STEREO-TONE/VOLUME CONTROL CIRCUIT

GENERAL DESCRIPTION

The TDA1524 is a monolithic integrated circuit designed as an active stereo-tone/volume control for car radios, TV receivers and mains-fed equipment. It includes functions for bass and treble control, volume control with built-in contour (can be switched off) and balance. *All these functions can be* controlled by d.c. voltages or by single linear potentiometers.

Features

- Few external components necessary
- Low noise due to internal gain
- Bass emphasis can be increased by a double-pole low-pass filter
- Wide power supply voltage range

QUICK REFERENCE DATA

Supply voltage (pin 3)	$V_P = V_{3\text{-}18}$	typ.	12	V
Supply current (pin 3)	$I_P = I_3$	typ.	35	mA
Maximum input signal with d.c. feedback (r.m.s. value)	$V_{i(rms)}$	typ.	2,5	V
Maximum output signal with d.c. feedback (r.m.s. value)	$V_{o(rms)}$	typ.	3	V
Volume control range	G_v		−80 to + 21,5	dB
Bass control range at 40 Hz	ΔG_v	typ.	± 15	dB
Treble control range at 16 kHz	ΔG_v	typ.	± 15	dB
Total harmonic distortion	THD	max.	0,5	%
Output noise voltage (unweighted; r.m.s. value) at f = 20 Hz to 20 kHz; V_P = 12 V;				
for max. voltage gain	$V_{no(rms)}$	typ.	310	μV
for voltage gain G_v = −40 dB	$V_{no(rms)}$	typ.	100	μV
Channel separation at G_v = −20 to + 21,5 dB	α_{cs}	typ.	60	dB
Tracking between channels at G_v = −20 to + 26 dB	ΔG_v	max.	2,5	dB
Ripple rejection at 100 Hz	RR	typ.	50	dB
Supply voltage range (pin 3)	$V_P = V_{3\text{-}18}$		7,5 to 16,5	V
Operating ambient temperature range	T_{amb}		−30 to + 80	°C

PACKAGE OUTLINE

18-lead DIL; plastic (SOT-102C).

purple binder, tab 2

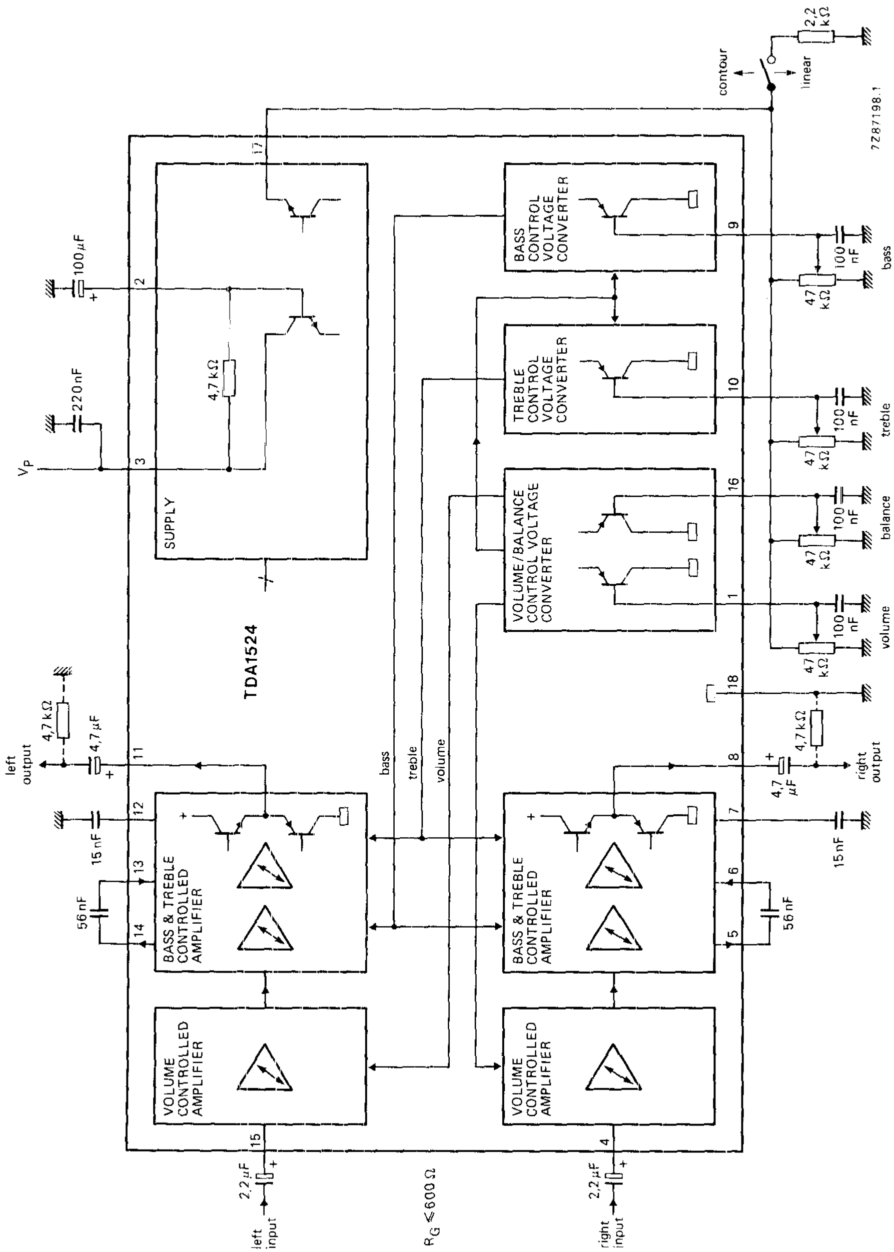


Fig. 1 Block diagram and application circuit with single-pole filter.

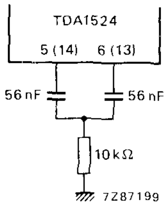


Fig. 2 Double-pole low-pass filter for improved bass-boost.

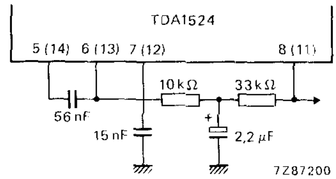


Fig. 3 D.C. feedback with filter network for improved signal handling.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage (pin 3)	$V_P = V_{3-18}$	max.	20	V
Total power dissipation	P_{tot}	max.	1200	mW
Storage temperature range	T_{stg}		−55 to + 150	°C
Operating ambient temperature range	T_{amb}		−30 to + 80	°C

DEVELOPMENT SAMPLE DATA

D.C. CHARACTERISTICS

$V_P = V_{3\text{-}18} = 12$ V; $T_{amb} = 25$ °C; measured in Fig. 1; $R_G \leqslant 600\ \Omega$; $R_L \geqslant 4{,}7$ kΩ; $C_L \leqslant 30$ pF; unless otherwise specified

parameter	symbol	min.	typ.	max.	unit
Supply (pin 3)					
Supply voltage	$V_P = V_{3\text{-}18}$	7,5	–	16,5	V
Supply current					
at $V_P = 8{,}5$ V	$I_P = I_3$	19	27	35	mA
at $V_P = 12$ V	$I_P = I_3$	25	35	45	mA
at $V_P = 15$ V	$I_P = I_3$	30	43	56	mA
D.C. input levels (pins 4 and 15) and output levels (pins 8 and 11) under all control voltage conditions without d.c. feedback					
at $V_P = 8{,}5$ V	$V_{4,15;\,8,11}$	2,8	4,4	5,7	V
at $V_P = 12$ V	$V_{4,15;\,8,11}$	3,9	6,1	8,1	V
at $V_P = 15$ V	$V_{4,15;\,8,11}$	3,9	7,6	11,1	V
with d.c. feedback					
at $V_P = 8{,}5$ V	$V_{4,15;\,8,11}$	3,6	4,4	4,9	V
at $V_P = 12$ V	$V_{4,15;\,8,11}$	5,2	6,1	6,8	V
at $V_P = 15$ V	$V_{4,15;\,8,11}$	6,2	7,6	8,8	V
Pin 17					
Internal potentiometer supply voltage at $V_P = 8{,}5$ V	$V_{17\text{-}18}$	3,5	3,75	4,0	V
Contour on/off switch (control by I_{17})					
contour (switch open)	$-I_{17}$	–	–	0,5	mA
linear (switch closed)	$-I_{17}$	1,5	–	10	mA
Application without internal potentiometer supply voltage at $V_P \geqslant 10{,}8$ V (contour cannot be switched off)					
Voltage range forced to pin 17	$V_{17\text{-}18}$	4,5	–	$V_P/2 - V_{BE}$	V
D.C. control voltage range for volume, bass, treble and balance (pins 1, 9, 10 and 16 respectively)					
at $V_{17\text{-}18} = 5$ V	$V_{1,9,10,16}$	1,0	–	4,25	V
using internal supply	$V_{1,9,10,16}$	0,25	–	3,8	V
Input current of control inputs (pins 1, 9, 10 and 16)	$-I_{1,9,10,16}$	–	–	5	μA

A.C. CHARACTERISTICS

$V_P = V_{3-18} = 8{,}5$ V; $T_{amb} = 25\ ^oC$; measured in Fig. 1; contour switch closed (linear position); volume, balance, bass, and treble controls in mid-position; $R_G \leqslant 600\ \Omega$; $R_L \geqslant 4{,}7\ k\Omega$; $C_L \leqslant 30$ pF; f = 1 kHz; unless otherwise specified

parameter	symbol	min.	typ.	max.	unit
Control range					
Max. gain of volume (Fig. 5)	$G_{v\ max}$	20,5	21,5	23	dB
Volume control range; $G_{v\ max}/G_{v\ min}$	ΔG_v	90	100	–	dB
Balance control range; $G_v = 0$ dB (Fig. 6)	ΔG_v	–	–40	–	dB
Bass control range at 40 Hz (Fig. 7)	ΔG_v	± 12	± 15	–	dB
Treble control range at 16 kHz (Fig. 8)	ΔG_v	± 12	± 15	–	dB
Contour characteristics		see Figs 9 and 10			
Signal inputs, outputs					
Input resistance; pins 4 and 15 (note 1) at gain of volume control: $G_v = 20$ dB	$R_{i4,15}$	10	–	–	kΩ
$G_v = -40$ dB	$R_{i4,15}$	–	160	–	kΩ
Output resistance (pins 8 and 11)	$R_{o8,11}$	–	–	300	Ω
Signal processing					
Power supply ripple rejection at $V_{P(rms)} \leqslant 200$ mV; f = 100 Hz; $G_v = 0$ dB	RR	35	50	–	dB
Channel separation (250 Hz to 10 kHz) at $G_v = -20$ to $+21{,}5$ dB	α_{cs}	46	60	–	dB
Spread of volume control with constant control voltage $V_{1-18} = 0{,}5\ V_{17-18}$	ΔG_v	–	–	± 3	dB
Gain tolerance between left and right channel $V_{16-18} = V_{1-18} = 0{,}5\ V_{17-18}$	$\Delta G_{v,L-R}$	–	–	1,5	dB
Tracking between channels for $G_v = 21{,}5$ to -26 dB f = 250 Hz to 6,3 kHz; balance adjusted at $G_v = 10$ dB	ΔG_v	–	–	2,5	dB

DEVELOPMENT SAMPLE DATA

A.C. CHARACTERISTICS (continued)

parameter	symbol	min.	typ.	max.	unit
Signal handling with d.c. feedback (Fig. 3)					
Input signal handling (note 2)					
at V_P = 8,5 V; THD = 0,5%; f = 1 kHz (r.m.s. value)	$V_{i(rms)}$	1,8	–	–	V
at V_P = 12 V; THD = 0,5%; f = 40 Hz to 16 kHz (r.m.s. value)	$V_{i(rms)}$	2,0	2,5	–	V
at V_P = 15 V; THD = 0,5%; f = 40 Hz to 16 kHz (r.m.s. value)	$V_{i(rms)}$	–	3,0	–	V
Output signal handling (note 2)					
at V_P = 8,5 V; THD = 0,5%; f = 1 kHz (r.m.s. value)	$V_{o(rms)}$	1,8	2,0	–	V
at V_P = 8,5 V; THD = 10%; f = 1 kHz (r.m.s. value)	$V_{o(rms)}$	–	2,2	–	V
at V_P = 12 V; THD = 0,5%; f = 40 Hz to 16 kHz (r.m.s. value)	$V_{o(rms)}$	2,5	3,0	–	V
at V_P = 15 V; THD = 0,5%; f = 40 Hz to 16 kHz (r.m.s. value)	$V_{o(rms)}$	–	4,0	–	V
Noise performance (V_P = 8,5 V)					
Output noise voltage (unweighted; Fig. 15) at f = 20 Hz to 20 kHz (r.m.s. value)					
for maximum voltage gain (note 3)	$V_{no(rms)}$	–	260	–	μV
for G_v = –3 dB (note 3)	$V_{no(rms)}$	–	70	140	μV
Output noise voltage; weighted as DIN 45405 of 1981, CCIR recommendation 468-2 (peak value)					
for maximum voltage gain (note 3)	$V_{no(m)}$	–	890	–	μV
for maximum emphasis of bass and treble (contour off; G_v = –40 dB)	$V_{no(m)}$	–	360	–	μV
Noise performance (V_P = 12 V)					
Output noise voltage (unweighted; Fig. 15) at f = 20 Hz to 20 kHz (r.m.s. value; note 4)					
for maximum voltage gain (note 3)	$V_{no(rms)}$	–	310	–	μV
for G_v = –16 dB (note 3)	$V_{no(rms)}$	–	100	200	μV
Output noise voltage; weighted as DIN 45405 of 1981, CCIR recommendation 468-2 (peak value)					
for maximum voltage gain (note 3)	$V_{no(m)}$	–	940	–	μV
for maximum emphasis of bass and treble (contour off; G_v = –40 dB)	$V_{no(m)}$	–	400	–	μV

parameter	symbol	min.	typ.	max.	unit
Noise performance (V_P = 15 V)					
Output noise voltage (unweighted; Fig. 15) at f = 20 Hz to 20 kHz (r.m.s. value; note 4)					
for maximum voltage gain (note 3)	$V_{no(rms)}$	–	350	–	μV
for G_v = 16 dB (note 3)	$V_{no(rms)}$	–	110	220	μV
Output noise voltage; weighted as DIN 45405 of 1981, CCIR recommendation 468-2 (peak value)					
for maximum voltage gain (note 3)	$V_{no(m)}$	–	980	–	μV
for maximum emphasis of bass and treble (contour off; G_v = –40 dB)	$V_{no(m)}$	–	420	–	μV

Notes to characteristics

1. Equation for input resistance (see also Fig. 4)

$$R_i = \frac{160\ k\Omega}{1 + G_v}\ ;\ G_{v\ max} = 12.$$

2. Frequencies below 200 Hz and above 5 kHz have reduced voltage swing, the reduction at 40 Hz and at 16 kHz is 30%.
3. Linear frequency response.
4. For peak values add 4,5 dB to r.m.s. values.

DEVELOPMENT SAMPLE DATA

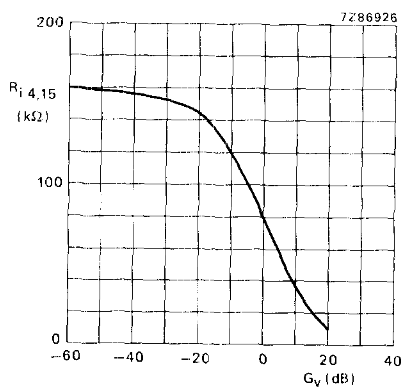


Fig. 4 Input resistance (R_i) as a function of gain of volume control (G_v). Measured in Fig. 1.

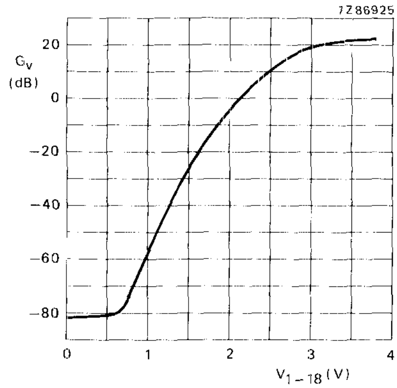


Fig. 5 Volume control curve; voltage gain (G_v) as a function of control voltage (V_{1-18}). Measured in Fig. 1 (internal potentiometer supply from pin 17 used); V_P = 8,5 V; f = 1 kHz.

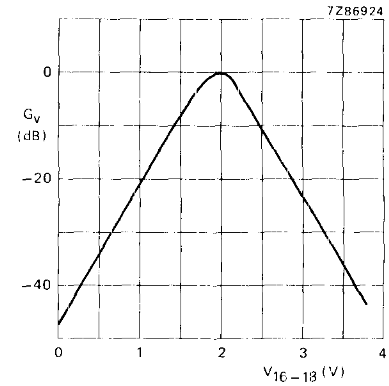


Fig. 6 Balance control curve; voltage gain (G_v) as a function of control voltage (V_{16-18}). Measured in Fig. 1 (internal potentiometer supply from pin 17 used); V_P = 8,5 V.

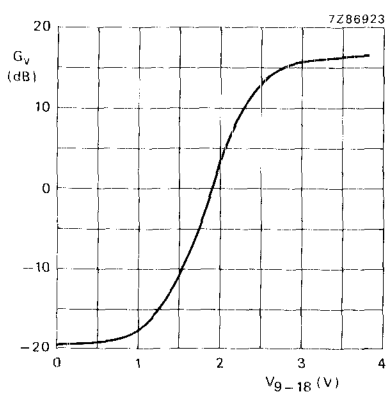


Fig. 7 Bass control curve; voltage gain (G_v) as a function of control voltage (V_{9-18}). Measured in Fig. 1 with single-pole filter (internal potentiometer supply from pin 17 used); V_P = 8,5 V; f = 40 Hz.

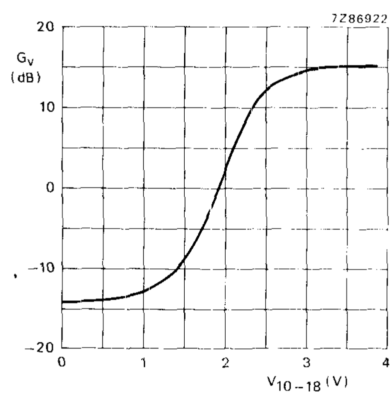


Fig. 8 Treble control curve; voltage gain (G_v) as a function of control voltage (V_{10-18}). Measured in Fig. 1 (internal potentiometer supply from pin 17 used); V_P = 8,5 V; f = 16 kHz.

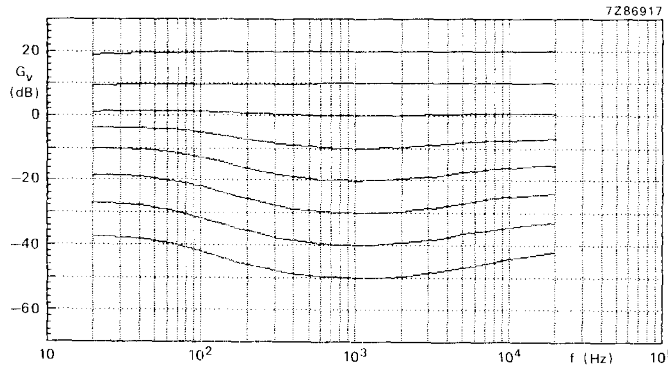


Fig. 9 Contour frequency response curves; voltage gain (G_V) as a function of audio input frequency. Measured in Fig. 1 with single-pole filter; V_P = 8,5 V.

DEVELOPMENT SAMPLE DATA

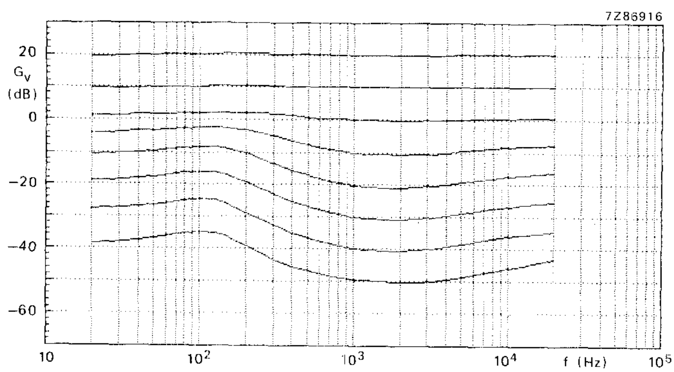


Fig. 10 Contour frequency response curves; voltage gain (G_V) as a function of audio input frequency. Measured in Fig. 1 with double-pole filter; V_P = 8,5 V.

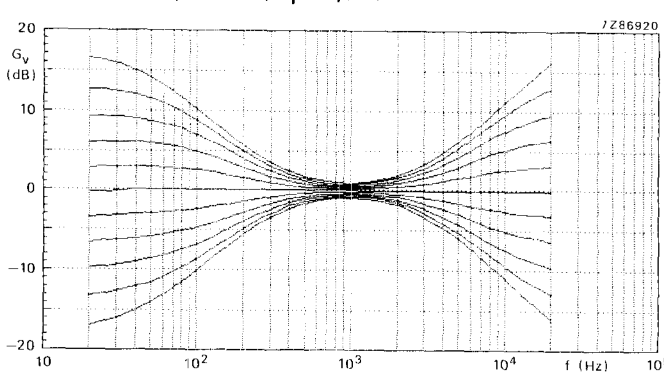


Fig. 11 Tone control frequency response curves; voltage gain (G_V) as a function of audio input frequency. Measured in Fig. 1 with single-pole filter; V_P = 8,5 V.

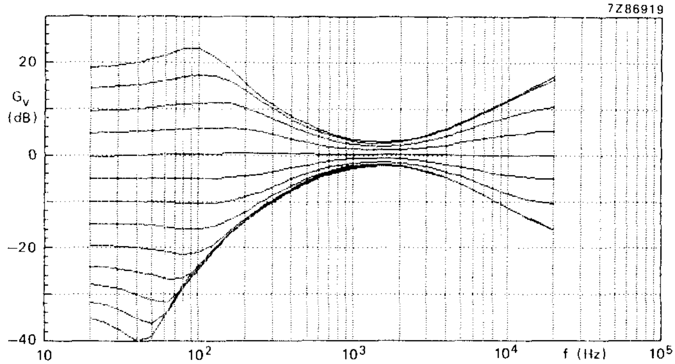


Fig. 12 Tone control frequency response curves; voltage gain (G_V) as a function of audio input frequency. Measured in Fig. 1 with double-pole filter; V_P = 8,5 V.

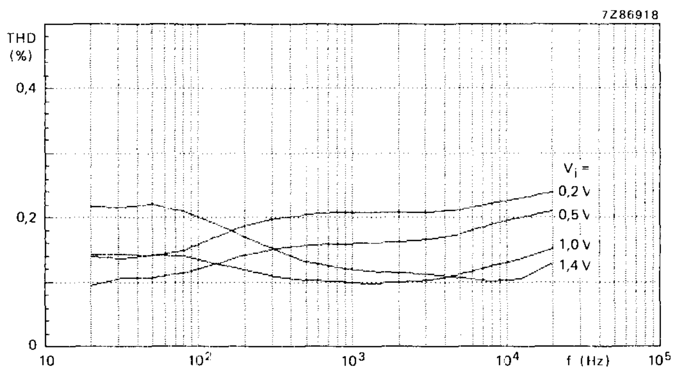


Fig. 13 Total harmonic distortion (THD); as a function of audio input frequency. Measured in Fig. 1; V_P = 8,5 V; volume control voltage gain at

$$G_V = 20 \log \frac{V_o}{V_i} = 0 \text{ dB.}$$

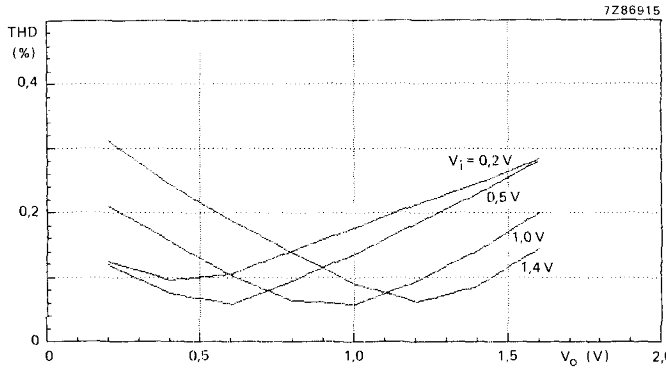
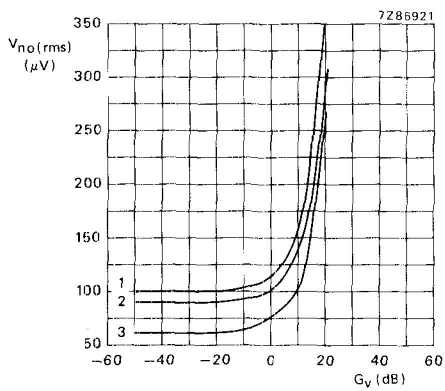


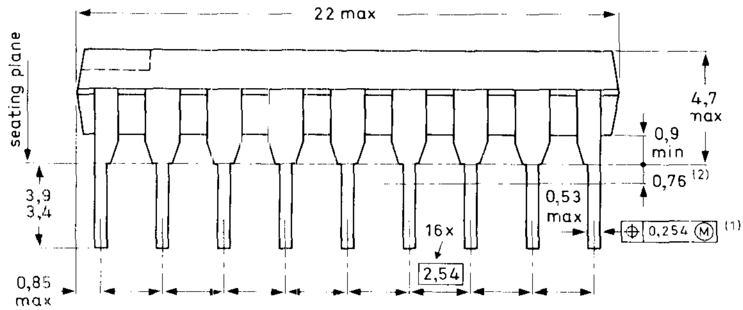
Fig. 14 Total harmonic distortion (THD); as a function of output voltage (V_O). Measured in Fig. 1; V_P = 8,5 V; f_i = 1 kHz.

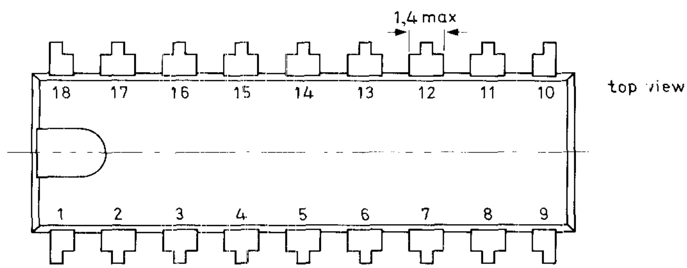


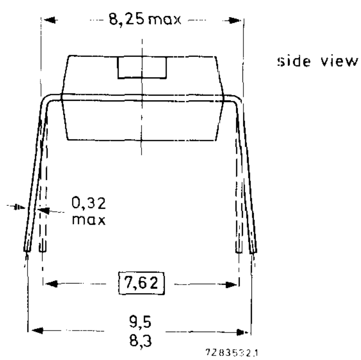
(1) V_P = 15 V.
(2) V_P = 12 V.
(3) V_P = 8,5 V.

Fig. 15 Noise output voltage ($V_{no(rms)}$; unweighted); as a function of voltage gain (G_v). Measured in Fig. 1; f = 20 Hz to 20 kHz.

18-LEAD DUAL IN-LINE; PLASTIC (SOT-102CS)







⊕ Positional accuracy.

Ⓜ Maximum Material Condition.

(1) Centre-lines of all leads are within ±0,127 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by ±0,254 mm.

(2) Lead spacing tolerances apply from seating plane to the line indicated.

Dimensions in mm