



# LA4166M

## Recording and Playback System for Microcassette Players

### Overview

The LA4166M is a recording and playback system IC that incorporates an on-chip motor control governor, making it ideal for use in microcassette and compact cassette recorders. The LA4166M features single-pin control for selecting recording or playback mode and a recording-mode indicator LED driver. The LA4166M is pin-compatible with the LA4165M. The LA4166M incorporates a preamplifier, an automatic level control (ALC) circuit and a power amplifier.

The preamplifier functions as both recording microphone amplifier and playback equalization amplifier. The ALC circuit cuts high-level inputs and boosts low-level inputs during recording. The power amplifier outputs 215mW (typ) into a 4Ω speaker. The LA4166M operates from a 1.8 to 3.6V supply and is available in 24-pin MFPs.

### Features

- On-chip motor control governor.
- Single-pin control for selecting recording or playback mode.
- Recording-mode indicator LED driver.
- Pin-compatible with LA4165M.
- Recording and playback preamplifier.
- ALC circuit.
- Power amplifier.
- 215mW (typ) output power into 4Ω speaker.
- 1.8 to 3.6V supply.
- 24-pin MFP.

### Specifications

#### Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V <sub>CC</sub>		4.5	V
Power dissipation	P <sub>D</sub>		1.1	W
Operating temperature range	T <sub>opr</sub>		-10 to +50	°C
Storage temperature range	T <sub>stg</sub>		-55 to +150	°C

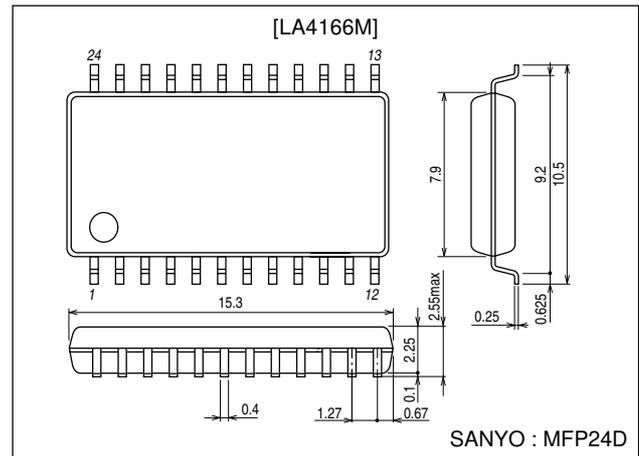
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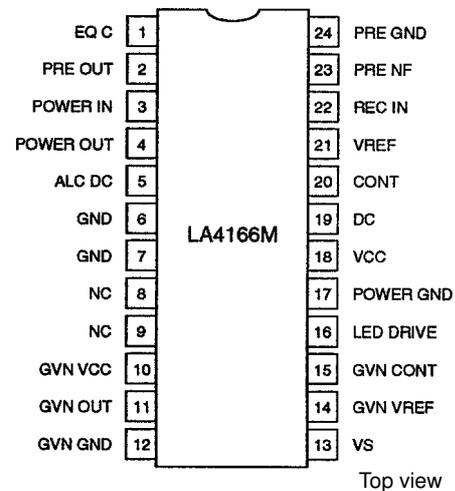
### Package Dimensions

unit:mm

3108-MFP24D



### Pin Assignment



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## Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V <sub>CC</sub>		3	V
Supply voltage range	V <sub>CC</sub>		1.8 to 3.6	V
Power amplifier load resistance	R <sub>L1</sub>		4 (Playback mode)	Ω
			10 (Recording mode)	kΩ
Preamplifier load resistance	R <sub>L2</sub>		10	kΩ

## Electrical Characteristics at Ta = 25°C, V<sub>CC</sub>=3V, power amplifier R<sub>L</sub>=4Ω (playback mode) or 10kΩ (recording mode), preamplifier R<sub>L</sub>=10kΩ, f=1kHz, 0dBm=0.775V unless otherwise noted.

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Preamplifier and power amplifier quiescent supply current	I <sub>CCO</sub>	Recording mode, V <sub>I</sub> =0V	12	25	38	mA
		Playback mode, V <sub>I</sub> =0V	13	26	39	mA
Preamplifier and power amplifier closed-loop voltage gain	V <sub>G1</sub>	Recording mode, V <sub>O</sub> =-5dBm	62.0	64.5	67.0	dB
		Playback mode, V <sub>O</sub> =-5dBm	71.0	73.5	76.0	dB
Preamplifier closed-loop voltage gain	V <sub>G2</sub>	Recording mode, V <sub>O</sub> =-10dBm, R <sub>NF</sub> =100Ω	32.5	35.0	37.5	dB
		Playback mode, V <sub>O</sub> =-10dBm, R <sub>NF</sub> =100Ω	42.5	45.0	47.5	dB
Preamplifier maximum output voltage	V <sub>O</sub>	Playback mode, THD=1%	0.3	0.6	1.0	V
Preamplifier input noise voltage	V <sub>NI</sub>	Playback mode, 20Hz to 20kHz output bandpass filter	0.5	1.1	2.0	μV
Preamplifier total harmonic distortion	THD <sub>1</sub>	Playback mode, V <sub>O</sub> =0.4V	0.01	0.11	1.0	%
Power amplifier voltage gain	V <sub>G3</sub>	V <sub>O</sub> =-5dBm, R <sub>L</sub> =4Ω	26.0	28.5	31.0	dB
Power amplifier output power	P <sub>O</sub>	THD=10%, R <sub>L</sub> =4Ω	180	215	350	mW
Power amplifier total harmonic distortion	THD <sub>2</sub>	P <sub>O</sub> =30mW, R <sub>L</sub> =4Ω	0.05	0.5	1.5	%
Power amplifier output noise voltage	V <sub>NO</sub>	R <sub>V</sub> =0Ω, R <sub>L</sub> =4Ω, 20Hz to 20kHz output bandpass filter	5	25	100	μV
ALC turn-ON input voltage	V <sub>I</sub>		-66.5	-69.0	-71.5	dBm
ALC range	ALCR	See note 1.	30	38	45	dB
ALC total harmonic distortion	THD <sub>3</sub>	V <sub>REC IN</sub> =-40dBm	0.1	0.67	1.5	%
ALC output voltage	V <sub>O</sub>	V <sub>REC IN</sub> =-40dBm	0.35	0.46	0.55	V
LED drive current	I <sub>LED</sub>	Using a red LED	1.0	2.5	4.5	mA
Governor reference voltage	V <sub>GVN REF</sub>	I <sub>m</sub> =100mA	1.1	1.25	1.4	V
Governor quiescent input current	I <sub>d</sub>	I <sub>m</sub> =100mA	2	3	6	mA
Governor current divider ratio	K	I <sub>m</sub> =50 to 100mA	45	50	55	
Governor residual output voltage	V <sub>sat</sub>	I <sub>m</sub> =200mA, V <sub>GVN REF</sub> =V <sub>GVN CONT</sub>	0.1	0.3	0.5	V
Governor reference voltage vs. supply voltage characteristic		V <sub>CC</sub> =1.8 to 4.5V, I <sub>m</sub> =100mA, See note 2.	0	0.1	0.5	%/V
Governor current divider ratio vs. supply voltage characteristic		V <sub>CC</sub> =2.0 to 4.5V, I <sub>m</sub> =50 to 100mA, See note 3.	0	0.1	0.5	%/V
Governor reference voltage ratio vs. output current characteristic		I <sub>m</sub> =50 to 200mA, See note 4.	0	0.007	0.03	%/mA
Governor current divider ratio vs. output current characteristic		I <sub>m</sub> =50 to 200mA, See note 5.	-0.05	0.005	0.05	%/mA

### Notes

1. Referred to ALC turn-ON voltage, input range for the output level to rise 2.5dB
2. The characteristic is given the equation

$$\left( \frac{\Delta V_{GVN REF}}{V_{GVN REF}} \right) + \Delta V_{CC}$$

3. The characteristic is given by the equation

$$\left( \frac{\Delta K}{K} \right) + \Delta V_{CC}$$

4. The characteristic is given by the equation

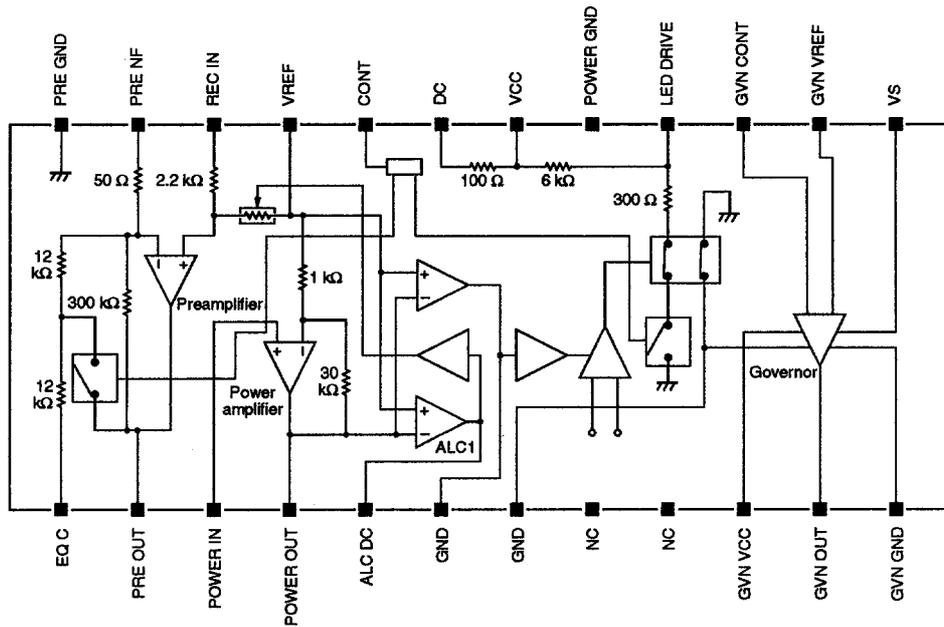
$$\left( \frac{\Delta V_{GVN REF}}{V_{GVN REF}} \right) + \Delta I_m$$

5. The characteristic is given by the equation

$$\left( \frac{\Delta K}{K} \right) + \Delta I_m$$

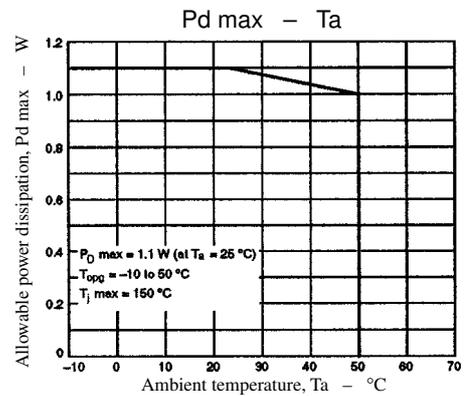
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## Block Diagram



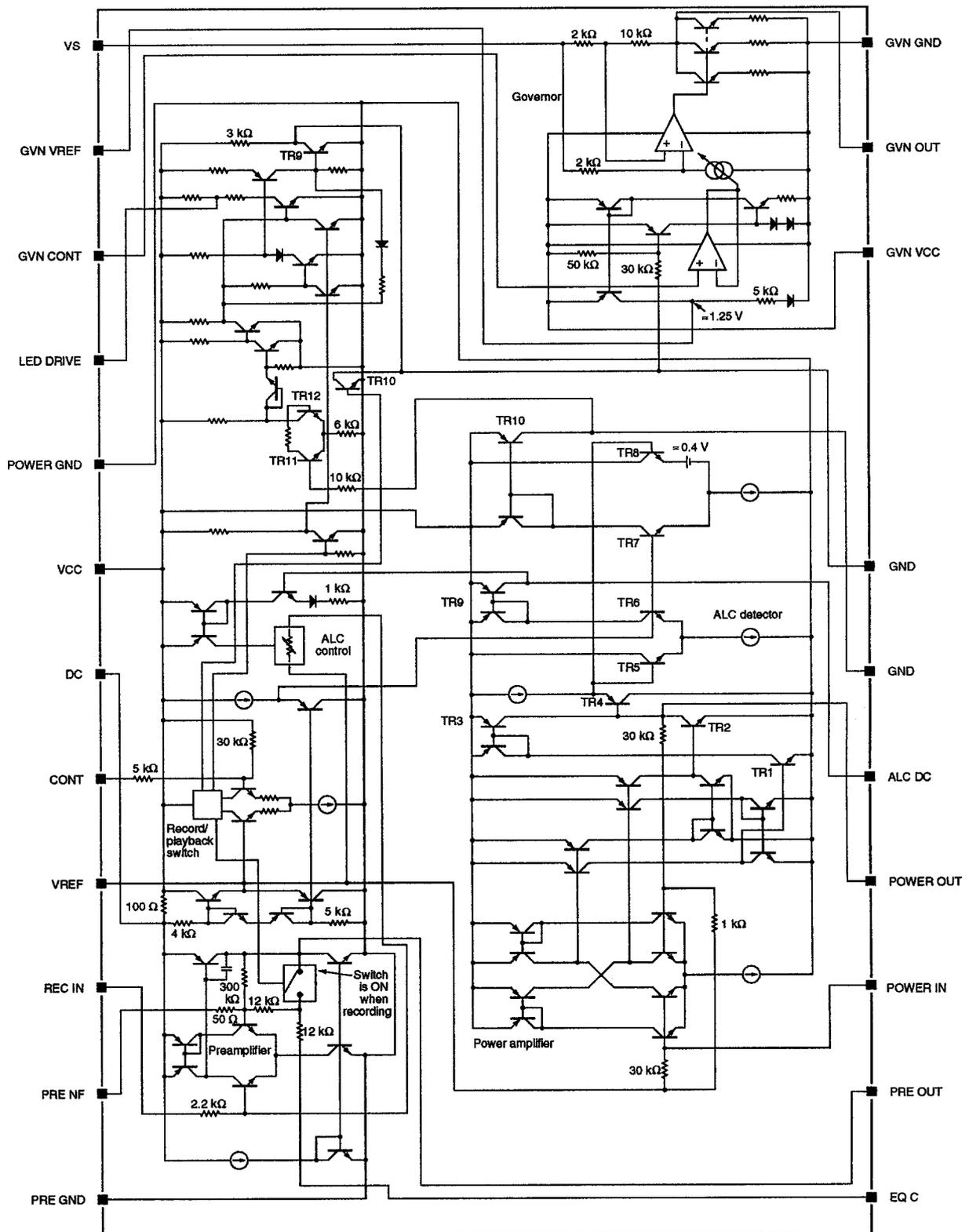
## Pin Description

Number	Name	Description
1	EQ C	Playback equalization capacitor connection
2	PRE OUT	Preamplifier output
3	POWER IN	Power amplifier input
4	POWER OUT	Power amplifier output
5	ALC DC	ALC characteristics control network connection
6, 7	GND	Ground
8, 9	NC	No connection
10	GVN V <sub>CC</sub>	1.8 to 3.6V governor supply
11	GVN OUT	Governor output
12	GVN GND	Governor ground
13	VS	Motor supply voltage
14	GVN VREF	Governor reference voltage output
15	GVN CONT	Governor control input
16	LED DRIVE	LED driver output
17	POWER GND	Power amplifier ground
18	V <sub>CC</sub>	1.8 to 3.6V supply
19	DC	Ripple-filter capacitor connection
20	CONT	Record and playback select input
21	VREF	Reference voltage output
22	REC IN	Recording signal input
23	PRE NF	Preamplifier gain control input
24	PRE GND	Preamplifier ground



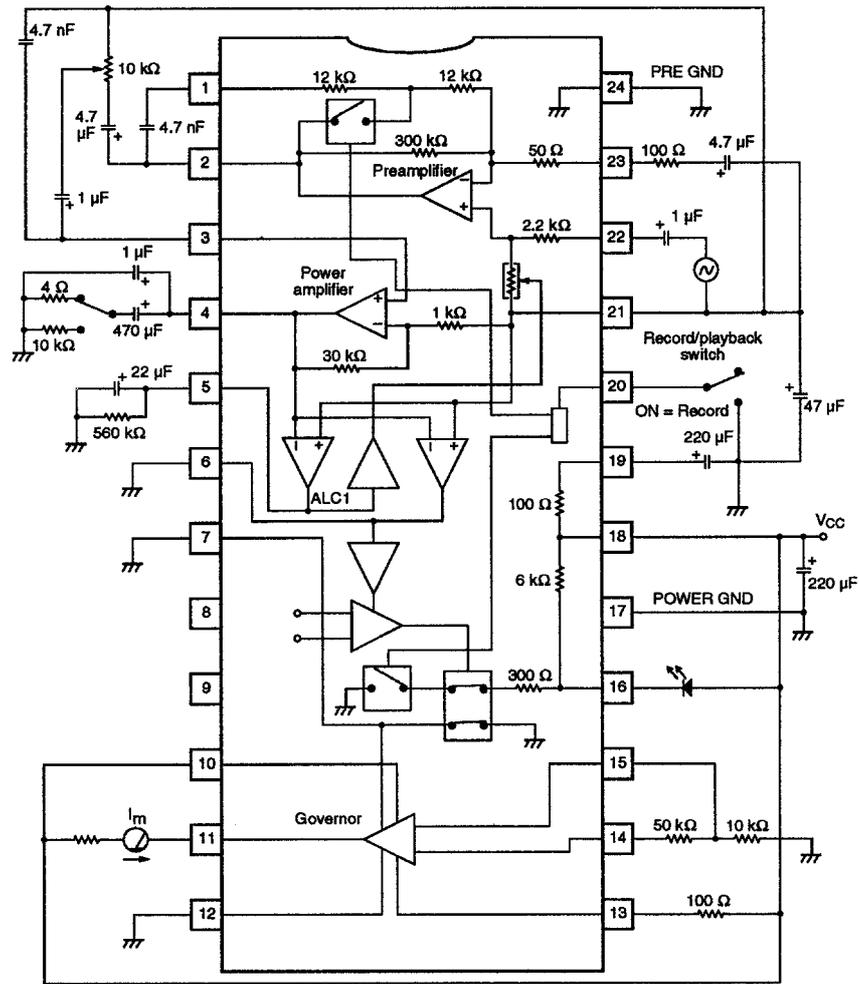
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## Schematic Diagram



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## Measurement Circuit



### Functional Description

The LA4166M comprises a preamplifier, an ALC, an LED driver, a power amplifier and a governor. The operation of these functional blocks in recording and playback modes is shown in table 1. Recording mode is selected when CONT is held at 0V, and playback mode, when CONT is open.

Table 1. Block operation

Mode	Preamplifier	ALC	LED driver	Power amplifier	Governor
Recording	ON	ON	ON	ON	ON
Playback	ON	OFF	OFF	ON	ON

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## Typical Application

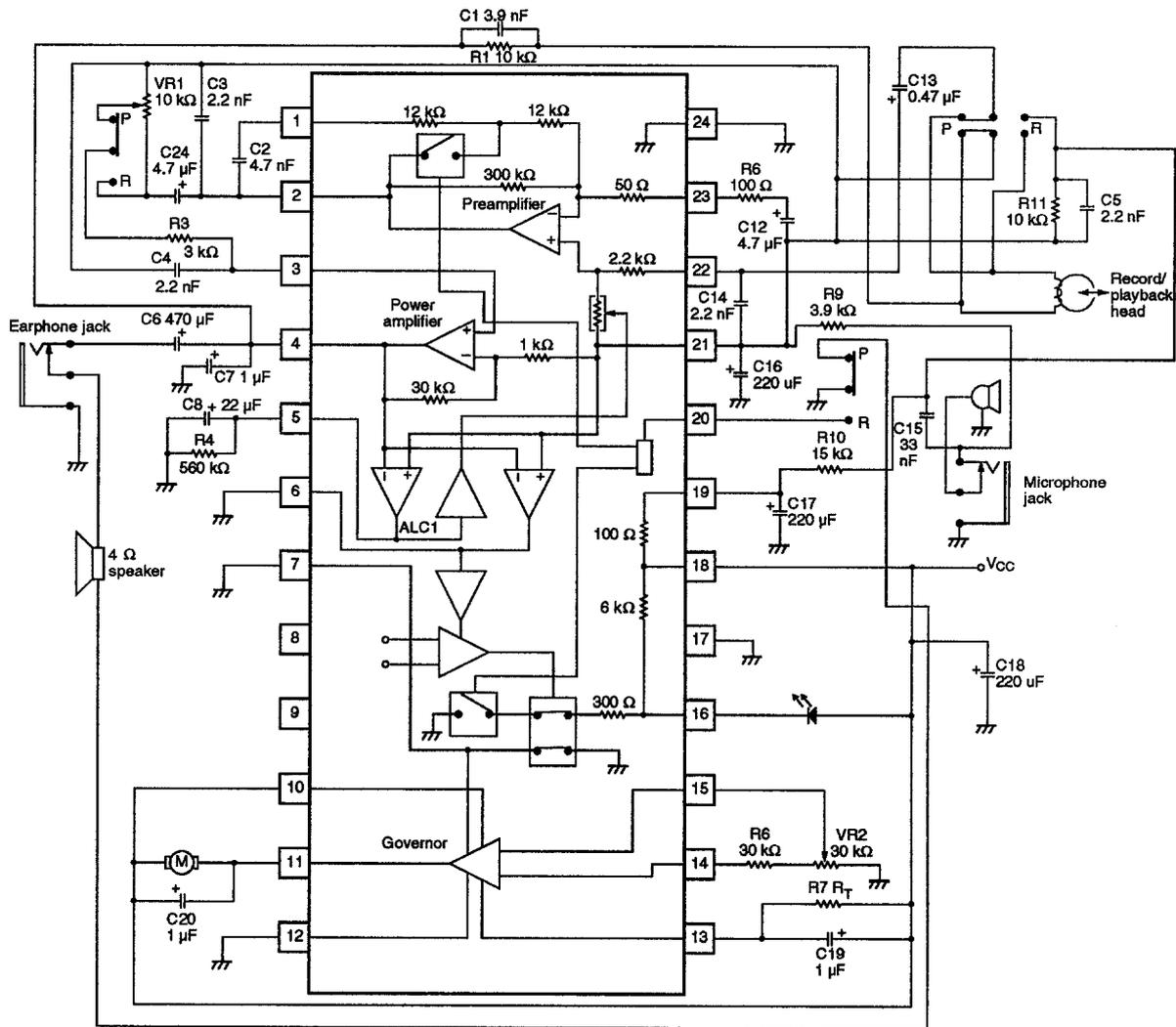


Figure 1. Application circuit

Note the external components are used to determine the LA4166M operating characteristics. For example, C2 determines the playback equalization characteristic, R8 determines the preamplifier gain, C8 and R4 determine the ALC attack and recovery times and C17 determines the power supply ripple rejection. The ripple rejection decreases as the capacitance C17 is decreased. Other components are used to determine the overall circuit characteristics. For example, C1 and R1 determine the recording current and C7 prevents output oscillations.

Note also that LA4166M internal components determine other LA4166M characteristics. For example, the 2.2kΩ PRE IN input resistor determines the ALC range, and the 1kΩ and 30kΩ resistors at the power amplifier inverting input determine amplifier gain.

In addition, LED DRIVE should be left open when not using the LED indicator function, the double-pole switch that controls LED DRIVE is normally closed, the NC pins should be left open, and the GND pins should be tied to ground

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