TDA1054M

LINEAR INTEGRATED CIRCUIT

PREAMPLIFIER WITH ALC FOR CASSETTE RECORDERS

- EXCELLENT VERSATILITY in USE (V_s from 4 to 20V)
- HIGH OPEN LOOP GAIN
- LOW DISTORTION
- LOW NOISE
- LARGE AUTOMATIC LEVEL CONTROL RANGE
- GOOD SUPPLY RIPPLE REJECTION
- STEREO MATCHING BETTER THAN 3 dB

The TDA 1054M is a monolithic integrated circuit in a 16-lead dual in-line plastic package. The functions incorporated are:
- Low noise preamplifier
- Automatic level control system (ALC)
- High gain equalization amplifier
- Supply voltage rejection facility (SVRF).

It is intended as preamplifier in cassette tape recorders and players, dictaphones, compressor and expander in industrial equipments, Hi-Fi preamplifiers and in wire diffusion receivers; for stereo applications the ALC matching is better than 3 dB.

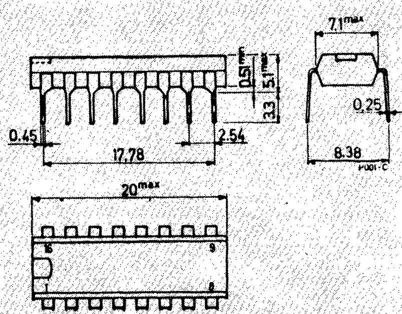
ABSOLUTE MAXIMUM RATINGS

V_s	Supply voltage	20	V
P_{tot}	Total power dissipation at $T_{amb} \leq 50°C$	500	mW
T_{stg}, T_j	Storage and junction temperature	-40 to 150	°C

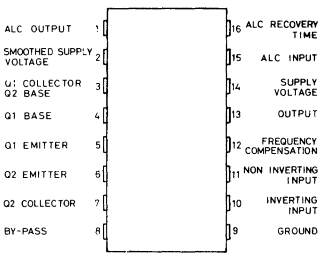
ORDERING NUMBERS: TDA 1054M mono applications
2 TDA 1054M stereo applications

MECHANICAL DATA

Dimensions in mm



CONNECTION AND SCHEMATIC DIAGRAMS
(top view)



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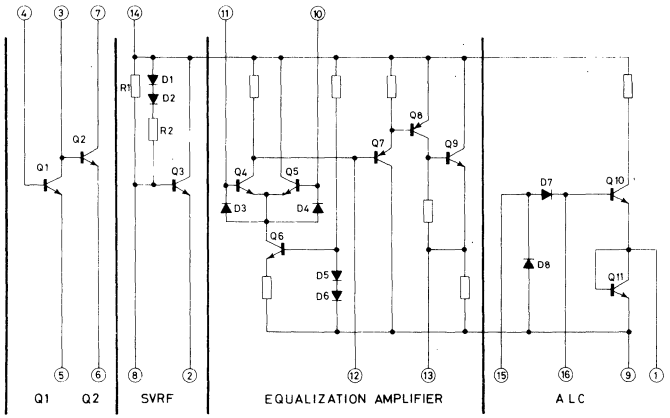

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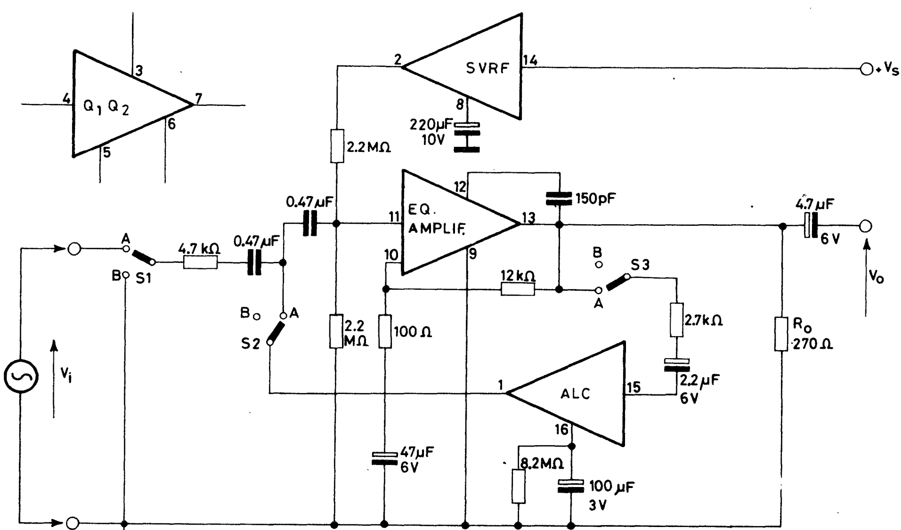
TEST CIRCUIT



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THERMAL DATA

$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max	200	°C/W

ELECTRICAL CHARACTERISTICS

(Refer to the test circuit, $T_{amb} = 25°C$)

	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_s	Supply voltage		4		20	V
I_d	Quiescent drain current	$V_s = 9V$ $R_L = \infty$ S1 = S2 = S3 = B		6		mA
h_{FE}	DC current gain	$I_C = 0.1$ mA $V_{CE} = 5V$	300	500		–
e_N	Input noise voltage (Q1)	$I_C = 0.1$ mA $V_{CE} = 5V$ f = 1 kHz		2		$\frac{nV}{\sqrt{Hz}}$
i_N	Input noise current (Q1)			0.5		$\frac{pA}{\sqrt{Hz}}$
NF	Noise figure (Q1)	$I_C = 0.1$ mA $V_{CE} = 5$ V $R_g = 4.7$ kΩ B (-3 dB) = 20 to 10,000 Hz		0.5	4	dB
G_V	Open loop voltage gain (for equalization amplifier)	$V_s = 9V$ f = 1 kHz		60		dB
V_o	Output voltage with A.L.C.	$V_s = 9V$ $V_i = 100mV$ f = 1 kHz S1 = S2 = S3 = A		1.1		V
R1	(for SVRF system)	see schematic diagram		7.5		kΩ
R2	(for SVRF system)			120		Ω
e_N	Input noise voltage (for equalization amplifier pin 11)	$V_s = 9V$ $R_g = 4.7$ kΩ $G_V = 40$ dB S1 = B B (-3 dB)= 22 Hz to 22 KHz		1.3		μV
V_{DR}	Drop-out (between pins 14 and 2)	$V_s = 9V$ $I_d = 6$ mA		0.8		V

Fig. 1 - Equivalent input spot voltage and noise current vs. bias current (input transistor Q_1)

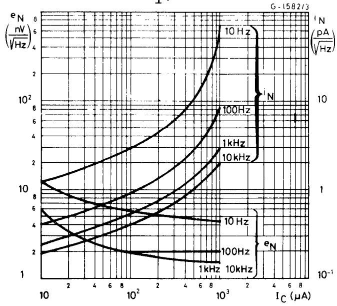


Fig. 2 - Equivalent input noise current vs. frequency (input transistor Q_1)

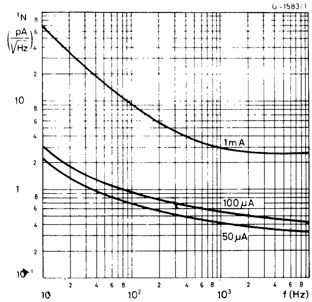


Fig. 3 - Equivalent input noise voltage vs. frequency (input transistor Q_1)

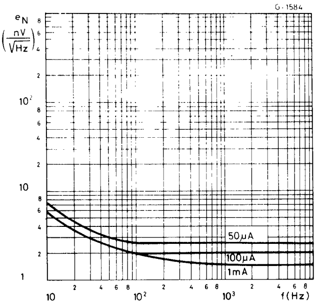


Fig. 4 - Noise figure vs. bias current (input transistor Q_1)

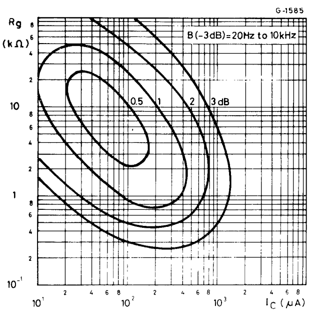


Fig. 5 - Optimum source resistance and minimum NF vs. bias current (input transistor Q_1)

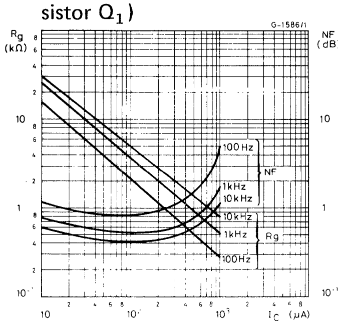


Fig. 6 - Current gain vs. collector current (input transistor Q_1)

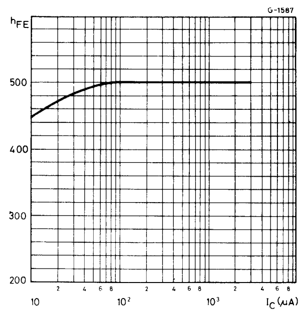


Fig. 7 - Open loop gain vs. frequency (equalization amplifier)

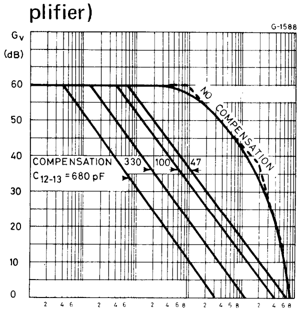
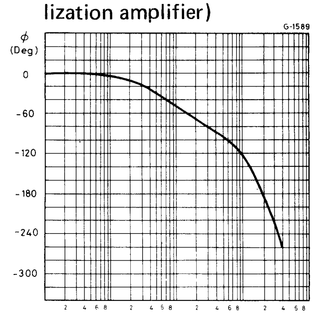


Fig. 8 - Open loop phase response vs. frequency (equalization amplifier)



APPLICATION INFORMATION

Fig. 9 - Application circuit for battery/mains cassette player and recorder

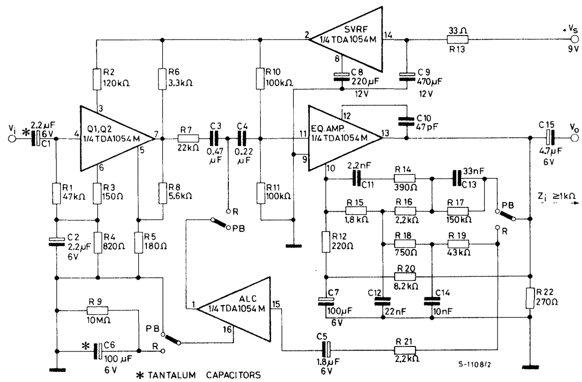
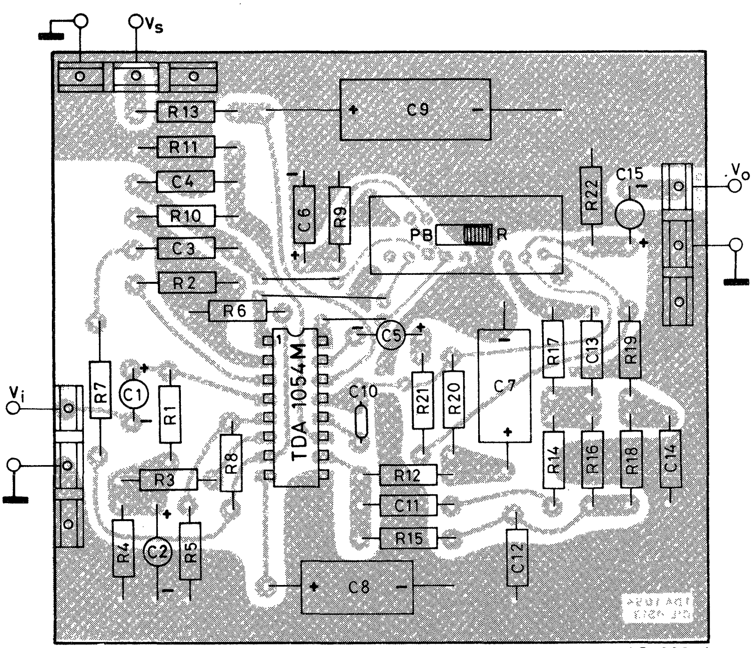


Fig. 10 - P.C. board and component layout for the circuit fig. 9 (1:1 scale)



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Typical performance of circuit in fig. 9

(T_{amb} = 25°C, V_s = 9V)

	Parameter	Test conditions	Min.	Typ.	Max.	Unit
PLAYBACK						
G_v	Voltage gain (open loop)	f = 20 to 20,000 Hz		110		dB
G_v	Voltage gain (closed loop)	f = 1 kHz		57		dB
$\lvert Z_i \rvert$	Input impedance	f = 100 Hz f = 1 kHz f = 10 kHz		10 41 43		kΩ kΩ kΩ
$\lvert Z_o \rvert$	Output impedance	f = 1 kHz		12	35	Ω
B	Frequency response			see fig. 12		
d	Distortion	V_o = 1V f = 1 kHz		0.1		%
	Output background noise	Z_g = 300 Ω + 120 mH (DIN 45405)		1.3		mV
***	Output weighted background noise	Z_g = 300 Ω + 120 mH (DIN 45405)		1.3		mV
$\frac{S+N}{N}$	Signal to noise ratio	V_o = 1.3V Z_g = 300 Ω + 120 mH		60		dB
SVR	Supply voltage ripple rejection at the output	f_{ripple} = 100 Hz		30		dB
t_{on}**	Switch-on time	V_o = 1V		500		ms
RECORDING						
G_v	Voltage gain (open loop)	f = 20 to 20,000 Hz		110		dB
G_v	Voltage gain (closed loop)	f = 1 kHz		70		dB
B	Frequency response			see fig. 14		
d*	Distortion without ALC	V_o = 1.1V f = 1 kHz		0.3		%
d	Distortion with ALC	V_o = 1.1V f = 10 kHz		0.4		%
ALC	Automatic level control range (for 3 dB of output voltage variation)	V_i ⩽ 40 mV f = 10 kHz		54		dB
V_o	Output voltage before clipping without ALC	f = 1 kHz		2.3		V
V_o	Output voltage with ALC	V_i = 30 mV f = 10 kHz		1.1		V

Typical performance of circuit in fig. 9 (continued)

Parameter		Test conditions *	Min.	Typ.	Max.	Unit
t_l **	Limiting time (see fig. 11)	ΔV_i = +40 dB f = 1 kHz		75		ms
t_{set} **	Level setting time (see fig. 11)	ΔV_i = +40 dB f = 1 kHz		300		ms
t_{rec} **	Recovery time (see fig. 11)	ΔV_i = −40 dB f = 1 kHz		150		s
t_{on} **	Switch-on time	V_o = 1.1V		500		ms
$\frac{S+N}{N}$ ****	Signal to noise ratio with ALC	V_o = 1.1V R_g = 470 Ω		64		dB

* Measured with selective voltmeter
** This value depends on external network
*** When the DIN 45511 norm for frequency response is not mandatory the equalization peak at 10 kHz can be avoided – so halving the output noise
**** Weighted noise measurement (DIN 45405)

Fig. 11 - Limiting, level setting, recovery time

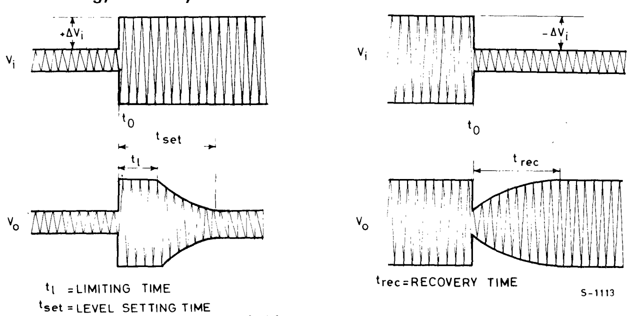


Fig. 12 - Relative frequency response for the circuit in fig. 9 (playback)

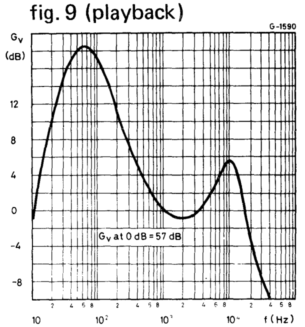


Fig. 13 - Distortion vs. frequency for the circuit in fig. 9 (playback)

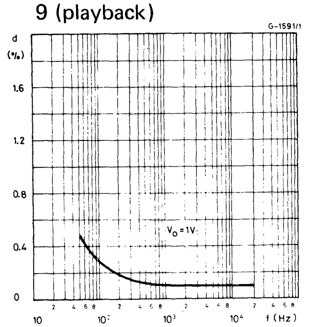


Fig. 14 - Relative frequency response for the circuit in fig. 9 (recording)

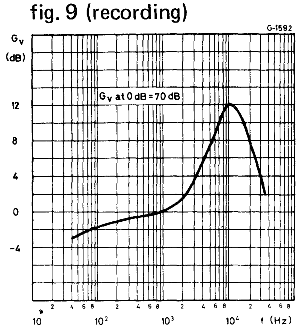


Fig. 15 - Output voltage variation and distortion with ALC vs. input voltage for the circuit in fig. 9 (recording)

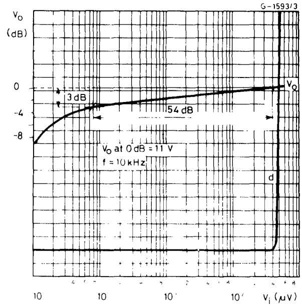


Fig. 16 - Distortion vs. frequency with ALC for the circuit in fig. 9 (recording)

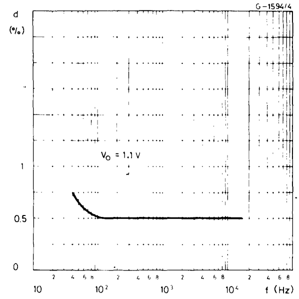


Fig. 17 - Limiting and level setting time vs. input signal variation

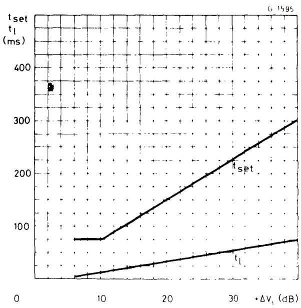


Fig. 18 - Low cost application circuit

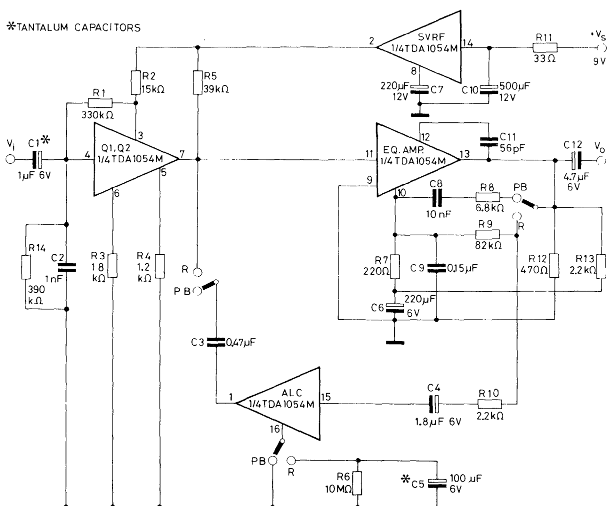
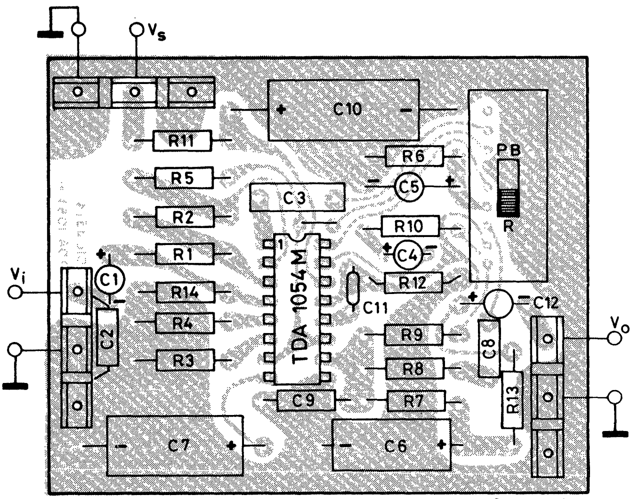


Fig. 19 - P.C. board and component layout for the circuit in fig. 18 (1:1 scale)



Typical performance of circuit in fig. 18

(T_{amb} = 25°C, V_s = 9V)

	Parameter	Test conditions	Min.	Typ.	Max.	Unit
PLAYBACK						
V_s	Supply voltage		5		12	V
I_d	Quiescent drain current			18		mA
G_v	Voltage gain (closed loop)	f = 1 kHz		54		dB
B	Frequency response	f = 100 Hz f = 1 kHz f = 6 kHz f = 10 kHz f = 60 kHz		12 0 5 11 10		dB dB dB dB dB
d	Distortion	V_o = 1V f = 1 kHz		0.6		%
e_N	Output weighted background noise	Z_g = 300 Ω + 120 mH (DIN 45405)		1.3		mV

Typical performance of circuit in fig. 18 (continued)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
RECORDING						
G_v	Voltage gain (closed loop)	f = 1 kHz		70		dB
B	Frequency response	f = 140 Hz f = 1 kHz f = 10 kHz		-3 0 4		dB dB dB
d	Distortion	V_o = 1.1V f = 10 kHz		0.7		%
ALC	Range for 3 dB of output voltage variation	$V_i \leq$ 40 mV f = 10 kHz		54		dB

Fig. 20 - Typical stereo application circuit for battery/mains cassette player and recorder

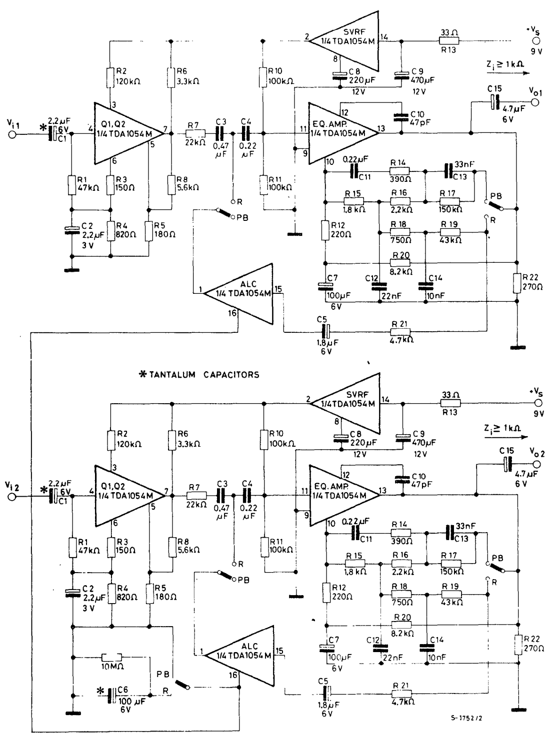


Fig. 21 - Complete cassette player and recorder

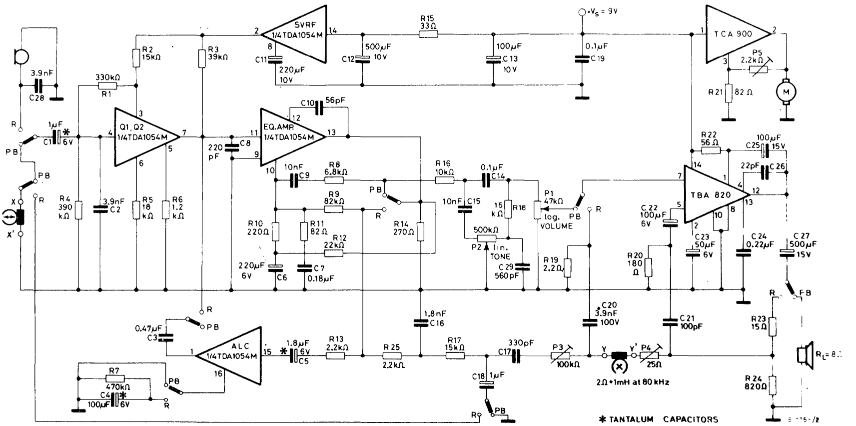


Fig. 22 - P.C. board and component layout for the circuit in fig. 21 (1:1 scale)