NE5532/5532A-FE,N, SE5532/5532A-FE

DESCRIPTION

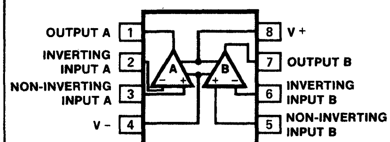
The 5532 is a dual high-performance low noise operational amplifier. Compared to most of the standard operational amplifiers, such as the 1458, it shows better noise performance, improved output drive capability and considerably higher small-signal and power bandwidths.

This makes the device especially suitable for application in high quality and professional audio equipment, instrumentation and control circuits, and telephone channel amplifiers. The op amp is internally compensated for gains equal to one. If very low noise is of prime importance, it is recommended that the 5532A version be used which has guaranteed noise specifications.

FEATURES

- Small-signal bandwidth: 10MHz
- Output drive capability: 600Ω, 10V (rms)
- Input noise voltage: 5nV/√Hz
- DC voltage gain: 50000
- AC voltage gain: 2200 at 10kHz
- Power bandwidth: 140kHz
- Slew-rate: 9V/μs
- Large supply voltage range: ±3 to ±20V

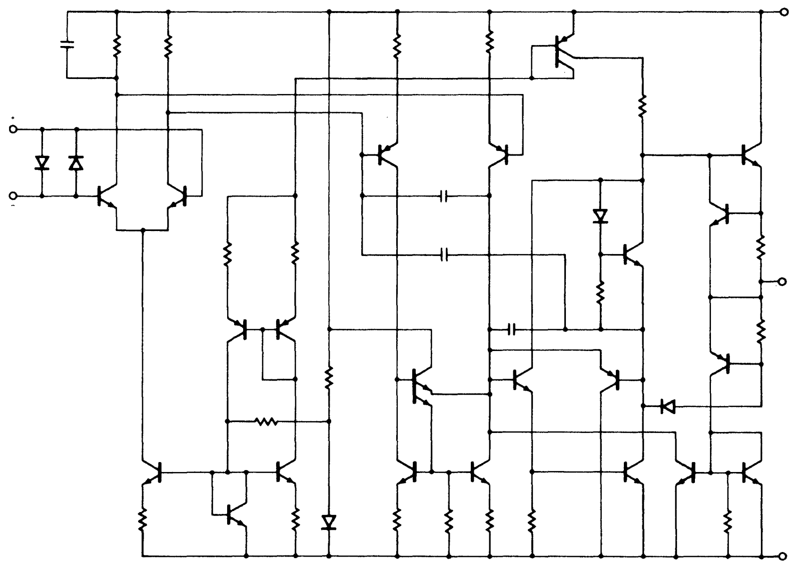
PIN CONFIGURATION



ORDER PART NO.
NE5532FE,N, SE5532FE
NE5532AFE,N, SE5532AFE

EACH AMPLIFIER

EQUIVALENT SCHEMATIC



ABSOLUTE MAXIMUM RATINGS

	PARAMETER	RATING	UNIT
V_S	Supply voltage	±22	V
V_{IN}	Input voltage	±V supply	V
V_{DIFF}	Differential input voltage[1]	±.5	V
T_A	Operating temperature range	0 to 70	°C
T_{STG}	Storage temperature	−65 to +150	°C
T_J	Junction temperature	150	°C
P_D	Power dissipation		
	5532FE	1000	mW
	Lead temperature (soldering, 10 sec)	300	°C

NOTES:

1. Diodes protect the inputs against over-voltage. Therefore, unless current-limiting resistors are used, large currents will flow if the differential input voltage exceeds 0.6V. Maximum current should be limited to ± 10mA.
2. Thermal resistance of the FE package is 125°C/W.

INTERNALLY COMPENSATED DUAL LOW NOISE OPERATIONAL AMPLIFIER

NE/SE5532/5532A

NE5532/5532A-FE,N, SE5532/5532A-FE

DC ELECTRICAL CHARACTERISTICS $T_A = 25°C$, $V_S = \pm 15V$ unless otherwise specified.[1, 2]

	PARAMETER	TEST CONDITIONS	SE5532/5532A			NE5532/5532A			UNIT
			Min	Typ	Max	Min	Typ	Max	
				.5	2		.5	4	mV
V_{OS}	Offset voltage	Over temperature			3			5	mV
					100		10	150	nA
I_{OS}	Offset current	Over temperature			200			200	nA
				200	400		200	800	nA
I_B	Input current	Over temperature			700			1000	nA
							8	16	mA
I_{CC}	Supply current	Over temperature			13				mA
V_{CM}	Common mode input range		±12	±13		±12	±13		V
CMRR	Common mode rejection ratio		80	100		70	100		dB
PSRR	Power supply rejection ratio			10	50		10	100	µV/V
A_{VOL}	Large signal voltage gain	$R_L \geq 2k\Omega$ $V_O = \pm 10V$	50			25	100		V/mV
		Over temperature	25			15			V/mV
		$R_L \geq 600\Omega$, $V_O = \pm 10V$	40			15	50		V/mV
		Over temperature	20			10			V/mV
V_{OUT}	Output swing	$R_L \geq 600\Omega$				±12	±13		V
		$R_L \geq 600\Omega$, $V_S = \pm 18V$				±15	±16		V
		$R_L \geq 2k\Omega$	±12	±13					V
R_{IN}	Input resistance		30	300		30	300		kΩ
I_{SC}	Output short circuit current			38			38		mA

NOTES
1. For NE5532, NE5532A, $T_{Min} = 0°C$, $T_{Max} = 70°C$.
2. For SE5532/5532A, $T_{Min} = -55°C$, $T_{Max} = +125°C$.

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

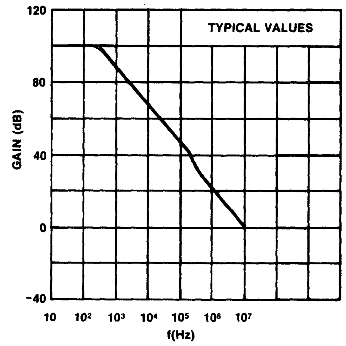
	PARAMETER	TEST CONDITIONS	NE/SE5532/5532A			UNIT
			Min	Typ	Max	
R_{OUT}	Output resistance	$A_V = 30dB$ Closed loop $f = 10kHz$, $R_L = 600\Omega$		0.3		Ω
	Overshoot	Voltage follower $V_{IN} = 100mV$ p-p $C_L = 100pF$ $R_L = 600\Omega$		10		%
	Gain	$f = 10kHz$		2.2		V/mV
	Gain bandwidth product	$C_L = 100pF$ $R_L = 600\Omega$		10		MHz
	Slew rate			9		V/µs
	Power bandwidth	$V_{OUT} = \pm 10V$		140		kHz
		$V_{OUT} = \pm 14V$, $R_L = 600\Omega$, $V_{CC} = \pm 18V$		100		kHz

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

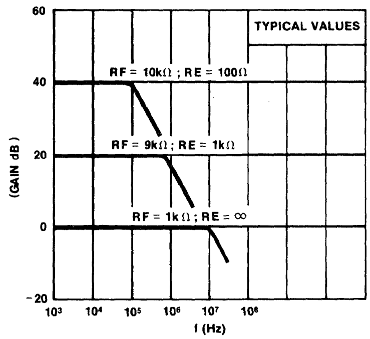
PARAMETER	TEST CONDITIONS	NE/SE5532			NE/SE5532A			UNIT
		Min	Typ	Max	Min	Typ	Max	
Input noise voltage	$f_O = 30Hz$		8			8	12	$nV/\sqrt{Hz}$
	$f_O = 1kHz$		5			5	6	$nV/\sqrt{Hz}$
Input noise current	$f_O = 30Hz$		2.7			2.7		$pA/\sqrt{Hz}$
	$f_O = 1kHz$		0.7			0.7		$pA/\sqrt{Hz}$
Channel separation	$f = 1kHz$, $RS = 5k\Omega$		110			110		dB

TYPICAL PERFORMANCE CHARACTERISTICS

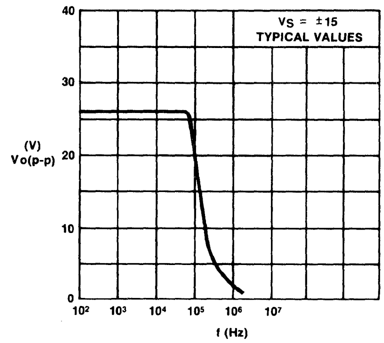
OPEN LOOP FREQUENCY RESPONSE



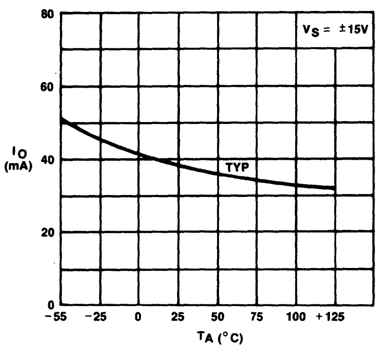
CLOSED LOOP FREQUENCY RESPONSE



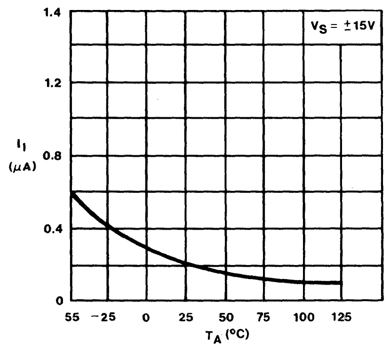
LARGE-SIGNAL FREQUENCY RESPONSE



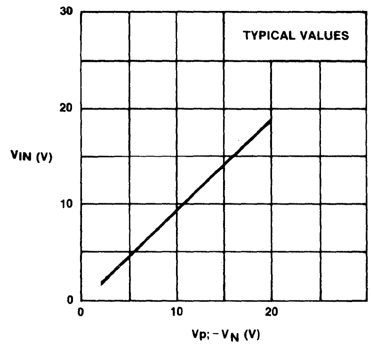
OUTPUT SHORT-CIRCUIT CURRENT



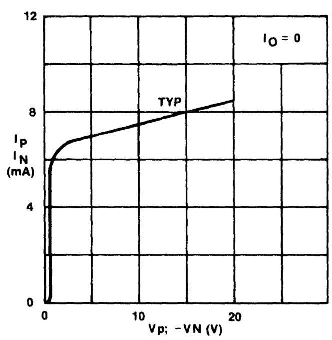
INPUT BIAS CURRENT



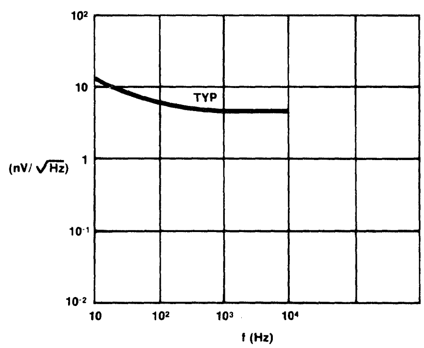
INPUT COMMON MODE VOLTAGE RANGE



SUPPLY CURRENT

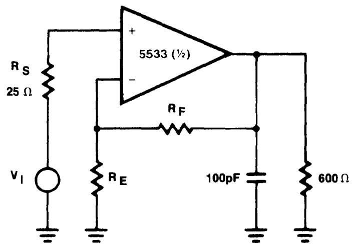


INPUT NOISE VOLTAGE DENSITY

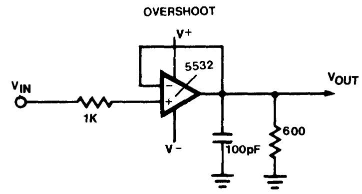


TEST CIRCUITS

CLOSED LOOP FREQUENCY RESPONSE



VOLTAGE FOLLOWER



APPLICATIONS

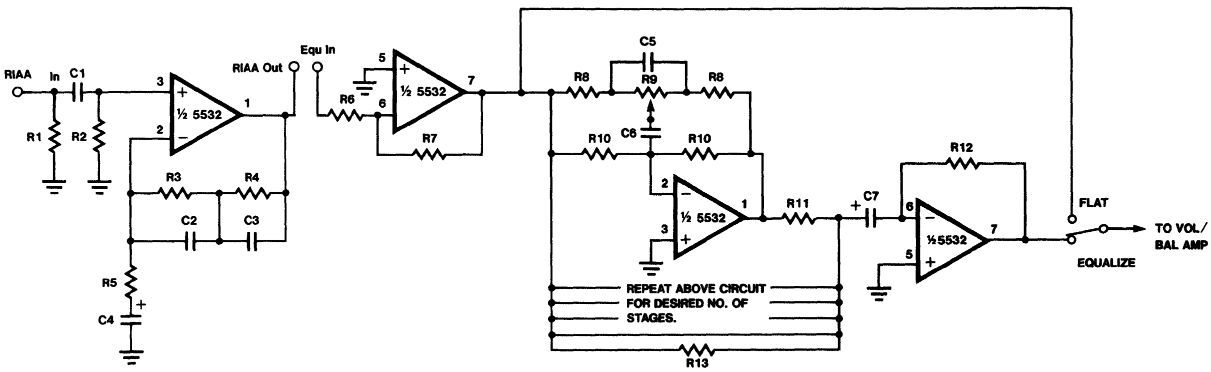
The Signetics 5532 High Performance Op Amp is an ideal amplifier for use in high quality and professional audio equipment which requires low noise and low distortion.

The circuit included in this application note has been assembled on a P.C. board, and tested with actual audio input devices (Tuner and Turntable). It consists of an RIAA pre-amp, input buffer, 5-band equalizer, and mixer. Although the circuit design is not new, its performance using the 5532 has been improved.

The RIAA pre-amp section is a standard compensation configuration with low frequency boost provided by the Magnetic cartridge and the RC network in the op amp feedback loop. Cartridge loading is accomplished via R1. 47k was chosen as a typical value, and may differ from cartridge to cartridge.

The Equalizer section consists of an input buffer, 5 active variable band pass/notch (depending on R9's setting) filters, and an

RIAA—EQUALIZER SCHEMATIC



COMPONENT VALUES

R1	47k	C1	.22µF
R2	1meg	C2	750pF
R3	100k	C3	.0033µF
R4	1meg	C4	33µF
R5	1.1k	C5	SEE TABLE
R6	100k	C6	SEE TABLE
R7	100k	C7	2.2µF
R8	SEE TABLE		
R9	(pot) SEE TABLE		
R10	SEE TABLE		
R11	100K		
R12	100K		
R13	20K (5 STAGES)		

COMPONENT VALUE TABLES

R9 = 25k R8 = 2.4k R10 = 240k			R9 = 50 k R8 = 5.1k R10 = 510k			R9 = 100k R8 = 10k R10 = 1 meg		
fo	C5	C6	fo	C5	C6	fo	C5	C6
23 Hz	1µF	.1µF	25 Hz	.47µF	.047µF	12 Hz	.47µF	.047µF
50 Hz	.47µF	.047µF	36 Hz	.33µF	.033µF	18 Hz	.33µF	.033µF
72 Hz	.33µF	.033µF	54 Hz	.22µF	.022µF	27 Hz	.22µF	.022µF
108 Hz	.22µF	.022µF	79 Hz	.15µF	.015µF	39 Hz	.15µF	.015µF
158 Hz	.15µF	.015µF	119 Hz	.1µF	.01µF	59 Hz	.1µF	.01µF
238 Hz	.1µF	.01µF	145 Hz	.082µF	.0082µF	72 Hz	.082µF	.0082µF
290 Hz	.082µF	.0082µF	175 Hz	.068µF	.0068µF	87 Hz	.068µF	.0068µF
350 Hz	.068µF	.0068µF	212 Hz	.056µF	.0056µF	106 Hz	.056µF	.0056µF
425 Hz	.056µF	.0056µF	253 Hz	.047µF	.0047µF	126 Hz	.047µF	.0047µF
506 Hz	.047µF	.0047µF	360 Hz	.033µF	.0033µF	180 Hz	.033µF	.0033µF
721 Hz	.033µF	.0033µF	541 Hz	.022µF	.0022µF	270 Hz	.022µF	.0022µF
1082 Hz	.022µF	.0022µF	794 Hz	.015µF	.0015µF	397 Hz	.015µF	.0015µF
1588 Hz	.015µF	.0015µF	1191 Hz	.01µF	.001µF	595 Hz	.01µF	.001µF
2382 Hz	.01µF	.001µF	1452 Hz	.0082µF	820pF	726 Hz	.0082µF	820pF
2904 Hz	.0082µF	820pF	1751 Hz	.0068µF	680pF	875 Hz	.0068µF	680pF
3502 Hz	.0068µF	680pF	2126 Hz	.0056µF	560pF	1063 Hz	.0056µF	560pF
4253 Hz	.0056µF	560pF	2534 Hz	.0047µF	470pF	1267 Hz	.0047µF	470pF
5068 Hz	.0047µF	470pF	3609 Hz	.0033µF	330pF	1804 Hz	.0033µF	330pF
7218 Hz	.0033µF	330pF	5413 Hz	.0022µF	220pF	2706 Hz	.0022µF	220pF
10827 Hz	.0022µF	220pF	7940 Hz	.0015µF	150pF	3970 Hz	.0015µF	150pF
15880 Hz	.0015µF	150pF	11910 Hz	.001µF	100pF	5955 Hz	.001µF	100pF
23820 Hz	.001µF	100pF	14524 Hz	820pF	82pF	7262 Hz	820pF	82pF
			17514 Hz	680pF	68pF	8757 Hz	680pF	68pF
			21267 Hz	560pF	56pF	10633 Hz	560pF	56pF
						12670 Hz	470pF	47pF
						18045 Hz	330pF	33pF

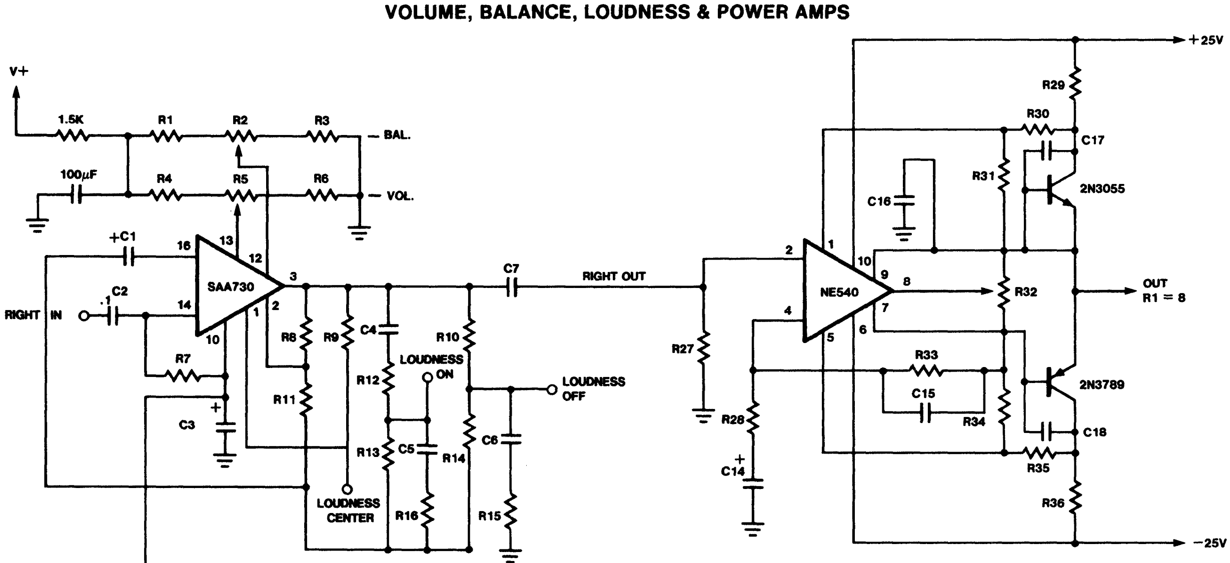
Figure 1

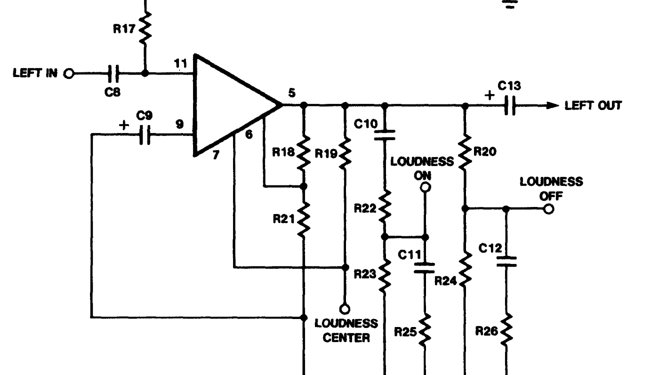
output summing amplifier. The input buffer is a standard unity gain design providing impedance matching between the pre amplifiers and the equalizer section. Because the 5532 is internally compensated, no external compensation is required. The 5-band active filter section is actually 5 individual active filters with the same feedback design for all 5. The main differance in all five stages is the values of C5 and C6 which are responsible for setting the center frequency of each stage. Linear pots are recommended for R9. To simplify use of this circuit, a component value table is provided, which lists center frequencies and their associated capacitor values. Notice that C5 equals (10) C6, and that the Value of R8 and R10 are related to R9 by a factor of 10 as well. The values listed in the table are common and easily found standard values.

The final stage is the summing amplifier/buffer stage, to sum the individual filters (Figure 2). Note the original signal is subtracted from the sum by a factor dependant on the number of filter stages. This subtraction is necessary to maintain a unity gain configuration at the output with all pots set to the flat position. If R13 were omitted the output with 1 volt at each stage would equal 5 volts (in this case) instead of the desired 1 volt. Full boost and cut using the table values is about ± 15dB. Although 5 bands were chosen for this application, the user may have as many bands as are required. Please note that the subtracting resistor R13, must be adjusted to meet the unity requirement using R13 = $\frac{100K}{\#\text{ of stages}}$ i.e. 5 stages = 20k.

The remainder of the circuit employs the Philips TCA 730H volume, balance, and loudness-control circuit and the Signetics NE540 power driver circuit, which as shown will net about 35 watts per channel RMS. The NE540 can be found in the Signetics Analog Data Manual, and Applications Manual. Information on the TCA730A may be obtained from Signetics Analog Division.

VOLUME, BALANCE, LOUDNESS & POWER AMPS





NOTE
All resistors ¼W 1% to 5% unless otherwise noted

PARTS LISTING

R1	10K	R21	5.6K	C1	10µF
R2	10K (POT)	R22	2.2K	C2	.1µF
R3	4.3K	R23	100K	C3	47µF
R4	7.5K	R24	22K	C4	.0047µF
R5	10K (POT)	R25	4.7K	C5	100pF
R6	2.7K	R26	3.9K	C6	100pF
R7	270K	R27	10K	C7	10µF
R8	22K	R28	100 OHMS	C8	.1µF
R9	100K	R29	.18 OHMS (2W)	C9	10µF
R10	2.2K	R30	56 OHMS	C10	.0047µF
R11	5.6K	R31	8.2K	C11	100pF
R12	2.2K	R32	1K TRIM POT	C12	100pF
R13	100K	R33	10K	C13	10µF
R14	22K	R34	8.2K	C14	50µF
R15	3.9K	R35	56 OHMS	C15	10pF
R16	4.7K	R36	.18 OHMS (2W)	C16	.0047µF
R17	270K			C17	500pF
R18	22K			C18	500pF
R19	100K				
R20	2.2K				

For additional information on the NE540, refer to Signetics Analog Data and Applications Manuals.

For additional information on the SAA730, contact Signetics Analog Division, Philips Representative.

Figure 2