

To our customers,

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April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

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# M65856SP

## Digital Echo with Mic-mixing Circuit

REJ03F0085-0100Z

Rev.1.0

Sep.22.2003

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### Description

The M65856SP is a CMOS IC that has a microphone peripheral circuit and an echo generation circuit for karaoke use, on a single chip.

Its Karaoke function makes it ideal for video CDs, mini-compos, CD radio cassette players, VIRs and other similar devices.

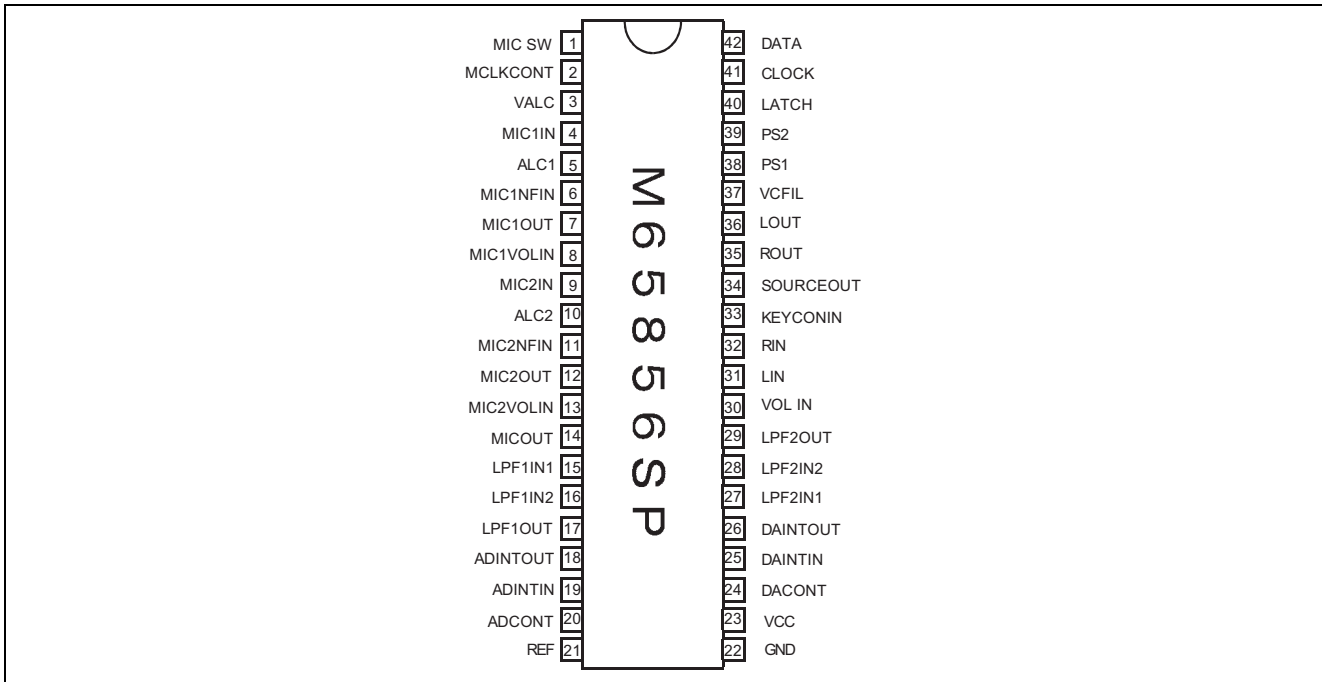
### Features

- High-performance digital echo circuit using 16-Kbit RAM
- Internal Surround function that allows audio from a monaural audio source to be reproduced in pseudo-stereo, and audio from a stereo audio source to be reproduced as surround audio
- A mic amplifier with an ALC makes it possible to handle overload input, and the ALC operating voltage can be externally set to the desired value.
- Internal dual-line mic volume, echo volume, and echo feedback volume
- Internal stereo mic mixing amplifier
- Internal functions for karaoke enjoyment (Vocal Cut, Auto Vocal Support)
- Interface pin provided for connection to an external key control IC
- The clock has an internal current control-type oscillation circuit, and the generation of unnecessary oscillation can be prevented because the clock does not affect anything external to the unit.
- Internal Auto Reset circuit that functions when the power supply is turned on
- 5 V single power supply

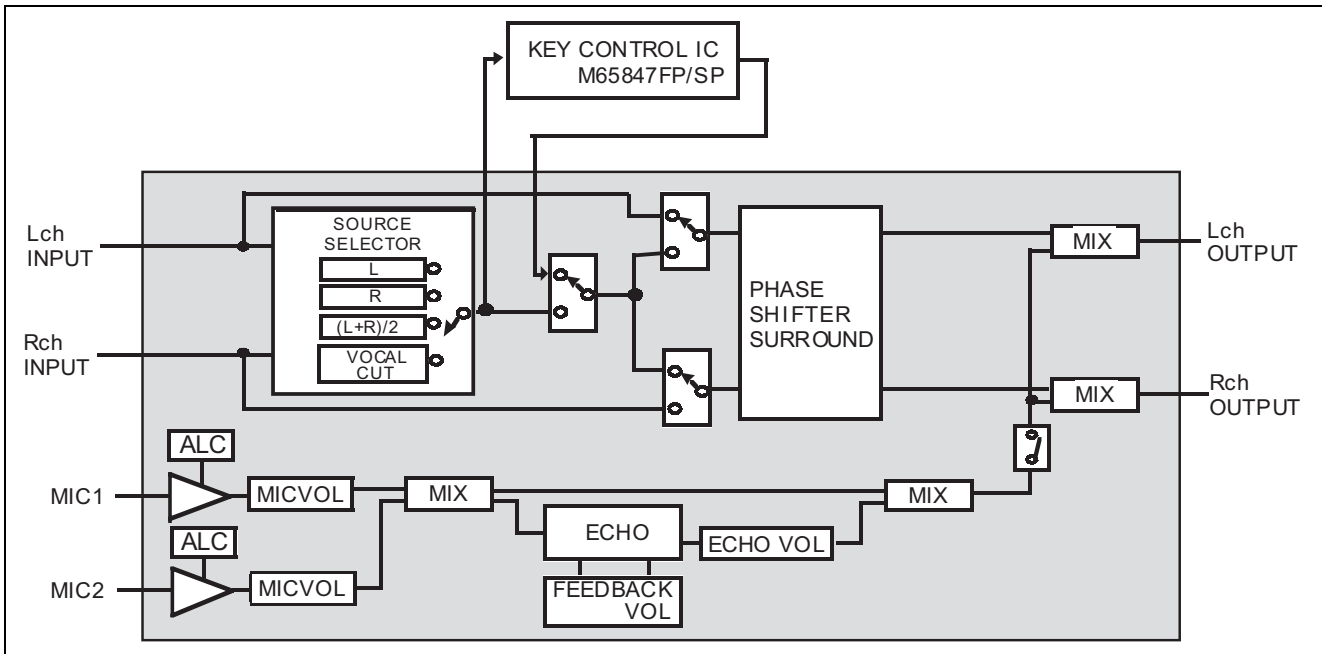
### Recommended Operating Conditions

- Operating power supply voltage range:  $V_{cc} = 4.5$  to  $5.5$  V  
Rated power supply voltage range:  $V_{cc} = 5$  V

Pin Configuration



System Block Diagram



**Description of Pin**

Pin no.	Symbol	Name	I/O	Function
1	MIC SW	Mic switch	I	L: Mic off H: Mic on
2	MCLKCONT	Oscillator input	—	Internal clock is controlled by external resistor
3	VALC	ALC operating voltage setting	—	ALC operating voltage is set by applied voltage value
4	MIC1IN	Mic 1 input	I	Used to connect Mic 1
5	ALC1	ALC1 control	—	Used to connect C for setting ALC attack and recovery times
6	MIC1NFIN	Mic 1 negative feedback input	I	Used to set the Mic 1 amplifier gain using external resistor
7	MIC1OUT	Mic 1 output	O	Mic 1 amplifier output
8	MIC1VOLIN	Mic 1 volume input	I	C coupling used to reduce noise when volume is switched
9	MIC2IN	Mic 2 input	I	Used to connect Mic 2
10	ALC2	ALC2 control	—	Used to connect C for setting ALC attack and recovery times
11	MIC2NFIN	Mic 2 negative feedback input	I	Used to set the Mic 2 amplifier gain using external resistor
12	MIC2OUT	Mic 2 output	O	Mic 2 amplifier output
13	MIC2VOLIN	Mic 2 volume input	I	C coupling used to reduce noise when volume is switched
14	MICOUT	Mic output	O	Mixing output of Mic 1 and Mic 2
15	LPF1IN1	Low-pass filter 1 input 1	I	Pre-filter before A/D conversion for digital echo
16	LPF1IN2	Low-pass filter 1 input 2	I	
17	LPF1OUT	Low-pass filter 1 output	O	
18	ADINTOUT	A/D integrator output	O	Configures an integrator for A/D conversion using external C
19	ADINTIN	A/D integrator input	I	
20	ADCONT	A/D control	—	Determines the constant when ADM-type A/D conversion is applied
21	REF	Reference power supply output	—	Used to connect C for 1/2 Vcc output and filter
22	GND	Ground	—	
23	VCC	Power supply	—	
24	DACONT	D/A control	I	Determines the constant when ADM-type D/A conversion is applied
25	DAINTIN	D/A integrator input	I	Configures an integrator for D/A conversion using external C
26	DAINTOUT	D/A integrator output	O	
27	LPF2IN1	Low-pass filter 2 input 1	I	Post-filter before D/A conversion for digital echo
28	LPF2IN2	Low-pass filter 2 input 2	I	
29	LPF2OUT	Low-pass filter 2 output	O	
30	VOLIN	Volume input	I	C coupling used to reduce noise when volume is switched
31	LIN	Left channel line input	I	
32	RIN	Right channel line input	I	
33	KEYCONIN	Monaural input supporting external key control IC	I	Interface pin for connecting external key control IC
34	SOURCEOUT	Monaural output supporting external key control IC	O	

**Description of Pin (cont)**

Pin no.	Symbol	Name	I/O	Function
35	ROUT	Right channel line output	O	Mixing output of mic and line systems
36	LOUT	Left channel line output	O	
37	VCFIL	Vocal Cut filter	—	C connection for low-pass filter that passes frequency components lower than the vocal band through
38	PS1	Phase shifter 1	I	Used to connect a C that configures phase shifter surround
39	PS2	Phase shifter 2	I	
40	LATCH	Latch	I	Serial path latch input
41	CLOCK	Clock	I	Serial path clock input
42	DATA	Data	I	Serial path data input

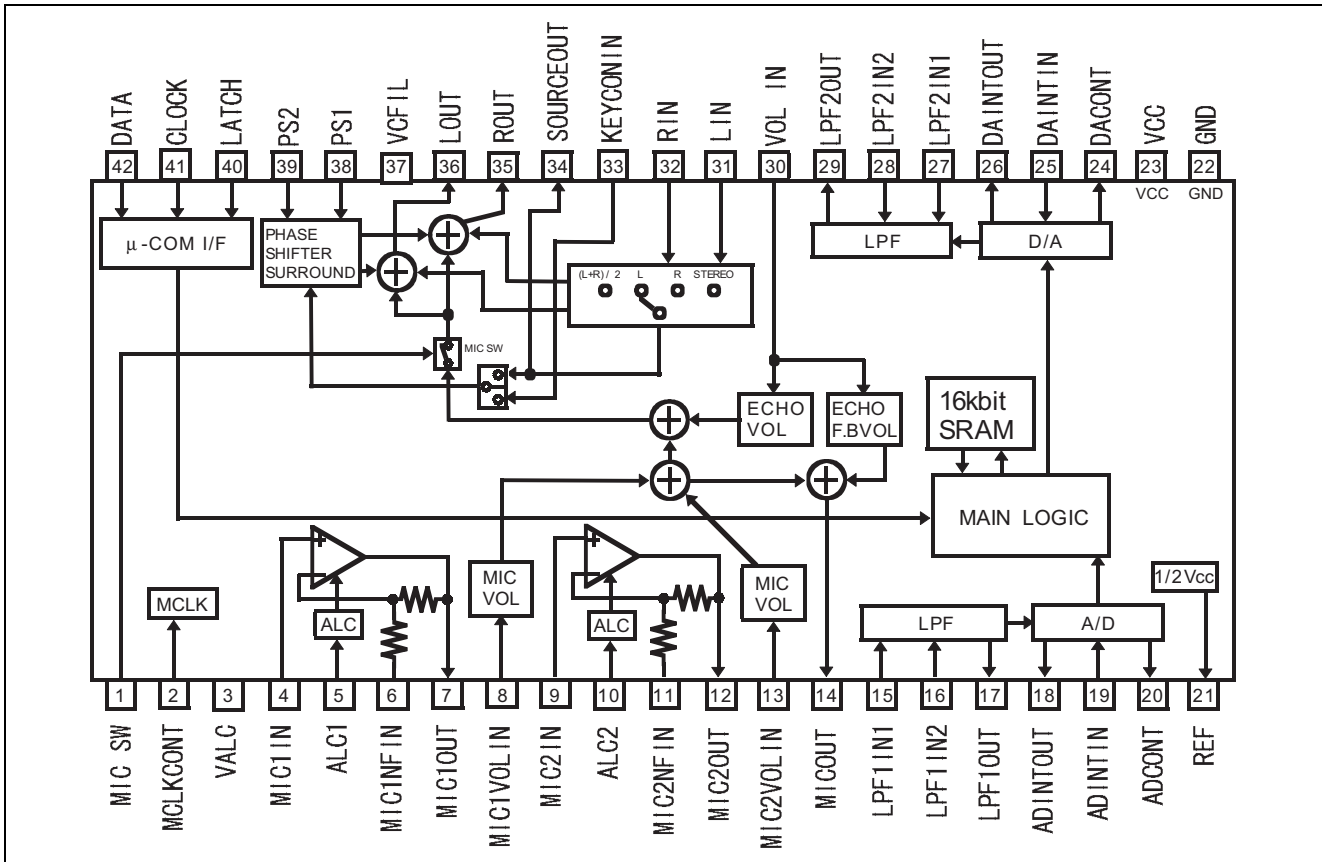
**Absolute maximum ratings**

Symbol	Item	Rating	Unit
VCC	Power supply voltage	6.0	V
Vi	Input voltage	-0.3 to Vcc+0.3	V
Pd	Internal power dissipation	1.1	W
Topr	Ambient operating temperature	-20 to +75	°C
Tstg	Storage temperature	-40 to +125	°C

**Recommended Operating Conditions**

Symbol	Parameter	Measurement conditions	Limits			Unit
			Min	Typ	Max	
VCC	Power supply voltage		4.5	5	5.5	V
VIL	Input voltage (L level)	Pins 40, 41, 42	0	—	0.8	V
VIH	Input voltage (H level)	Pins 40, 41, 42	2.4	—	VDD	V

Block Diagram



## Electrical Characteristics

(Unless otherwise noted,  $V_{CC} = 5\text{ V}$ ,  $f = 1\text{ kHz}$ ,  $V_i = 100\text{ mVrms}$ ,  $T_a = 25^\circ\text{C}$ )

Symbol	Item	Measurement conditions	Limits			Unit	
			Min.	Typ.	Max.		
Total	Icc	Current drawn by the circuit	When there is no signal			mA	
Mic amplifier	Gvo	Amplifier bare gain	$V_o = -17\text{ dBV}$			dB	
	THD1	Output distortion	$V_o = -17\text{ dBV}$ , other than ALC operation			%	
	THD2	Output distortion	$V_i = -37\text{ dBV}$ , when using ALC operation			%	
	VoALC	ALC operating voltage measurement	Measured value = $-10$ to $+30\text{dBV}$			dB	
	TAL CAT	ALC attack time	$C = 4.7\ \mu\text{F}$			msec	
	TAL CRE	ALC recovery time	$C = 4.7\ \mu\text{F}$			sec	
	VoMAX	Maximum output voltage	THD = 10%			Vrms	
	No	Output noise voltage	$R_g = 620\ \Omega$ , JIS-A			dBV	
	Zi	Input impedance	6	10	16	k $\Omega$	
Mic volume	Gv	Gain between input/output	At maximum volume			dB	
	ATTmax	Maximum attenuation	At minimum volume			dBV	
	THD	Output distortion	At maximum volume			%	
	ViMAX	Maximum input voltage	THD = 10%			Vrms	
	No	Output noise voltage	JIS-A			dBV	
Echo volume	Gv	Gain between input/output	Volume 0 dB			dB	
	ATTmax	Maximum attenuation	At minimum volume			dBV	
	THD	Output distortion	At maximum volume			%	
	VoMAX	Maximum output voltage	THD = 10%			Vrms	
	No	Output noise voltage	JIS-A			dBV	
Digital echo	Gv	Gain between input/output	-3	0	+3	dB	
	VoMAX	Maximum output voltage	THD = 10%			Vrms	
	Td	Delay time	Sets delay time using micro-computer	88.4	104.0	119.6	msec
				117.9	138.7	159.5	msec
				132.6	156.0	179.4	msec
				176.9	208.1	239.3	msec
	THD	Output distortion	$T_d = 104.0\text{ mS}$ , 30 kHzLPF	—	1.0	2.0	%
			$T_d = 138.7\text{ mS}$ , 30 kHzLPF	—	1.5	3.0	%
			$T_d = 156.0\text{ mS}$ , 30 kHzLPF	—	1.5	3.0	%
			$T_d = 208.1\text{ mS}$ , 30 kHzLPF	—	2.0	4.0	%
No	Output noise voltage	$V_i = 0\text{mVrms}$ , JIS-A	—	-87	-72	dBV	
		$T_d = 104.0\text{ mS}$ , $R_g = 620\ \Omega$					
		$V_i = 0\text{mVrms}$ , JIS-A	—	-85	-70	dBV	
		$T_d = 138.7\text{ mS}$ , $R_g = 620\ \Omega$					
		$V_i = 0\text{mVrms}$ , JIS-A	—	-85	-70	dBV	
		$T_d = 156.0\text{ mS}$ , $R_g = 620\ \Omega$					
		$V_i = 0\text{mVrms}$ , JIS-A	—	-82	-67	dBV	
		$T_d = 208.1\text{ mS}$ , $R_g = 620\ \Omega$					



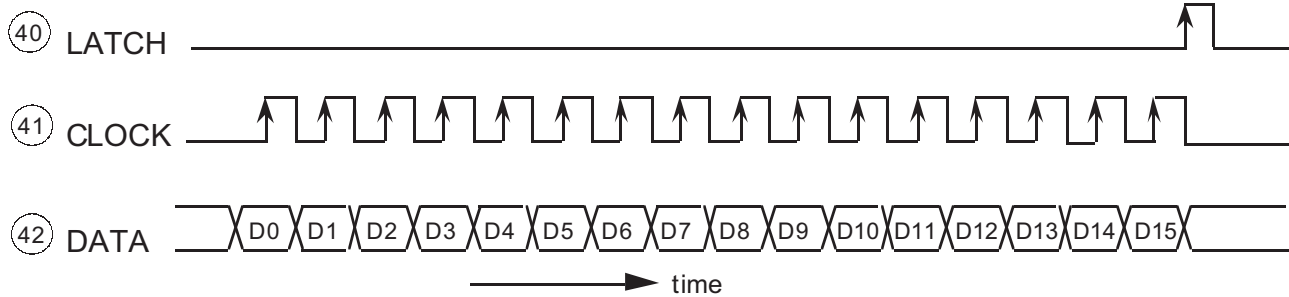
**Electrical Characteristics (cont)**

Symbol	Item	Measurement conditions	Limits			Unit	
			Min.	Typ.	Max.		
Line	Gv	Gain between input/output	-3	0	+3	dB	
	THD	Output distortion	30 kHzLPF	—	0.02	0.04	%
	VoMAX	Maximum output voltage	THD = 10%	1.1	1.7	—	Vrms
	No	Output noise voltage	JIS-A, MIC SW OFF	—	-95	-90	dBV
	CS	Channel separation	JIS-A	—	-70	-50	dB
	Zi	Input impedance		10	20	30	kΩ
	Grej	Vocal elimination ratio	Vocal Cut	14	18	—	dB

## Serial Data Format

This product is controlled by the serial data in the format indicated below.

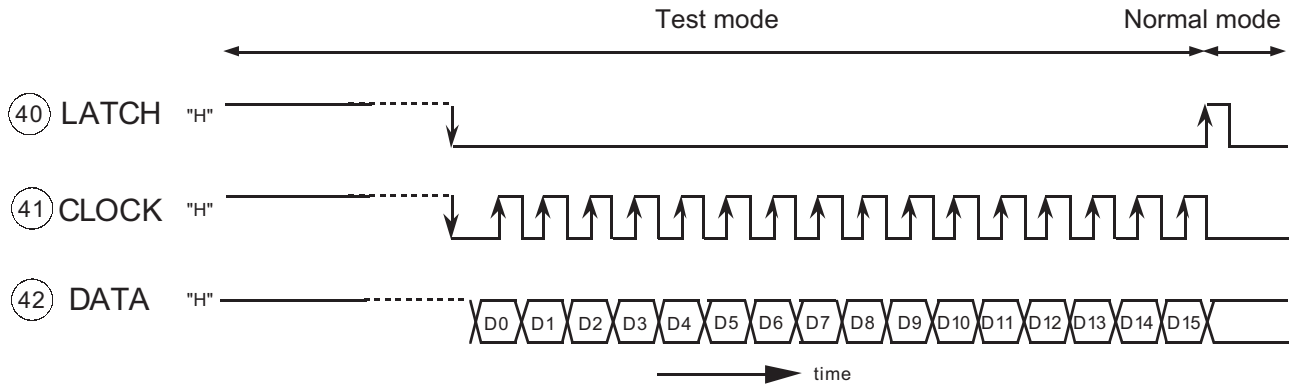
DATA (Pin 42) is read on the rising edge of CLOCK (Pin 41), and the 16 bits of data, which are filled in starting from the right, are loaded on the rising edge of LATCH (Pin 40).



Data	Function	Control contents	Data	Function	Control contents
D0	D1	Digital echo	DO	D1	Echo volume
	D2	Used to set the delay time in 4 stages, from 104.0 ms to 208.1 ms		D2	Used to set the volume in 8 stages, between +3 dB to -15 dB and -∞
	D3			D3	
DO = "L"	D4	Source selector	DO = "H"	D4	Feedback volume
	D5	Voice multiplex software support		D5	Used to set the volume in 5 stages, between -2 dB to -7 dB and -∞
	D6	Used to set 5 types of multiplex modes: Lch Monaural, Rch Monaural, (L + R) / 2, Vocal Cut, and Stereo		D6	
	D7	Phase shifter		D7	Mic 1 volume
	D8	Surround using phase shifter; effects can be varied by adjusting external resistor		D8	Used to set the volume in 8 stages, between 0 dB to -18 dB and -∞
	D9	Auto vocal support		D9	
	D10	Key control pass-through		D10	Mic 2 volume
	D11	Enables / disables external key control		D11	Used to set the volume in 8 stages, between 0 dB to -18 dB and -∞
	D12, D13	Mic switch		D12	
		Sets MIC OUT SW to ON or OFF		D13	
	D14	In Test mode and Normal mode, D12 = "L" and D13 = "L"		D14	Address
	D15	Address		D15	Data is read when D14 = "L" and D15 = "H"; otherwise canceled
		Data is read when D14 = "L" and D15 = "H"; otherwise canceled			

(Usage Precautions)

1. If the power supply is turned on when DATA (Pin 42), CLOCK (Pin 41), and LATCH (Pin 40) are all "H", the mode switches to the Test mode. Please be aware that the settings in this mode are different from those in the mode following an auto reset.
2. After the serial data has been input in the Test mode, the mode is canceled on the rising edge of LATCH (Pin 40), and returns to the normal (Standard) mode.



**Function Settings**

**Delay time settings**

Data				Delay time
D0	D3	D2	D1	
L	L	—	—	104.0 ms
L	L	H	—	138.7 ms
L	H	L	—	156.0 ms
L	H	H	L	208.1 ms
L	H	H	H	Delay OFF

**Source selector**

Data				Source selector
D0	D6	D5	D4	
L	L	L	L	Lch, Monaural
L	L	L	H	Rch, Monaural
L	L	H	—	(L + R) / 2
L	H	L	—	Vocal Cut
L	H	H	—	Stereo

**Phase shifter surround settings**

Delay time		Phase shifter surround		
D0	D8	D7	Surround switch	Effect
L	L	L	OFF	-
L	L	H	ON	Effect (small)
L	H	L	ON	Effect (medium)
L	H	H	ON	Effect (large)

**Auto vocal support switch**

Data		Auto vocal support switch
D0	D9	switch
L	L	OFF
L	H	ON

**Input selector switch**

Data		Setting
D0	D10	
L	L	External key control supported (Note)
	H	External key control not supported (pass-through)

**Mic mixing switch**

Data		MIC SW	Setting
D0	D11		
L	L	OFF	Mic mixing OFF
	H	ON	Mic mixing ON

Note: Only monaural signals are supported as output signals to external key control (Pin 34: SOURCEOUT), so when external key control is supported, the D4 to D6 source selectors should be set to a setting other than "Stereo". (If set to "Stereo", external key control will not be supported.)

**Volume Settings**
**Echo volume settings**

Data				Setting (dB)
D0	D3	D2	D1	
	L	L	L	+3
	L	L	H	0
H	L	H	L	-3
	L	H	H	-6
	H	L	L	-9
	H	L	H	-12
	H	H	L	-15
	H	H	H	-∞

**Echo feedback volume settings**

Data				Setting (dB)
D0	D6	D5	D4	
	L	L	L	-2
	L	L	H	-3
H	L	H	L	-5
	L	H	H	-7
	H	L	L	-∞

**Mic volume settings**

Data					Setting (dB)
D0	D9	D8	D7	MIC1 volume	
	D12	D11	D10	MIC2 volume	
	L	L	L	0	
	L	L	H	-3	
H	L	H	L	-6	
	L	H	H	-9	
	H	L	L	-12	
	H	L	H	-15	
	H	H	L	-18	
	H	H	H	-∞	

**Address settings**

Data			Address
D0	D15	D14	
L, H	L	L	Data Cancel
	L	H	
	H	L	Data Read
	H	H	Data Cancel

## Explanation of Functions

### (1) Auto reset

When the power supply is turned on, a reset is carried out automatically, and after approximately 120 ms ( $V_{CC} = 5\text{ V}$ , REF pin C = 47  $\mu\text{F}$ ), the function settings are set as described below.

- Delay time setting: 104.0 ms
- Source selector: Stereo
- Phase shifter surround setting: OFF
- Auto vocal support switch: OFF
- Key control pass-through: External key control supported
- Mic mixing switch: OFF
- Echo volume:  $-\infty$
- Feedback volume:  $-\infty$
- Mic volume setting:  $-9\text{ dB}$

#### \*1. Reset time

The reset time is determined by the values of the resistor in the IC and the capacitor C attached to the REF pin. It can be determined using the following equation.

$$\text{Reset time (msec)} = 2.5 \times C (\mu\text{F})$$

Example) When C = 47  $\mu\text{F}$

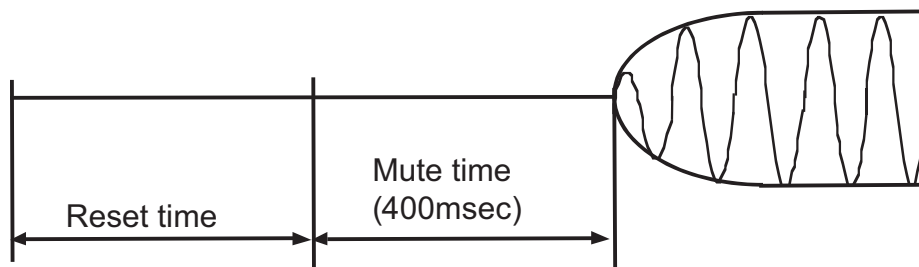
$$\text{Reset time} = 2.5 \times 47 = 117.5 (\text{msec})$$

This results in a reset time of approximately 120 msec

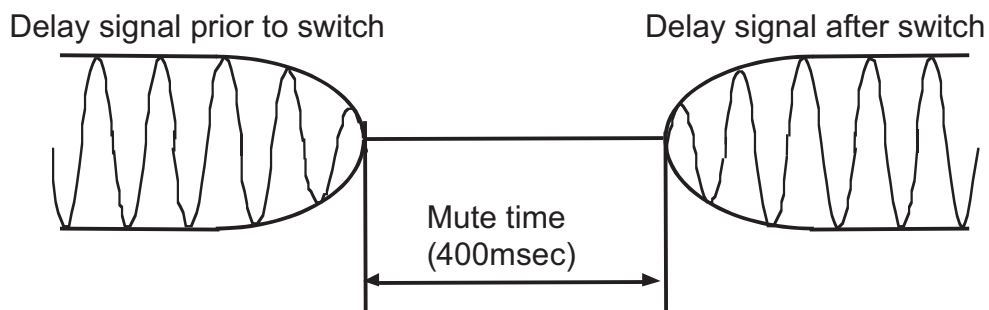
### (2) Auto mute function

When the power supply is turned on or when the delay time setting is switched, the auto mute function is activated in order to suppress the shock noise of the digital delay.

- When the power supply is turned on



- When the delay time setting is switched

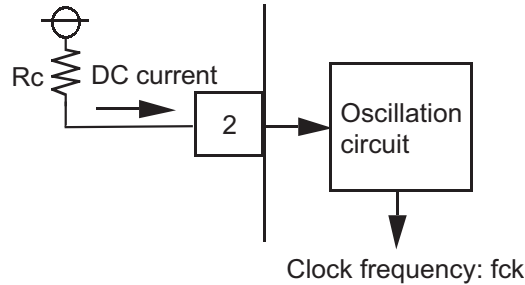


(3) Clock oscillation circuit

This IC incorporates a current control-type oscillation circuit. The oscillation circuit can be configured simply by connecting a resistor for current control to Pin 2 (MCLKCONT).

Moreover, the clock is completely internal, so the generation of unnecessary oscillation can be prevented because the clock does not affect anything external to the circuit.

The oscillation frequency is  $f_{ck} = 2 \text{ MHz}$  ( $R_c = 47 \text{ k}\Omega$ )



(4) Mic amplifier

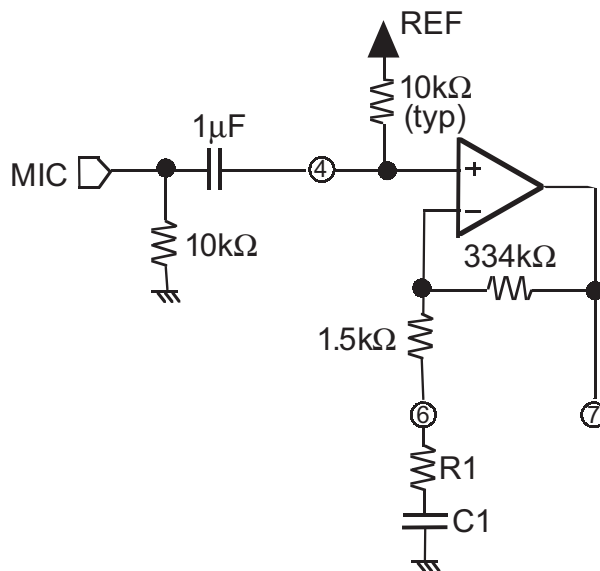
The gain  $G_v$  and low-pass cutoff frequency  $f_{cl}$  of the mic amplifier are expressed as follows:

$$G_v = 20 \log \left( \frac{R_1 + 1.5\text{K} + 334\text{K}}{R_1 + 1.5\text{K}} \right) \quad f_{cl} = \frac{1}{2\pi \cdot (R_1 + 1.5\text{K}) \cdot C_1}$$

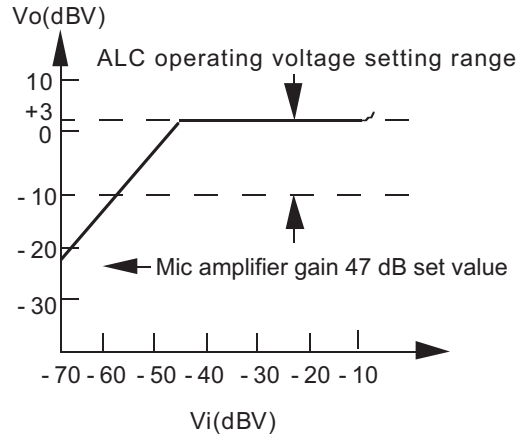
$$G_v (\text{max}) = 47 \text{ dB}, f_{cl} = 48.2 \text{ Hz}$$

$$R_1 = 0 \Omega, C_1 = 2.2 \mu\text{F}$$

As one example of the various constants,  $v = 37 \text{ dB}$  and  $f_{cl} = 15.1 \text{ Hz}$ , then  $R_1 = 3.3 \text{ K}\Omega$  and  $C_1 = 2.2 \mu\text{F}$ .

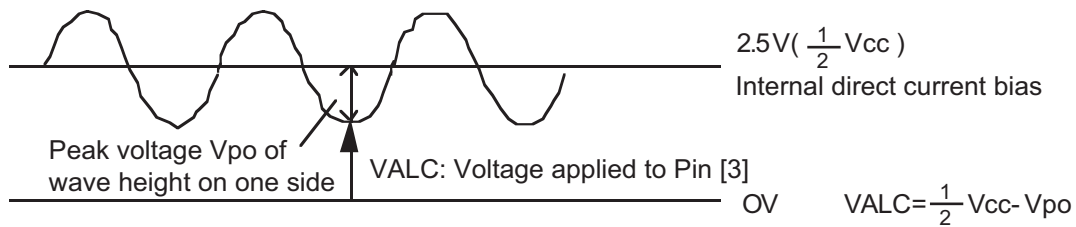


(5) ALC level diagram



(6) ALC operating voltage setting

The ALC operating voltage may be set to any desired value within a range of -10 dBV to +3 dBV, depending on the value of the direct current voltage applied to Pin 3 (ALC operating voltage setting).

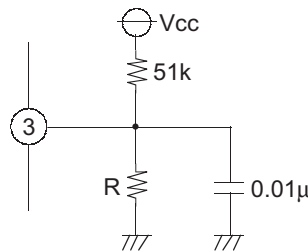


Example showing the ALC operating voltage set to -5 dB (when  $V_{cc} = 5$  V)

$$-5 \text{ dBV} = 0.56 \text{ V}_{rms} = 1.59 \text{ V}_{p-p} = 0.8 \text{ V}_{p-o}$$

$$VALC = 2.5 - 0.8 = 1.7 \text{ V}$$

Because of the high input impedance of Pins 5 and 10, which exceeds  $1 \text{ M}\Omega$ , the ALC reference voltage can be applied by splitting the resistance.

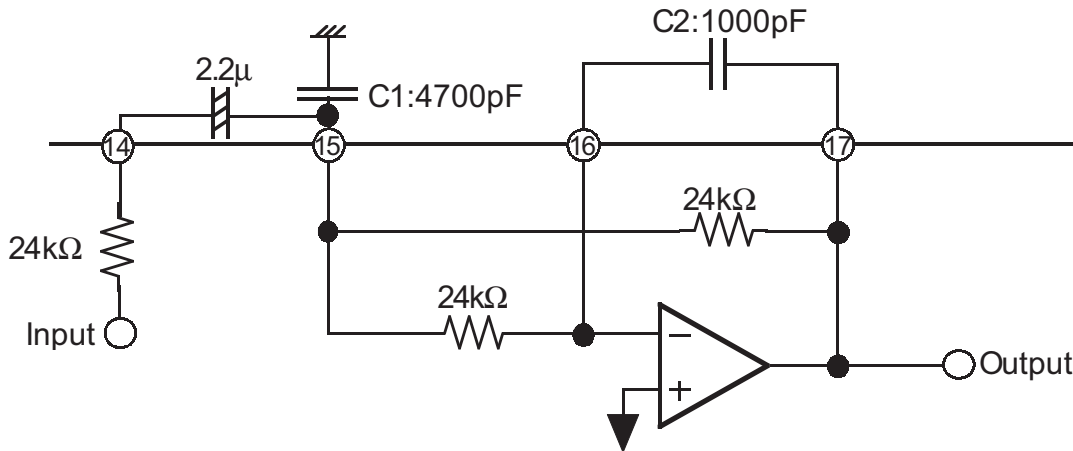


at  $V_{cc} = 5$  V:

ALC operating voltage (dBV)	Voltage VALC (V) applied to Pins 5 and 10	Resistance R ( $\Omega$ )
+3	0.50	5.6 k
0	1.09	15 k
-2	1.38	20 k
-4	1.61	24 k
-6	1.79	27 k
-8	1.94	33 k
-10	2.05	36 k

**(7) Digital echo input/output low-pass filter**

The digital echo input/output low-pass filter is configured as shown below.



The precision of the resistance in the IC is approximately ±30%.

The cutoff frequency (fc) is as follows:

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

The quality factor (Q) is as follows:

$$Q = \frac{1}{3} \sqrt{\frac{C1}{C2}} \cong 0.72$$

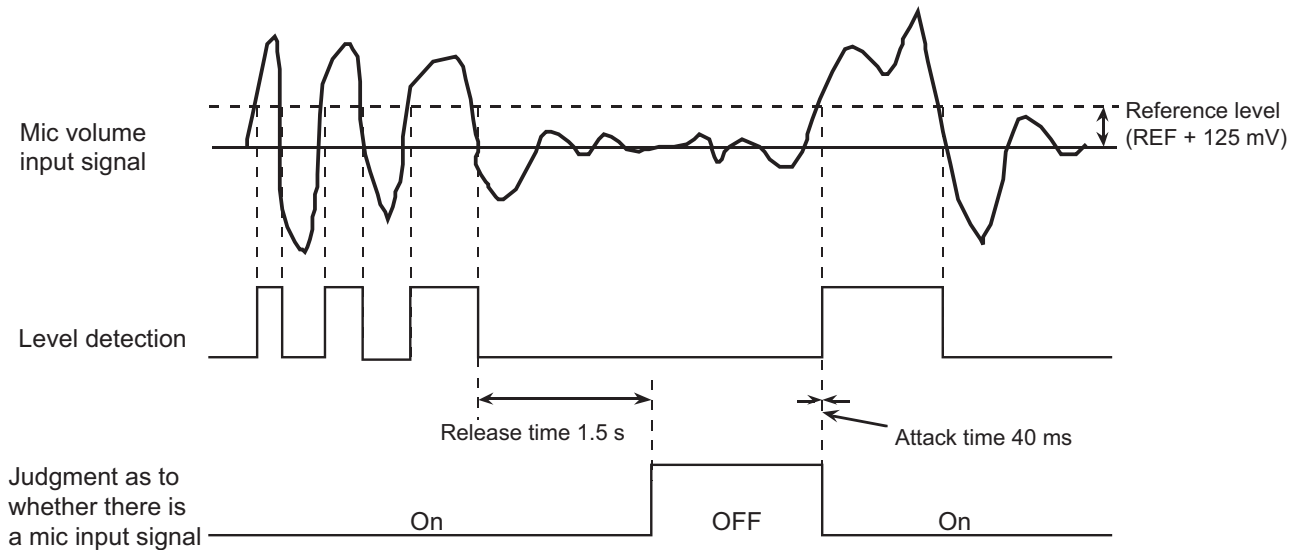
**(8) Auto Vocal Support**

When the Karaoke function is used, and when the Audio Signal Source selector is set to “Lch Monaural” (to eliminate the vocal component when multiplex voice software is being used) or “Vocal Cut” (to eliminate the vocal component of ordinary music software), with no voice being input from the microphone, the Auto Vocal Support function is used to output the vocal component of the audio source to provide vocal support.

Presence of mic input signal	Source selector setting		
Yes	Lch Monaural	Vocal Cut	Stereo Rch Monaural (L + R) / 2
No	(L+R) / 2	(L+R) / 2	Same as when there is mic input



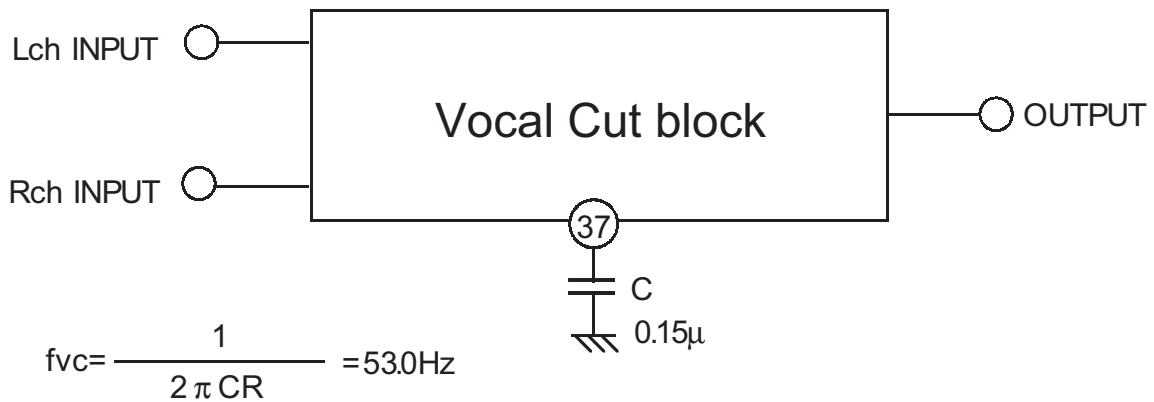
**Timing at which the presence/absence of a mic input signal is detected**



**(9) Vocal Cut**

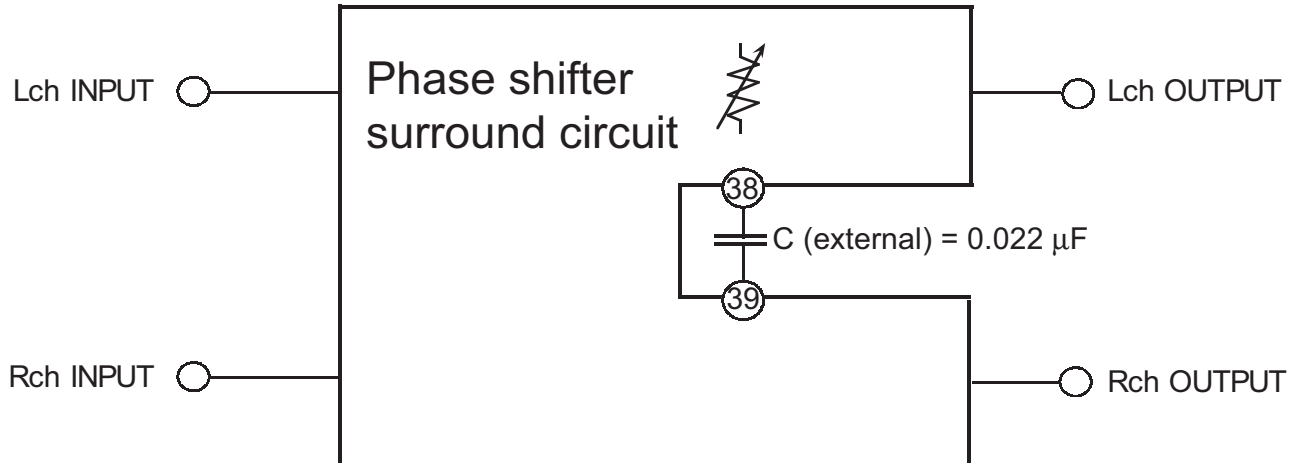
This eliminates the vocal component from ordinary music sources (stereo). Normally, the vocal component occupies a center fixed position, and is input to the L and R channels at the same phases and same amplitude. Consequently, Lch – Rch can be used to cut the vocal component.

In this case, however, the low-pass region of music with no sense of a fixed position is also eliminated, so a low-pass filter has to be used to pass the low-pass component through to augment what is missing acoustically.



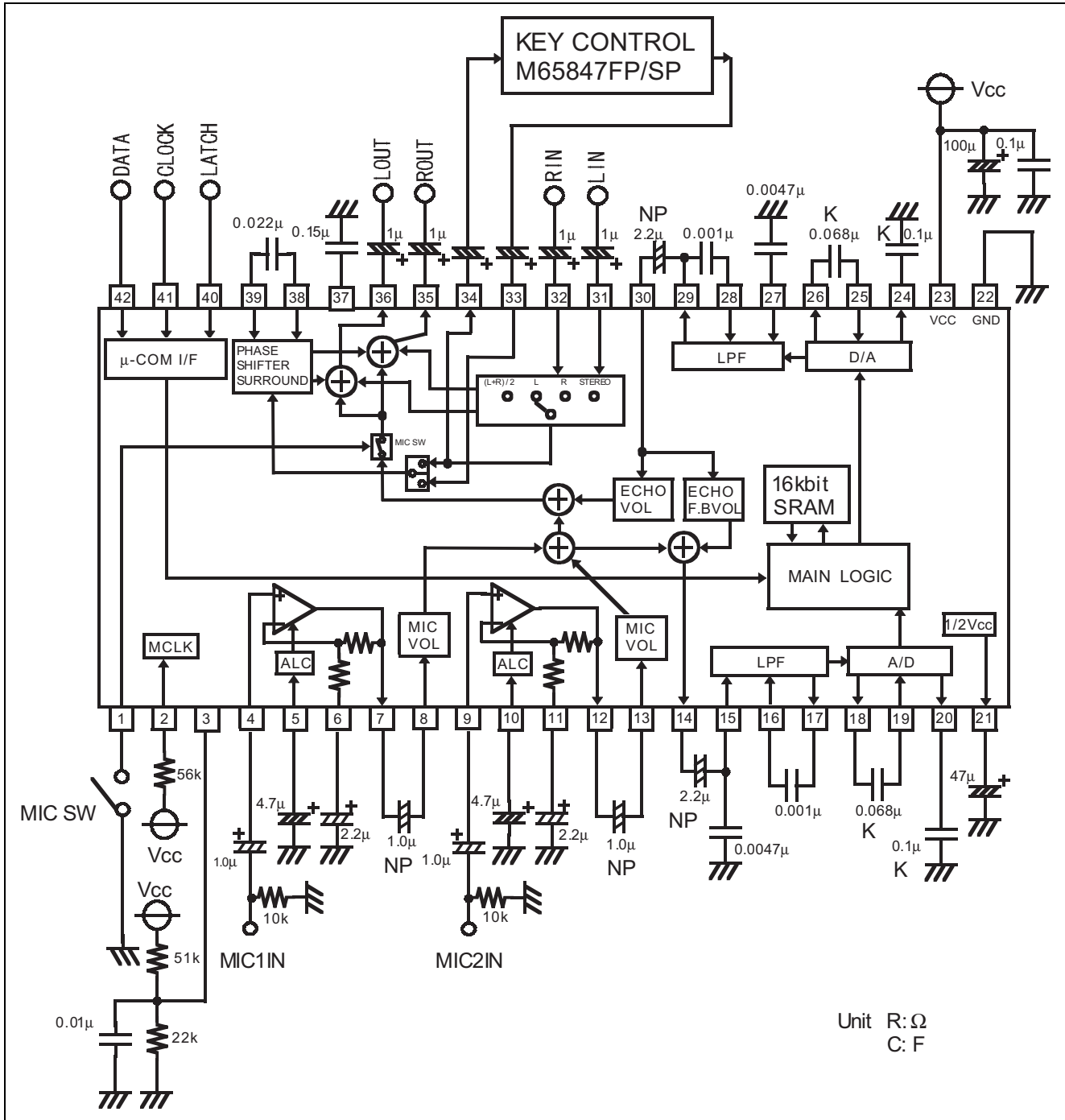
The low-pass filter is configured of an internal resistor R (20 kΩ) and an external capacitor C. If C = 0.15 μF, the cutoff frequency will be 53 Hz.

(10) Phase shifter block



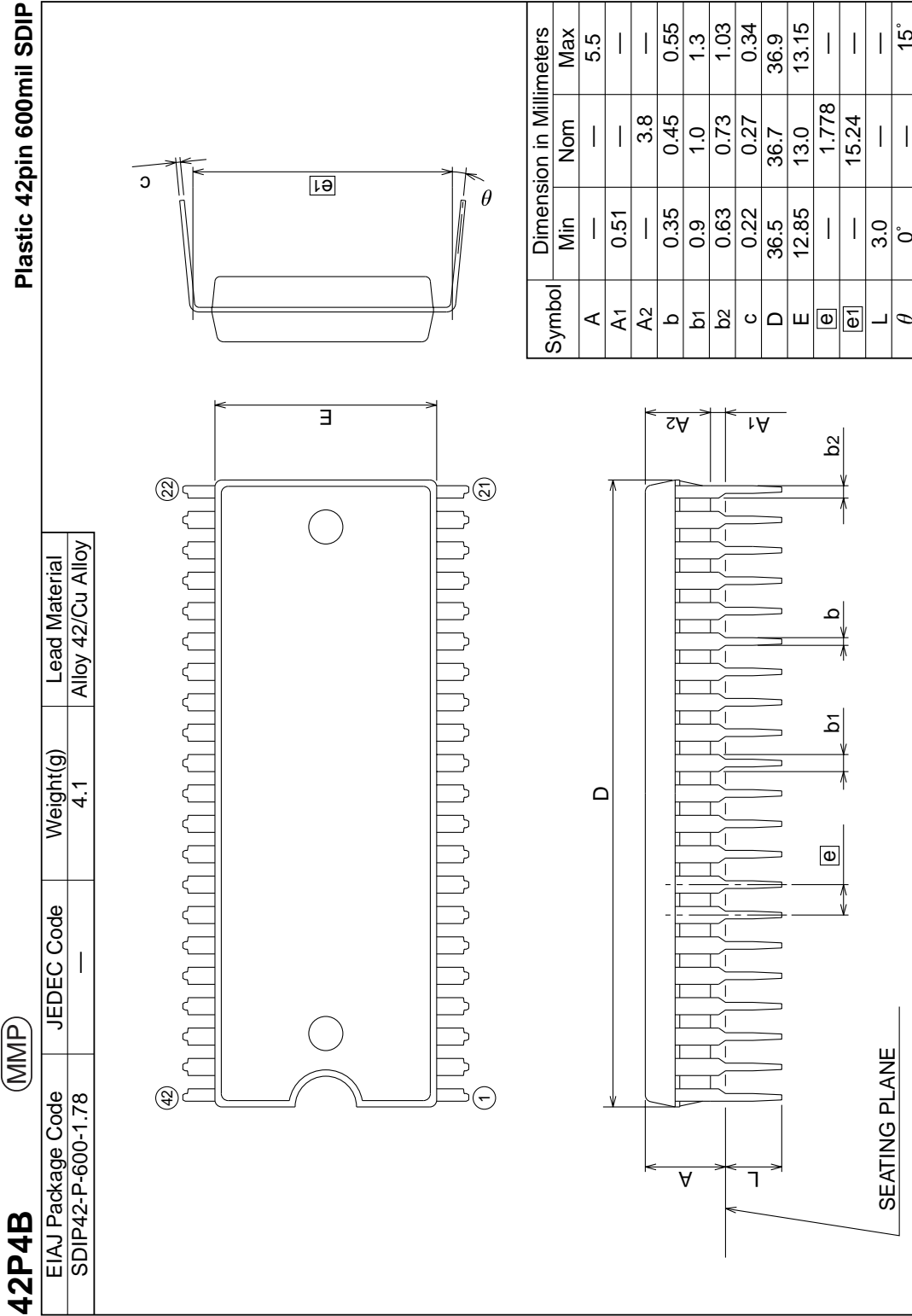
Source selector	Surround
L	
R	
(L+R) / 2	Pseudo-stereo
Vocal Cut	
Stereo	Stereo surround

Application Example



Note: Where capacitors are marked with a “K”, K-rank capacitors should be used.  
Where capacitors are marked with “NP”, capacitors with no polarity should be used.

Package Dimensions



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**Renesas Technology America, Inc.**  
450 Holger Way, San Jose, CA 95134-1368, U.S.A  
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**Renesas Technology Europe Limited.**  
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, United Kingdom  
Tel: <44> (1628) 585 100, Fax: <44> (1628) 585 900

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Tel: <49> (89) 380 70 0, Fax: <49> (89) 929 30 11

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26/F., Ruijin Building, No.205 Maoming Road (S), Shanghai 200020, China  
Tel: <86> (21) 6472-1001, Fax: <86> (21) 6415-2952

**Renesas Technology Singapore Pte. Ltd.**  
1, Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632  
Tel: <65> 6213-0200, Fax: <65> 6278-8001