MITSUBISHI SOUND PROCESSOR ICs

M65854FP

5G SERIES KARAOKE

DIGITAL ECHO WITH MICROPHONE MIXING CIRCUIT

DESCRIPTION

The M65854 is a CMOS IC built-in Digital Echo function with microphone peripheral circuits for "Karaoke" equipment packed in a single chip.

It is suitable for "Karaoke" equipments such as Video CD Player, Mini Stereo, CD-Radio Cassette, TV or VCR.

FEATURES

- High performance digital echo circuit thanks to 16Kbit memory
- Built-in surround function which works Simulated Stereo for monaural source and Stereo Surround for stereo source
- ALC-equipped microphone amplifiers permit excessively high input. ALC operating voltage can be set as desired.
- 2 microphone volumes and echo effect volume are included
- Stereo microphone-line mixing amplifiers
- Karaoke entertainment functions such as vocal cut and automatic vocal support system
- Built-in current-control oscillation circuit
- Built-in automatic reset circuit activated with power on
- The use of AUDIO SW easy to control without Microcomputer
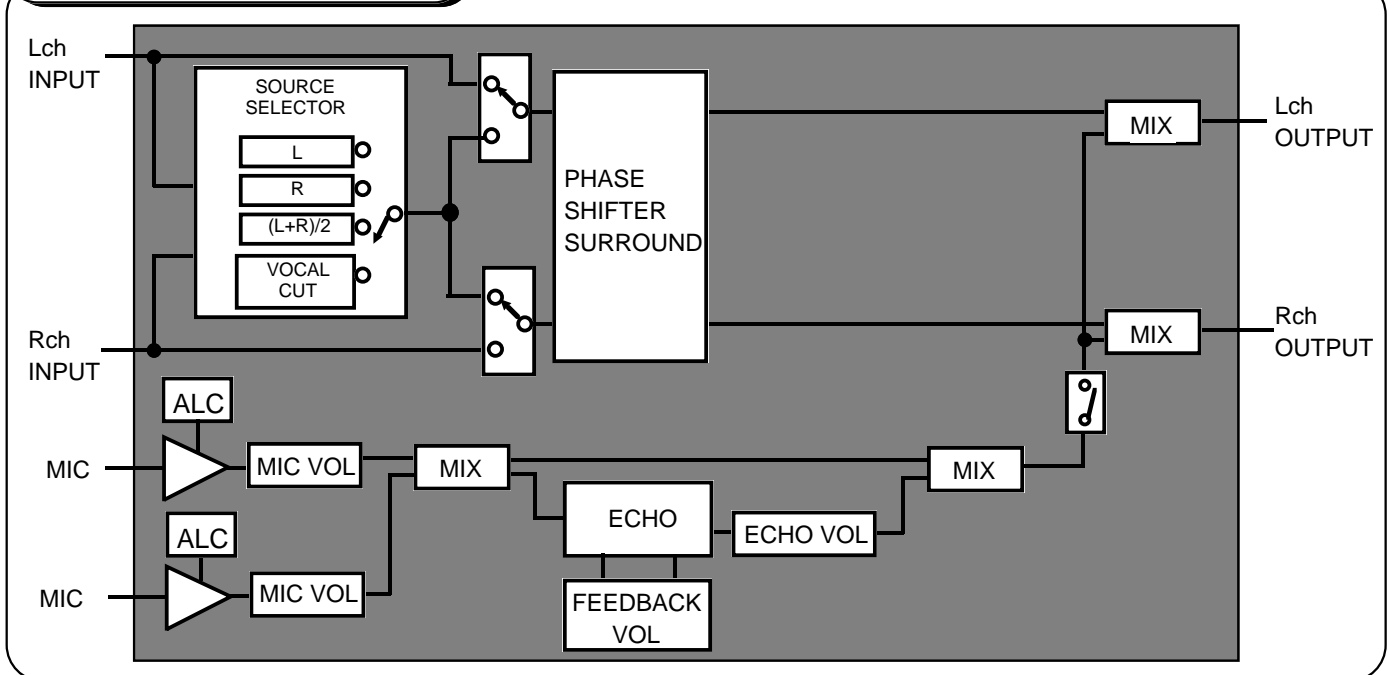- 5V single power supply

RECOMMENDED OPERATING CONDITION

- Supply voltage range • • • • • • • • • •Vcc = 4.5 ~ 5.5V
  Rated supply voltage • • • • • • • • • • Vcc = 5V

PIN CONFIGURATION

Pin	Name		Pin	Name
1	MCLKCONT		42	MIC1VOL
2	MIC1IN		41	MIC2VOL
3	ALC1		40	ECHOVOL
4	MIC1NFIN		39	AUDSW5
5	MIC1OUT		38	AUDSW4
6	MIC1VOLIN		37	AUDSW3
7	MIC2IN		36	AUDSW2
8	ALC2		35	AUDSW1
9	MIC2NFIN		34	PS2
10	MIC2OUT		33	PS1
11	MIC2VOLIN		32	LOUT
12	MIC OUT		31	ROUT
13	LPF1IN1		30	VCFIL
14	LPF1IN2		29	LIN
15	LPF1OUT		28	RIN
16	ADINTOUT		27	LPF2OUT
17	ADINTIN		26	LPF2IN2
18	ADCONT		25	LPF2IN1
19	REF		24	DAINTOUT
20	GND		23	DAINTIN
21	VCC		22	DACONT

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SYSTEM CONFIGURATION

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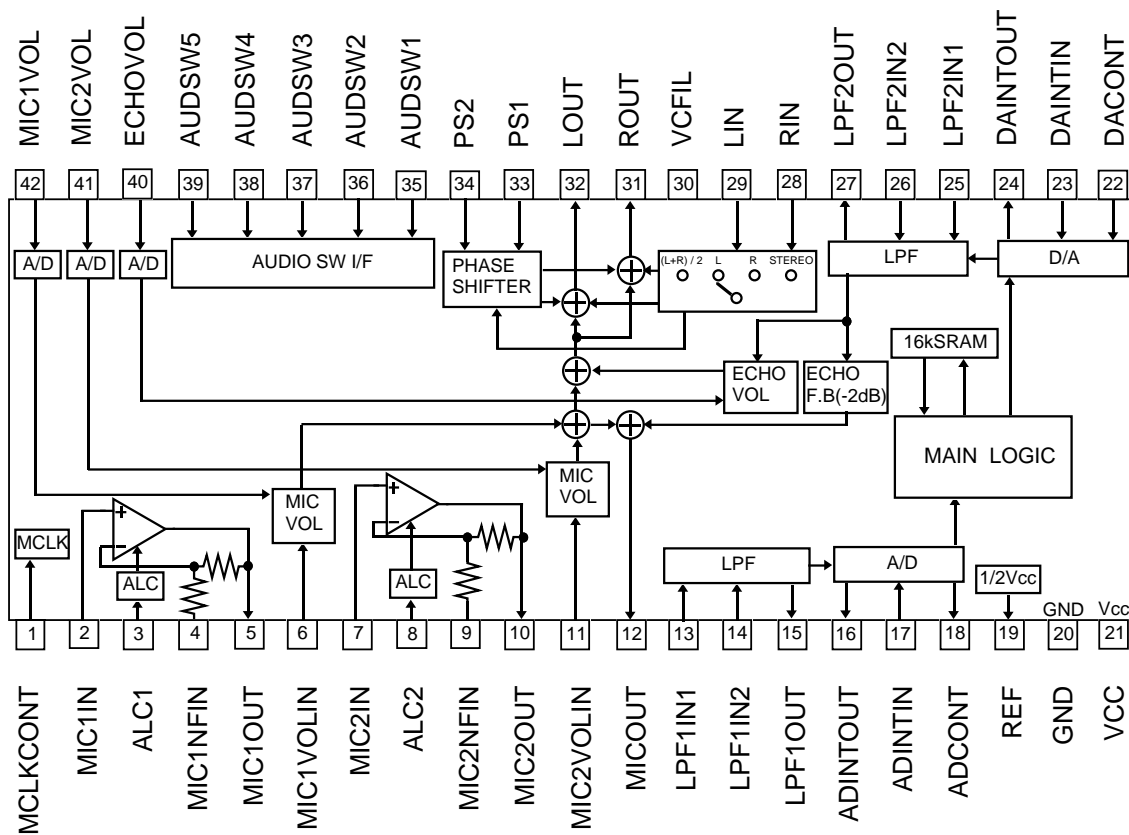some parametric limits are subject to change.

DIGITAL ECHO WITH MICROPHONE MIXING CIRCUIT

PIN CONFIGURATION

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PIN DESCRIPTION

Pin No.	Symbol	Nam	I/O	Function
1	MCLKCONT	Clock control	—	Controls built-in clock generation circuit with external R
2	MIC1IN	Microphone 1 input	I	To connect MIC1
3	ALC1	ALC1 control	—	To connect ALC attack / recovery time setting capacitor
4	MIC1NFIN	Microphone 1 negative feedback input	I	To connect low cut-off frequency of MIC1 amplifier setting capacitor
5	MIC1OUT	Microphone 1 input	O	To connect capacitor to reduce noise generated at time of volume change
6	MIC1VOLIN	Microphone 1 volume input	I	
7	MIC2IN	Microphone 2 input	I	To connect MIC2
8	ALC2	ALC2 control	—	To connect ALC attack/recovery time setting capacitor
9	MIC2NFIN	Microphone 2 negative feedback input	I	To connect low cut-off frequency of MIC2 amplifier setting capacitor
10	MIC2OUT	Microphone 2 input	O	To connect capacitor to reduce noise generated at time of volume change
11	MIC2VOLIN	Microphone 2 volume input	I	
12	MICOUT	Microphone output	O	Mixing output of MIC1 and MIC2
13	LPF1IN1	Low pass filter 1 input 1	I	Pre-filter before A/D convertor for digital delay
14	LPF1IN2	Low pass filter 1 input 2	I	
15	LPF1OUT	Low pass filter 1output	O	
16	ADINTOUT	A/D integrator output	O	Composes D/A conversion integrator with external capacitor
17	ADINTIN	A/D integrator input	I	
18	ADCONT	A/D control	—	To determine adaptive time constant of A/D convertor with ADM system
19	REF	Reference power output	—	To connect 1/2 Vcc output and filter capacitor
20	GND	Ground	—	
21	VCC	Power supply	—	

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Pin No.	Symbol	Nam	I/O	Function
2 2	DACONT	D/A control	—	To determine adaptive time constant of D/A convertor with ADM system
2 3	DAINTIN	D/A integrator input	I	Composes D/A conversion integrator with external capacitor
2 4	DAINTOUT	D/A integrator output	O	
2 5	LPF2IN1	Low pass filter 2 input 1	I	Post-filter after D/A conversion for digital delay
2 6	LPF2IN2	Low pass filter 2 input 2	I	
2 7	LPF2OUT	Low pass filter 2 output	O	
2 8	RIN	Rch line input	I	Rch line input
2 9	LIN	Lch line input	I	Lch line input
3 0	VCFIL	Vocal cut filter	—	Processes frequencies lower than the vocal band
3 1	ROUT	Rch output	O	Rch mixing output
3 2	LOU	Lch output	O	Lch mixing output
3 3	PS1	Phase shift input 1	I	Determines a constant at time of phase shift
3 4	PS2	Phase shift input 2	I	
3 5	AUDSW1	Source selector and Auto vocal support sw	I	Source selector and Auto vocal support sw : audio signal is selected by setting these switches to L or H
3 6	AUDSW2			
3 7	AUDSW3			
3 8	AUDSW5	Auto vocal support sw	I	Auto vocal support sw : ON set to H,OFF set to L
3 9	AUDSW4	Phase shift sw	I	Phase shift sw : ON set to H,OFF set to L
4 0	ECHOVOL	Echo effect volume control	I	Echo effect volume control by DC voltage
4 1	MIC2VOL	MIC2 volume control	I	MIC2 volume control by DC voltage
4 2	MIC1VOL	MIC1 volume control	I	MIC1 volume control by DC voltage

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DIGITAL ECHO WITH MICROPHONE MIXING CIRCUIT

ELECTRICAL CHARACTERISTICS

(Vcc=5V,f=1kHz,vi=100mVrms,Ta=25°C Unless otherwise noted)

	Symbol	Parameter	Test conditions	Limits			Unit
				Min	Typ	Max	
TOTAL	Icc	Circuit current	No signal provided	—	35		mA
Microphone amplifier	Gvo	Amplifier gain	Vo = -17dBV		47		dB
	THD1	Distortion	Vo = -17dBV,with ALC not operated	—	0.1	0.5	%
	THD2	Distortion	Vi= -37dBV,with ALC operated	—	3.0	6.0	%
	VoALC	ALC operating voltage	measurement : +2dBV	0	+2	+4	dBV
	TALCAT	ALC attack time	C=4.7µF	25	40	55	msec
	TALCRE	ALC recovery time	C=4.7µF	1.0	1.5	2.0	sec
	VoMAX	Maximum output voltage	THD=10%	1.2	1.3	—	Vrms
	No	Output noise voltage	Gv=47dB,f=100 to 5KHz	—	-68	-57	dBV
	Zi	Input impedance		5	10	20	KΩ
Mic volume	Gv	I/O voltage gain	Volume max	-3	0	+3	dB
	ATTmax	Maximum attenuation	Volume min	—	-72	-67	dBV
	THD	Distortion	Volume max	—	0.15	0.30	%
	ViMAX	Maximum input voltage	THD=10%	1.3	1.6	—	Vrms
	No	Output noise voltage	JIS - A	—	-96	-90	dBV
Echo effect / Echo feed back volume	Gv	I/O voltage gain	Volume max	-3	0	+3	dB
	ATTmax	Maximum attenuation	Volume min	—	-72	-67	dBV
	THD	Distortion	Volume max	—	0.15	0.30	%
	VoMAX	Maximum output voltage	THD=10%	1.1	1.4	—	Vrms
	No	Output noise voltage	JIS - A	—	-96	-90	dBV

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	Symbol	Parameter	Test conditions	Limits			Unit
				Min	Typ	Max	
Digital echo	Gv	I/O voltage gain		-3	0	+3	dB
	VoMAX	Maximum output voltage	THD=10%	1.1	1.4	—	Vrms
Digital echo	Td	Delay Time	Sets Delay time with microcomputer.	147.4	196.6	245.7	msec
	THD	Distortion	Td=196.6mS,30KHzLPF	2.0	2.0	4.0	%
	No	Output noise voltage	Vi=0mVrms,JIS - A Td=196.6msec,Rg=620Ω	-67	-82	—	dBV
LINE	Gv	I/O voltage gain		-3	0	+3	dB
	THD	Distortion	30KHzLPF	—	0.02	0.04	%
	VoMAX	Maximum output voltage	THD=10%	1.1	1.7	—	Vrms
	No	Output noise voltage	JIS - A, MIC1VOLandMIC2VOL=0.0V	-90	-95	—	dBV
	CS	Channel separation	Lin=400Hz,Rout JIS - A		-70		dB
	Zi	Input impedance		10	20	30	KHz
	Grej	Vocal removal ratio	Vocal cut	14	18	—	dB

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DIGITAL ECHO WITH MICROPHONE MIXING CIRCUIT

ABSOLUTE MAXIMUM RATINGS

Symbol	Name	Test conditions	Ratings	Units
Vcc	Supply voltage		6.0	V
Vi	Circuit current		-0.3 ~ Vcc+0.3	V
Pd	Input Voltage		1.1	W
Topr	Operating temperature		-20 ~ +75	°C
Tstg	Storage temperature		-40 ~ +125	°C

RECOMMENDED OPERATING CONDITION

Symbol	Parameter	Test conditions	Limits			Units
			Min	Typ	Max	
VDD	Digital supply voltage		4.5	5	5.5	V
V_{IL}	L input level		0	—	0.3VDD	V
V_{IH}	H input level		0.7VDD	—	VDD	V

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DIGITAL ECHO WITH MICROPHONE MIXING CIRCUIT

FUNCTION CONTROL

• SOURCE SELECTOR SWITCH

Control Data			Source select
AUDSW3	AUDSW2	AUDSW1	
L	L	L	Lch, monaural
L	L	H	Rch, monaural
L	H	L	(L+R) / 2
L	H	H	Vocal cut
H	L	L	Stereo
H	H	H	TEST MODE

• AUTO VOCAL SUPPORT SWITCH

Control Data	AUTO VOCAL SUPPORT
AUDSW4	Auto vocal support SW
L	OFF
H	ON

• PHASE SHIFTER SURROUND CONTROL

Control Data	PHASE SHIFTER SURROUND
AUDSW5	Surround SW
L	OFF
H	ON

• Microphone volume attenuation

DC voltage control (V) MIC2VOL(pin41) MIC1VOL(pin42)	Attenuation [dB]
5.0	0
4.0	-3
3.5	-6
3.0	-9
2.5	-12
2.0	-15
1.5	-18
1.0	-∞
0.0	

• Echo effect volume attenuation

DC voltage control (V) ECHOVOL(pin40)	Attenuation [dB]
5.0	+3
4.0	0
3.5	-3
3.0	-6
2.5	-9
2.0	-12
1.5	-15
1.0	-∞
0.0	

• Digital echo output control

Control Data		Digital echo output control
MIC1VOL	MIC2VOL	
—	—	ON
0.0 (V)	0.0 (V)	OFF

Note:

When the MIC1VOL and MIC2VOL are —∞ at the same time, the Digital echo output control will automatically be the Digital echo output off mode.
Please use the Digital echo output control for Mic sw.

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DIGITAL ECHO WITH MICROPHONE MIXING CIRCUIT

FUNCTION DESCRIPTION

(1) AUTO RESET

Settings are reset automatically when the IC is powered up. The reset state is automatically canceled approximately 150msec after powering up(Vcc=5V and the capacitor connected to pin C=100μF).

By auto reset, operation mode setting become as follows.

•Source Selector : stereo
•Phase Shifter Surround Control : OFF   •Auto Vocal support Switch : OFF
•Echo effect Volume : — ∞   •Microphone Volume Attenuation : -10dB

(2) AUTO MUTE FUNCTION

The IC carries out auto mute function at the time of powering up in order to suppress shock noise that the digital delay may produce.

•At power up
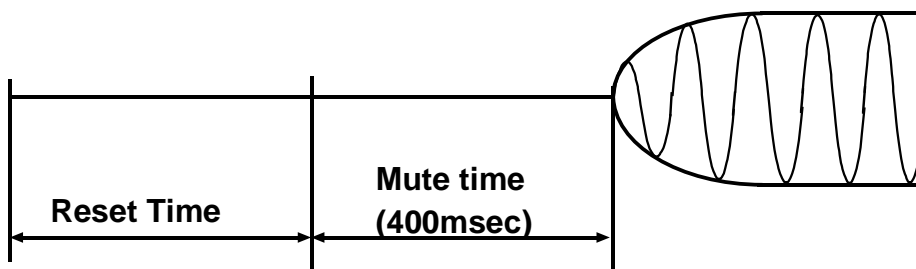
Reset Time   **Mute time (400msec)**

DIGITAL ECHO WITH MICROPHONE MIXING CIRCUIT

(3) Clock oscillator circuit

This IC incorporates a current control type clock oscillator circuit in it, thus providing circuit configuration just by connecting an Rc for current control pin 1 (MCLKCONT). Fully internal clock supply prevents occurrence of undesired radiation without affecting any external circuit.
The oscillator frequency fck is following.

$$fck = 4 \text{ MHz}(Rc=22K\Omega)$$

Rc — DC Current

1 — Clock oscillator circuit

Clock frequency:fck
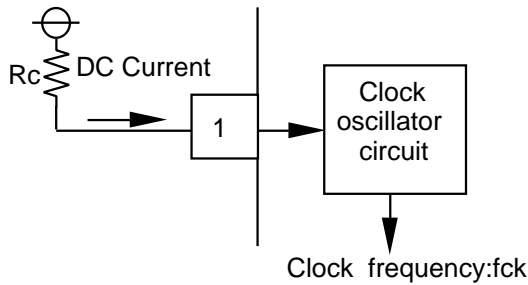
Note:
The delay time (Td) for echo is determined by the clock frequency (fck).

$fck = 4 \text{ MHz}(Rc = 22K\Omega)$
Delay time = 196.6msec

Delay time = $1/fck \times 48 \times N$
(N = the number of memory bits = 16384

(4) Microphone amplifier

The gain(Gv) and low cut-off frequency(fcl) of microphone amplifier are expressed as follows.
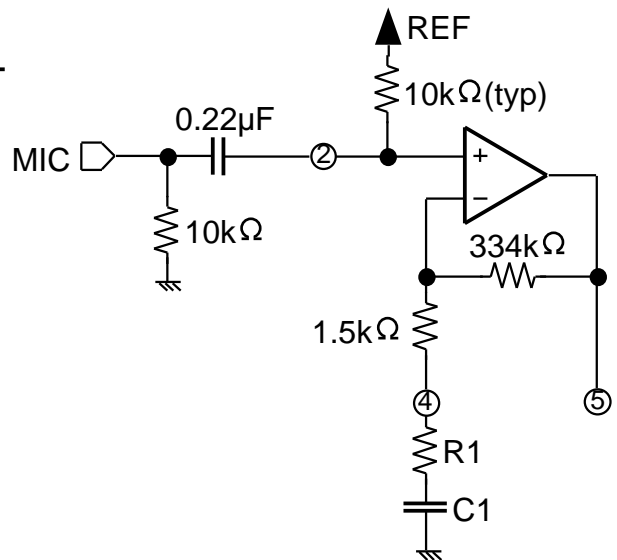
$$Gv = 20\log \cdot \frac{R1+1.5K+334K}{R1+1.5K} \qquad fcl = \frac{1}{2 \cdot (R1+1.5K) \cdot C1}$$

Gv(max)=47dB,fcl=225Hz
R1=0Ω,C1=0.47µF

Assuming Gv=37dB, fcl=220Hz,for instance, the constants take the following values.

R1=3.3KΩ,C1=0.15µF

MIC
0.22µF
② 10kΩ
10kΩ REF
10kΩ(typ)
334kΩ
1.5kΩ
④ ⑤
R1
C1

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(5)ALC level diagram
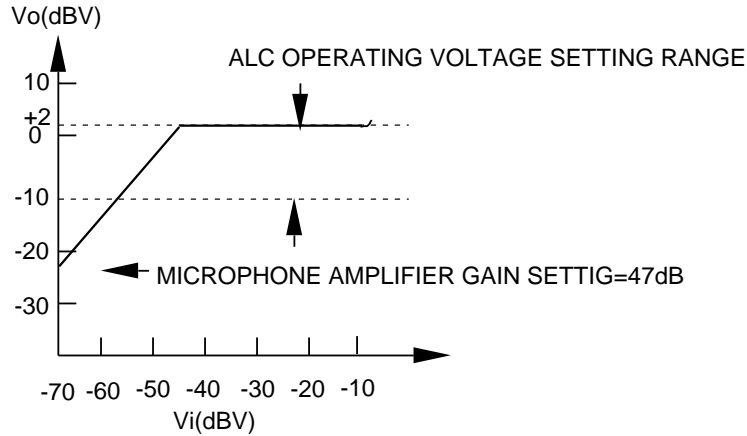
(6) Input and output LPF for the digital echo

The input and output LPF for the digital echo are configured as shown. figure below.
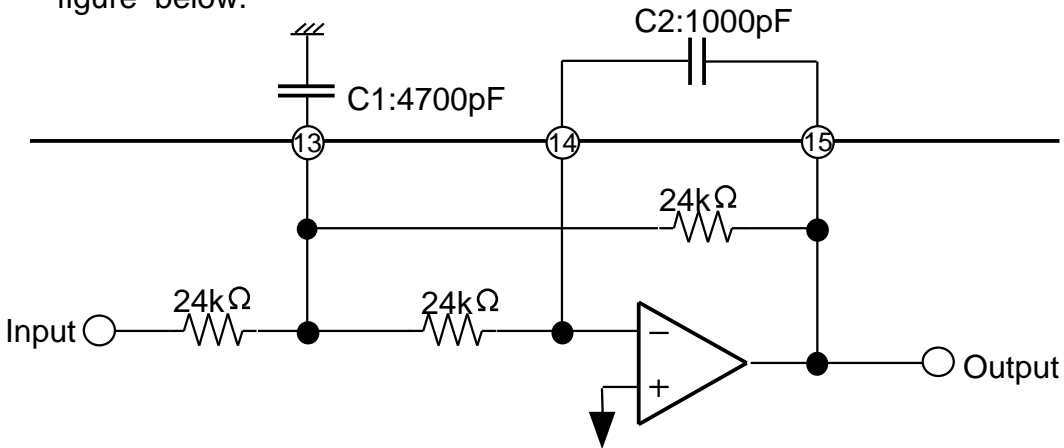
The accuracy of the internal resistance of the IC is approximately ±30%

Cut-off frequency(fc) is given as follows.

$$fc = \frac{1}{2 \times 24k\Omega \times \sqrt{C1 \times C2}} = \frac{1}{2 \times 24k\Omega \times \sqrt{4700pF \times 1000pF}} \fallingdotseq 3.1KHz$$

Quality factor (Q) is given by the following equation for long echo.

$$Q = \frac{1}{3}\sqrt{\frac{C1}{C2}} \fallingdotseq 0.72 \quad \text{(Figure of 0.7 is recommended)}$$

(7) Auto vocal support

If you can not continue sing a song, the reference vocal from the source will support you automatically.

Signal Detection	Source selector mode		
On	Lch monaural	vocal cut	Stereo Rch monaural (L+R)/2
Off	(L+R)/2	(L+R)/2	same as above

The timing of microphone input signal detection
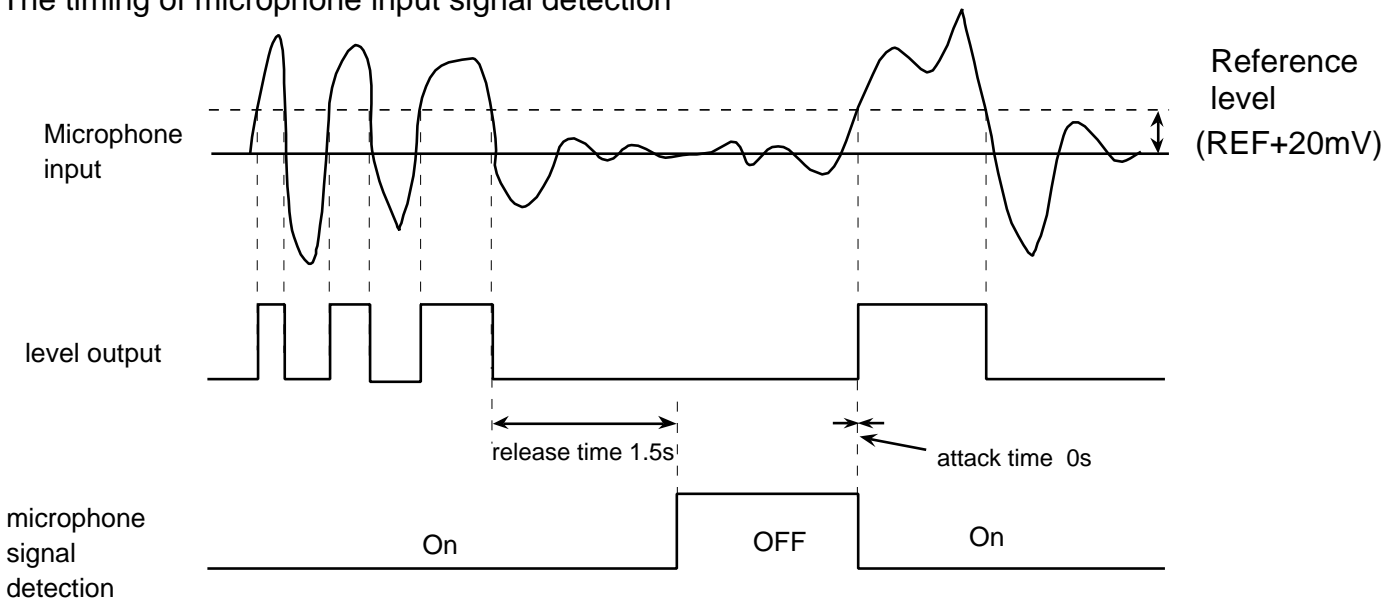
(8) Vocal cut support

The sound components of the same phase and same sound volume in the L and R channels are attenuated.

This made also allows components with lower frequency than the vocal band to pass through the filter, to compensate insufficient low-frequency sound.

Lch INPUT ◯ ──┐
               │ ┌─────────────────────┐
               └─│   │
                 │   vocal cut block   │────◯ OUTPUT
               ┌─│   │
Rch INPUT ◯ ──┘ └──────────(30)───────┘
                             │
                            ═╪═ C
                             ⊥ 0.15μ

$$fvc = \frac{1}{2\pi CR} = 53.0Hz$$
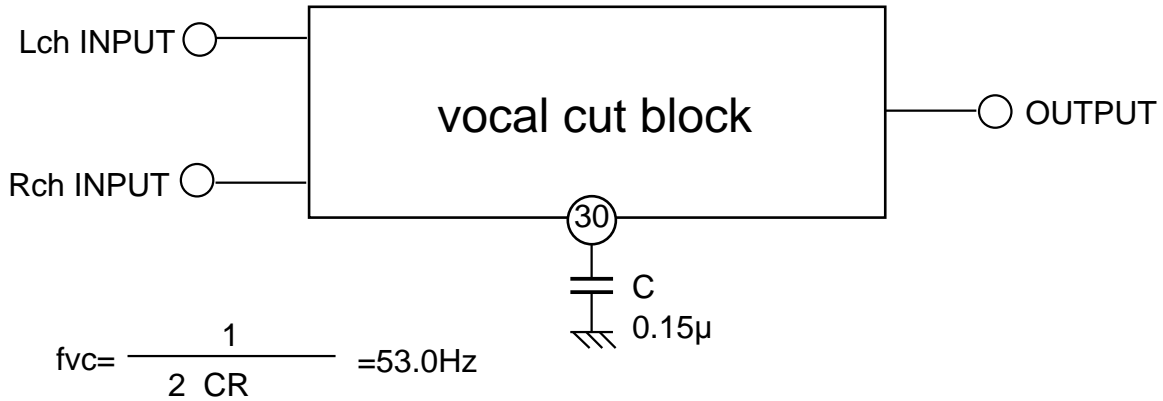
LPF is formed by the internal R (20kΩ) and the external C,
where C=0.15μF , cut off frequency is 53Hz.

(9) Following is the phase shifter block, which makes phase surround effect.

Lch INPUT ◯ ──┐
               │ ┌──────────────────────────┐
               └─│ Phase Shifter   ⌇ │──────◯ Lch OUTPUT
                 │ Surround   ⌇ │
                 │   (33)│
                 │   ═╪═ C(external)=0.022μF
                 │   (34)│
Rch INPUT ◯ ──┐ │   │
               └─│   │──────◯ Rch OUTPUT
                 └──────────────────────────┘

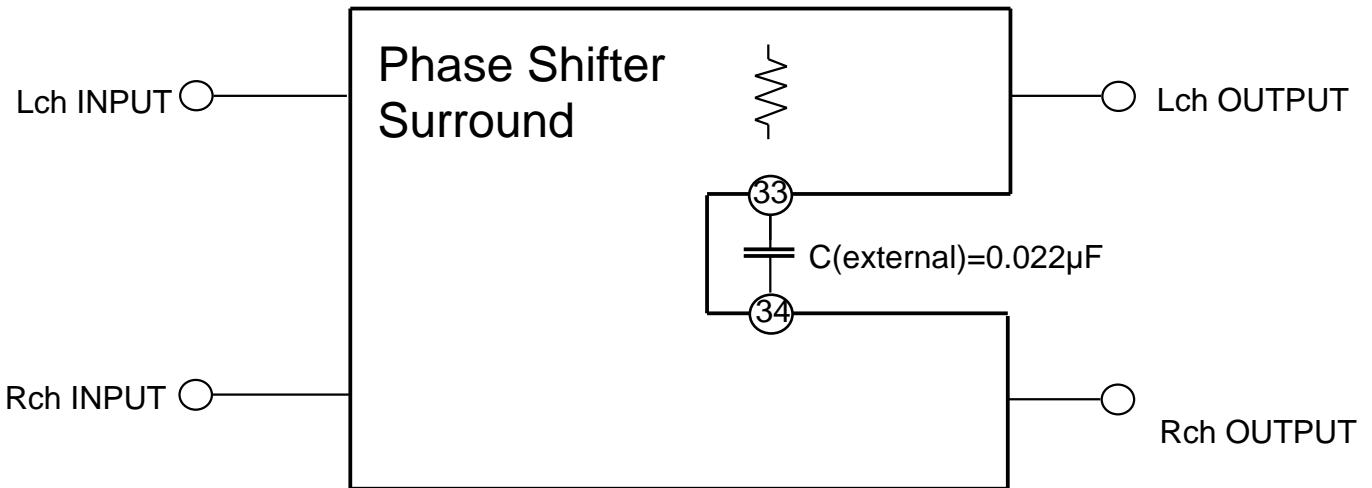| Source selector	Surround
L	
R	Simulated Stereo
(L+R)/2	
Vocal cut	
Stereo	Stereo Surround

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APPLICATION EXAMPLE

Unit R: Ω
C: F