

**PRELIMINARY**  
 Notice: This is not a final specification.  
 Some parametric limits are subject to change.

# M61500FP

## TONE CONTROL/VOLUME CONTROL

### DESCRIPTION

The M61500FP is the sound controller powered by "QSurround" system. The "QSurround" system decodes and virtualize multi-speaker surround sound from various matrix surround encoded sources: Dolby Surround, stereo downmixed AC-3, stereo downmixed DTS. Produces normal and wide 3D sound expansion from any stereo input signal.

(Note) This device is produced under license from QSound Lab, Inc. (Canada).

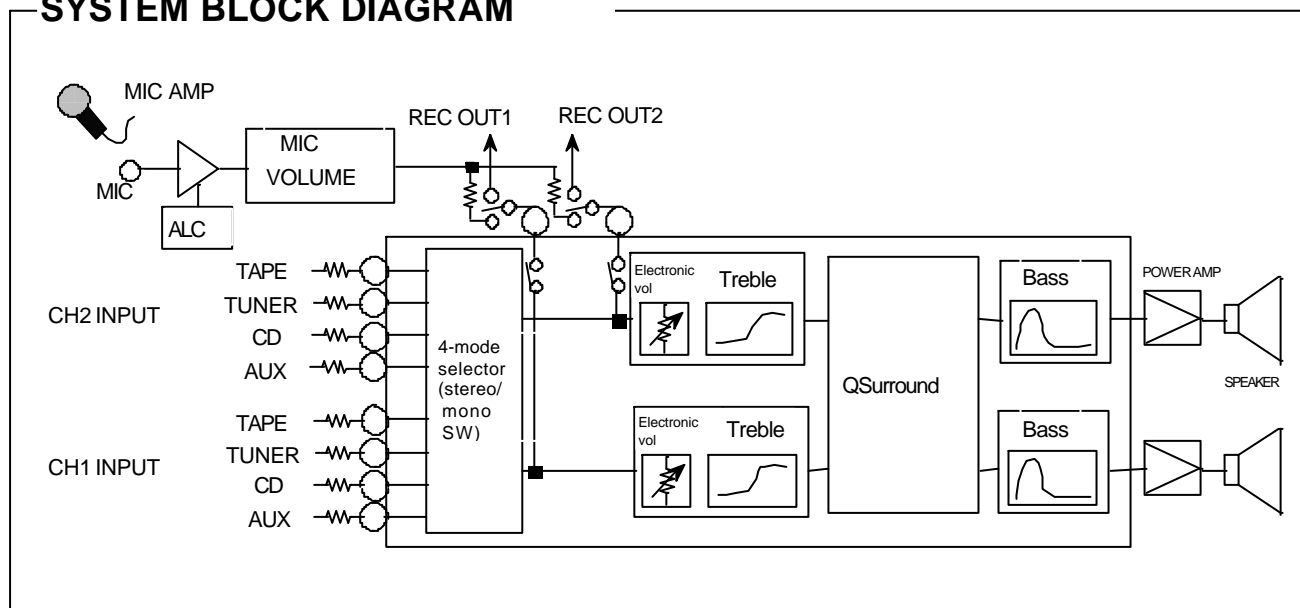
### FEATURES

- Built-in "QSurround" sound technology
- Electronic volume.  
0 ~ -84dB, infinitesimal
- 2-band tone control  
Bass(0 ~ +21dB/3dB STEP)  
Treble(0 ~ +9dB/3dB STEP)
- 5 input selector(The fifth input can be used as REC OUT or MIC MIX.)

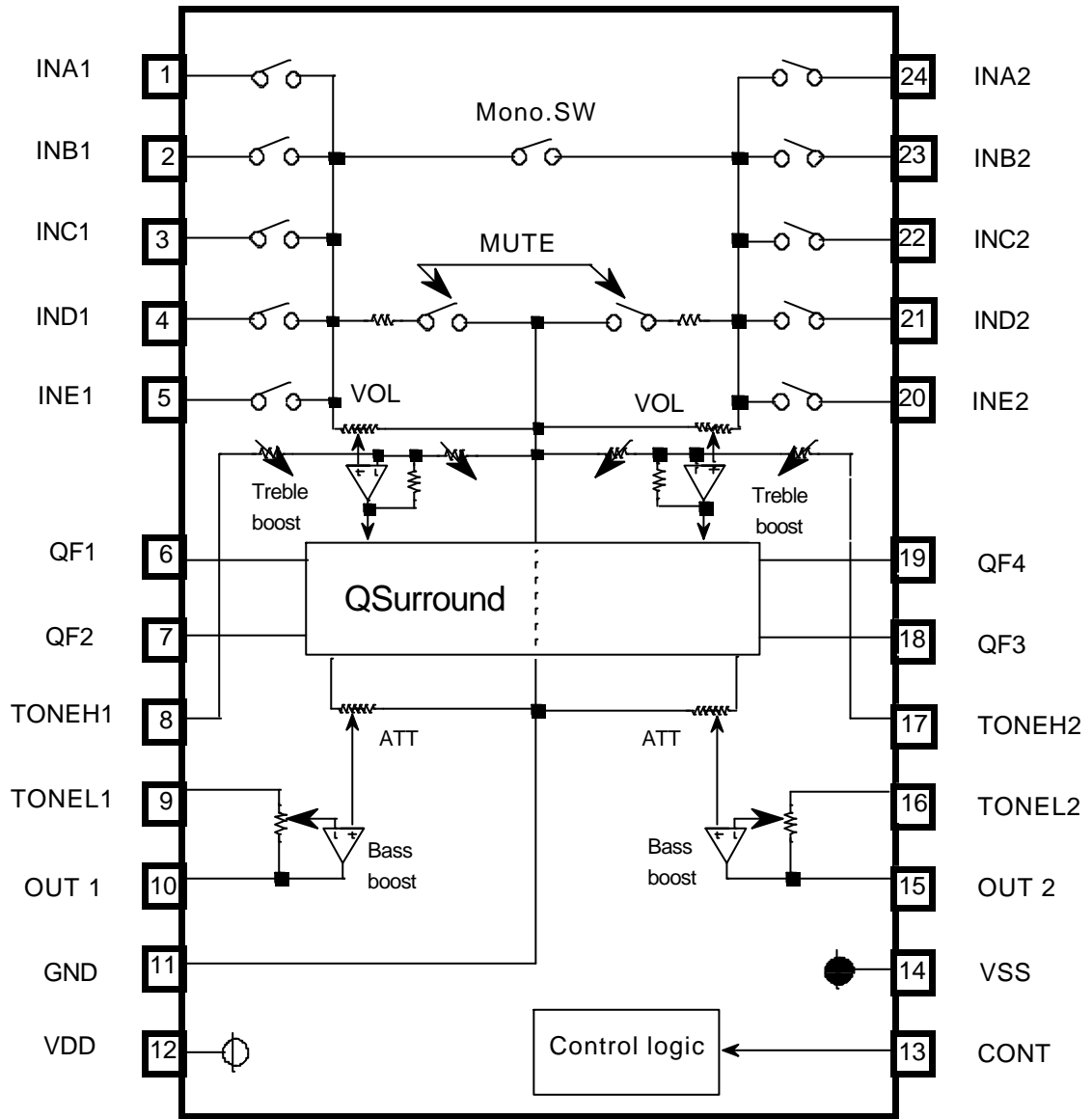
### RECOMMENDED OPERATING CONDITIONS

Supply voltage range \_\_\_\_\_ + 2.25~+ 2.75V

### SYSTEM BLOCK DIAGRAM



# BLOCK DIAGRAM



Units Resistance :ohm  
Capacitance: F

## PIN DESCRIPTION

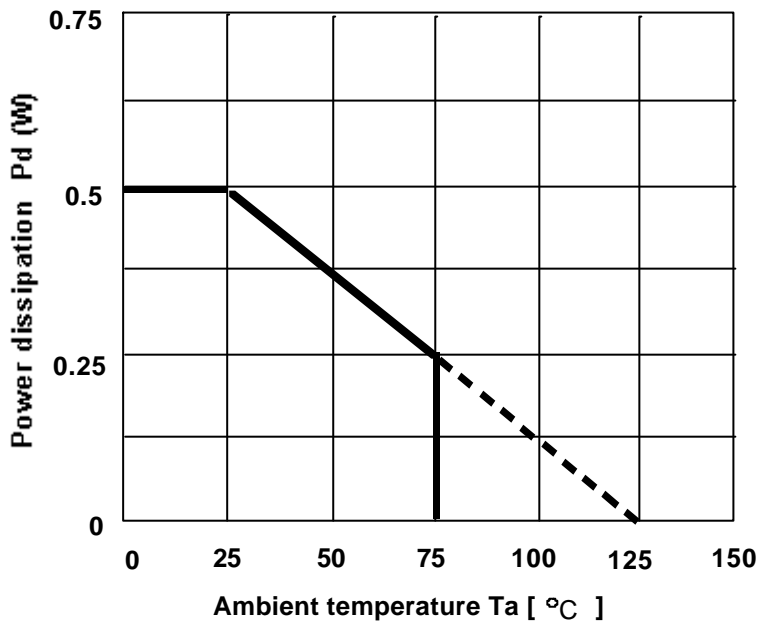
Pin No.	Name	Function
1	IN A1	INPUTs of the channel 1 <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">             The swich of INE can be controlled independently.              Please set "ALL OFF" mode when the switch of E is only ON.           </div>
2	IN B1	
3	IN C1	
4	IN D1	
5	INE1	
6	QF1	QSurround filter 1
7	QF2	QSurround filter 2
8	TONEH1	Treble control adjustment of the channel 1
9	TONEL1	Bass control adjustment of the channel 1
10	OUT1	OUTPUT of the channel 1
11	GND	Ground
12	VDD	Supply voltage(+)
13	CONT	Control data input from a microcontroller
14	VSS	Supply voltage(-)
15	OUT2	OUTPUT of the channel 2
16	TONEL2	Bass control adjustment of the channel 2
17	TONEH2	Treble control adjustment of the channel 2
18	QF3	QSurround filter 3
19	QF4	QSurround filter 4
20	INE2	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">             The swich of INE can be controlled independently.              Please set "ALL OFF" mode when the switch of E is only ON.           </div> INPUTs of the channel 2
21	IN D2	
22	IN C2	
23	IN B2	
24	IN A2	

## ABSOLUTE MAXIMUM RATINGS

(Ta=25 °C, unless otherwise noted)

Symbol	Parameter	Test conditions	Rating	Unit
VDD-VSS	Supply voltage		6.0	V
$K_{\theta}$	Thermal derating	Note:1	5	mW/°C
Pd	Power dissipation		500	mW
Topr	Operating temperature		-20 ~ 75	°C
Tstg	Storage temperature		-40 ~ 125	°C

### Thermal derating(maximum rating)



Note.1 reference PC Board

Size :70mmX70mm

Thickness:1.6mm

Material :glass epoxy

Copper pattern dimension

Width :0.25mm

Length :25 ~ 30mm/lead

Thickness:18um

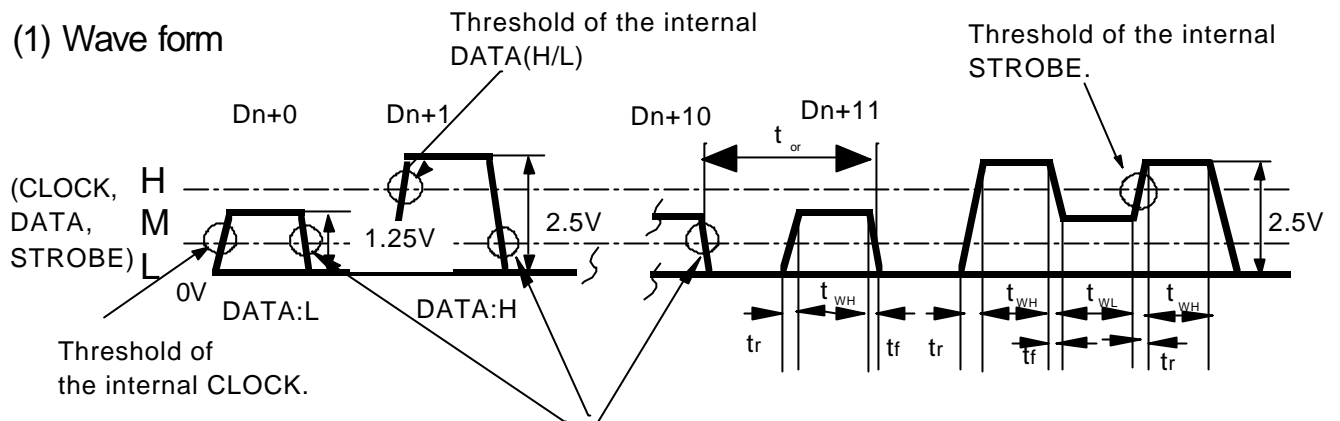
## Recommended operating conditions

Symbol	Parameter	Pin No.	Condition	Limits			Unit
				min.	typ.	max.	
VDD	Supply voltage(+)	12		2.25	2.5	2.75	V
VSS	Supply voltage(-)	14		-2.75	-2.5	-2.25	
CONT	Control data input voltage	13		GND	—	VDD	



# CONTROL SIGNALS SPECIFICATION

## (1) Wave form



The internal DATA latch at the falling edges of this clock signal.

## (2) Voltage control signal

Digital input signal		Condition	Limits			Unit
			min.	typ.	max.	
L signal	L	VDD=2.5V, VSS=-2.5V	GND	—	0.4	V
M signal	M	VDD=2.5V, VSS=-2.5V	1.0	1.25 (VDD/2)	1.5	
H signal	H	VDD=2.5V, VSS=-2.5V	2.1	—	VDD	

## (3) Timing control signal

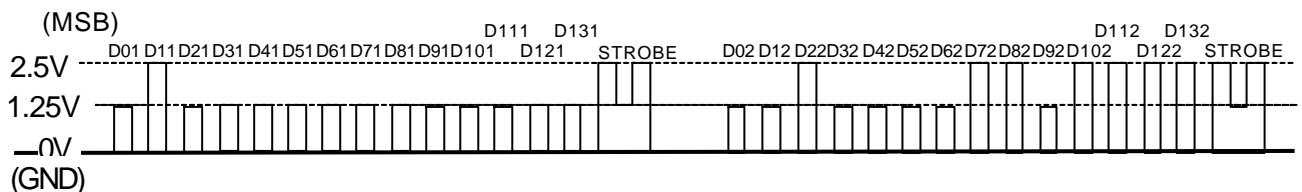
Symbol	Parameter	Limits			Unit
		min	typ	max	
$t_{cr}$	Cycle time of digital signal	8	—	—	usec
$t_{WH}$	Pulse width of digital signal("H"level)	3.6	—	—	
$t_{WL,C}$	Pulse width of digital signal("L"level)	3.6	—	—	
$t_r$	Rise time of digital signal	—	—	0.4	
$t_f$	Fall time of digital signal	—	—	0.4	

## (4) Control signal example(Refer to page 6 on the control data)

An example of the mode control

BYPASS/SURROUND SW: SURROUND  
 VOL/TREBLE SHARE AMP GAIN: 20dB  
 INPUT : INA,  
 VOLUME : 0dB  
 MUTE : OFF

SURROUND MODE: QSurround  
 SURROUND EFFECT: 0dB  
 MODE: STEREO  
 BASS: 18dB  
 TREBLE: 6dB  
 RECOUT: ON(INE)



# CONTROL DATA FORMAT

\*It's necessary to set up the all control data after power on.

## (1) INPUT DATA

(MSB) ← Input order

Slot1	D01	D11	D21	D31	D41	D51	D61	D71	D81	D91	D101	D111	D121	D131
	0	Bypass/ Surround SW	Vol/Treble share amp gain SW 0:20dB 1:18dB 2:16dB 3:14dB	INPUT 0:IN A 1:IN B 2:IN C 3:IN D			D2 to D6:(a)Master volume condition					MUTE ON/OFF 0:OFF 1:ON  (INPUT ALL OFF)	CHIP/SLOT SELECT 0:select 1:no select 2:no select 3:no select	
Slot2	D02	D12	D22	D32	D42	D52	D62	D72	D82	D92	D102	D112	D122	D132
	Surround mode		Surround effect		Mode select 0:stereo 1:mono1 only 2:mono2 only 3:mono1+2		Bass(boost) 0:0dB, 1:3dB, 2:6dB, 3:9dB, 4:12dB, 5:15dB, 6:18dB, 7:21dB			Treble(boost) 0:0dB,1:3dB 2:6dB,3:9dB		INE ON/OFF 0:OFF 1:ON	CHIP/SLOT SELECT 0:no select 1:no select 2:no select 3:select	

### (a) Master volume

ATT	D61	D71	D81	D91	D101
-0.0dB	0	0	0	0	0
-2.0dB	1	0	0	0	0
-4.0dB	0	1	0	0	0
-6.0dB	1	1	0	0	0
-8.0dB	0	0	1	0	0
-10.0dB	1	0	1	0	0
-12.0dB	0	1	1	0	0
-14.0dB	1	1	1	0	0
-16.0dB	0	0	0	1	0
-18.0dB	1	0	0	1	0
-20.0dB	0	1	0	1	0
-22.0dB	1	1	0	1	0
-24.0dB	0	0	1	1	0
-26.0dB	1	0	1	1	0
-28.0dB	0	1	1	1	0
-30.0dB	1	1	1	1	0
-32.0dB	0	0	0	0	1
-34.0dB	1	0	0	0	1
-36.0dB	0	1	0	0	1
-40.0dB	1	1	0	0	1
-44.0dB	0	0	1	0	1
-48.0dB	1	0	1	0	1
-52.0dB	0	1	1	0	1
-56.0dB	1	1	1	0	1
-60.0dB	0	0	0	1	1
-64.0dB	1	0	0	1	1
-68.0dB	0	1	0	1	1
-72.0dB	1	1	0	1	1
-76.0dB	0	0	1	1	1
-80.0dB	1	0	1	1	1
-84.0dB	0	1	1	1	1
the infinitesimal	1	1	1	1	1

### (b) Input select

Input select		D41	D51	D111	D112
IN A	IN E off	0	0	0	0
IN B		1	0		
IN C		0	1		
IN D		1	1		
IN A to D all OFF		*	*	1	1 *1
IN A-D select	IN E on	A: 0	0	0	1 *2
		B: 1	0		
		C: 0	1		
		D: 1	1		

\*1) The input impedance is about 5k as input INE.

\*2) INE can be controlled independently.  
It can be used as Rec output.

### (c) Mode control

Mode	D42	D52
stereo	0	0
mono1 only	1	0
mono2 only	0	1
mono1+2	1	1

### (d) Treble control

Treble	D92	D102
0dB	0	0
3dB	1	0
6dB	0	1
9dB	1	1

### (e) Bass control

Bass	D62	D72	D82
0dB	0	0	0
3dB	1	0	0
6dB	0	1	0
9dB	1	1	0
12dB	0	0	1
15dB	1	0	1
18dB	0	1	1
21dB	1	1	1

### (f) Chip/Slot control

Chip/Slot	D12*	D13*
select(slot1)	0	0
no select	1	0
no select	0	1
select(slot1)	1	1

### (g) Treble amp gain SW

Gain SW	D21	D31
20dB	0	0
18dB	1	0
16dB	0	1
14dB	1	1

### (h) Bypass/ Surround SW

Bypass/ Surround SW	D11
Bypass	0
Surround	1

### (i) Surround mode

Mode	D02	D12
QSurround	0	0
..	1	0
Wide surround	0	1
Normal surround	1	1

### (j) Surround effect (Valid in the surround mode. Set 0dB at QSurround.)

Effect	D22	D32
+3dB	0	0
0dB	1	0
-3dB	0	1
-6dB	1	1

## (2) NOTICE OF CONTROL DATA

- 1.Input only the control data at (1) INPUT DATA.
- 2.The interval of data transmission from the microcontroller is over 0.1 sec.This is waiting time for soft-switching to reduce the shocknoise.
- 3.It's necessary to set up the all control data after power-on,although the internal circuit is forced as belows,when  $(VDD-VSS) \leq 3.3V(TYP)$ .

Parameter	Condition
Gain SW	18dB
Input select	ALL OFF
Master volume	infinitesimal
MUTE	ON(Input ALLOFF)
Surround effect	- 6dB
Surround	OFF
Surround mode	QSurround
Mode select	stereo
Bass	0dB
Treble	0dB
IN E	ON

## ELECTRICAL CHARACTERISTICS

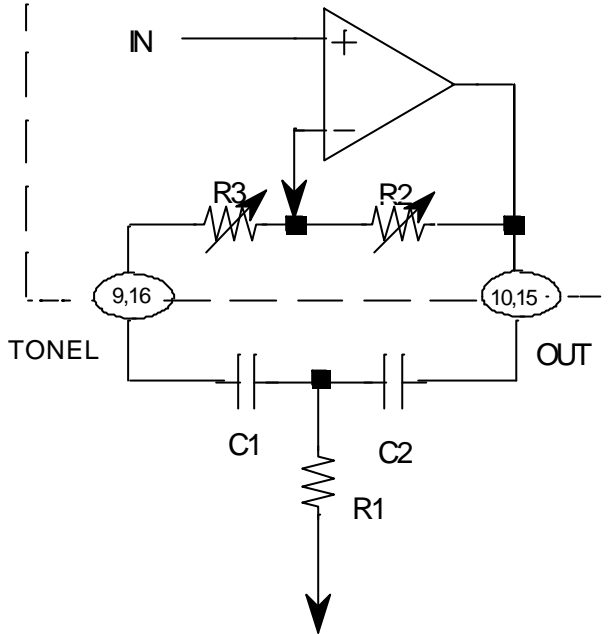
(VDD=2.5V, VSS=-2.5V, f=1kHz, Vi=100mV(rms), VOL=0dB, BASS=0dB, TREBLE=0dB, VOL/TREBLE SHARE AMP=18dB, SURROUND=BYPASS, RL=10K, Ta=25°C, unless otherwise noted)

Symbol	Parameter	Condition	Limits			Unit	
			min.	typ.	max.		
IDD	Circuit current of positive power supply	Quiescent	—	30	45	mA	
ISS	Circuit current of negative power supply	Quiescent	—	-30	-45	mA	
Gv1	Voltage gain (selector)	Vol/Treble share amp gain=18dB Bypass	16	18	20	dB	
Gv2	Voltage gain (tone control)	Vol/Treble share amp gain=18dB QSurround mode Vi=20mVrms	25.5	27.5	29.5	dB	
Vomax	Maximum output voltage	RL=10k, THD=1%	1.2	1.6	—	Vrms	
THD	Total harmonic distortion	BW=400 ~ 30kHz	—	0.02	0.08	%	
No1	Output noise voltage	JIS-A, Rg=5.1k, VOL=the infinitesimal BYPASS	—	6	15	uVrms	
No2		JIS-A, Rg=5.1k, VOL=the infinitesimal QSurround mode	—	11	30	uVrms	
ATTmax	Maximum attenuation	Output reference level (Vo=1Vrms), ATT=the infinitesimal, JIS-A	—	-95	-90	dB	
GB1	Bass boost	3dB	f=1kHz, Vo=80mVrms	1.5	3	4.5	dB
GB2		6dB		4.5	6	7.5	
GB3		9dB		7.5	9	10.5	
GB4		12dB		10.5	12	13.5	
GB5		15dB		13.5	15	16.5	
GB6		18dB		16.5	18	19.5	
GB7		21dB		19.5	21	22.5	
GT1	Treble boost	3dB	f=1kHz, Vo=80mVrms	1.5	3	4.5	dB
GT2		6dB		4.5	6	7.5	
GT3		9dB		7.5	9	10.5	



# FUNCTION DESCRIPTION

## (1) Equivalent circuit of the bass boost



$$F_0 = \frac{1}{2\pi \sqrt{R1(R2+R3)C1C2}} \quad (\text{Hz})$$

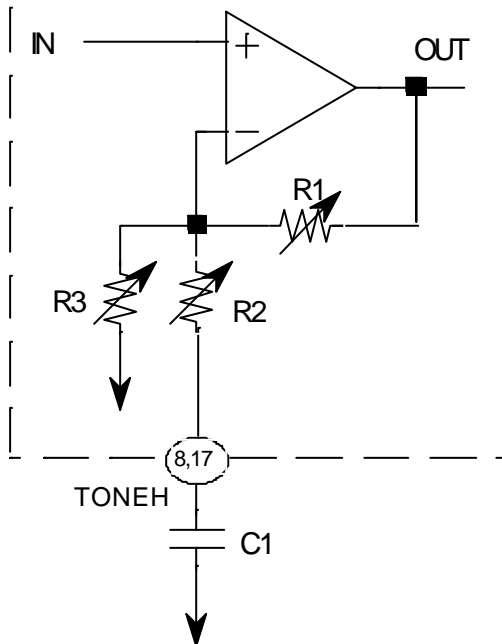
$$Q = \frac{1}{C1+C2} \sqrt{\frac{C1C2R2}{R1}}$$

$$(C1=C2) \quad Gv = 20 \log \frac{\frac{R2+R3}{R1} + 2}{\frac{R3}{R1} + 2} \quad (\text{dB})$$

R2,R3 (typical)

Bass boost	3dB	6dB	9dB	12dB	15dB	18dB	21dB	
Resistor	R2	15.4	25.7	32.9	38.7	41.6	44.2	46
(k)	R3	30.6	20.3	13.1	7.3	4.4	1.8	0

## (2) Equivalent circuit of the treble boost



$$F_c = \frac{1}{2\pi R2 C1} \quad (\text{Hz})$$

$$Gv = 20 \log \frac{R1 + \{(R2+Zc)\}/R3}{(R2+Zc)\}/R3} \quad (\text{dB})$$

$$Zc = \frac{1}{j\omega C1} \quad (\text{ohm})$$

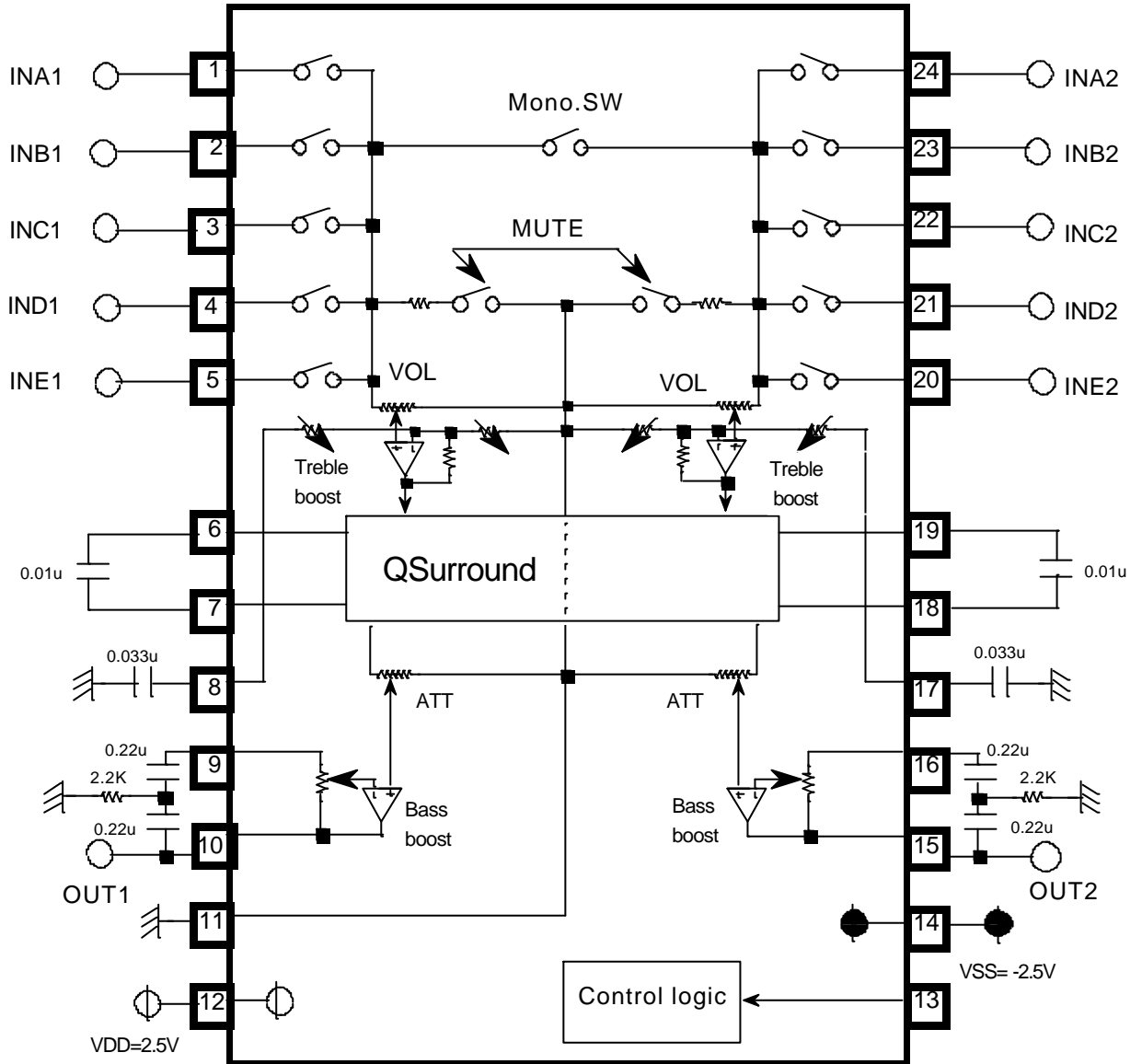
R2 (typical)

Treble boost	3dB	6dB	9dB
R2 (k)	5.3	2.2	1.2

R1,R3 (typical)

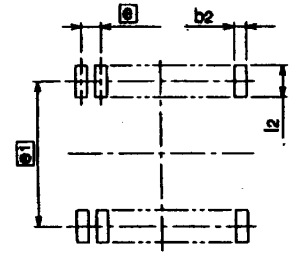
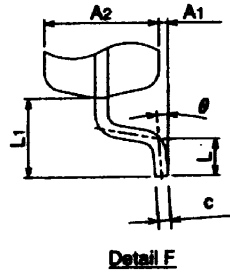
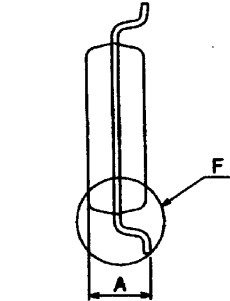
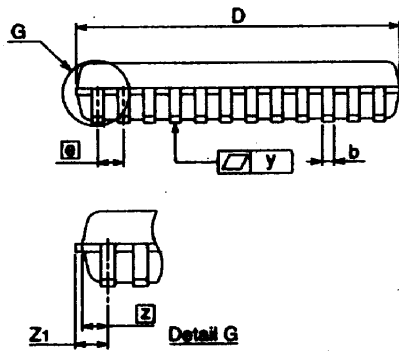
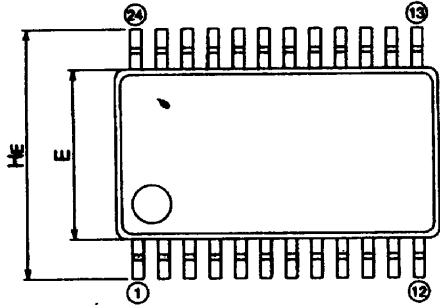
Gain	14dB	16dB	18dB	20dB
R1 (k)	10.88	13.65	17.21	21.60
R3 (k)	2.72	2.57	2.48	2.40

# APPLICATION EXAMPLE



Units Resistor : ohm  
Capacitor: F

# OUTLINE



Recommended Mount Pad

Symbol	Dimension in Millimeters		
	Min	Nom	Max
A	-	-	2.1
A1	0	0.1	0.2
A2	-	1.8	-
b	0.3	0.35	0.45
c	0.18	0.2	0.25
D	10.0	10.1	10.2
E	5.2	5.3	5.4
ⓐ	-	0.8	-
HE	7.5	7.8	8.1
L	0.4	0.6	0.8
L1	-	1.25	-
ⓑ	-	0.65	-
Z1	-	-	0.8
y	-	-	0.1
$\theta$	0°	-	8°
b2	-	0.5	-
ⓐ1	-	7.62	-
l2	1.27	-	-