



LA3235W

1.5 V Record Preamplicifier

Overview

The LA3235W is a single-chip record system IC for use in 1.5 V headphone stereo products. While previous recording systems were implemented using a dedicated tape drive, by using the LA3235W, such a system can be implemented by adding electronic switching to a playback-only tape drive. Additionally, a compact record/playback system can be implemented with just two chips by combining this IC and the LA4590W 1.5 V preamplifier/power amplifier IC

Functions

- Microphone amplifier (with ALC) ×2
- Microphone monitor amplifier ×2
- Radio amplifier (with ALC) ×2
- Record bias power supply
- Record amplifier ×4 (with forward/reverse switching and muting functions)
- Microphone power supply
- All control circuits, including electronic switching circuits, built in

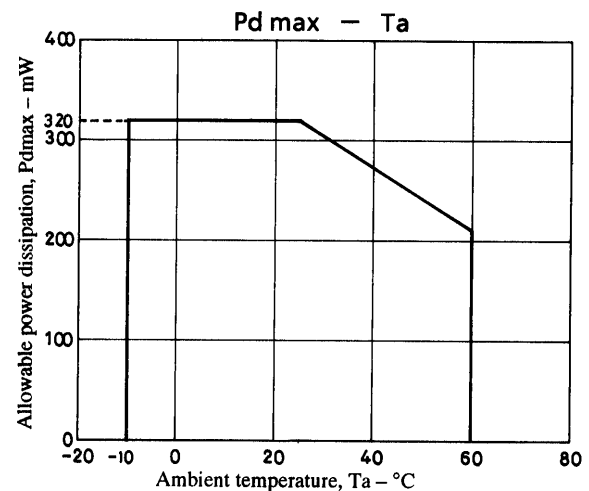
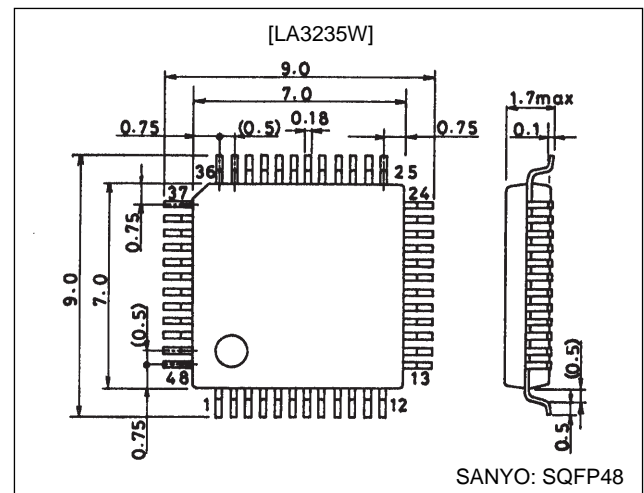
Features

- Miniature package (48-pin SQFP)
- Built-in microphone and record bias power supplies
- Built-in radio amplifier with ALC circuit
- Systems can be easily controlled from a microprocessor using the built-in electronic switching, power supply, and amplifier block control circuits.

Package Dimensions

unit: mm

6134A-SQFP48



Specifications

Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_{CC\text{ max}}$		4.5	V
Allowable power dissipation	$P_{d\text{ max}}$		320	mW
Operating temperature	T_{opr}		-10 to +65	$^\circ\text{C}$
Storage temperature	T_{stg}		-40 to +125	$^\circ\text{C}$

Operating Conditions at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V_{CC1}, V_{CCRF}		1.5	V
	V_{CC2}		2.4	V
Operating supply voltage range	V_{CC1}, V_{CCRF}		0.9 to 2.2	V
	V_{CC2}		2.0 to 4.0	V

Operating Characteristics at $T_a = 25^\circ\text{C}$, V_{CC1} and $V_{CCRF} = 1.2\text{ V}$, $V_{CC2} = 2.4\text{ V}$, $f = 1\text{ kHz}$, $0\text{ dBm} = 0.775\text{ V}$, $R_{LMIC} = 10\text{ k}\Omega$, $R_{L\text{Radio}} = 10\text{ k}\Omega$, $R_{L\text{MON}} = 10\text{ k}\Omega$, $R_{L\text{REC}} = 3\text{ k}\Omega$

Parameter	Symbol	Conditions	min	typ	max	Unit
No signal supply current: record/ V_{CC1}	I_{CCR1}	Microphone $R_g = 6.8\text{ k}\Omega$	0.08	0.13	0.23	mA
No signal supply current: record/ V_{CCRF}	I_{CCR}	Microphone $R_g = 6.8\text{ k}\Omega$	2.0	3.5	5.0	mA
No signal supply current: record/ V_{CC2}	I_{CCR2}	Microphone $R_g = 6.8\text{ k}\Omega$	0.85	1.5	2.1	mA
No signal supply current: playback/ V_{CC1}	I_{CCP1}			0.1	5.0	μA
No signal supply current: playback/ V_{CCRF}	I_{CCP}		0.36	0.6	1.0	mA
No signal supply current: playback/ V_{CC2}	I_{CCP2}		0.3	0.5	0.75	mA
[Microphone amplifier] (measured with ALC off)						
Voltage gain (closed)	V_{GM}	$V_O = -20\text{ dBm}$		35		dB
Maximum output voltage	$V_{O\text{ maxM}}$	THD = 1%		320		mV
Total harmonic distortion	THD_M	$V_O = 200\text{ mV}$		0.1		%
Output noise voltage	V_{NOM}	$R_g = 6.8\text{ k}\Omega$, BPF = 20 Hz to 20 kHz		130		μV
Crosstalk (interchannel)	CT_M	$V_O = -20\text{ dBm}$, TUNE 1 KHz		46		dB
Ripple rejection ratio	$SVRR_M$	$R_g = 6.8\text{ k}\Omega$, $f_R = 100\text{ Hz}$, $V_R = -30\text{ dBm}$		37		dB
[Radio Amplifier] (measured with ALC off)						
Voltage gain (closed)	V_{GR}	$V_O = -20\text{ dBm}$		14.5		dB
Maximum output voltage	$V_{O\text{ maxR}}$	THD = 1%		320		mV
Total harmonic distortion	THD_R	$V_O = 200\text{ mV}$		0.1		%
Output noise voltage	V_{NOR}	$R_g = 6.8\text{ k}\Omega$, BPF = 20 Hz to 20 kHz		30		μV
Crosstalk (interchannel)	CT_R	$V_O = -20\text{ dBm}$, TUNE 1 KHz		59		dB
Ripple rejection ratio	$SVRR_R$	$R_g = 6.8\text{ k}\Omega$, $f_R = 100\text{ Hz}$, $V_R = -30\text{ dBm}$		55		dB
[Monitor Amplifier]						
Voltage gain (closed)	V_{GMON}	$V_O = -20\text{ dBm}$		9.5		dB
Maximum output voltage	V_{OMON}	THD = 1%		260		mV
Total harmonic distortion	THD_{MON}	$V_O = 100\text{ mV}$		0.1		%
Output noise voltage	V_{NOMON}	BPF = 20 Hz to 20 kHz		11		μV
Crosstalk (interchannel)	CT_{MON}	$V_O = -20\text{ dBm}$		59		dB
Ripple rejection ratio	$SVRR_{MON}$	$f_R = 100\text{ Hz}$, $V_R = -30\text{ dBm}$		57		dB
[Record Amplifier]						
Voltage gain (closed)	V_{GREC}	$V_O = -10\text{ dBm}$		22		dB
Maximum output voltage	V_{OREC}	THD = 1%		670		mV
Total harmonic distortion	THD_{REC}	$V_O = 300\text{ mV}$		0.08		%
Output noise voltage	V_{NOREC}	BPF = 20 Hz to 20 kHz		46		μV
Crosstalk (interchannel)	CT_{REC}	$V_O = -10\text{ dBm}$		55		dB
Ripple rejection ratio	$SVRR_{REC}$	$f_R = 100\text{ Hz}$, $V_R = -30\text{ dBm}$		55		dB

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Parameter	Symbol	Conditions	min	typ	max	Unit
[Microphone + Record]						
Voltage gain (closed)	V_{GMR}	$V_O = -10$ dBm, ALC OFF	52	56.6	60	dB
Maximum output voltage	V_{OMR}	THD = 3%	500	700		mV
Total harmonic distortion	THD_{MR}	$V_i = -40$ dBm		0.55	1.3	%
ALC voltage	$ALCV_{MR}$	$V_i = -40$ dBm, $R_g = 6.8$ k Ω	300	400	500	mV
ALC balance	$ALCB_{MR}$	$V_i = -40$ dBm, $R_g = 6.8$ k Ω		0	1.5	dB
ALC start input	$ALCI_{MR}$		-65.5	-62.5	-59.5	dBm
ALC width	$ALCW_{MR}$	Input level relative to the ALC start point such that the output is +3 dB.	35	42		dB
Output noise voltage	V_{NOMR}	$R_g = 6.8$ k Ω , BPF = 20 Hz to 20 kHz		1.5	2.8	mV
Crosstalk (interchannel)	CT_{MR}	$V_i = -40$ dBm	11	19		dB
Ripple rejection ratio	$SVRR_{MR1}$	$R_g = 6.8$ k Ω , $f_R = 100$ Hz, $V_R = -30$ dBm	10	16		dB
	$SVRR_{MR2}$	$R_g = 6.8$ k Ω , $f_R = 100$ Hz, $V_R = -20$ dBm With ripple added to V_{CC2} , TUNE = 100 Hz	50	58		dB
[Radio + Record]						
Voltage gain	V_{GRR}	$V_O = -10$ dBm, ALC OFF	31.5	35.5	39.5	dB
Maximum output voltage	V_{ORR}	THD = 3%	470	570		mV
Total harmonic distortion	THD_{RR}	$V_i = -30$ dBm		0.55	1.3	%
ALC voltage	$ALCV_{RR}$	$V_i = -30$ dBm, $R_g = 6.8$ k Ω	300	410	500	mV
ALC balance	$ALCB_{RR}$	$V_i = -30$ dBm, $R_g = 6.8$ k Ω		0	1.5	dB
ALC start input	$ALCI_{RR}$		-45.5	-42.5	-39.5	dBm
ALC width	$ALCW_{RR}$	Input level relative to the ALC start point such that the output is +3 dB.	35	40		dB
Output noise voltage	V_{NORR}	$R_g = 6.8$ k Ω , BPF = 20 Hz to 20 kHz		340	610	μ V
Crosstalk (interchannel)	CT_{RR}	$V_i = -30$ dBm	35	47		dB
Ripple rejection ratio	$SVRR_{RR}$	$R_g = 6.8$ k Ω , $f_R = 100$ Hz, $V_R = -30$ dBm	25	32		dB
[Microphone + Monitor]						
Voltage gain (closed)	V_{GMMON}	$V_O = -20$ dBm, ALC OFF	39.5	43.5	47.5	dB
Maximum output voltage	V_{OMMON}	THD = 3%	150	310		mV
Total harmonic distortion	THD_{MMON}	$V_i = -40$ dBm		0.55	1.3	%
ALC voltage	$ALCV_{MMON}$	$V_i = -40$ dB, $R_g = 6.8$ k Ω	60	90	135	mV
Output noise voltage	V_{NOMMON}	$R_g = 6.8$ k Ω , BPF = 20 Hz to 20 kHz		350	650	μ V
Crosstalk (interchannel)	CT_{MMON}	$V_i = -40$ dBm	11	19		dB
Ripple rejection ratio	$SVRR_{MMON}$	$R_g = 6.8$ k Ω , $f_R = 100$ Hz, $V_R = -30$ dBm	21	27		dB
	$SVRR'_{MMON}$	$R_g = 6.8$ k Ω , $f_R = 100$ Hz, $V_R = -20$ dBm With ripple added to V_{CC2} , TUNE = 100 Hz	60	70		dB
[Record Bias Power Supply]						
Output voltage	V_{RBR1}	$I_{RBR} = -50$ mA	0.92	1.0	1.08	V
Ripple rejection ratio	$SVRR_{RBR1}$	$f_R = 100$ Hz, $V_R = -30$ mA $I_{RBR} = -50$ mA, 2SB1295; using 6 ranks	45	53		dB
Output voltage	V_{RBR2}	$V_{CC1} = 1.0$ V, $I_{RBR} = 30$ mA	0.89	0.93		V
Ripple rejection ratio	$SVRR_{RBR2}$	$V_{CC1} = 1.0$ V, $f_R = 100$ Hz, $V_R = -30$ dBm $I_{RBR} = 30$ mA, 2SB1295; using 6 ranks	33	40		dB
[Microphone Power Supply]						
Output voltage	V_{MR}	$I_{MR} = 3$ mA	1.55	1.65	1.75	V
Ripple rejection ratio	$SVRR_{MR}$	$f_R = 100$ Hz, $V_R = -20$ dBm $I_{MR} = 3$ mA, with ripple added to V_{CC2}	55	70		dB
[Switching Control]: Record mode						
Forward: CONT A and C pins: source	I_{FA}, I_{FC}	Measured with $R_L = 10$ k Ω	20	35		μ A
Forward: CONT B pin sink	V_{FB}	$I_{IN} = 100$ μ A		64	150	mV
Forward: CONT D pin sink	V_{FD}	$I_{IN} = 500$ μ A		110	230	mV
Reverse: CONT B and D pins source	I_{RB}, I_{RD}	Measured with $R_L = 10$ k Ω	20	35		μ A
Reverse: CONT A pin sink	V_{RA}	$I_{IN} = 100$ μ A		64	150	mV
Reverse: CONT C pin sink	V_{RC}	$I_{IN} = 500$ μ A		110	230	mV
CONT E pin sink	V_E	$I_{IN} = 100$ μ A		30	70	mV

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Parameter	Symbol	Conditions	min	typ	max	Unit
[Switching Control]: Playback mode						
CONT C and D pins source	I_{PC}, I_{PD}	Measured with $R_L = 10\text{ k}\Omega$	20	35		μA
CONT E pin source	I_E	Measured with $R_L = 10\text{ k}\Omega$	10	18		μA
CONT A and B pins sink	V_{PA}, V_{PB}	$I_{IN} = 100\text{ }\mu\text{A}$		64	150	mV
Radio CONT F pin sink	V_{RF}	$I_{IN} = 100\text{ }\mu\text{A}$		64	150	mV
Microphone CONT F pin	V_{MF}	$V_i = -40\text{ dBm}, R_g = 6.8\text{ k}\Omega$	1.1	1.2		V

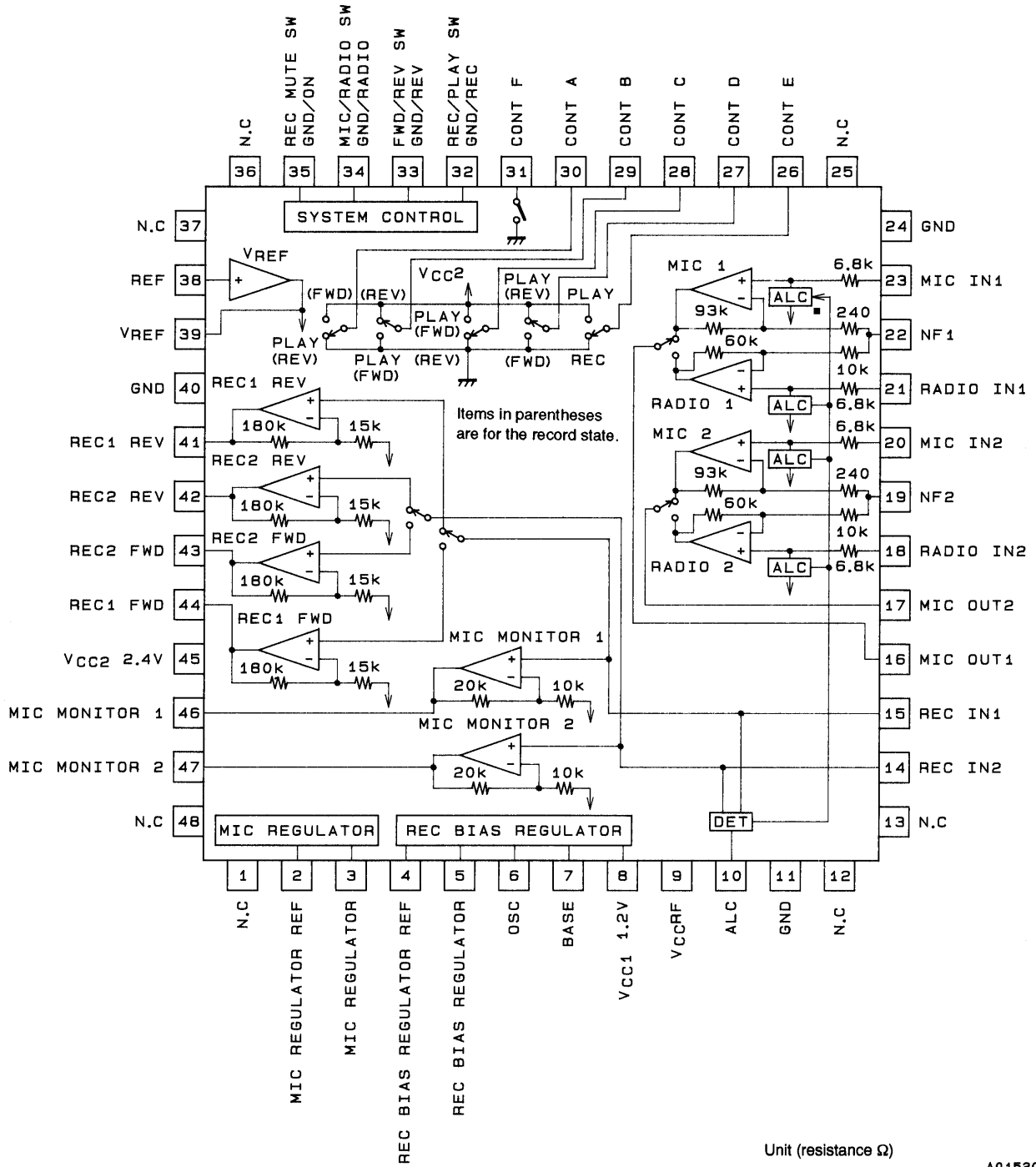
Switching Control Block: Operating Mode Table

Item		A*1	B*1	C*1	D*1	E*1	F*2
REC/MIC/RADIO	FWD	H	L	H	L	L	L
	REV	L	H	L	H	L	L
PLAY	MIC	L	L	H	H	H	H
	RADIO	L	L	H	H	H	L

Note: 1. The high-level voltage for A, B, C, D, and E is close to the V_{CC2} voltage.
 2. The high-level voltage for F is close to the V_{CCRF} voltage.

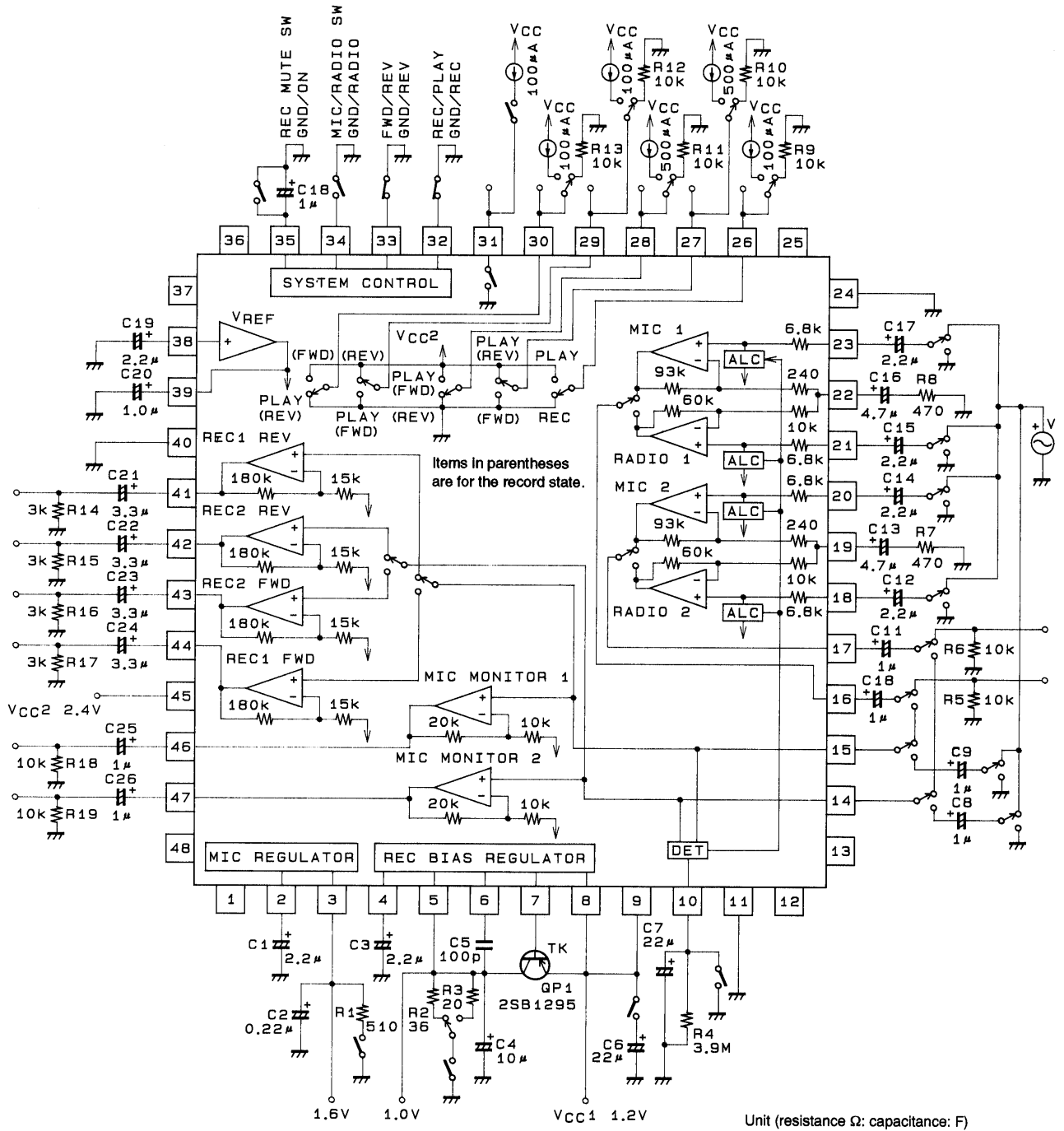
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Block Diagram



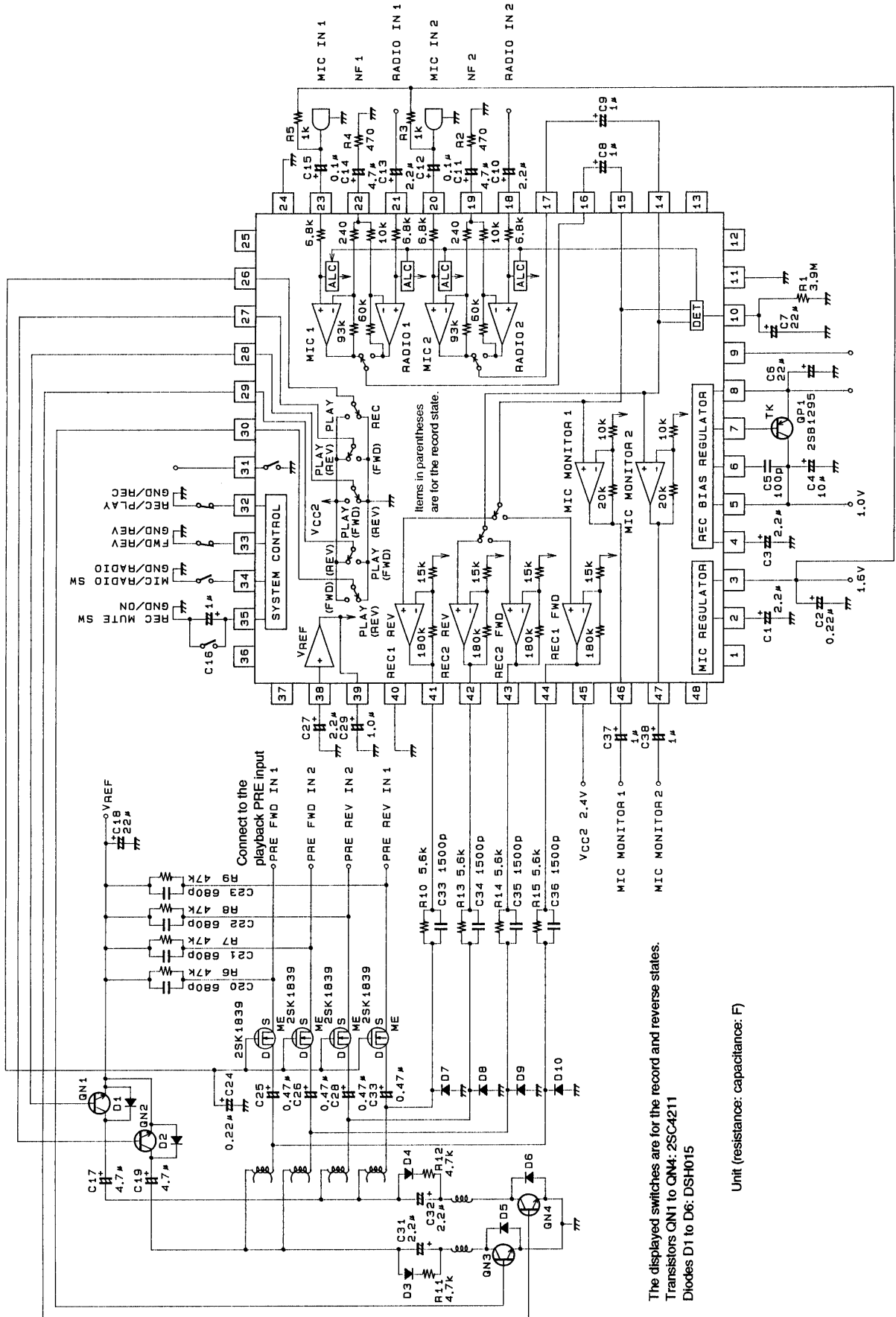
A01520

Test Circuit Diagram



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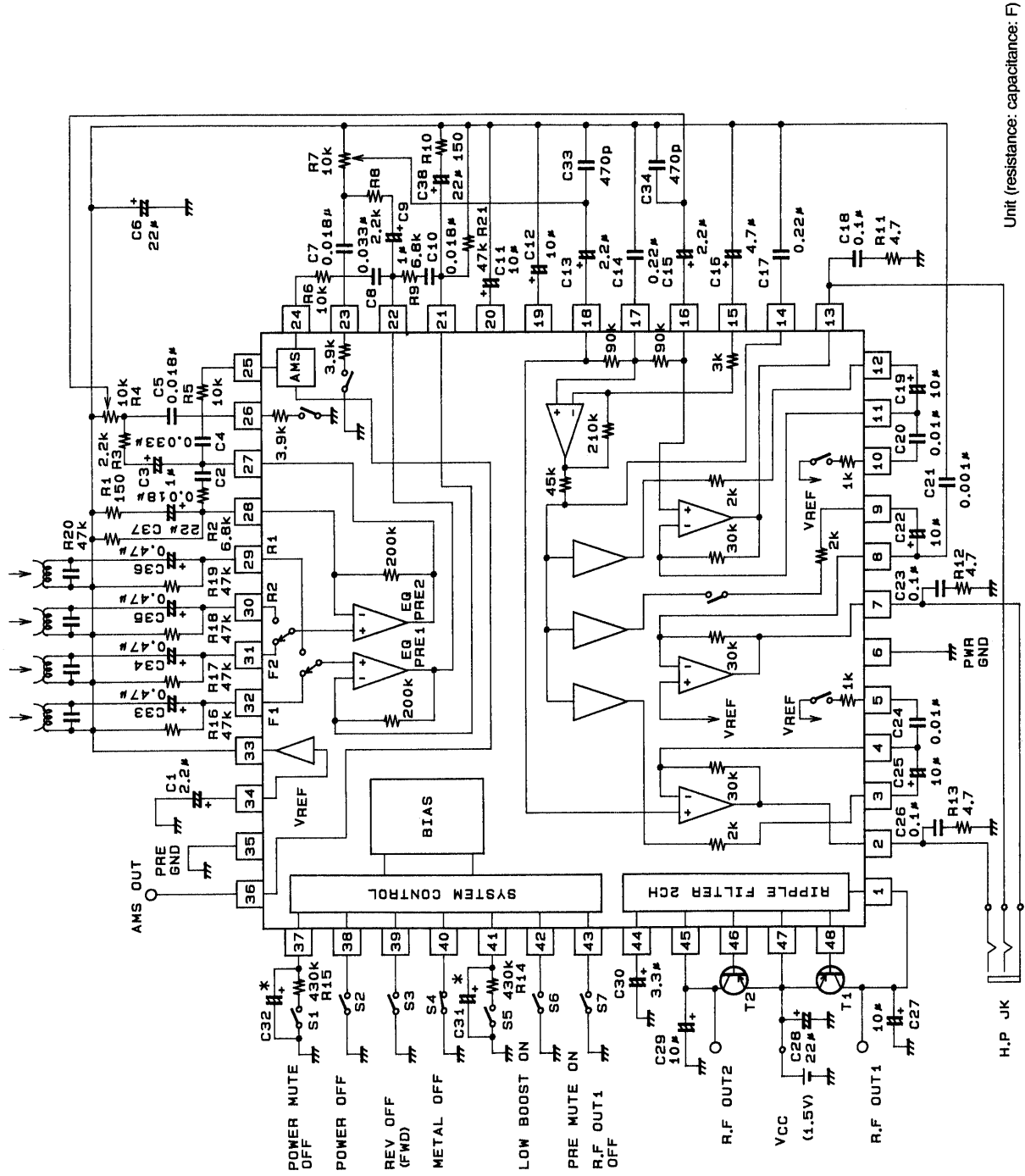
Application Circuit Example 1



The displayed switches are for the record and reverse states.
 Transistors QN1 to QN4: 2SC4211
 Diodes D1 to D6: DSH015

Unit (resistance: capacitance: F)

Application Circuit Example 2: Circuit using the LA4590W



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Pin Functions : The indicated pin voltages are for V_{CC1} and $R_F = 1.2 \text{ V}$ and $V_{CC2} = 2.4 \text{ V}$.

Pin No.	Pin	Pin voltage (V)	Internal equivalent circuit	Notes
2	MIC REGULATOR REF	1.4	<p style="text-align: right;">A05200</p>	<ul style="list-style-type: none"> Microphone power supply reference bias low-pass filter connection
3	MIC REGULATOR	1.65	<p style="text-align: right;">A05201</p>	<ul style="list-style-type: none"> Microphone power supply output Always on in record mode
4	REC BIAS REGULATOR REF	1.0	<p style="text-align: right;">A05202</p>	<ul style="list-style-type: none"> Record bias power supply reference bias low-pass filter connection The value of the capacitor connected to this pin determines the SVRR.
5	REC BIAS REGULATOR	1.0	<p style="text-align: right;">A05203</p>	<ul style="list-style-type: none"> Record bias power supply output Always on in record mode
6	OSC	0.5	<p style="text-align: right;">A05204</p>	<ul style="list-style-type: none"> Oscillation suppression capacitor connection

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Pin No.	Pin	Pin voltage (V)	Internal equivalent circuit	Notes
7	BASE	0.55	<p style="text-align: right;">A05205</p>	<ul style="list-style-type: none"> External pnp transistor base drive connection
10	ALC	0.7	<p style="text-align: right;">A05206</p>	<ul style="list-style-type: none"> Microphone and radio ALC rectifier connection The external resistor and capacitor connected to this pin determine the ALC attack and recovery times.
14 15	REC IN2 REC IN1	0.8	<p style="text-align: right;">A05207</p>	<ul style="list-style-type: none"> Record amplifier and microphone monitor amplifier inputs A buzz reduction capacitor is incorporated in these pin circuits. The input resistance is 10 kΩ.
16 17	MIC OUT1 IMC OUT2	0.8	<p style="text-align: right;">A05208</p>	<ul style="list-style-type: none"> Microphone and radio amplifier outputs
18 21	RADIO IN2 RADIO IN1	0.8	<p style="text-align: right;">A05209</p>	<ul style="list-style-type: none"> Radio amplifier inputs The input resistance is variable over the range 6.8 to 36.8 kΩ.

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Pin No.	Pin	Pin voltage (V)	Internal equivalent circuit	Notes
19 22	NF2 NF1	0.8		<ul style="list-style-type: none"> Microphone and radio amplifier noise filter connections
20 23	MIC IN2 MIC IN1	0.8		<ul style="list-style-type: none"> Microphone amplifier inputs The input resistance is variable over the range 6.8 to 36.8 kΩ.
26 27 28	CONT E CONT D CONT C	V_{CC2} to 0		<ul style="list-style-type: none"> Fixed-current pull-up current sources Pin 26.....18 μA Pins 27 and 28.....35 μA
29 30	CONT B CONT A	V_{CC2} to 0		<ul style="list-style-type: none"> 35-μA fixed-current pull-up current sources
31	CONT F	V_{CCRF} to 0		<ul style="list-style-type: none"> The pull-up resistor has a value of 100 kΩ ±20%.

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Pin No.	Pin	Pin voltage (V)	Internal equivalent circuit	Notes
32	REC/PLAY SW	V_{CCRF} to 0		<ul style="list-style-type: none"> Sets the system to record mode when pulled down and to playback mode when open. Record mode condition: $V_{32} \leq 0.1$ V
33	FWD/REV SW	0.7 to 0		<ul style="list-style-type: none"> Output source current $I_{33} \approx 4 \mu\text{A}$ Sets the system to reverse mode when pulled down. Reverse mode condition: $V_{33} \leq 0.4$ V
34	MIC/RADIO SW	0.7 to 0		<ul style="list-style-type: none"> Output source current $I_{34} \approx 8 \mu\text{A}$ Sets the system to radio mode when pulled down. Radio mode condition: $V_{34} \leq 0.4$ V
35	REC MUTE SW	V_{CCRF} to 0		<ul style="list-style-type: none"> Output source current $I_{35} \approx 13 \mu\text{A}$ Sets the system to muted mode when pulled down. Muted mode condition: $V_{35} \leq 0.1$ V
38	REF	0.8		<ul style="list-style-type: none"> V_{REF} amplifier reference bias low-pass filter connection

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Pin No.	Pin	Pin voltage (V)	Internal equivalent circuit	Notes
39	V _{REF}	0.8		<ul style="list-style-type: none"> • V_{REF} amplifier output • Virtual ground bias for all amplifier blocks • The V_{REF} amplifier makes this a low-impedance circuit.
41 42 43 44	REC1 REV REC2 REV REC2 FWD REC1 FWD	1.0		<ul style="list-style-type: none"> • Record amplifier outputs • The output impedance in playback mode is 195 kΩ ±20%.
46 47	MIC MONITOR 1 MIC MONITOR 2	0.8		<ul style="list-style-type: none"> • Microphone monitor amplifier output

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