LINEAR INTEGRATED CIRCUITS

PREAMPLIFIER WITH ALC FOR C_rO_2 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
- STEREO MATCHING BETTER THAN 3 dB (matched pair)

The TDA 2054M 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

It is intended as preamplifier in tape and cassette recorders and players (C_rO_2), dictaphones, compressor and expander in telephonic equipments, Hi-Fi preamplifiers and in wire diffusion receivers; for stereo applications the ALC matching is better than 3 dB.

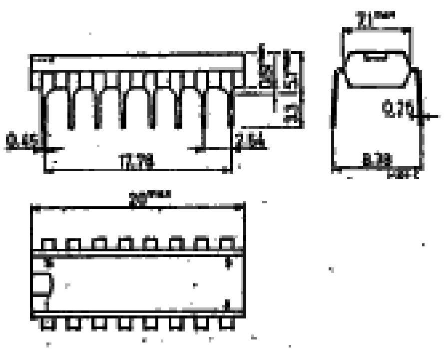
ABSOLUTE MAXIMUM RATINGS

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

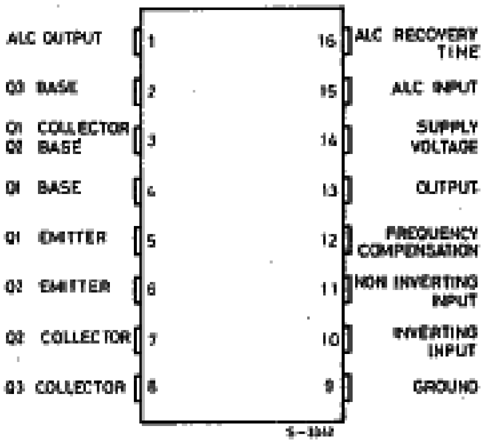
ORDERING NUMBERS: TDA 2054M mono applications
2 TDA 2054M stereo applications

MECHANICAL DATA

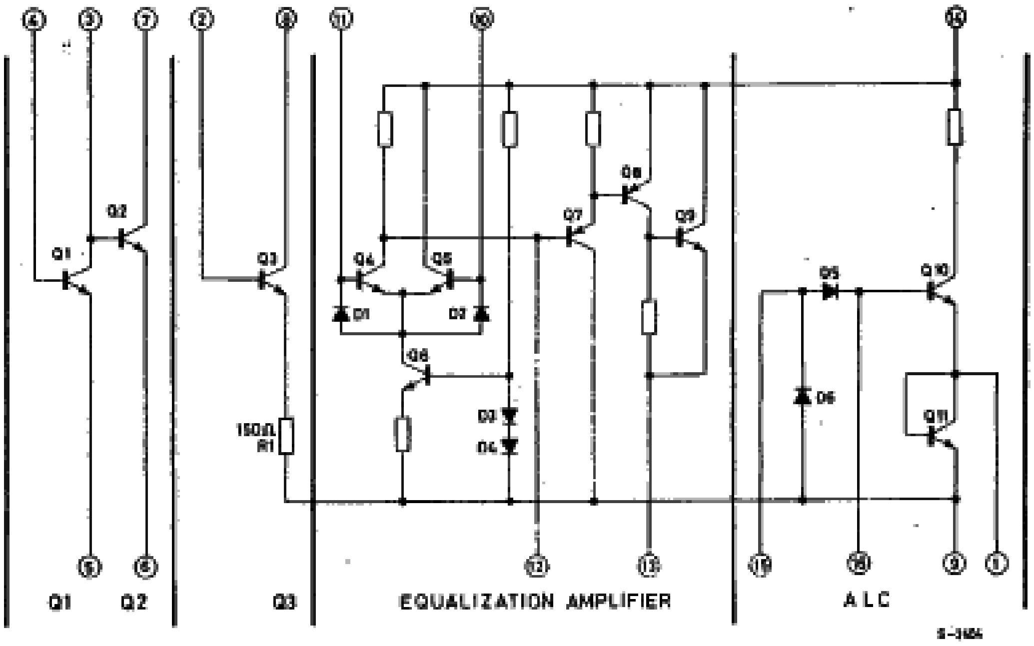
Dimensions in mm



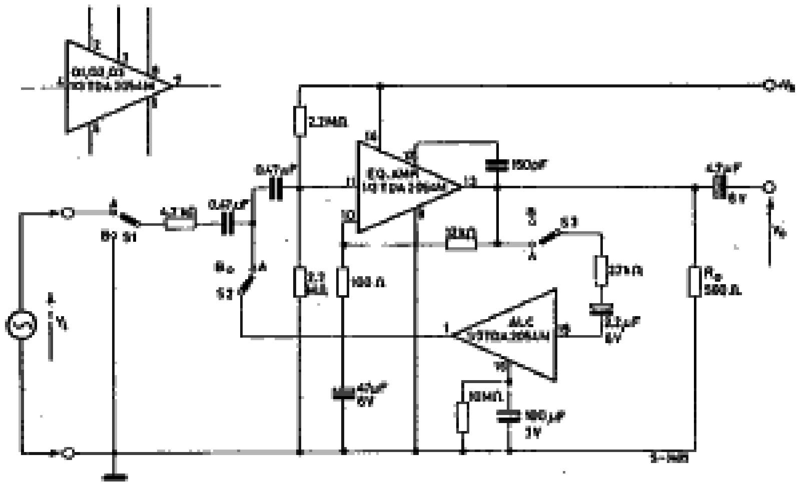
CONNECTION DIAGRAM



SCHEMATIC DIAGRAM



TEST CIRCUIT



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	$V_s = 9V$ S1 = S2 = S3 = at B		10		mA
h_{FE}	DC current gain (Q1, Q2, Q3)	$I_c = 0.1$ mA $V_{CE} = 5V$	300	500		–
e_N	Input noise voltage (Q1, Q2, Q3)	$I_c = 0.1$ mA $V_{CE} = 5V$ f = 1 KHz		2		$\frac{nV}{\sqrt{Hz}}$
i_N	Input noise current (Q1, Q2, Q3)			0.5		$\frac{pA}{\sqrt{Hz}}$
NF	Noise figure (Q1, Q2, Q3)	$I_c = 0.1$ mA $V_{CE} = 5V$ $R_g = 4.7$ KΩ B (-3 dB) = 20 to 10000 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.	$V_s = 9V$ $V_i = 100$ mV f = 1 KHz S1 = S2 = S3 at A		0.6		V
e_N	Equivalent input noise voltage (for equalization amplifier pin 11)	$V_s = 9V$ $G_v = 40$ dB S1 at B B (-3 dB) = 20 to 20000 Hz		1.3		µV
R_1	Q3 emitter resistance		105	150	195	Ω

Fig. 1 - Equivalent input spot voltage and noise current vs. bias current (transistors Q1, Q2, Q3)

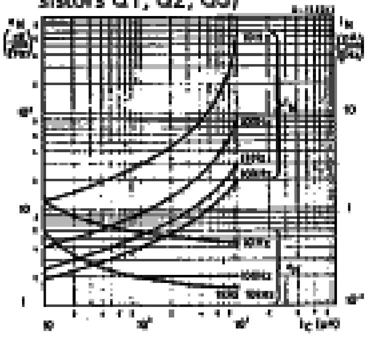


Fig. 2 - Equivalent input noise current vs. frequency (transistors Q1, Q2, Q3)

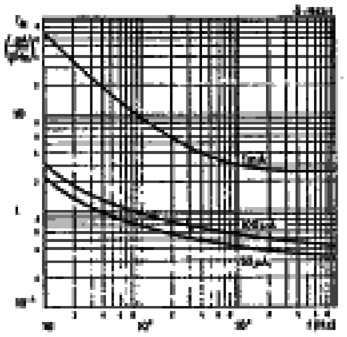


Fig. 3 - Equivalent input noise voltage vs. frequency (transistors Q1, Q2, Q3)

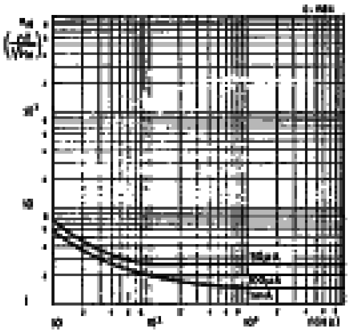


Fig. 4 - Noise figure vs. bias current (transistors Q1, Q2, Q3)

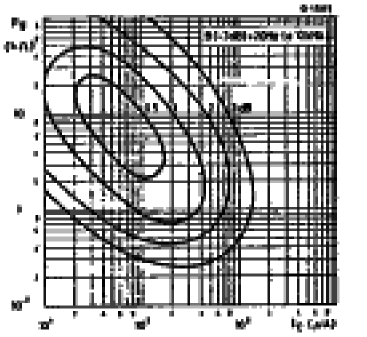


Fig. 5 - Optimum source resistance and minimum NF vs. bias current (transistors Q1, Q2, Q3)

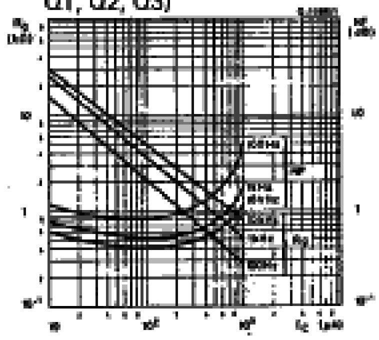


Fig. 6 - Current gain vs. collector current (transistors Q1, Q2, Q3)

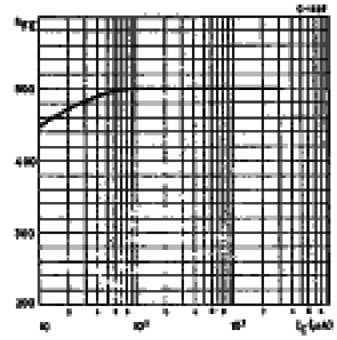


Fig. 7 - Open loop gain vs. frequency (equalization amplifier)

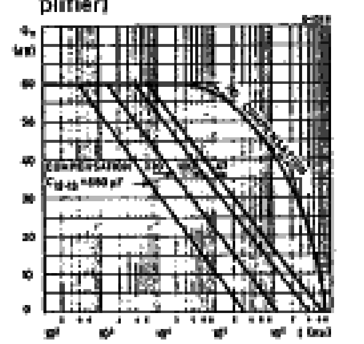


Fig. 8 - Open loop phase response vs. frequency (equalization amplifier)

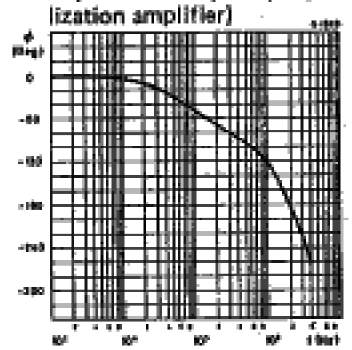
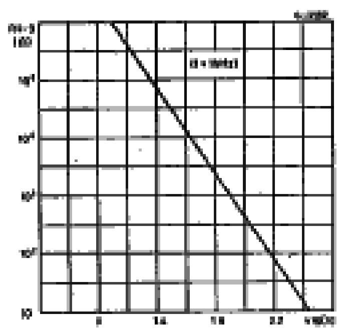


Fig. 9 - Dinamic resistance R_{1-9} vs. ALC voltage V_{16}



APPLICATION INFORMATION

Fig. 9 - Application circuit for C_rO_2 cassette player and recorder

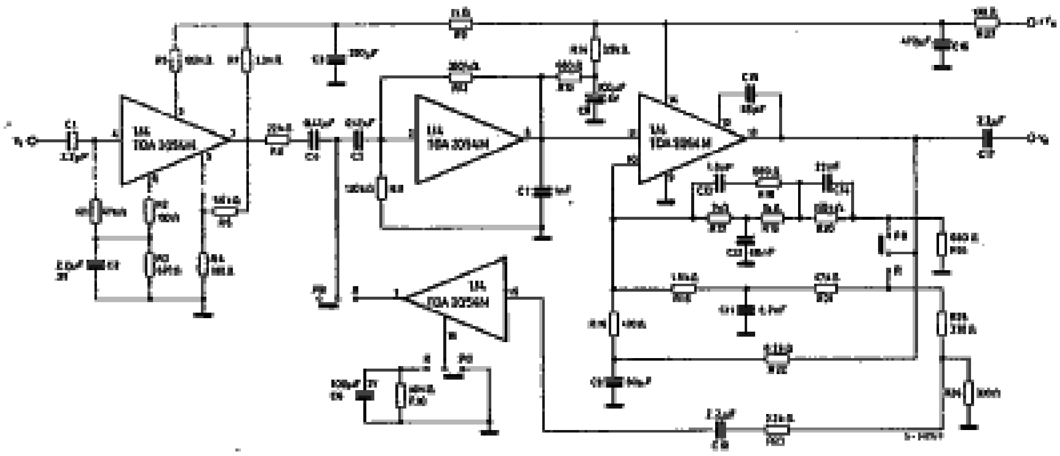
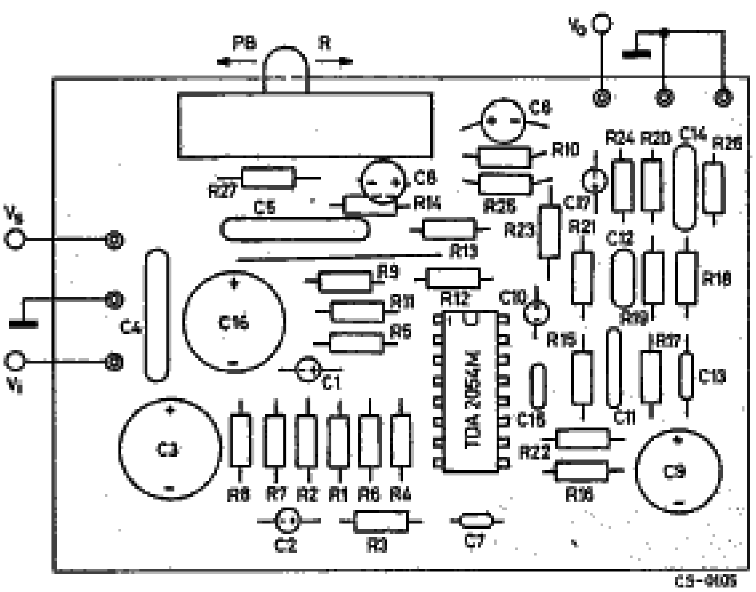


Fig. 10 - P.C. board and component layout for the circuit of Fig. 9 (1:1 scale)



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 20000 Hz		134		dB
G_v	Voltage gain (closed loop)	f = 1 KHz		60		dB
Z_i	Input impedance	f = 100 Hz f = 1 KHz f = 10 KHz		10 41 43		KΩ KΩ KΩ
Z_o	Output impedance	f = 1 KHz		12	35	Ω
B	Frequency response			see fig. 11		
d	Distortion	V_o = 1V f = 1 KHz		0.2		%
	Output background noise	Z_g = 300Ω + 120 mH (DIN 45405)		1.5		mV
***	Output weighted background noise			1		mV
$\frac{S+N}{N}$	Signal to noise ratio	V_o = 1.5V Z_g = 300Ω + 120 mH		60		dB
t_{on}*	Switch-on time	V_o = 1V		500		ms
RECORDING						
G_v	Voltage gain (open loop)	f = 20 to 20000 Hz		134		dB
G_v	Voltage gain (closed loop)	f = 1 KHz		72		dB
B	Frequency response			see fig. 13		
d	Distortion with ALC	V_o = 1V f = 10 KHz		0.5		%
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		3		V
V_o	Output voltage with ALC	V_i = 30 mV f = 1 KHz		1.1		V
t_l*	Limiting time (see fig. 17)	ΔV_i = +40 dB f = 1 KHz		75		ms
t_{set}*	Level setting time (see fig. 17)			300		ms
t_{rec}*	Recovery time (see fig. 17)	ΔV_i = −40 dB f = 1 KHz		150		sec.
t_{on}*	Switch-on-time	V_o = 1V		500		ms
$\frac{S+N}{N}$***	Signal to noise ratio with ALC	V_o = 1V R_g = 470Ω		64		dB

* This value depends on external network.

** When the DIN 45511 norm for frequency response is not mandatory the equalization peak at 15 KHz can be avoided - so halving the output noise.

*** Weighted noise measurements (DIN 45405).

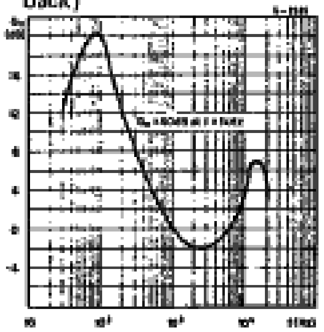


Fig. 11 - Frequency response for the circuit in fig. 9 (playback)

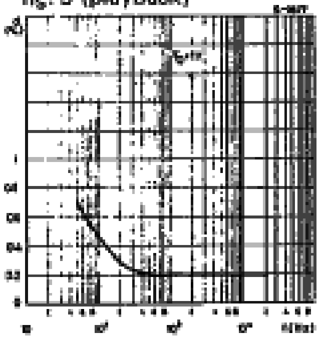


Fig. 12 - Distortion vs. frequency for the circuit in fig. 9 (playback)

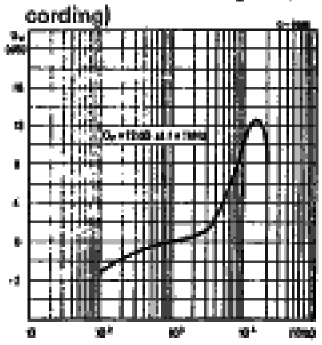


Fig. 13 - Frequency response for the circuit in fig. 9 (recording)

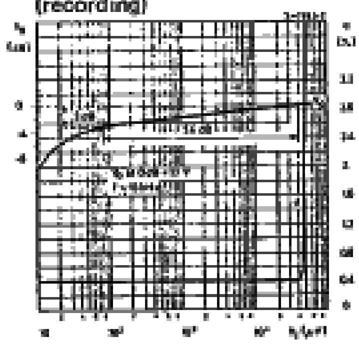


Fig. 14 - Output voltage variation and distortion with ALC vs. input voltage for the circuit in fig. 9 (recording)

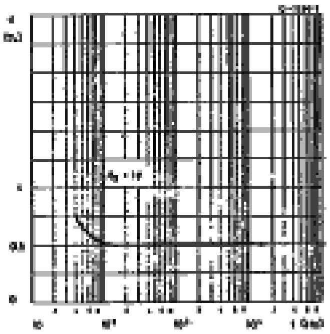


Fig. 15 - Distortion vs. frequency with ALC for the circuit in fig. 9 (recording)

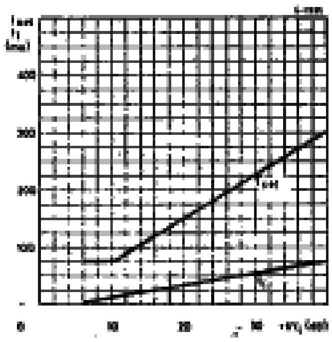


Fig. 16 - Limiting and level setting time vs. input signal variation

Fig. 17 - Limiting, level setting, recovery time