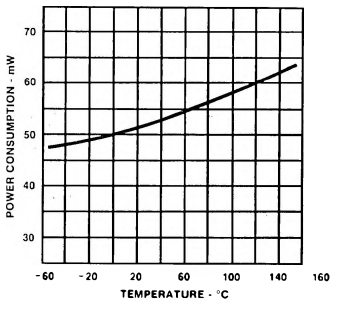
INPUT COMMON MODE VOLTAGE RANGE AS A FUNCTION OF SUPPLY VOLTAGE



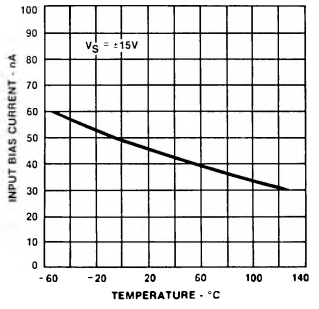
POWER CONSUMPTION AS A FUNCTION OF SUPPLY VOLTAGE



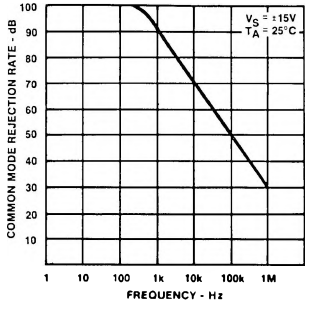
POWER CONSUMPTION AS A FUNCTION OF AMBIENT TEMPERATURE



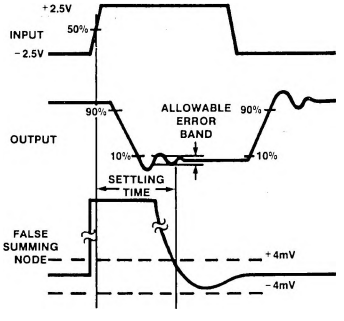
INPUT BIAS CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



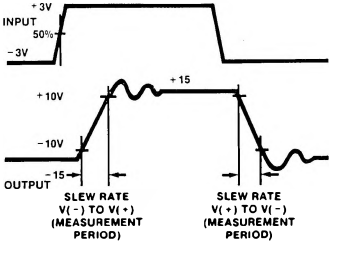
COMMON MODE REJECTION RATIO AS A FUNCTION OF FREQUENCY



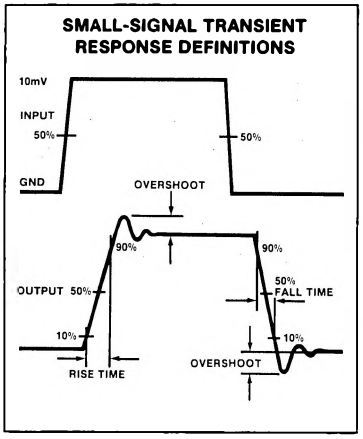
SETTLING TIME MEASUREMENT WAVEFORMS



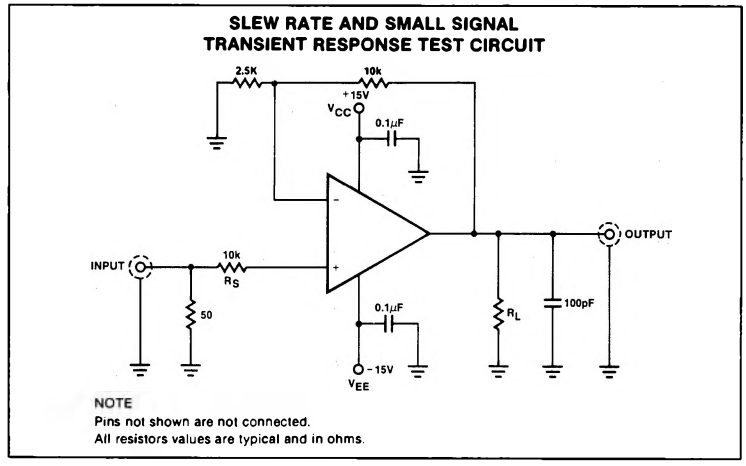
SLEW RATE MEASUREMENT VCC = ±20V



TYPICAL PERFORMANCE CHARACTERISTICS (Cont'd)

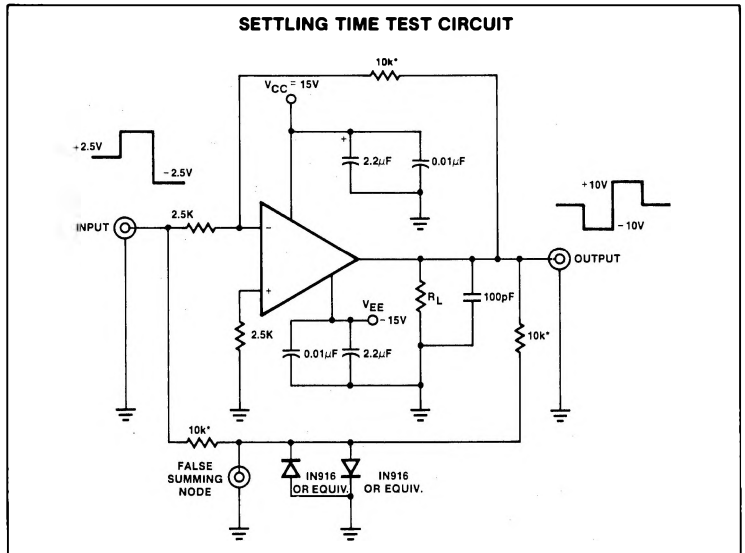


TEST LOAD CIRCUITS



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

TEST LOAD CIRCUITS (Cont'd)



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

HIGH SLEW RATE OP AMP

SE/NE538

INTRODUCTION

The Signetics NE538 is an undercompensated op amp. The NE538 has a typical slew rate of 50V/μs and a gain bandwidth product of 6MHz.

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 Figure 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:

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

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

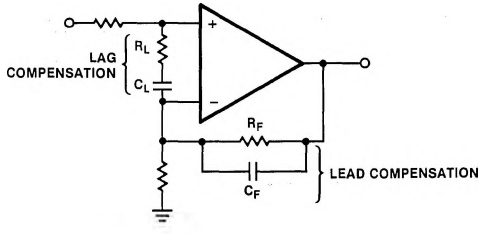


Figure 1. Non-Inverting Configuration

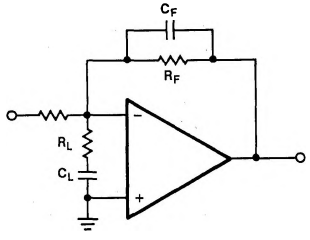


Figure 2. Inverting Configuration

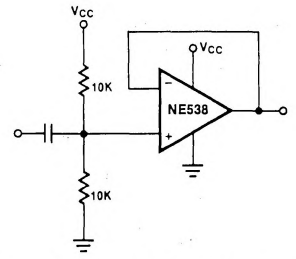


Figure 3. Voltage Follower with Single Power Source

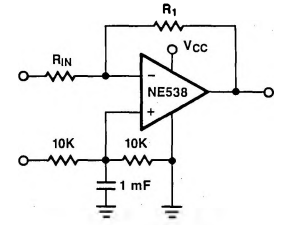


Figure 4. Inverting Amp With Single Power Supply

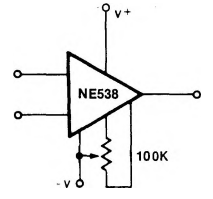
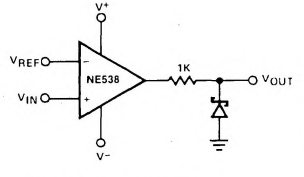


Figure 5. Offset Adjust Circuit



All resistor values are in ohms.

Figure 6. Voltage Comparator