

T-74-05-01

Ordering number: EN \*3735

<b>SANYO</b>	No.*3735	Monolithic Linear IC
		<b>LA9300M</b>
		<b>R-DAT Recording, Playback and Equalization Amplifier</b>

Preliminary

### OVERVIEW

The LA9300M is a recording, playback and equalization amplifier for R-DAT (Digital Audio Tape) equipment. It incorporates two complete recording/playback amplifiers, equalizers and limiters.

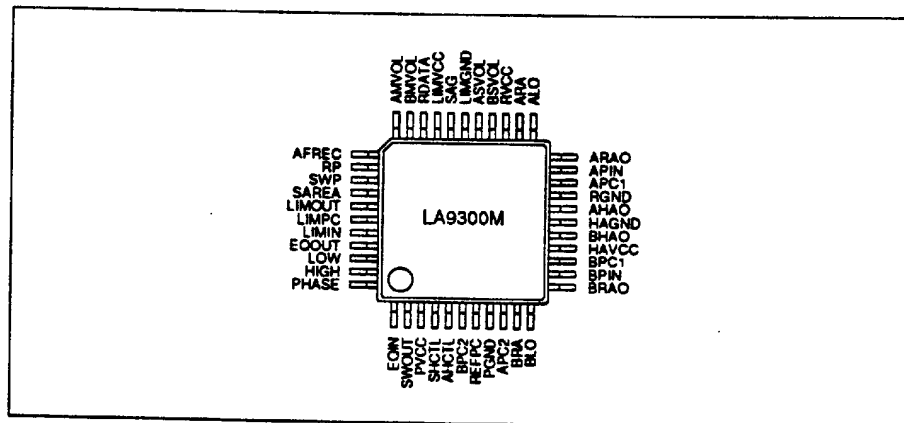
The LA9300M provides an easy interface to digital signal processing (DSP) devices and a low external component count, making it ideal for use as the front-end of a DAT player/recorder.

The LA9300M operates from a single 5 V supply and is available in 44-pin QFPs.

### FEATURES

- Two complete recording/playback amplifiers
- PCM equalizer
- Simple interface to DSP devices
- Low external component count
- Internal selection of pilot signal recording current
- Single 5 V supply
- 44-pin QFP

### PINOUT



Specifications and information herein are subject to change without notice.

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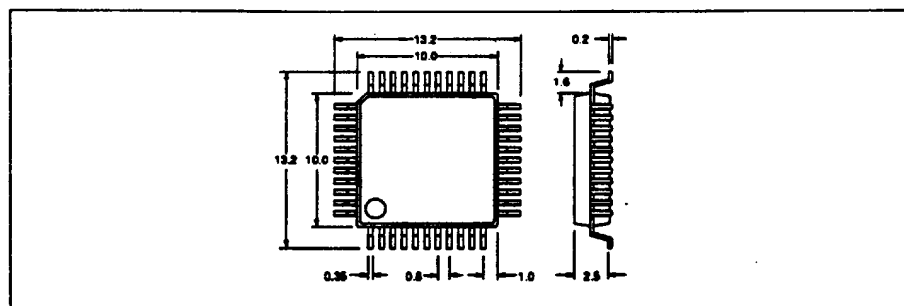
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# LA9300M

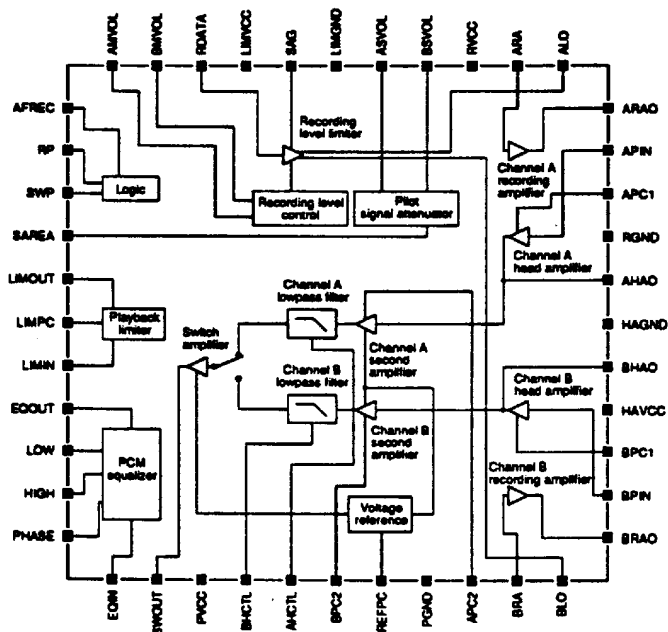
## PACKAGE DIMENSIONS

Unit: mm

3148-QIP44MA



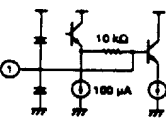
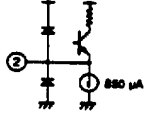
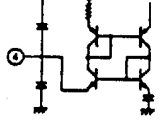
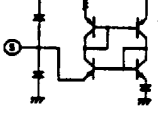
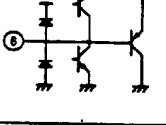
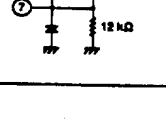
## BLOCK DIAGRAM



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## LA9300M

## PIN DESCRIPTION

Number	Name	Equivalent circuit	Description
1	EQIN		PCM equalizer input. Nominal voltage = 3.2 V
2	SWOUT		Channel A/B switch amplifier output. Emitter follower. Nominal voltage = 2.55 V
3	PVCC		5 V supply for lowpass filter, switch amplifier, equalizer, logic circuits and reference voltage circuit
4	BHCTL		Channel B lowpass filter cutoff frequency adjust. Nominal voltage = 0.75 V
5	AHCTL		Channel A lowpass filter cutoff frequency adjust. Nominal voltage = 0.75 V
6	BPC2		Channel B second-amplifier bypass capacitor. Nominal voltage = 1.45 V
7	REFPC		Reference voltage bypass capacitor. Nominal voltage = 2.5 V
8	PGND		Ground for lowpass filter, switch amplifier, equalizer, logic circuits and reference voltage

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Number	Name	Equivalent circuit	Description
9	APC2		Channel A second-amplifier bypass capacitor. Nominal voltage = 1.45 V
10	BRA		Channel B recording amplifier input. Nominal voltage = 0.7 V
11	BLO		Channel B recording limiter output. Emitter follower. Nominal voltage = 3.6 V
12	BRAO		Channel B recording amplifier output. Open collector
13	BPIN		Channel B head amplifier input. Nominal voltage = 2.3 V
14	BPC1		Channel B head amplifier bypass capacitor. Nominal voltage = 1.6 V
15	HAVCC		5 V supply for head amplifiers and second amplifiers
16	BHAO		Channel B head amplifier output. Emitter follower. Nominal voltage = 2.95 V
17	HAGND		Ground for head amplifiers and second amplifiers
18	AHAO		Channel A head amplifier output. Nominal voltage = 2.95 V
19	RGND		Ground for recording amplifiers

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Number	Name	Equivalent circuit	Description
20	APC1		Channel A head amplifier bypass capacitor. Nominal voltage = 1.6 V
21	APIN		Channel A head amplifier input. Nominal voltage = 2.3 V
22	ARAO		Channel A recording amplifier output
23	ALO		Channel A recording limiter output. Nominal voltage = 3.6 V
24	ARA		Channel A recording amplifier input. Nominal voltage = 0.7 V
25	RVCC		5 V supply for recording amplifiers
26	BSVOL		Channel B pilot signal attenuation adjust. Nominal voltage = 0.7 V
27	ASVOL		Channel A pilot signal attenuation adjust. Nominal voltage = 0.7 V
28	LIMGND		Ground for playback and recording limiters, volume and pilot signal attenuators
29	SAG		Recording limiter sag compensation capacitor. Nominal voltage = 4.3 V

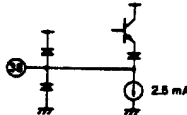
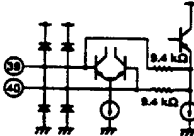
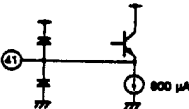
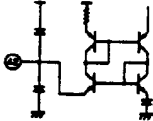
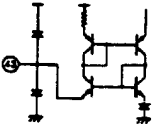
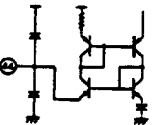
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Number	Name	Equivalent circuit	Description
30	LIMVCC		5 V supply for playback and recording limiters, volume and pilot signal attenuators
31	RDATA		Recording data input
32	BMVOL		Channel B recording amplitude adjust
33	AMVOL		Channel A recording amplitude adjust
34	AFREC		After-recording mode control pin
35	RP		Recording/playback mode control pin
36	SWP		Channel A/B select input
37	SAREA		Recording current control input

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Number	Name	Equivalent circuit	Description
38	LIMOUT		Playback limiter output. Emitter follower
39	LIMPC		Playback limiter bypass capacitor. Nominal voltage = 2.5 V
40	LIMIN		Playback limiter input. Nominal voltage = 2.5 V
41	EQOUT		PCM equalizer output. Emitter follower. Nominal voltage = 1.7 V
42	LOW		PCM equalizer low-frequency adjust. Nominal voltage = 0.7 V
43	HIGH		PCM equalizer high-frequency adjust. Nominal voltage = 0.7 V
44	PHASE		PCM equalizer phase adjust. Nominal voltage = 0.7 V

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## LA9300M

## SPECIFICATIONS

## Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage	$V_{CC}$ max	7	V
Power dissipation	$P_D$	500	mW
Operating temperature range	$T_{opg}$	-25 to 75	deg. C
Storage temperature range	$T_{stg}$	-40 to 125	deg. C

## Recommended Operating Conditions

 $T_A = 25$  deg. C

Parameter	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	5	V
Supply voltage range	$V_{CC}$	4.75 to 5.25	V

## Electrical Characteristics

 $V_{CC} = 5.0$  V,  $T_A = 25$  deg. C

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
LOW-level input voltage	$V_{IL}$		0	-	$0.2V_{CC}$	V
HIGH-level input voltage	$V_{IH}$		$0.8V_{CC}$	-	$V_{CC} + 0.2$	V
Playback-mode supply current	$I_{CCP}$	SWP is LOW, SAREA is LOW, S6a, S5c	21	35	49	mA
Recording-mode supply current excluding recording amplifier bias current	$I_{CCR}$	SWP is LOW, SAREA is LOW, S6a, S7a, S2a, S3a	11	18	25	mA
Channel A recording amplifier bias current	$I_{BA}$	SAREA is LOW, S7b	18.2	19.9	21.7	mA
Channel B recording amplifier bias current	$I_{BB}$	SAREA is LOW, S2b	18.2	19.9	21.7	mA
Channels A and B limiter output amplitude	$V_{OL}$	SAREA is LOW, $f = 1$ MHz, duty cycle = 50%, $V_{S2} = V_{S3} = 2.0$ V, S6a, S7b, S3a, S2b, S8 closed	100	120	144	mV <sub>pp</sub>
		SAREA is LOW, $f = 1$ MHz, duty cycle = 50%, $V_{S2} = V_{S3} = 2.5$ V, S6a, S7b, S3a, S2b, S8 closed	308	370	438	
		SAREA is LOW, $f = 1$ MHz, duty cycle = 50%, $V_{S2} = V_{S3} = 2.5$ V, S6a, S7b, S3a, S2b, S8 closed	631	750	894	



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Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Channels A and B limiter output amplitude	$V_{OL}$	SAREA is HIGH, $f = 1$ MHz, duty cycle = 50%, $V_{S2} = V_{S3} = 2.2$ V, S6a, S7b, S3a, S2b, S8 closed, $R_{26} = R_{27} = 11$ k $\Omega$	78	100	123	mV <sub>p-p</sub>
		SAREA is HIGH, $f = 1$ MHz, duty cycle = 50%, $V_{S2} = V_{S3} = 2.2$ V, S6a, S7b, S3a, S2b, S8 closed, $R_{26} = R_{27} = 68$ k $\Omega$	289	370	455	
		SAREA is HIGH, $f = 1$ MHz, duty cycle = 50%, $V_{S2} = V_{S3} = 2.2$ V, S6a, S7b, S3a, S2b, S8 closed, $R_{26} = R_{27} = 230$ k $\Omega$	378	485	596	
Channels A and B recording duty cycle	Duty <sub>1</sub>	SAREA is LOW, $f = 1$ MHz, duty cycle = 50%, $V_{S2} = V_{S3} = 2.2$ V, S6a, S7b, S3a, S2b, S8 closed	47	50	53	%
Channels A and B recording amplifier output level	$V_O$	$f = 1$ MHz, $V_{inac2} = 300$ mV <sub>p-p</sub> sine wave, S6b, S7a, S3b, S2a	1.25	1.40	1.57	V <sub>p-p</sub>
		$f = 10$ MHz, $V_{inac2} = 300$ mV <sub>p-p</sub> sine wave, S6b, S7a, S3b, S2a	0.88	1.10	1.40	
Channels A and B recording amplifier second-harmonic distortion	HD <sub>S1</sub>	$f = 5$ MHz, $V_{inac2} = 300$ mV <sub>p-p</sub> sine wave, S6b, S7a, S3b, S2a	-	-42	-37	dB
Channel A playback amplifier output level	$V_{PA}$	$f = 1$ MHz, $V_{inPS} = 20.6$ mV <sub>p-p</sub> sine wave, $R_4 = R_5 = 2$ k $\Omega$ , S4a, S5b	208	330	523	mV <sub>p-p</sub>
Channel B playback amplifier output level	$V_{PB}$	$f = 1$ MHz, $V_{inPS} = 20.6$ mV <sub>p-p</sub> sine wave, $R_4 = R_5 = 2$ k $\Omega$ , S4b, S5c	208	330	523	mV <sub>p-p</sub>
Channel A playback amplifier second-harmonic distortion	HD <sub>22</sub>	$f = 1$ MHz, $V_{inPS} = 20.6$ mV <sub>p-p</sub> sine wave, $R_4 = R_5 = 2$ k $\Omega$ , S4a, S5b	-	-50	-37	dB
Channel B playback amplifier second-harmonic distortion	HD <sub>23</sub>	$f = 1$ MHz, $V_{inPS} = 20.6$ mV <sub>p-p</sub> sine wave, $R_4 = R_5 = 2$ k $\Omega$ , S4b, S5c	-	-50	-37	dB

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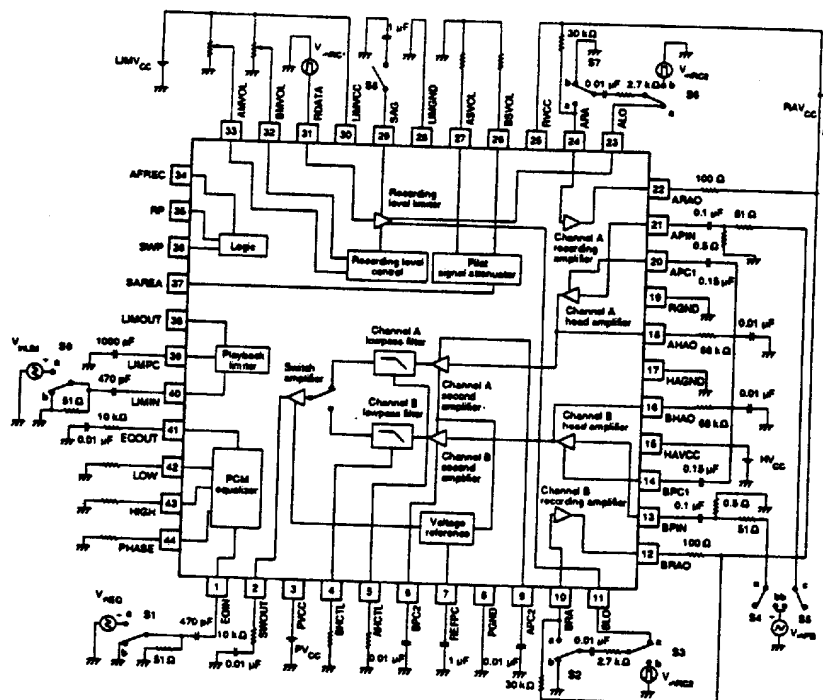
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Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Channel A playback amplifier frequency characteristic	$F_c$	$f = 10 \text{ MHz/1 MHz}$ , $V_{inP} = 20.6 \text{ mV}_{P-P}$ sine wave, $R_4 = R_5 = 2 \text{ k}\Omega$ , $S4a, S5b$	-5.5	-1.5	0.5	dB
Channel B playback amplifier frequency characteristic	$F_{cB}$	$f = 10 \text{ MHz/1 MHz}$ , $V_{inP} = 20.6 \text{ mV}_{P-P}$ sine wave, $R_4 = R_5 = 2 \text{ k}\Omega$ , $S4b, S5c$	-5.5	-1.5	0.5	dB
Equalizer frequency characteristic	$F_{c20}$	$f = 1.5 \text{ MHz}$ , $V_{inEQ} = 200 \text{ mV}_{P-P}$ sine wave, $R_{43-44} = 7.5 \text{ k}\Omega$ , $S1a, RP$ is LOW, SWP is LOW, SAREA is LOW.	-4.9	-4.0	-3.3	dB
		$f = 4.7 \text{ MHz}$ , $V_{inEQ} = 200 \text{ mV}_{P-P}$ sine wave, $R_{43-44} = 7.5 \text{ k}\Omega$ , $S1a, RP$ is LOW, SWP is LOW, SAREA is LOW.	3.0	5.2	7.4	
Equalizer phase response	$\phi_n$	$f = 1.5 \text{ MHz}$ , $V_{inEQ} = 200 \text{ mV}_{P-P}$ sine wave, $R_{43-44} = 7.5 \text{ k}\Omega$ , $S1a, RP$ is LOW, SWP is LOW, SAREA is LOW.	137	167	197	°
		$f = 4.7 \text{ MHz}$ , $V_{inEQ} = 200 \text{ mV}_{P-P}$ sine wave, $R_{43-44} = 7.5 \text{ k}\Omega$ , $S1a, RP$ is LOW, SWP is LOW, SAREA is LOW.	-102	-52	-1	
Playback limiter duty cycle	$Duty_2$	$f = 5 \text{ MHz}$ , $V_{inLIM} = 100 \text{ mV}_{P-P}$ sine wave, $S0a, RP$ is LOW, SWP is LOW, SAREA is LOW.	47	52	54	%

## Note

$S_{mn}$  indicates a switch position where  $m$  is the switch number, 1 to 8, and  $n$  is the switch position, a, b or c.

### Measurement Circuit



## Recording

SAG is used to compensate for the differentiation effect of the head coil. In particular, the pilot signal recording current is a differentiated waveform. SAG adjusts the phase of the pilot signal's fundamental wave component.

The signals from the variable limiter are voltage-to-current converted, and then amplified by the recording amplifiers. Current gain is approximately 43 dB.

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**Playback****Head amplifiers**

These amplify the signal from the tape heads. Voltage gain is approximately 42 dB.

**Second amplifiers**

These further amplify the output from the head amplifiers. Voltage gain is approximately 12 dB.

**Playback lowpass filters**

These modify the frequency characteristics of the playback signal. The filter response is controlled by the resistor connected to AHCTL for channel A, and to BHCLT, for channel B. These resistors should be in the range 2 to 30 k $\Omega$ .

**SW amplifier**

This buffers the signal selected from the lowpass filter outputs. Channel A is selected when SWP is LOW, and channel B, when SWP is HIGH.

**PCM equalizer**

This equalizes the output signal to compensate for the distortion introduced by the recording process. The equalization characteristics are controlled by external resistors connected to LOW, HIGH, and PHASE (pins 42, 43 and 44, respectively). These resistors should be in the range 2 to 30 k $\Omega$ .

**Playback limiter**

This shapes the PCM equalizer output into a rectangular waveform.

**OPERATING MODES**

Mode	Channel	Mode control pins				Playback amplifiers	PCM equalizer and playback limiters	Recording-level limiters, amplitude control and recording amplifiers	Pilot attenuator
		AFREC	RP	SWP	SAREA				
Playback	A	L	L	L	L	✓	✓	x	x
	B	L	L	H	L	✓	✓	x	x
Recording	A	L	H	L	L/H	x	x	✓	x/✓
	B	L	H	H	L/H	x	x	✓	x/✓
After recording (playback)	A	H	L	L	L	✓	✓	x	x
	B	H	L	H	L	✓	✓	x	x
After recording (recording)	A	H	H	L	L/H	x	✓	✓	x/✓
	B	H	H	H	L/H	x	✓	✓	x/✓

**Notes**

✓ = operating, x = halted

x/✓ means halted when SAREA is LOW, and operating, when SAREA is HIGH.

## TYPICAL APPLICATION

