

**SANYO**

No. 3853A

**LA8632, LA8632M****Low-voltage, Low-current Compander**

## OVERVIEW

The LA8632 and LA8632M are low-voltage, low-current compander ICs for battery-powered, cordless telephone applications.

The LA8632 and LA8632M feature a good signal-to-noise ratio and a high dynamic range at voice-signal frequencies. The output compression is given by  $V_o = 0.5 \log V_i$ , and the expansion, by the inverse operation.

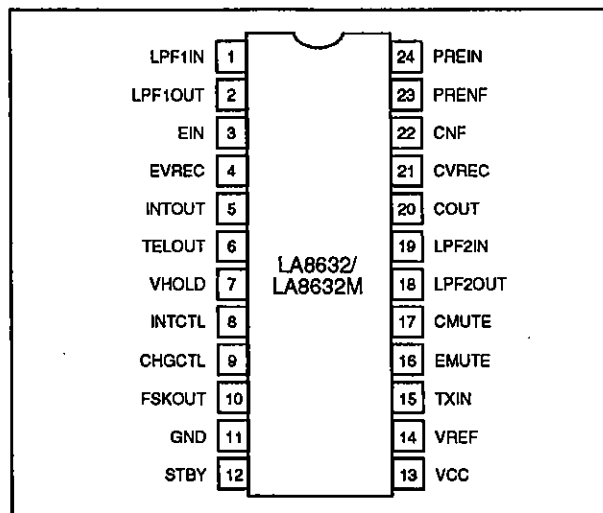
The LA8632 and LA8632M also feature an FSK comparator for receiving FSK-modulated digital data, a microphone amplifier, selectable intercom or telephone operation expander outputs, and an output mute control.

The LA8632 and LA8632M operate from a 2.4 to 6.0 V supply and are available in 24-pin DIPs and 24-pin MFPs.

## FEATURES

- Low-voltage operation and low-power consumption
- On-chip frequency-shifted keyed (FSK) comparator
- On-chip microphone amplifier with audio limiter and mute option
- Expander output analog switch for telephone or intercom operation
- Low-power, standby mode
- 2.4 to 6.0 V supply
- 24-pin DIP and 24-pin MFP

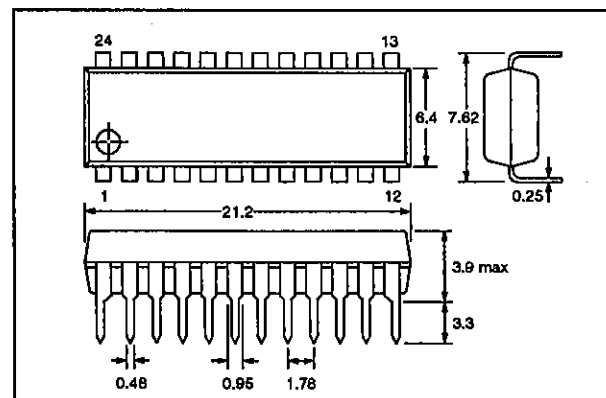
## PINOUT



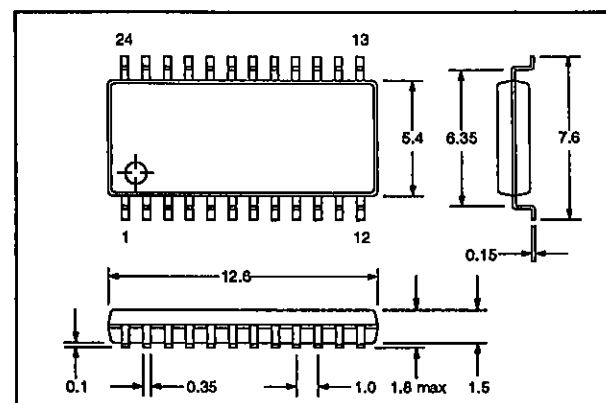
## PACKAGE DIMENSIONS

Unit: mm

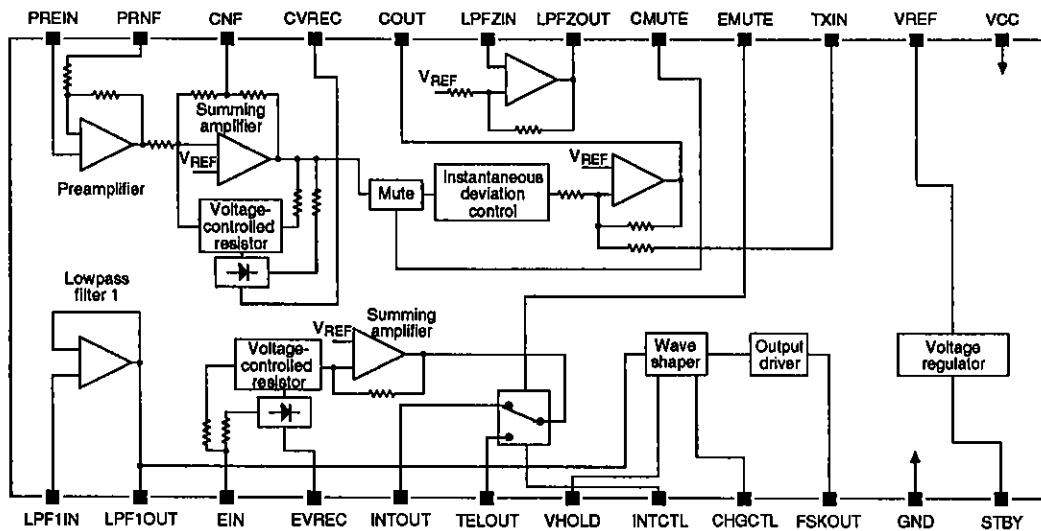
### 3067-DIP24S (LA8632)



### 3112-MFP24S (LA8632M)



**BLOCK DIAGRAM**



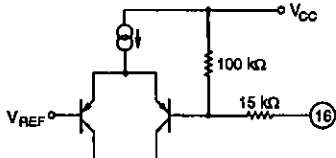
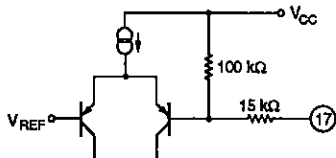

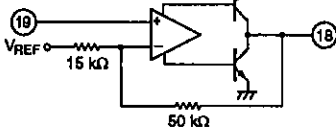
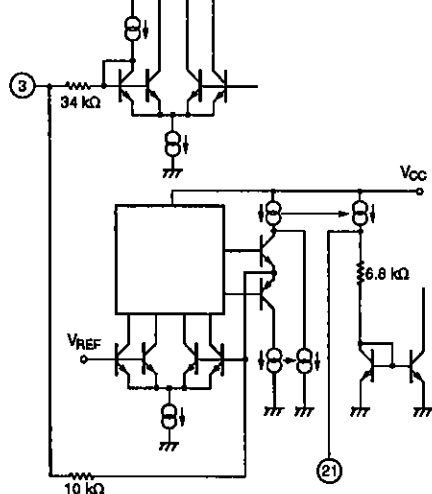
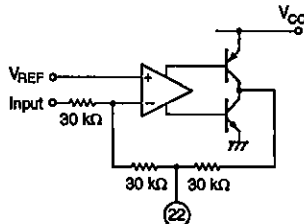
**PIN DESCRIPTION**

Number	Name	Equivalent circuit	Description
1	LPF1IN		Lowpass filter 1 buffer amplifier (class A) input. Nominal voltage is 1.2 V.
2	LPF1OUT		Lowpass filter 1 buffer amplifier (class A) output. Nominal voltage is 1.2 V.
3	EIN		Expander voltage-to-current converter input. Nominal voltage is 1.5 V.
4	EVREC		Expander full-wave rectifier
5	INTOUT		Expander intercom op-amp (class AB) output. Nominal voltage is 1.5 V.

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Number	Name	Equivalent circuit	Description
6	TEOUT		Expander telephone op-amp (class AB) output. Nominal voltage is 1.5 V.
7	VHOLD		Voltage hold capacitor connection. Nominal voltage is 1.2 V.
9	CHGCTL		Charge control input. Nominal voltage is $V_{CC}$ .
10	FSKOUT		Frequency-shifted keyed comparator, open-collector output
8	INTCTL		Intercom control input. Nominal voltage is 3 V.
11	GND		Ground
12	STBY		Standby control input. Nominal voltage is 1.5 V.
14	VREF		Reference voltage amplifier (class B) capacitor connection. Nominal voltage is 1.5 V.
13	VCC		Voltage supply
15	TXIN		Transmit data input. Nominal voltage is 1.5 V.
20	COUT		Companion amplifier (class AB) output. Nominal voltage is 1.5 V.

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Number	Name	Equivalent circuit	Description
16	EMUTE		<p>Expander mute control input. Nominal voltage is 3 V.</p>
17	CMUTE		<p>Compressor mute control input. Nominal voltage is 3 V.</p>
18	LPF2OUT		<p>Lowpass filter 2 buffer amplifier (class AB) output. Nominal voltage is 1.5 V.</p>
19	LPF2IN		<p>Lowpass filter 2 buffer amplifier (class AB) input. Nominal voltage is 1.5 V.</p>
21	CVREC		<p>Compressor full-wave rectifier capacitor</p>
22	CNF		<p>Compressor negative feedback capacitor connection. Nominal voltage is 1.5 V.</p>

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Number	Name	Equivalent circuit	Description
23	PRENF		Compressor preamplifier negative feedback network connection. Nominal voltage is 1.5 V.
24	PREIN		Compressor preamplifier input. Nominal voltage is 1.5 V.

**SPECIFICATIONS**

**Absolute Maximum Ratings**

Parameter	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	8	V
Power dissipation	$P_D$	300	mW
Operating temperature range	$T_{op}$	-20 to 75	°C
Storage temperature range	$T_{stg}$	-40 to 125	°C

**Recommended Operating Conditions**

$T_a = 25\text{ °C}$

Parameter	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	3	V
Supply voltage range	$V_{CC}$	2.4 to 6.0	V

**Electrical Characteristics**

**Supply current**

$V_{CC} = 3\text{ V}$ ,  $T_a = 25\text{ °C}$ ,  $V_{BI} = 1.2\text{ V}$ ,  $f = 1\text{ kHz}$

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Quiescent supply current	$I_{CC1}$		2.5	3.4	5.0	mA
Standby supply current	$I_{CC2}$	No signal. CHGCTL is HIGH. STBY is LOW.	300	500	700	μA

**Compressor**

$V_{CC} = 3\text{ V}$ ,  $T_a = 25\text{ °C}$ ,  $V_{BI} = 1.2\text{ V}$ ,  $f = 1\text{ kHz}$ ,  $0\text{ dB} = 10\text{ mV}$ ,  $A_{PV} = 20\text{ dB}$ ,  $R_L = 10\text{ k}\Omega$

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Input impedance	$R_i$		-	50	-	kΩ
COU <sub>T</sub> rms output voltage	$V_o$	$V_i = 0\text{ dB}$	210	265	335	mV
Gain error	$A_{err}$	$V_i = -20\text{ dB}$	-0.5	0.0	0.5	dB
		$V_i = -40\text{ dB}$	-1.0	0.0	1.0	
Total harmonic distortion	THD	$V_i = 0\text{ dB}$	-	0.25	1.00	%

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Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
COOUT rms output noise voltage	$V_{NO}$	$R_g = 620 \Omega$ , $f = 20 \text{ Hz to } 20 \text{ kHz}$	–	1.5	3.0	mV
Limiting voltage	$V_L$		1.25	1.40	1.55	$V_{pp}$
Maximum preamplifier voltage gain	$A_{PV}$		–	28	–	dB
Data voltage gain	$A_{DV}$		–2	0	2	dB
Mute attenuation	$\alpha$	$V_I = 0 \text{ dB}$ . CMUTE is HIGH.	–60	–73	–	dB
Crosstalk	CT	Expander rms input voltage = 100 mV	–25	–34	–	dB

**Expander**

$V_{CC} = 3 \text{ V}$ ,  $T_a = 25 \text{ }^\circ\text{C}$ ,  $V_{BI} = 1.2 \text{ V}$ ,  $f = 1 \text{ kHz}$ ,  $0 \text{ dB} = 100 \text{ mV}$ , LPF1 gain = 0 dB,  $R_L = 10 \text{ k}\Omega$

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Expander rms output voltage	$V_O$	$V_I = 0 \text{ dB}$	100	125	160	mV
Maximum expander rms output voltage	$V_O \text{ max}$	THD = 10%, $R_L = 10 \text{ k}\Omega$	0.6	1.0	–	V
Gain error	$A_{err}$	$V_I = 5 \text{ dB}$	–0.5	0	0.5	dB
		$V_I = -20 \text{ dB}$	–1.0	0	1.0	
		$V_I = -30 \text{ dB}$	–1.5	0	2.0	
Total harmonic distortion	THD	$V_I = 0 \text{ dB}$ . CHGCTL is HIGH.	–	0.40	1.00	%
Expander rms output noise voltage	$V_{NO}$	$R_g = 620 \Omega$ , $f = 20 \text{ Hz to } 20 \text{ kHz}$	–	13	80	$\mu\text{V}$
Mute attenuation	$\alpha$	$V_I = 0 \text{ dB}$ . EMUTE is HIGH.	–60	–70	–	dB
Crosstalk	CT	Compressor rms input voltage = 10 mV	–60	–83	–	dB

**Compressor lowpass filter**

$V_{CC} = 3 \text{ V}$ ,  $T_a = 25 \text{ }^\circ\text{C}$ ,  $V_{BI} = 1.2 \text{ V}$ ,  $f = 1 \text{ kHz}$  unless otherwise noted

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Attenuation	$\alpha$	$f = 3.4 \text{ kHz}$	–	–3	–	dB
		$f > 3.4 \text{ kHz}$	–	–18	–	dB/octave
Total harmonic distortion	THD	$V_{TXIN} = 10 \text{ mV}$	–	0.15	1.00	%
Maximum LPP2OUT rms output voltage	$V_O \text{ max}$	THD = 10%, $R_L = 10 \text{ k}\Omega$	0.6	1.0	–	V

**Expander lowpass filter**

$V_{CC} = 3\text{ V}$ ,  $T_a = 25\text{ }^\circ\text{C}$ ,  $V_{BI} = 1.2\text{ V}$ ,  $f = 1\text{ kHz}$  unless otherwise noted

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Attenuation	$\alpha$	$f = 3.4\text{ kHz}$	-	-3	-	dB
		$f > 3.4\text{ kHz}$	-	-18	-	dB/octave
Total harmonic distortion	THD	$V_{LPF\text{IN}} = 100\text{ mV}$	-	0.35	1.00	%
Maximum LPF1OUT rms output voltage	$V_O\text{ max}$	THD = 10%, $R_L = 7.7\text{ k}\Omega$	0.20	0.34	-	V

**Frequency-shifted keyed comparator**

$V_{CC} = 3\text{ V}$ ,  $T_a = 25\text{ }^\circ\text{C}$ ,  $V_{BI} = 1.2\text{ V}$ ,  $f = 1\text{ kHz}$

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
CHGCTL duty cycle	Duty	$V_{IN} = 100\text{ mV}$	43	48	53	%
CHGCTL ON voltage	$V_{ON}$		1	-	-	V
CHGCTL OFF voltage	$V_{OFF}$		-	-	0.4	V
CHGCTL input impedance	$R_i$		-	200	-	$\text{k}\Omega$
VHOLD input/output current	$I_O$	$V_{CHGCTL} = 2\text{ V}$	-	80	-	$\mu\text{A}$
FSKOUT LOW-level output voltage	$V_{OL}$	$R_L = 100\text{ k}\Omega$	-	-	0.3	V
FSKOUT HIGH-level output voltage	$V_{OH}$	$R_L = 100\text{ k}\Omega$	2.8	-	-	V

**Standby mode characteristics**

$V_{CC} = 3\text{ V}$ ,  $T_a = 25\text{ }^\circ\text{C}$ ,  $V_{BI} = 1.2\text{ V}$ ,  $f = 1\text{ kHz}$

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
STBY voltage	$V_{STBY}$		-	-	0.7	V
STBY output current	$I_O$		-	-	50	$\mu\text{A}$

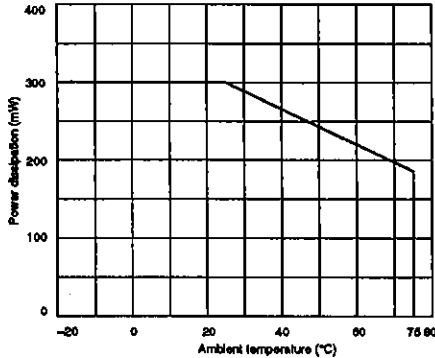
**Digital input characteristics**

$V_{CC} = 3\text{ V}$ ,  $T_a = 25\text{ }^\circ\text{C}$ ,  $V_{BI} = 1.2\text{ V}$ ,  $f = 1\text{ kHz}$

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
EMUTCTL and CMUTCTL LOW-level input voltage	$V_{IL}$		-	-	0.65	V
EMUTCTL and CMUTCTL HIGH-level input voltage	$V_{IH}$		$0.6V_{CC}$	-	-	V
EMUTCTL and CMUTCTL LOW-level input current	$I_{IL}$	$V_I = 0.2\text{ V}$	-	-	100	$\mu\text{A}$
EMUTCTL and CMUTCTL HIGH-level input current	$I_{IH}$	$V_I = 2\text{ V}$	-	-	5	$\mu\text{A}$

**Typical Performance Characteristics**

**Power dissipation vs. ambient temperature**



**DESIGN NOTES**

The gain of the compressor summing amplifier is two at DC, and undefined at AC. The cutoff frequency is determined by the RC network formed by the external capacitor connected to CNF and the internal 30 kΩ resistor.

The expander output is on TEOUT when INTCTL is HIGH or open, and on INTOUT when LOW.

In FSK waveform reconstruction, LOW-level output is during the positive signal interval of a cycle.

**Compression**

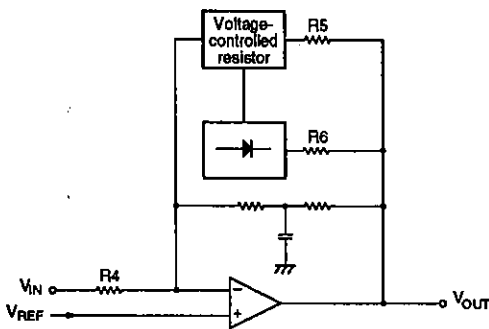


Figure 1. Compressor equivalent circuit

The compressor output voltage is given by the equation

$$V_O = \sqrt{\frac{R_5 R_6 I_2}{3 R_4}} V_{in} = 0.316 \times \sqrt{V_I}$$

where  $I_2$  is half the common-mode current of the VCA voltage-to-current converter differential amplifier.

**Expansion**

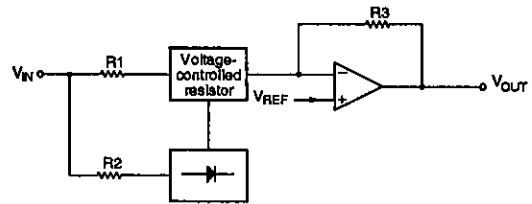


Figure 2. Expander equivalent circuit

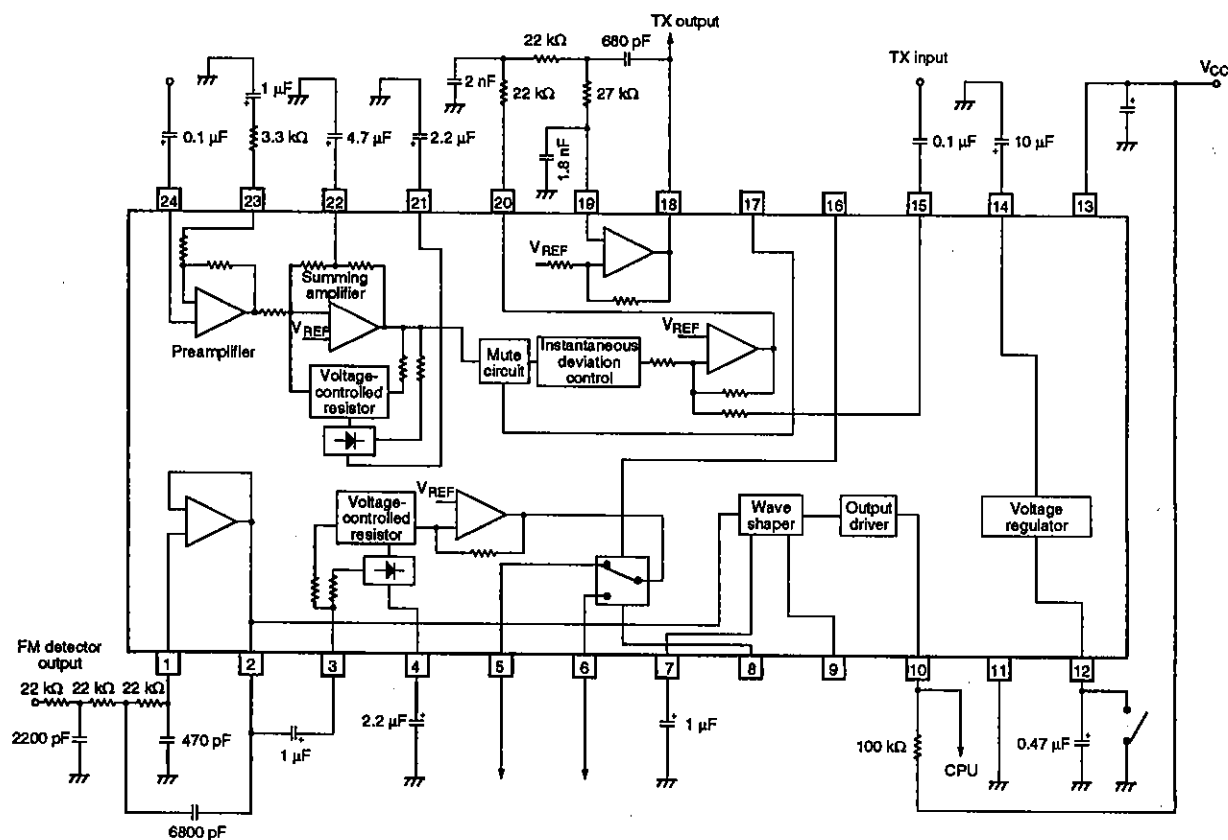
The expander output voltage is given by the equation

$$V_O = \frac{3 R_3}{R_1 R_2 I_1} V_I^2 = 10 \times V_I^2$$

where  $I_1$  is half the common-mode current of the VCA voltage-to-current converter differential amplifier.



## TYPICAL APPLICATION



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