LINEAR INTEGRATED CIRCUITS

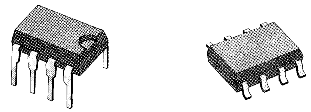
LS4558N

PRELIMINARY DATA

DUAL HIGH PERFORMANCE OPERATIONAL AMPLIFIER

- SINGLE OR SPLIT SUPPLY OPERATION
- LOW POWER CONSUMPTION
- HIGH UNITY GAIN BANDWIDTH
- NO CROSSOVER DISTORTION
- NO POP NOISE
- SHORT CIRCUIT PROTECTION
- HIGH CHANNEL SEPARATION

The LS4558N is a high performace dual operational amplifier with frequency and phase compensation built into the chip. The internal phase compensation allows stable operation as voltage follower in spite of its high gain-bandwidth products. The circuit presents very stable electrical characteristics over the entire supply voltage range and the specially designed input stage allow the LS4558N to be used in **low noise audio signal processing application**. The optimized class AB output stage completely eliminates crossover, distortion, under any load conditions, has large source and sink capacity and is short circuit protected.



Minidip **SO-8**

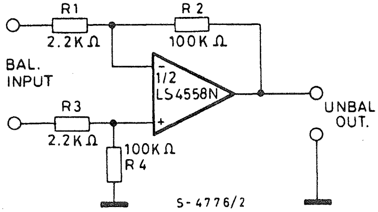
ABSOLUTE MAXIMUM RATINGS

V_s	Supply voltage		± 18	V
V_I	Input voltage		$\pm V_s$	
V_i	Differential input voltage		$\pm (V_s - 1)$	V
P_{tot}	Power dissipation at $T_{amb} = 70°C$	Minidip	665	mW
		Micropackage	400	mW
T_{op}	Operating temperature		0 to 70	°C
T_j	Junction temperature		150	°C
T_{stg}	Storage temperature		-55 to 150	°C

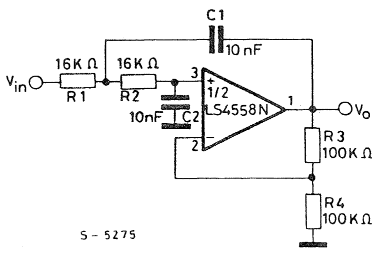
ORDERING NUMBER: LS 4558 NB (Minidip)
LS 4558 NM (Micropackage)

TYPICAL APPLICATIONS:

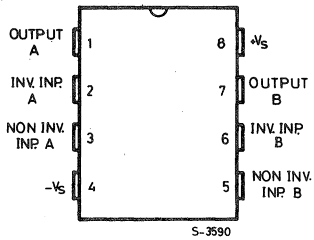
Balanced input audio preamplifier



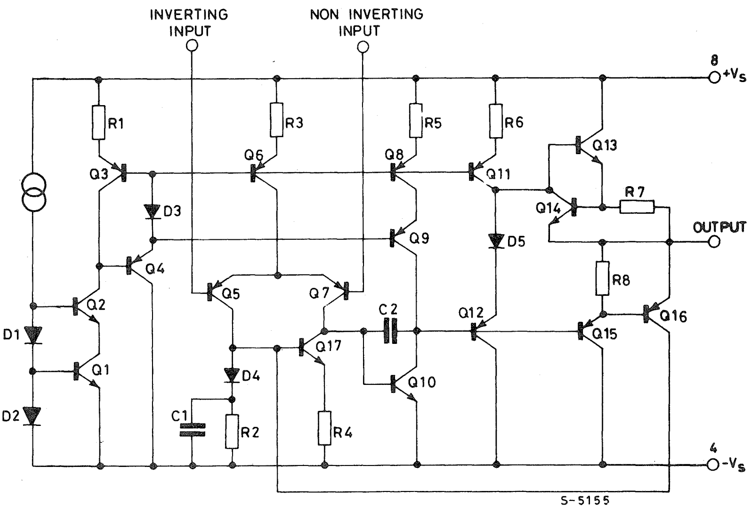
DC coupled low-pass active filter
(f = 1KHz, G_v = 6dB



CONNECTION DIAGRAM
(top view)



SCHEMATIC DIAGRAM
(one section)



THERMAL DATA

		Minidip	SO-8
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	120 °C/W	200°C/W

ELECTRICAL CHARACTERISTICS ($V_s = \pm 15V$, $T_{amb} = 25°C$, unless otherwise specified)

	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_s	Supply current (*)			1	2	mA
I_b	Input bias current			50	500	nA
		$T_{min} < T_{op} < T_{max}$			800	nA
R_i	Input resistance	f = 1 KHz	0.3	1		MΩ
V_{os}	Input offset voltage	$R_g \leq 10$ KΩ		0.5	5	mV
		$R_g \leq 10$ KΩ $T_{min} < T_{op} < T_{max}$			7.5	mV
I_{os}	Input offset current			20	200	nA
		$T_{min} < T_{op} < T_{max}$			500	nA
I_{sc}	Output short circuit current			23		mA
G_v	Large signal open loop voltage gain	R_L = 2 KΩ	86	100		dB
B	Gain-bandwidth product	f = 20 KHz	2	3		MHz
e_N	Total input noise voltage	f = 1 KHz R_g = 50Ω R_g = 1 KΩ R_g = 10 KΩ		8 10 18	15	$\frac{nV}{\sqrt{Hz}}$
e_N	Popcorn noise	B = 1 Hz to 1 KHz R_g = 10 KΩ t = 10 sec			10	μV peak
d	Distortion	G_v = 20 dB R_L = 2 KΩ V_o = 2 Vpp f = 1 KHz		0.03		%
V_o	Output voltage swing	R_L = 2 KΩ		± 13		V
V_o	Large signal voltage swing	R_L = 10 KΩ f = 10 KHz		28		Vpp
Transient response	Rise time	V_i = 20 mV R_L = 2 KΩ C_L = 100 pF		0.13		μS
	Overshoot			5		%
SR	Slew rate	unity gain R_L = 2 KΩ	0.8	1.5		V/μs
CMR	Common mode rejection	V_i = 10V $T_{min} < T_{op} < T_{max}$	70	90		dB
SVR	Supply voltage rejection	V_i = 1V f = 100 Hz $T_{min} < T_{op} < T_{max}$	80	100		dB
CS	Channel separation	f = 10 KHz R_g = 1 KΩ		105		dB

(*) Both amplifiers.

Fig. 1 - Open loop frequency and phase response

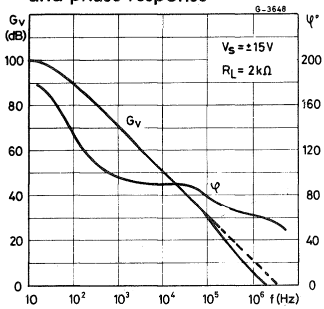


Fig. 2 - Open loop gain vs. ambient temperature

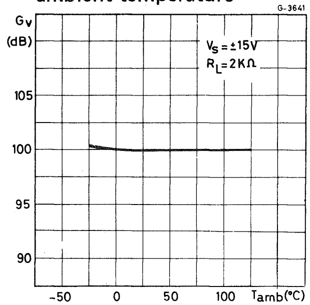


Fig. 3 - Supply voltage rejection vs. frequency

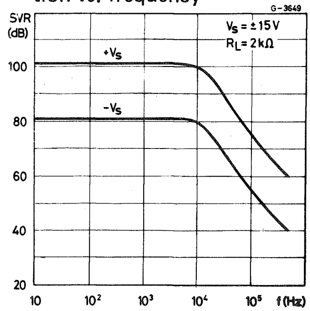


Fig. 4 - Large signal frequency response

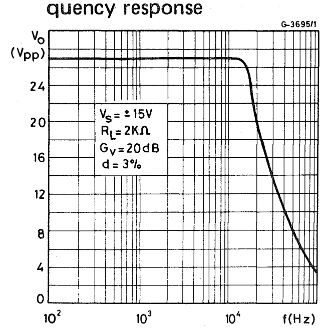


Fig. 5 - Output voltage swing vs. load resistance

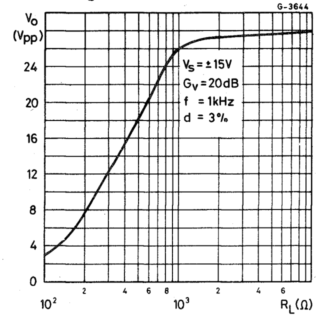


Fig. 6 - Total input noise vs. frequency

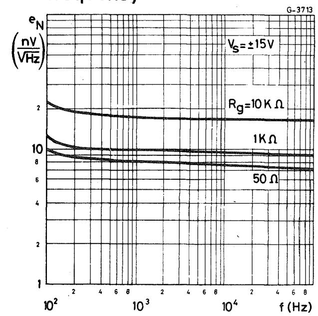


Fig. 7 - Channel separation

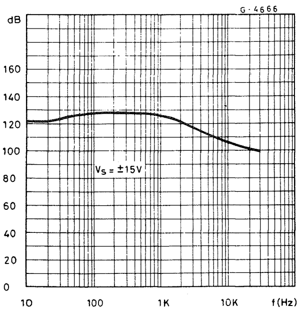


Fig. 8 - Transient response

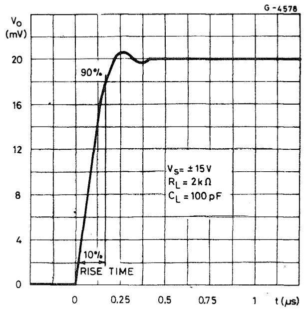
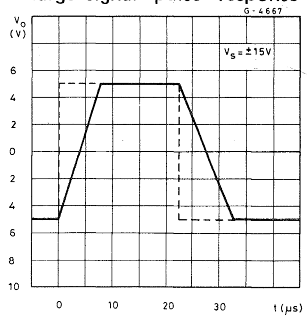
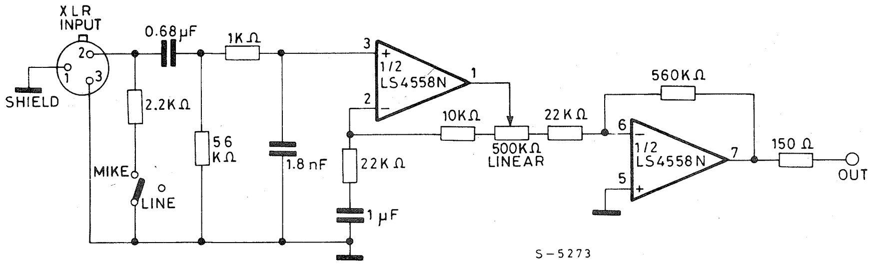


Fig. 9 - Voltage follower large-signal pulse response



APPLICATION INFORMATION

Fig. 10 - Mike/Line preamplifier for audio mixers (0 dB to 60 dB continuously variable gain)



Note — The particular characteristics of the circuit of fig. 10 is that using a linear potentiometer, the gain is continuously variable in a logarithmic mode from 0 dB to 60 dB in the audio band.

Fig. 11 - Microphones nomograph

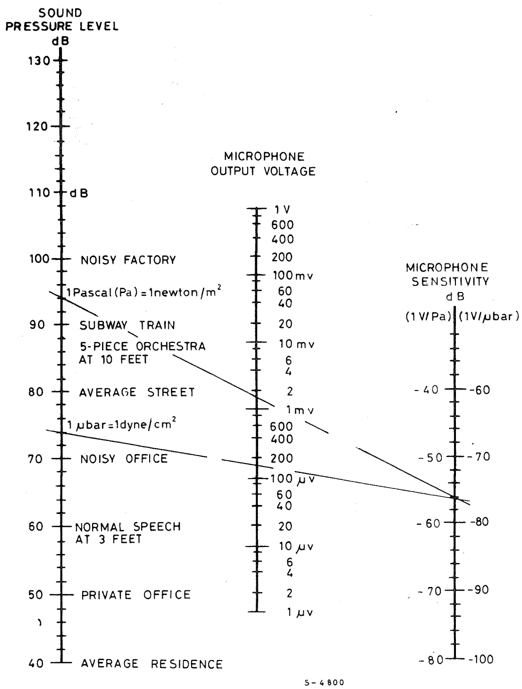


Fig. 12 - Very Low-Noise mike preamplifier (G_v = 40 dB)

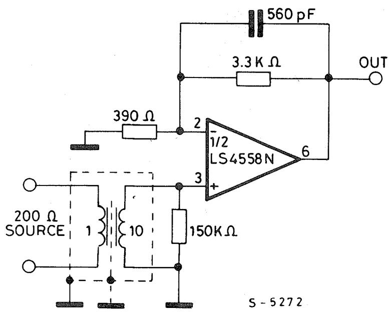
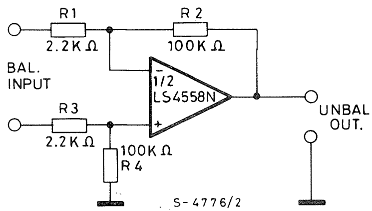


Fig. 13 - Balanced input audio pre-amplifier



APPLICATION INFORMATION (continued)

Fig. 14 - 20 Hz to 200 Hz variable High-pass filter (G_v = 3 dB)

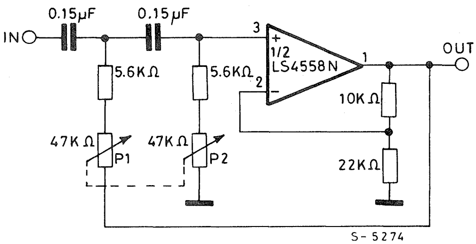


Fig. 15 - Frequency response of the High-pass filter of fig. 14

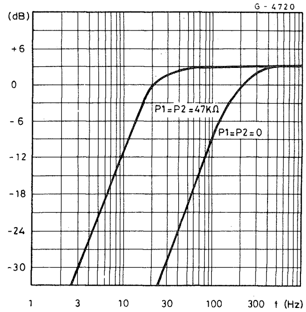


Fig. 16 - DC coupled low-pass active filter (f = 1KHz, G_v= 6 dB)

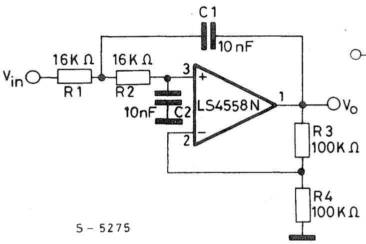


Fig. 17 - Switchable HP-LP audio filter

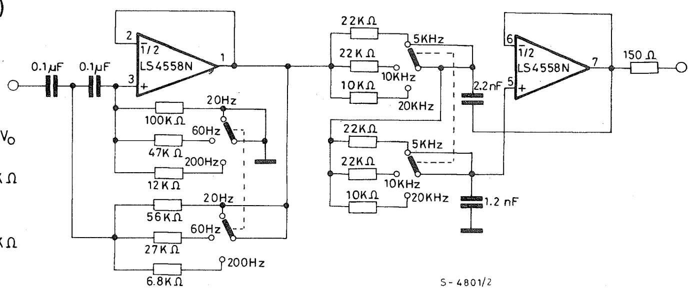
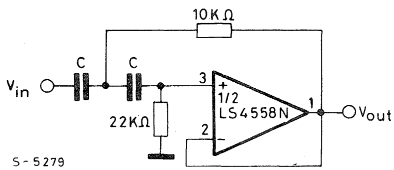
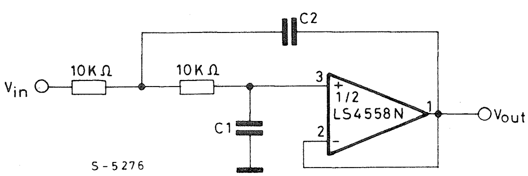


Fig. 18 - Subsonic or rumble filter (G_v= 0 dB)



f_c (Hz)	C (μF)
15	0.68
22	0.47
30	0.33
55	0.22
100	0.1

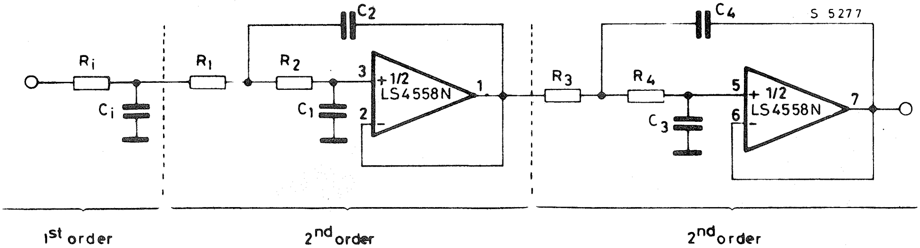
Fig. 19 - High-cut filter (G_v= 0 dB)



f_c (KHz)	C1 (nF)	C2 (nF)
3	3.9	6.8
5	2.2	4.7
10	1.2	2.2
15	0.68	1.5

APPLICATION INFORMATION (continued)

Fig. 20 - Fifth order 3.4 KHz low-pass Butterworth filter



For $f_c = 3.4$ KHz and $R_i = R1 = R2 = R3 = R4 = 10\ K\Omega$, we obtain:

$$C1 = 1.354 \cdot \frac{1}{R} \cdot \frac{1}{2\pi f_c} = 6.33\ nF$$

$$C1 = 0.421 \cdot \frac{1}{R} \cdot \frac{1}{2\pi f_c} = 1.97\ nF$$

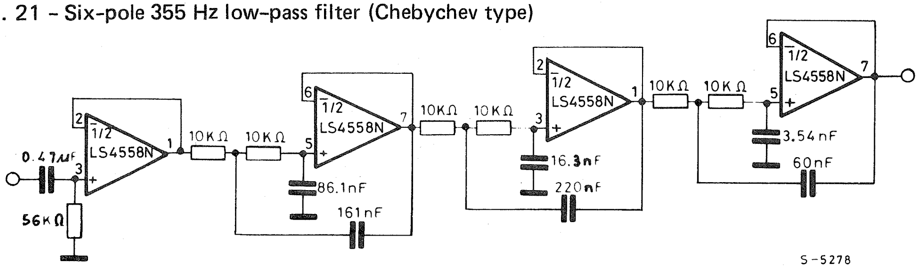
$$C2 = 1.753 \cdot \frac{1}{R} \cdot \frac{1}{2\pi f_c} = 8.20\ nF$$

$$C3 = 0.309 \cdot \frac{1}{R} \cdot \frac{1}{2\pi f_c} = 1.45\ nF$$

$$C4 = 3.325 \cdot \frac{1}{R} \cdot \frac{1}{2,\pi f_c} = 15.14\ nF$$

The attenuation of the filter is 30 dB at 6.8 KHz and better than 60 dB at 15 KHz.

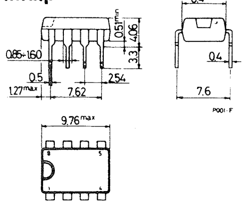
Fig. 21 - Six-pole 355 Hz low-pass filter (Chebychev type)



This is a 6- pole Chebychev type with ± 0.25 dB ripple in the passband. A decoupling stage is used to avoid the influence of the input impedance on the filter's characteristics. The attenuation is about 55 dB at 710 Hz and reaches 80 dB at 1065 Hz. The in band attenuation is limited in practice to the ± 0.25 dB ripple and does not exceed 0.5 dB at 0.9 fc.

MECHANICAL DATA (Dimensions in mm)

Minidip



SO-8