

M61529FP

Audio Signal Processor with Surround

REJ03F0010-0100Z

Rev.1.00

Sep.04.2003

Description

M61529FP is the semiconductor integrated circuit for Home Audio. M61529FP includes 2ch electronic volume, Tone control, 4 Input Selector, Bass Boost, REC output and Mic Mixing. This IC is suitable for Mini Component. A difference in M61529FP and M61519FP has just changed Tone Input ATT from 0/-13dB to 0/-8.2dB.

Features

- 2ch Master Volume (L,R Independent Control)
 - Main Volume : 0dB to -76dB (2dB or 4dB step), $-\infty$
 - Trim Volume : 0dB to -15dB (1dB step)

*Total level is fixed at -87dB, on condition that the total level of Trim and Master volume is under "-87dB".
- Tone Control (Bass/Mid/Treble)
 - ± 8 dB (2dB step)
- 4 Input Selector with Mute
- Surround Function
- Vocal Cut Function
- Bass Boost Function
- L+R Output for Spectrum Analysis Display
- L+R Output for Subwoofer
- MIC Mixing Function
- 2 REC output with mute
- Input ATT : -5/0/+3.5dB
- Tone Input ATT : 0/-8.2dB
- External Input ATT : +3/0/-3/-6dB

Application

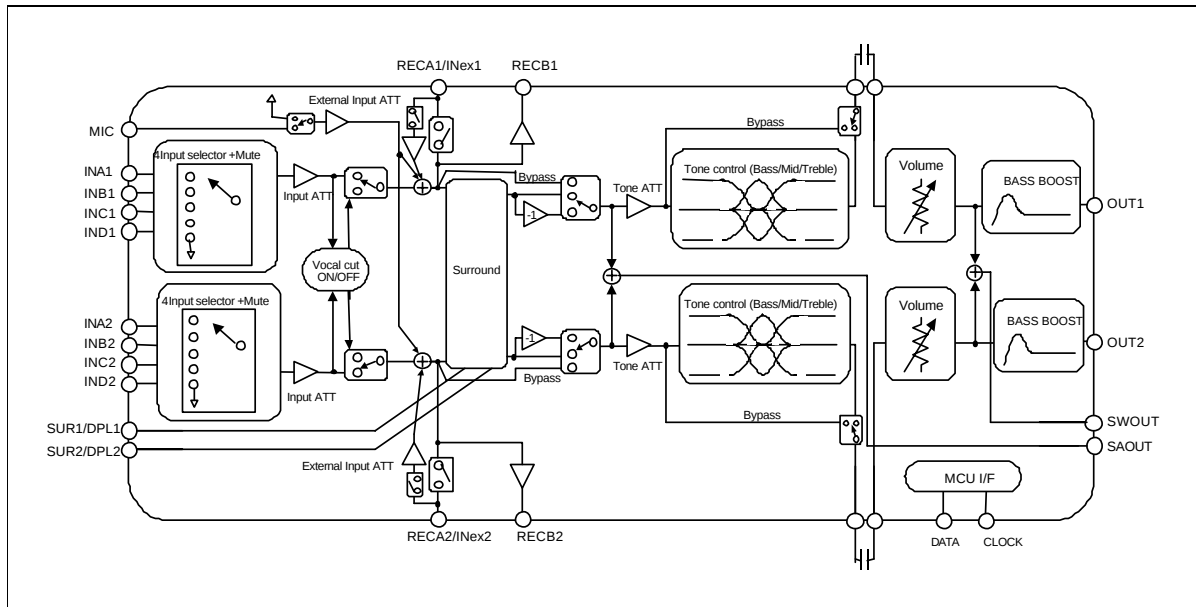
Mini/Micro Component, Radio-Cassette Recorder with CD Player, etc.

Recommended Operating Conditions

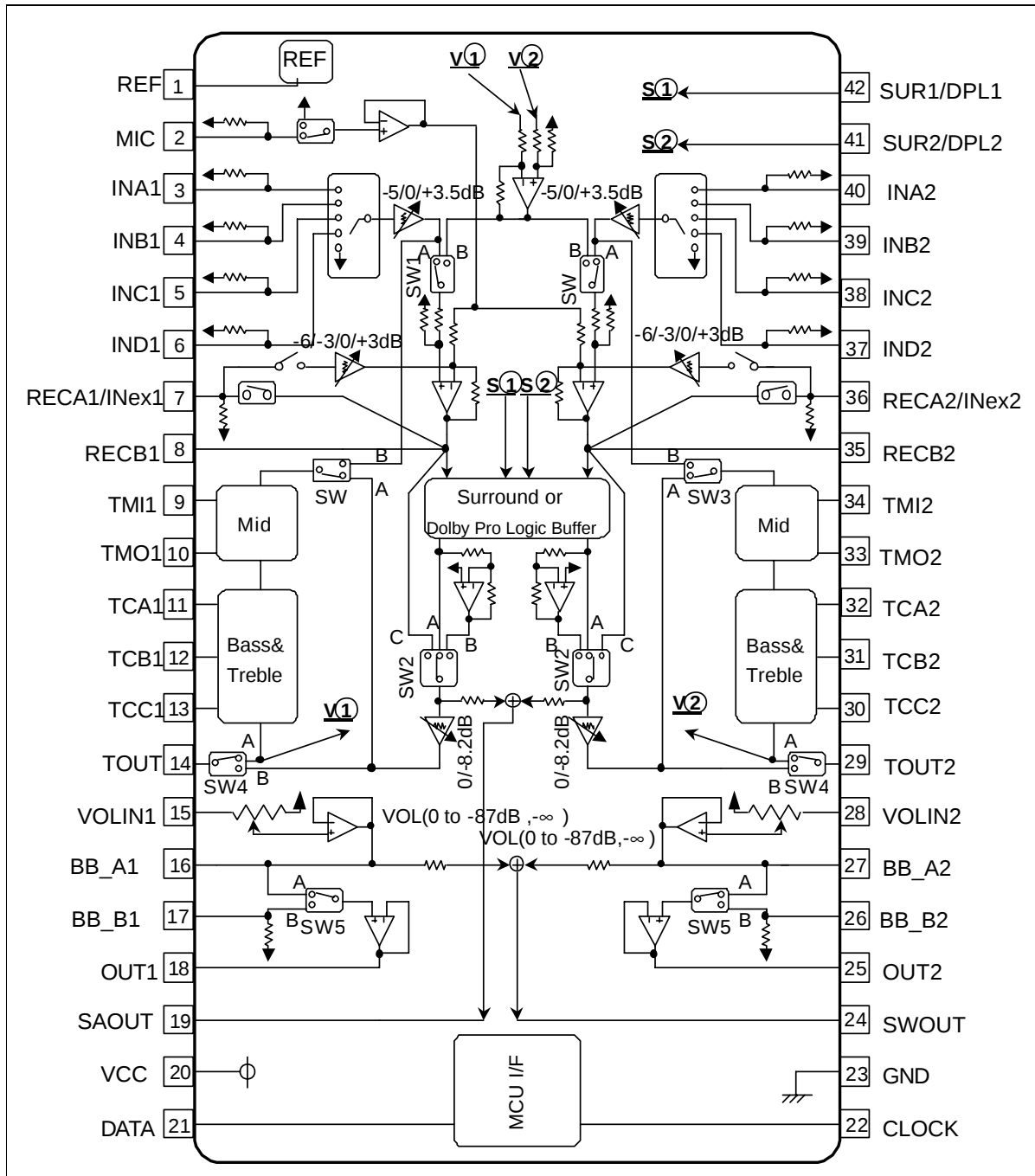
Supply voltage range.....8.0 to 10.0V

Recommended supply voltage.....9.0V

System Block Diagram



Pin Configuration and Block Diagram



Note : Dolby

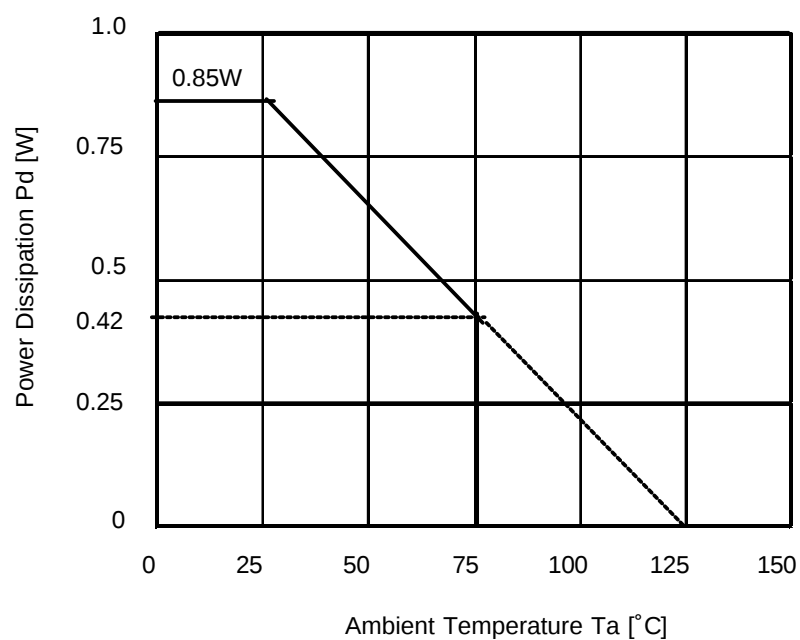
Pin Description

Pin No.	Symbol	Function
1	REF	Input pin of internal reference (REF=4.5V)
2	MIC	Input pin of MIC Mixing
3, 4, 5, 6 37, 38, 39, 40	INA to IND	Input Selector
41, 42	SUR/DPL	External pins for surround, Switching use with DPL Input pin
7, 8, 35, 36	RECA/INex, RECB	Output pins for REC, RECA can switch mute function and external Input pins (At external input, RECA Switch is fixed mute position.)
9, 10, 33, 34	TMI, TMO	External pins for Mid (sympathetic vibration type)
11, 12, 13, 30, 31, 32	TCA, TCB, TCC	External pins for Bass/Treble (Shelving type)
14, 29	TOUT	Output pins of tone control
15, 28	VOLIN	Input pins of electronic volume
16, 17, 26, 27	BB_A, BB_B	External pins for Bass boost
18, 25	OUT	Output pins
19	SAOUT	Mix pins for spectrum Analyzer (L+R/2)
24	SWOUT	Mix pin for super woofer
20	VCC	Internal analog, power pin for digital circuit
23	GND	Internal analog, GND pin for digital circuit
21, 22	DATA, CLOCK	DATA for serial data, Clock input pin

Absolute Maximum Ratings

Symbol	Parameter	Conditions	Limits	Units
V_{cc}	Supply voltage		10.5	V
P_d	Power dissipation	$T_a \leq 25^\circ\text{C}$	850	mW
K	Thermal derating	$T_a > 25^\circ\text{C}$	8.6	mW/ $^\circ\text{C}$
T_{opr}	Operating temperature		-20 to +75	$^\circ\text{C}$
T_{stg}	Storage temperature		-40 to +125	$^\circ\text{C}$

Thermal Derating

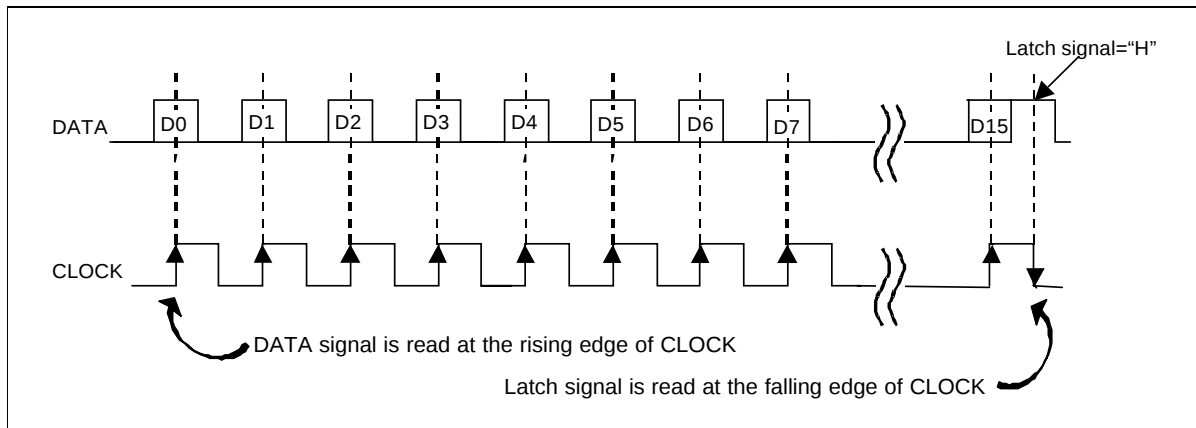


Recommended Operating Condition

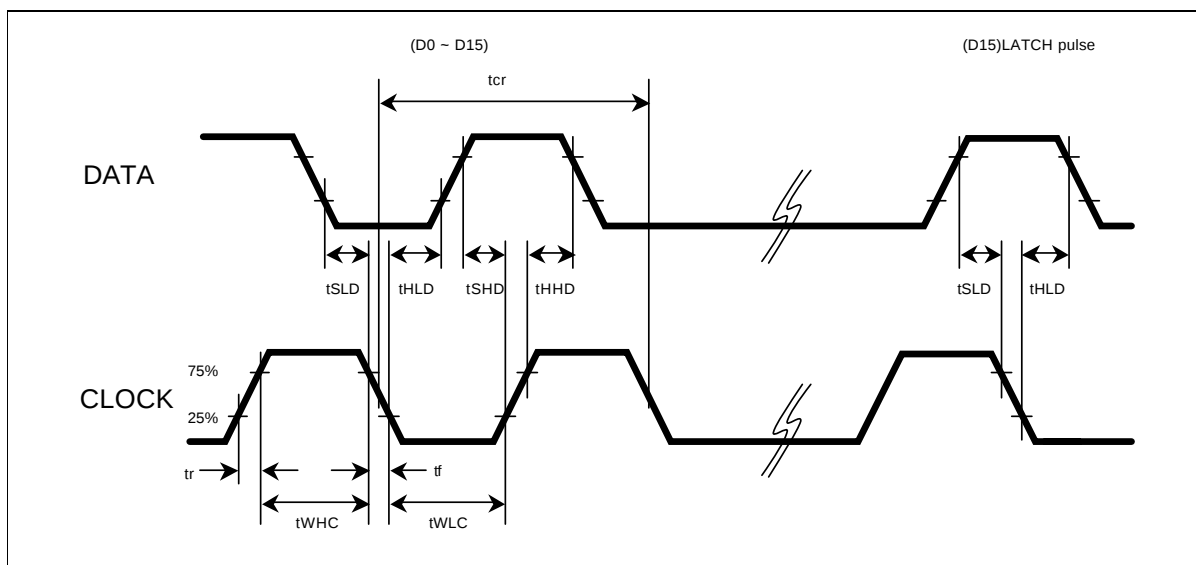
($T_a = 25^\circ\text{C}$, unless otherwise noted.)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage	V_{CC}		8	9	10	V
Logic "H" level Input voltage	V_{IH}	$V_{CC} = 9\text{V}$	2.2	—	5.5	V
Logic "L" level Input voltage	V_{IL}	$V_{CC} = 9\text{V}$	0	—	0.6	V

Relationship Between Data and Clock and Latch



Data Timing (Recommended conditions)



Digital Block Timing Regulation

Symbol	Parameter	Limits			Unit
		Min	typ	Max	
t_{cr}	CLOCK cycle time	4	—	—	μs
t_{WHC}	CLOCK pulse width ("H" level)	1.6	—	—	
t_{WLC}	CLOCK pulse width ("L" level)	1.6	—	—	
t_r	CLOCK rise time	—	—	0.4	
t_f	CLOCK fall time	—	—	0.4	
t_{SHD}	DATA setup time ("H" level) CLOCK rise	0.8	—	—	
t_{SLD}	DATA setup time ("L" level) CLOCK rise	0.8	—	—	
t_{HHD}	DATA hold time ("H" level)	0.8	—	—	
t_{HLD}	DATA hold time ("L" level)	0.8	—	—	

(10) Trim volume (Lch and Rch)

Trim	D0, 4C	D1, 5C	D2, 6C	D3, 7C
● 0dB	0	0	0	0
-1dB	0	0	0	1
-2dB	0	0	1	0
-3dB	0	0	1	1
-4dB	0	1	0	0
-5dB	0	1	0	1
-6dB	0	1	1	0
-7dB	0	1	1	1
-8dB	1	0	0	0
-9dB	1	0	0	1
-10dB	1	0	1	0
-11dB	1	0	1	1
-12dB	1	1	0	0
-13dB	1	1	0	1
-14dB	1	1	1	0
-15dB	1	1	1	1

Note : Total level is fixed at -87dB, on condition that the total level of Trim and Master volume is under “-87dB”.
(example: Trim -15dB, Master -76dB Total level is -87dB)

(12) Master volume (L, Rch)

Master	D0, 5D	D1, 6D	D2, 7D	D3, 8D	D4, 9D
0dB	0	0	0	0	0
-2dB	0	0	0	0	1
-4dB	0	0	0	1	0
-6dB	0	0	0	1	1
-8dB	0	0	1	0	0
-10dB	0	0	1	0	1
-12dB	0	0	1	1	0
-14dB	0	0	1	1	1
-16dB	0	1	0	0	0
-18dB	0	1	0	0	1
-20dB	0	1	0	1	0
-22dB	0	1	0	1	1
-24dB	0	1	1	0	0
-26dB	0	1	1	0	1
-28dB	0	1	1	1	0
-30dB	0	1	1	1	1
-32dB	1	0	0	0	0
-34dB	1	0	0	0	1
-36dB	1	0	0	1	0
-38dB	1	0	0	1	1
-40dB	1	0	1	0	0
-42dB	1	0	1	0	1
-44dB	1	0	1	1	0
-48dB	1	0	1	1	1
-52dB	1	1	0	0	0
-56dB	1	1	0	0	1
-60dB	1	1	0	1	0
-64dB	1	1	0	1	1
-68dB	1	1	1	0	0
-72dB	1	1	1	0	1
-76dB	1	1	1	1	0
• -∞dB	1	1	1	1	1

Electrical Characteristics

Unless otherwise noticed, Ta = 25°C, VCC = 9V, f = 1kHz, Surround bypass, tone bypass and bass boost = OFF

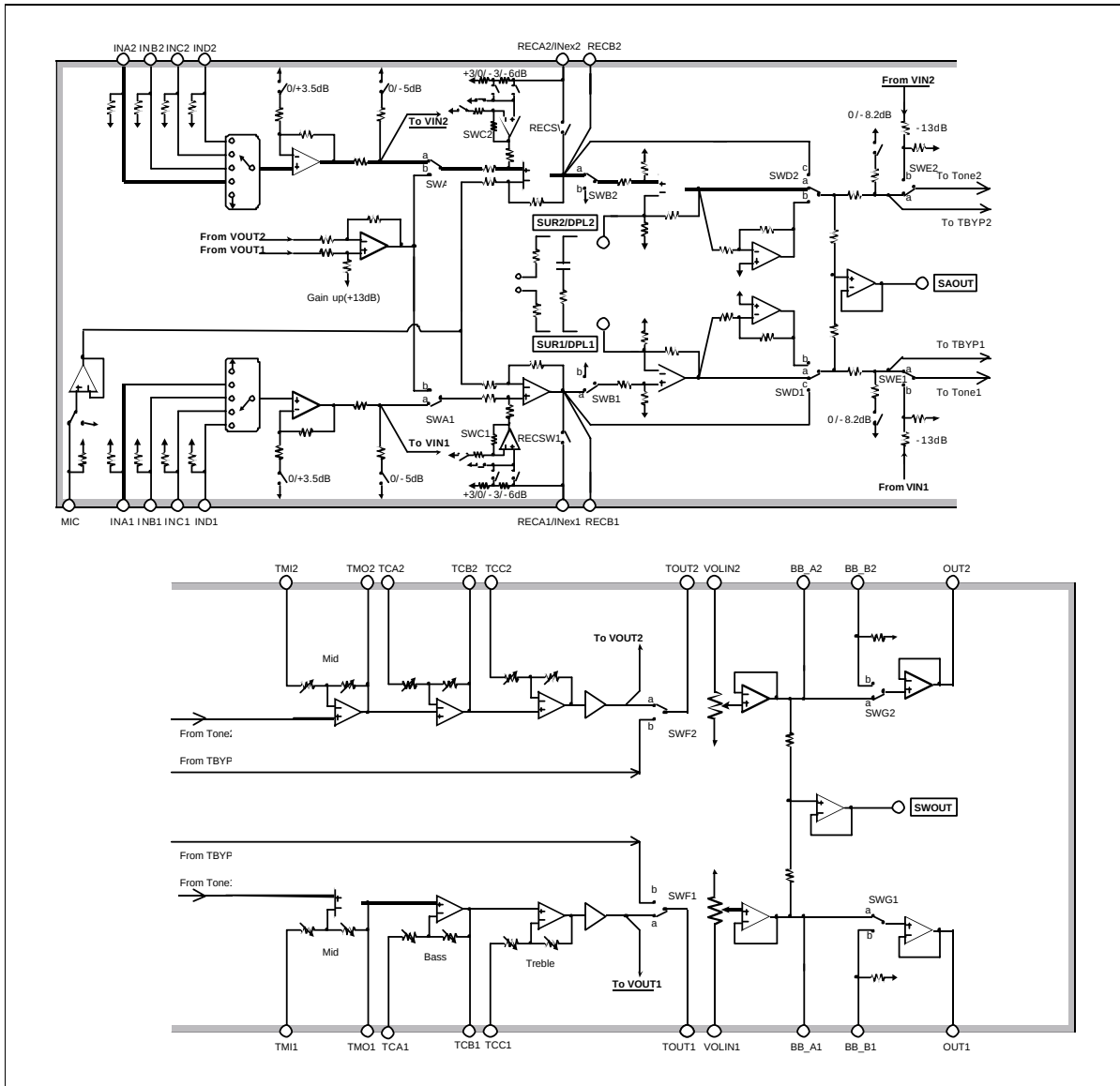
	Parameter	Symbol	Test Condition	Limits			Unit	
				Min	Typ	Max		
Voltage	Analog positive power circuit current	Alcc	At V_{cc} =9.0V, 20 pin terminal current and no signal	—	25	40	mA	
Input and Output	Input resistance	Rin	Input pin 3-6pin,37-40pin,2pin	30	60	90	kΩ	
	Maximum input voltage	VIM	(3,40)pin IN, (8,35)pin OUT RL=10kΩ, THD=1%, Input ATT=-5dB	1.8	2.2	—	Vrms	
	Maximum output voltage	VOM	(3,40)pin IN, (18,25)pin OUT Bass boost ON, f=100Hz, RL=10kΩ, THD=5%	1.8	2.2	—	Vrms	
		VrecOM	(3,40)pin IN, (7,8)(35,36)pin OUT RL=47kΩ, THD=1%, Input ATT=+3.5dB	1.6	2.0	—	Vrms	
	Output terminal voltage	Vodc	At No signal, (18,25)pin OUT	4.0	4.5	5.0	V	
		Vrecdc		4.0	4.5	5.0	V	
	Pass gain	Gv	Vi=1Vrms,FLAT, Gain from (3-18 pin) to (40-25 pin), Input ATT=0dB	-2.0	0.0	2.0	dB	
	Maximum attenuation	ATT	Vo=1Vrms,(18,25)pin OUT JIS-A, Vol.=—∞	—	-92	-87	dB	
	Output noise voltage	Vono	JIS-A, At no signal,Rg=0W	Vol.=0dB	—	10.0	20.0	μVrms
			(8.35)pin OUT	Vol.=—∞	—	4.0	8.0	μVrms
Distortion factor	Vrecno	JIS-A, At no signal, Rg=0Ω (18.25)pin OUT	—	6.0	12.0	μVrms		
		THD	BW:400-30kHz, Vo=0.5Vrms, RL=10kΩ	—	0.02	0.05	%	
		THDrec	BW:400-30kHz, Vo=0.5Vrms, RL=47kΩ	—	0.01	0.05	%	
Cross talk between channels	CT	Vo.=0.5Vrms,RL=10kΩ, JIS-A, Rg=0kΩ	—	-70	55	dB		
	CT rec	Vo.=0.5Vrms, RL=47kΩ, JIS-A, Rg=0kΩ	—	-70	55	dB		
Tone Control	Bass voltage gain	Gbassb	f=100Hz	-8dB	6	8	10	dB
		Gbassc		+8dB	-10	-8	-6	dB
	Mid voltage gain	Gmidb	f=1kHz	-8dB	6	8	10	dB
		Gmidc		-8dB	-10	-8	-6	dB
	Treble voltage gain	Gtrebb	f=10kHz	+8dB	6	8	10	dB
		Gtrebc		-8dB	-10	-8	-6	dB
	Balance between channel	BALton	At each boost value of -8dB and +8dB, Vo=1Vrms, (14,29)pin OUT	-2	0	2	dB	
	MIX Signal	Super woofa output gain	GvSW	Vi=1Vrms, FLAT, Gain from (3-18 pin) to (40-25 pin), Input ATT=0dB	-8.0	-6.0	-4.0	dB
distortion factor		THDSW	BW:400-30kHz, Vo=0.3Vrms, RL=47kΩ 15pin IN, 24pin OUT	—	0.03	0.1	%	
Output noise voltage		VnoSW	JIS-A, At no signal ,Rg=0Ω, 24pin OUT	—	20	—	μVrms	
Output gain for spectrum Analyzer Display		GvSP	Vi=1Vrms, FLAT, Input ATT=0dB, 3pin IN, 19pin OUT	-8.0	-6.0	-4.0	dB	

- Mix Signal Characteristics is provided only CH1 Input. (CH2 Rg=0Ω)

Block Diagram

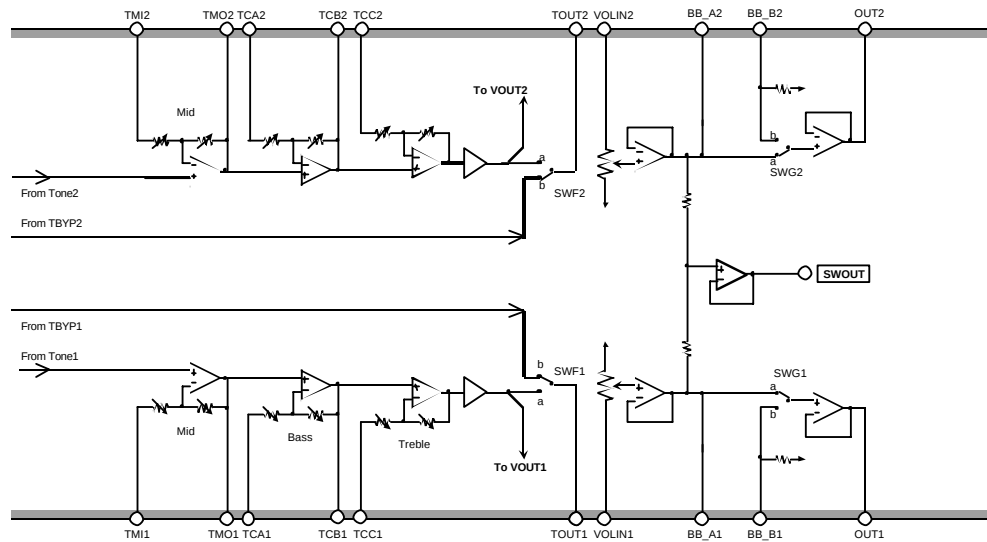
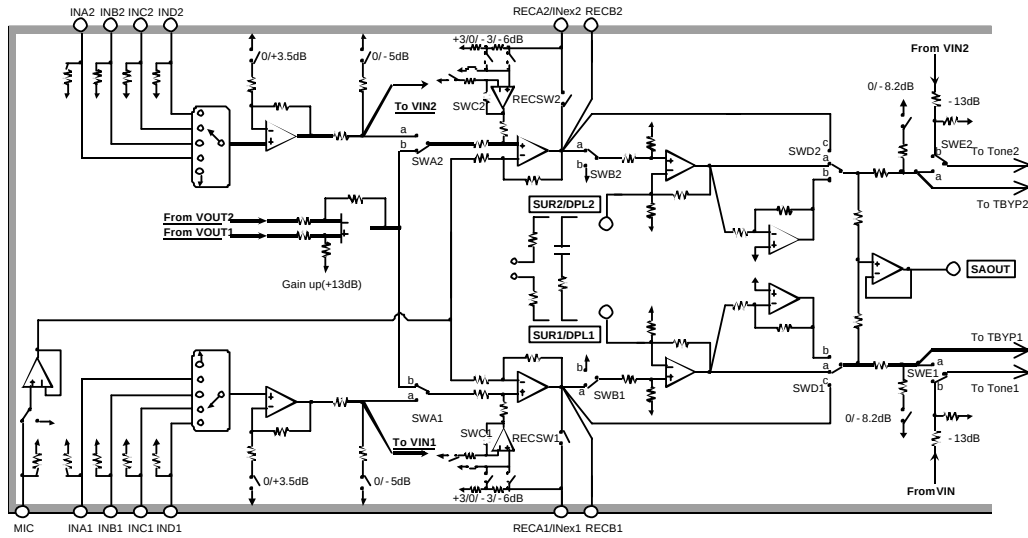
(1) Vocal cut OFF (Bold line; Selector INA, Surround ON, Tone ON, Bassboost OFF)

SWA	a; Vocal Cut OFF	b; Vocal Cut ON	
SWB	a; Surround	b; DPL	
SWC	External Input ATT(+3/0/-3/-6dB/OFF)		
SWD	a; Surround	b; DPL	c; BYPASS
SWE	a; Tone control	b; Vocal Cut	
SWF	a; Tone control	b; Tone bypass, Vocal Cut	
SWG	a; Bassboost OFF	b; Bassboost ON	

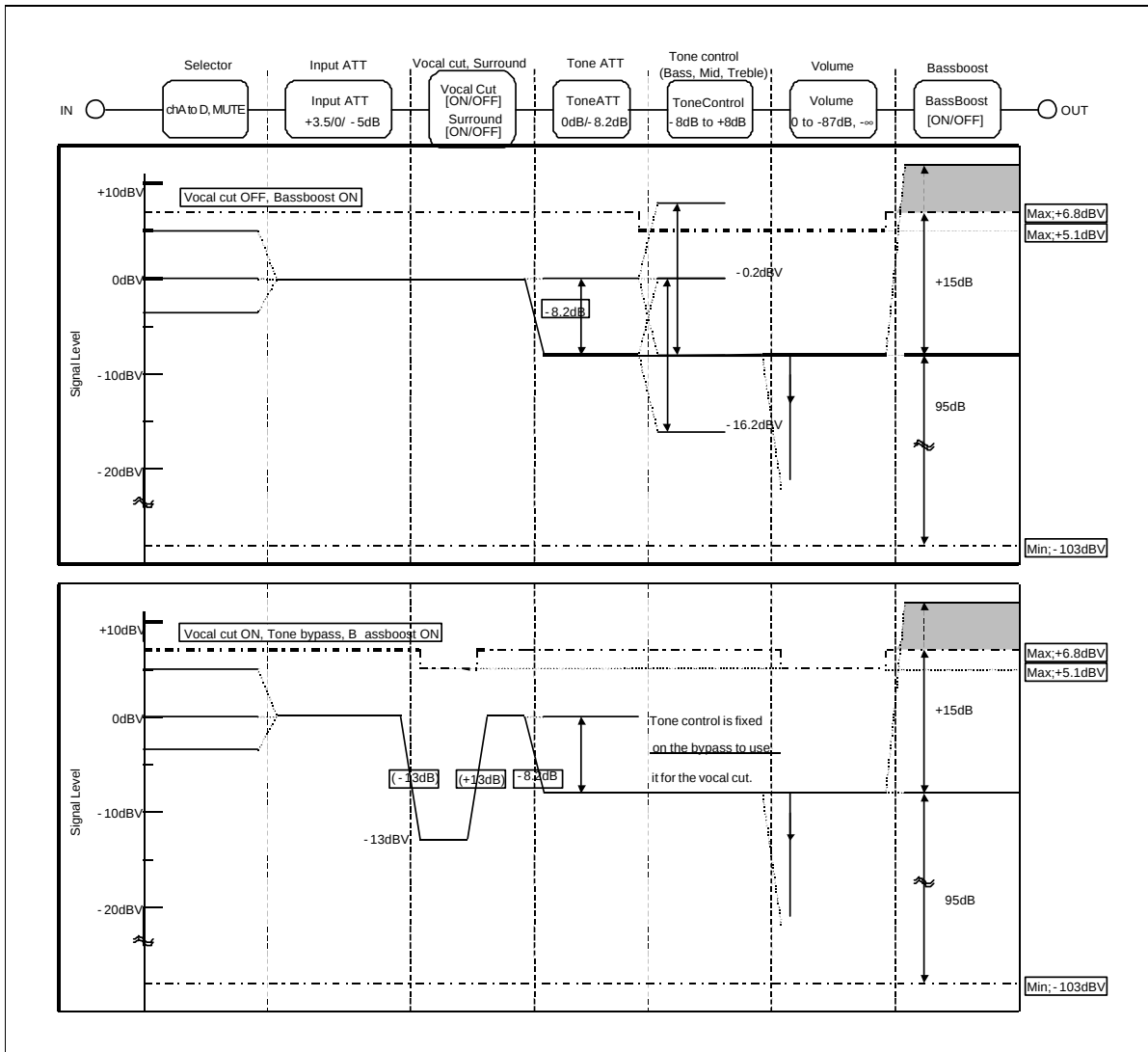


(2) Vocal cut ON (Bold line; Selector INA, Surround ON, Tone OFF, Bassboost OFF)

SWA	a; Vocal Cut OFF	b; Vocal Cut ON	
SWB	a; Surround	b; DPL	
SWC	External Input ATT(+3/0/-3/-6dB/OFF)		
SWD	a; Surround	b; DPL	c; BYPASS
SWE	a; Tone control	b; Vocal Cut	
SWF	a; Tone control	b; Tone bypass, Vocal Cut	
SWG	a; Bassboost OFF	b; Bassboost ON	



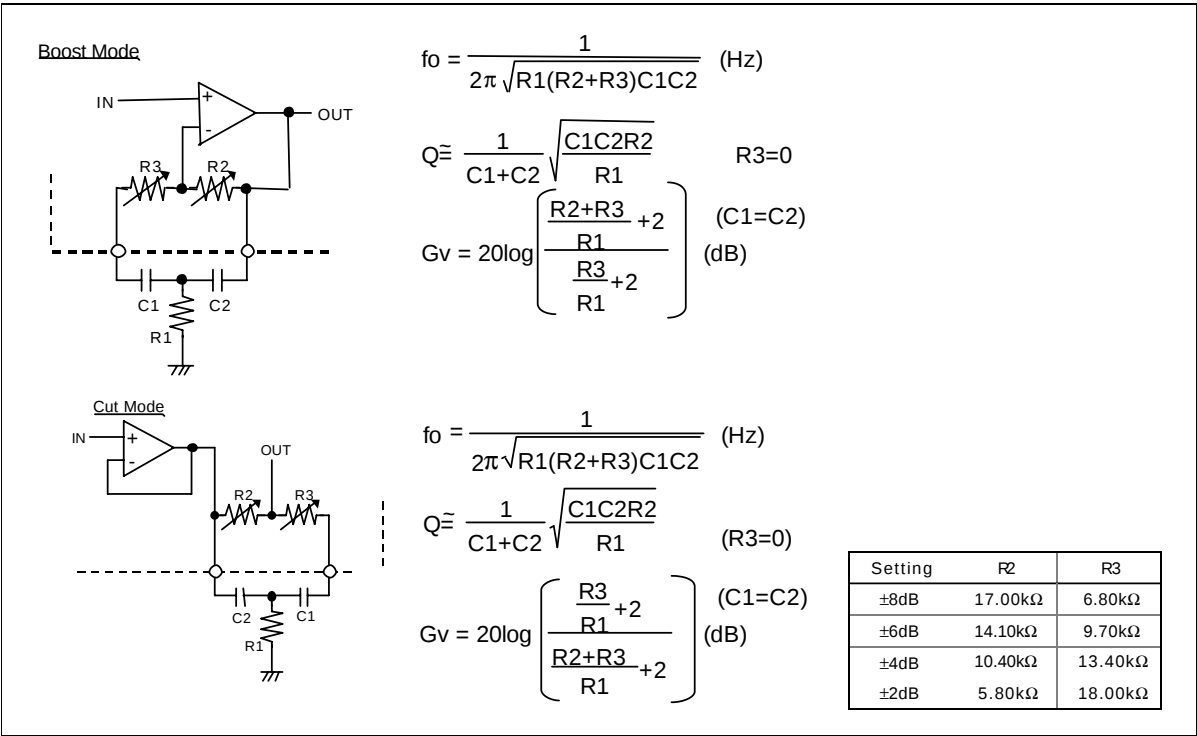
Signal Level Diagram



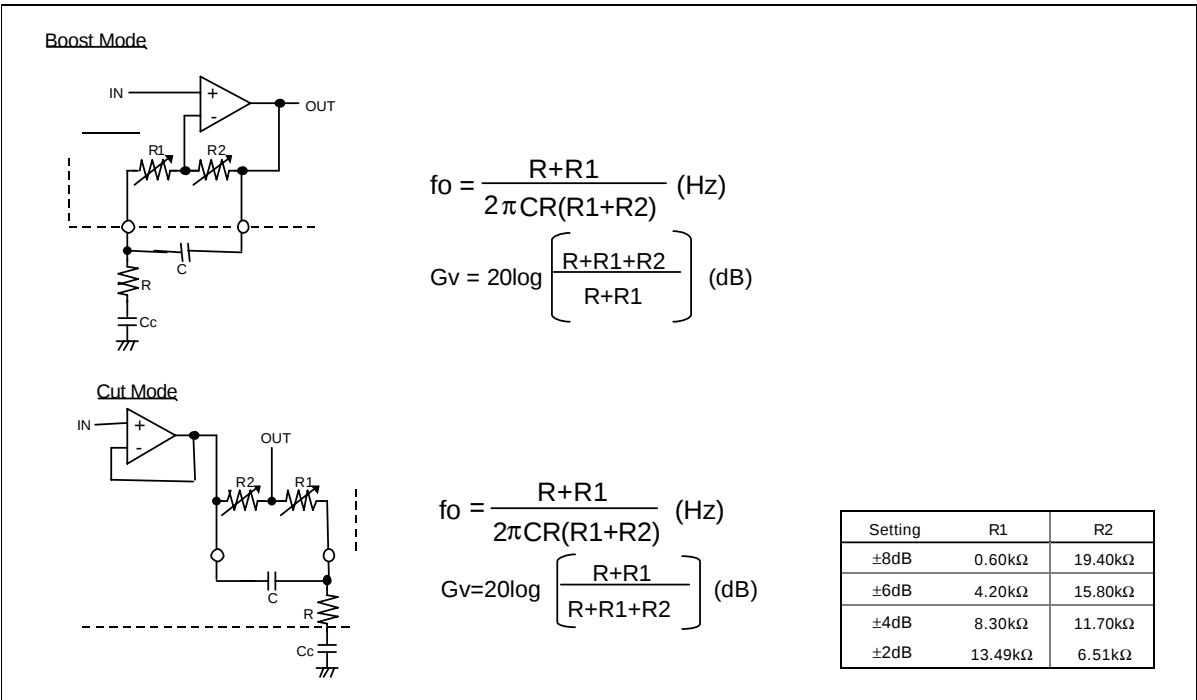
Function Discription

(1) Equivalent circuit of tone control

(a) Mid



(b) Bass



(c) Treble

Boost Mode

$f_0 = \frac{1}{2\pi CR1} \text{ (Hz)}$

$G_v = 20\log \left[\frac{R1+R2}{R1} \right] \text{ (dB)}$

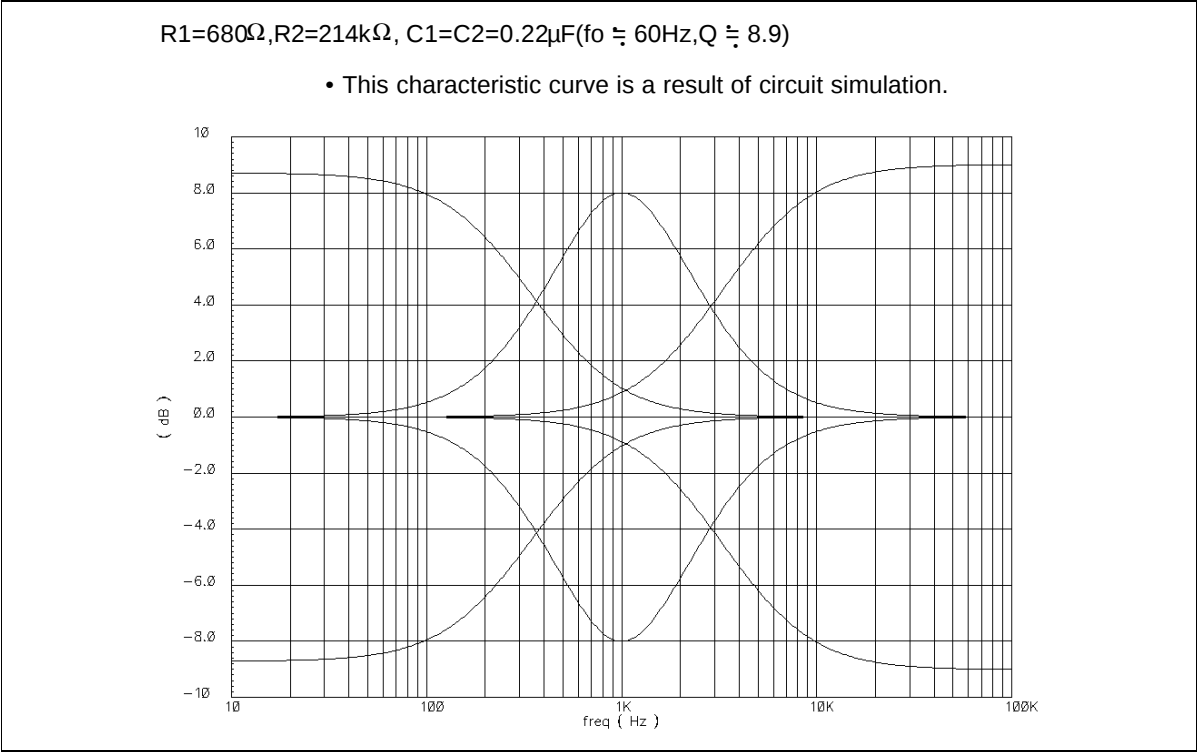
Cut Mode

$f_0 = \frac{1}{2\pi CR1} \text{ (Hz)}$

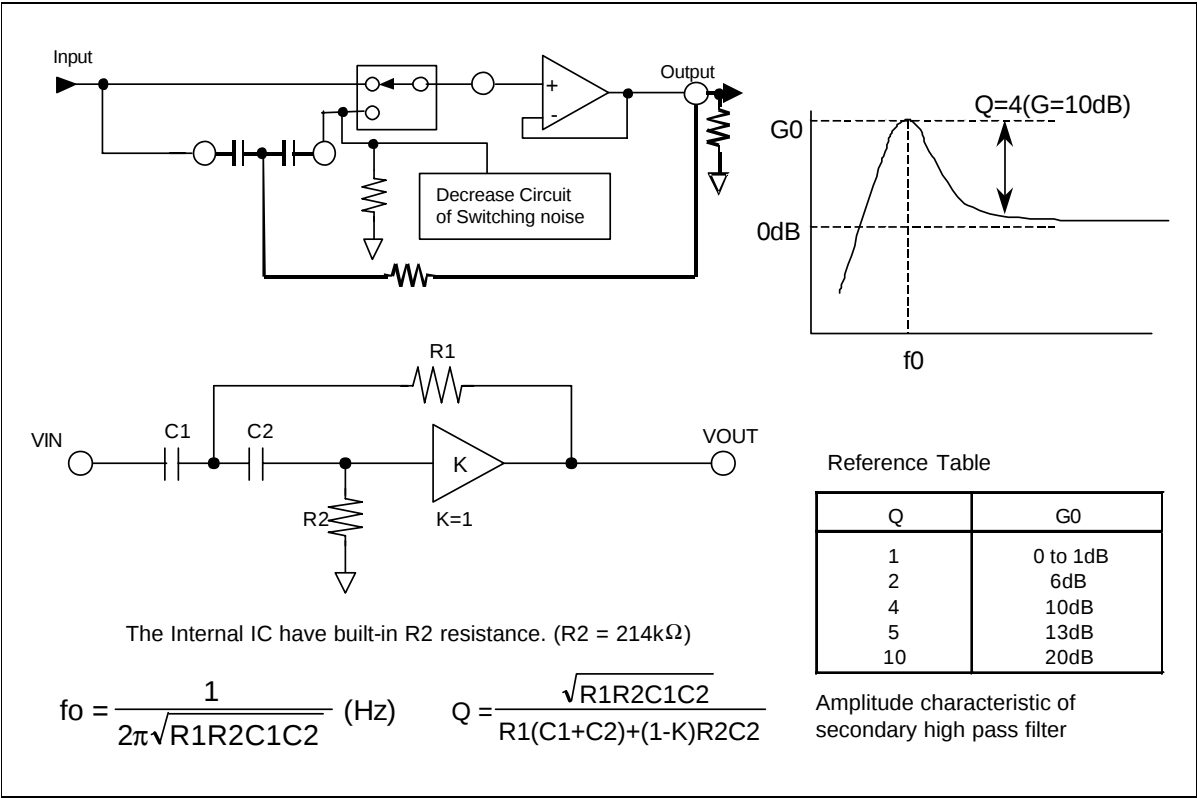
$G_v = 20\log \left[\frac{R1}{R1+R2} \right] \text{ (dB)}$

Setting	R1	R2
±8dB	5.12kΩ	9.91kΩ
±6dB	6.92kΩ	8.11kΩ
±4dB	9.12kΩ	5.91kΩ
±2dB	11.73kΩ	3.30kΩ

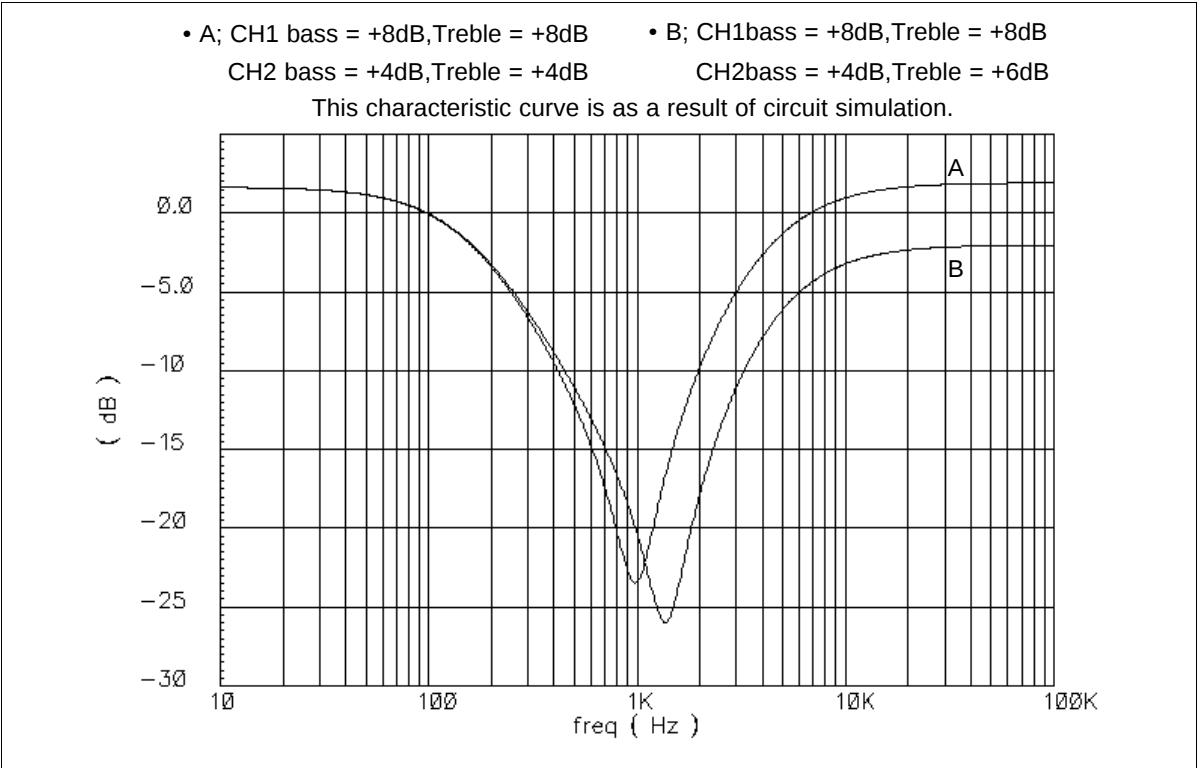
(d) Characteristic Curve of Tone Control



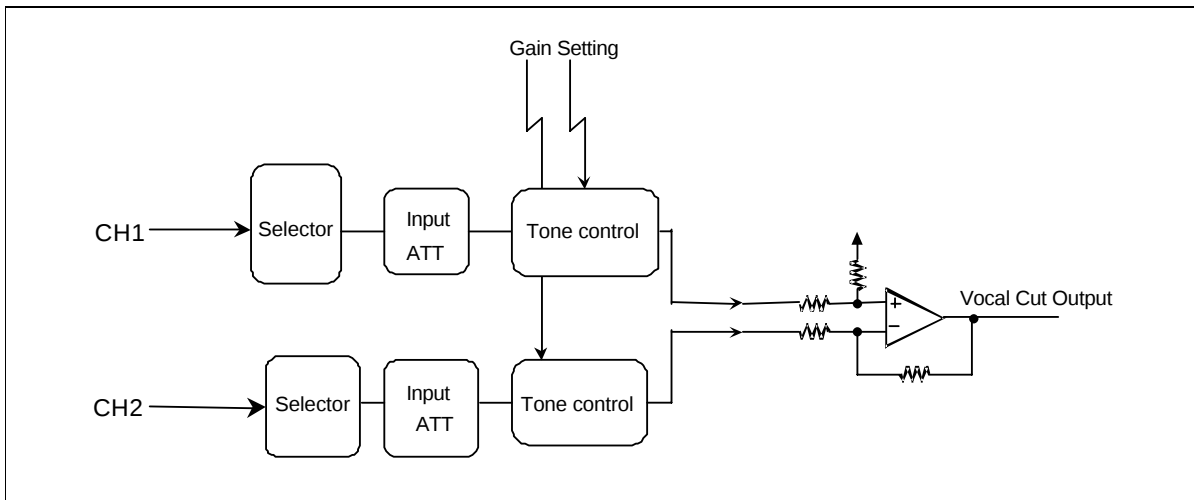
(2) Equivalent circuit of bass boost



- Characteristic Curve of bass boost



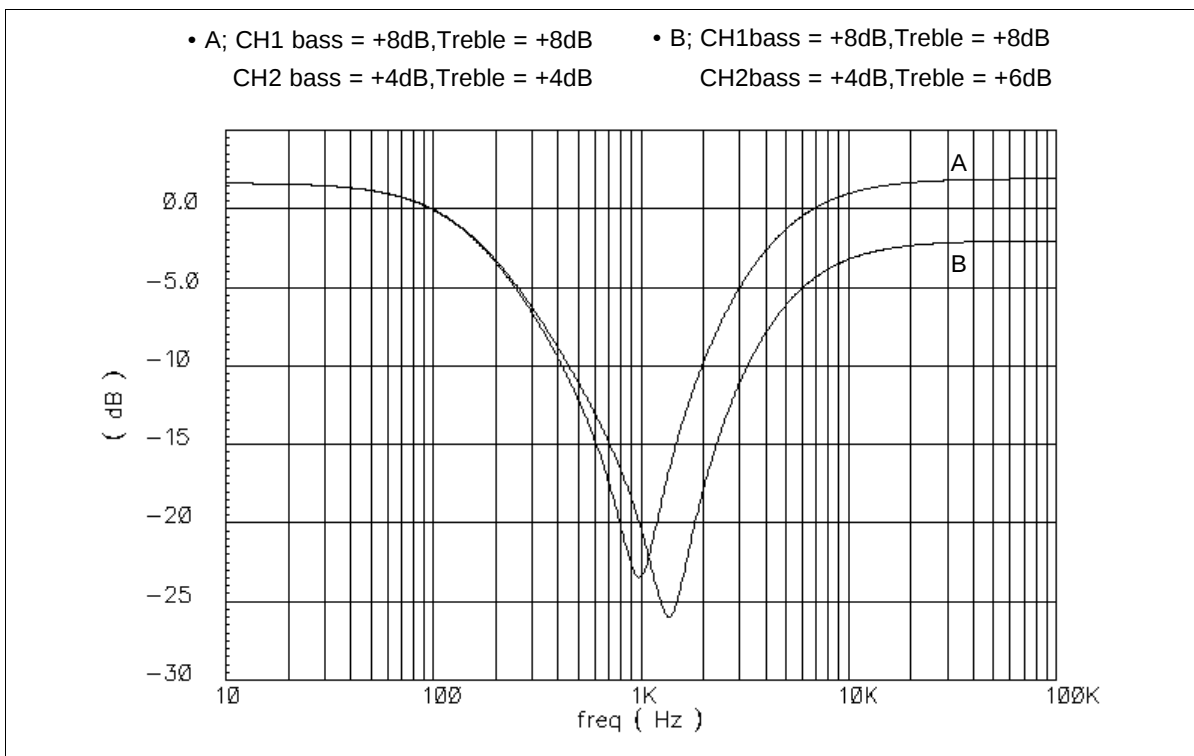
(3) Equivalent circuit of vocal cut



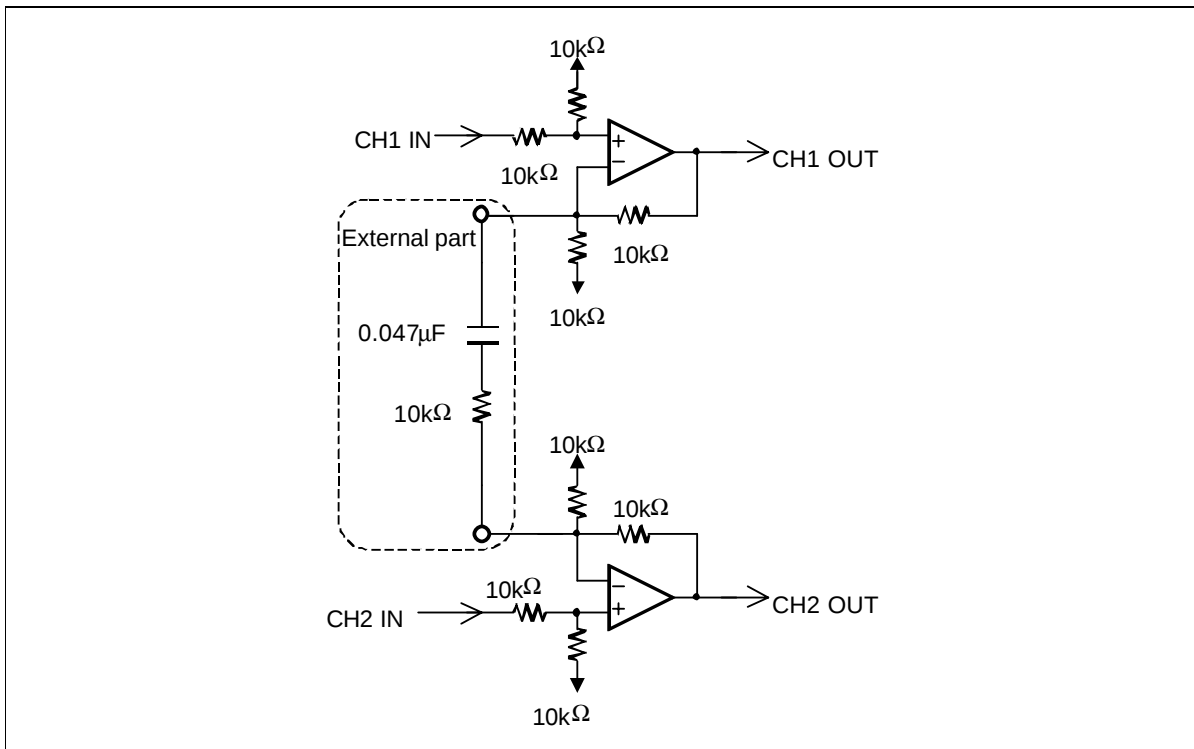
- Tone control cannot use at Vocal cut mode.
- Tone control can use only Bass & Treble mode. (Mid mode is 0dB fixed.)

Output difference of Tone control CH1 and CH2, The characteristic to cut only Middle part of Phase Input Signal is realized.

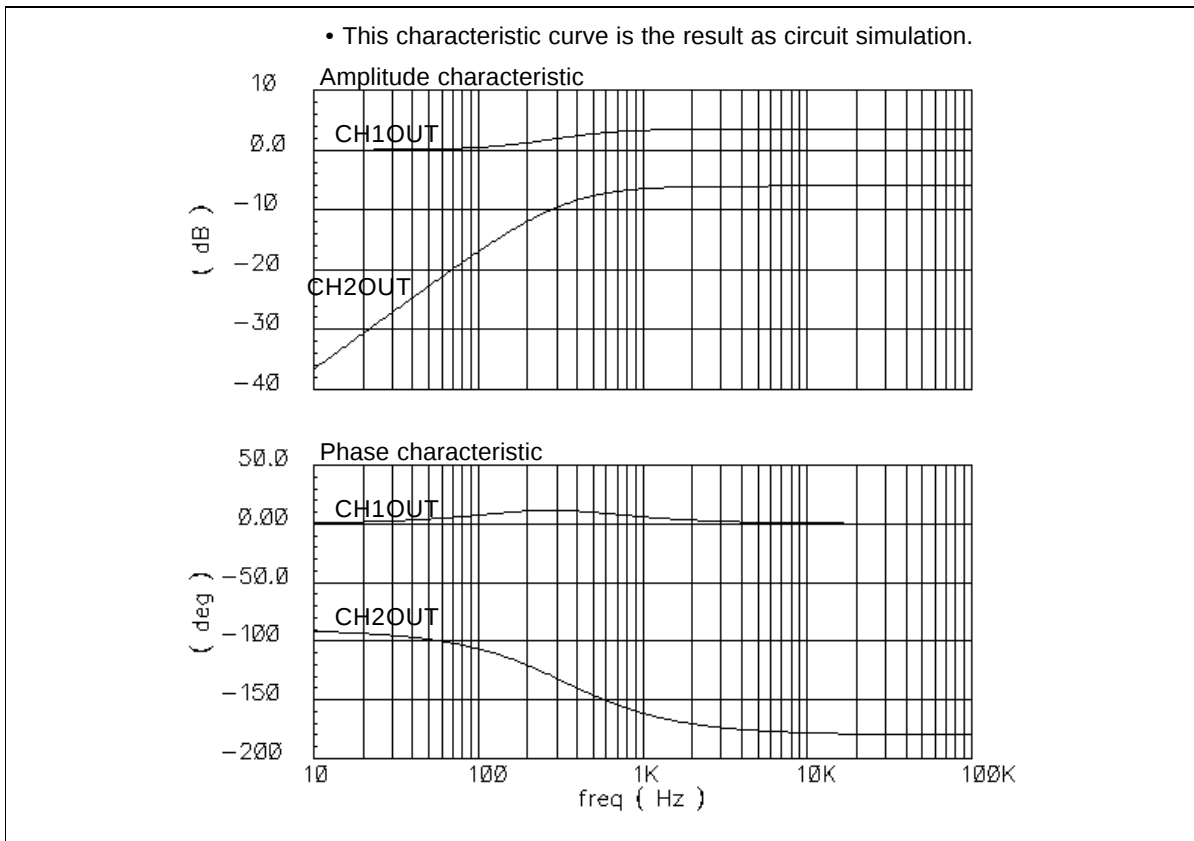
- Characteristic curve example (Phase signal input CH1,CH2)



(4) Surround equivalent circuit

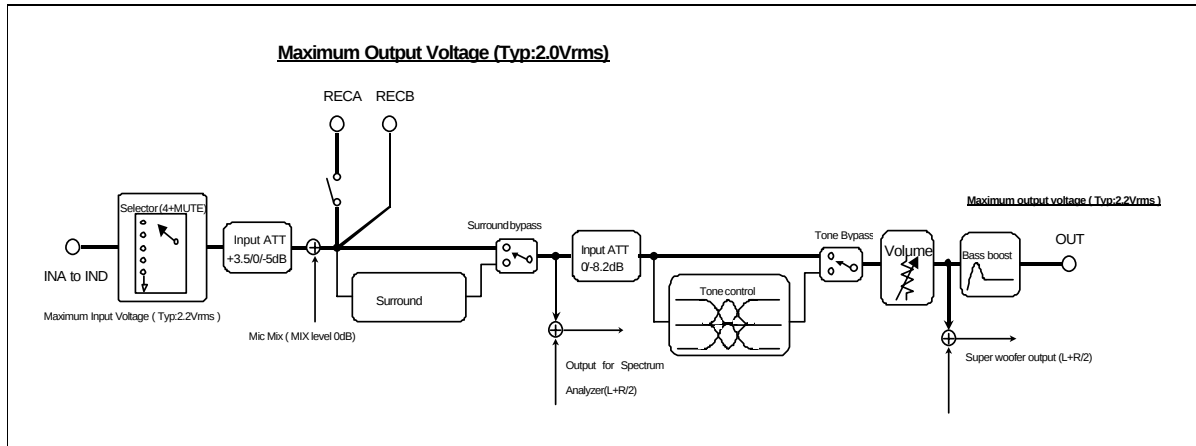


- Characteristic curve example (Only CH1 Input)

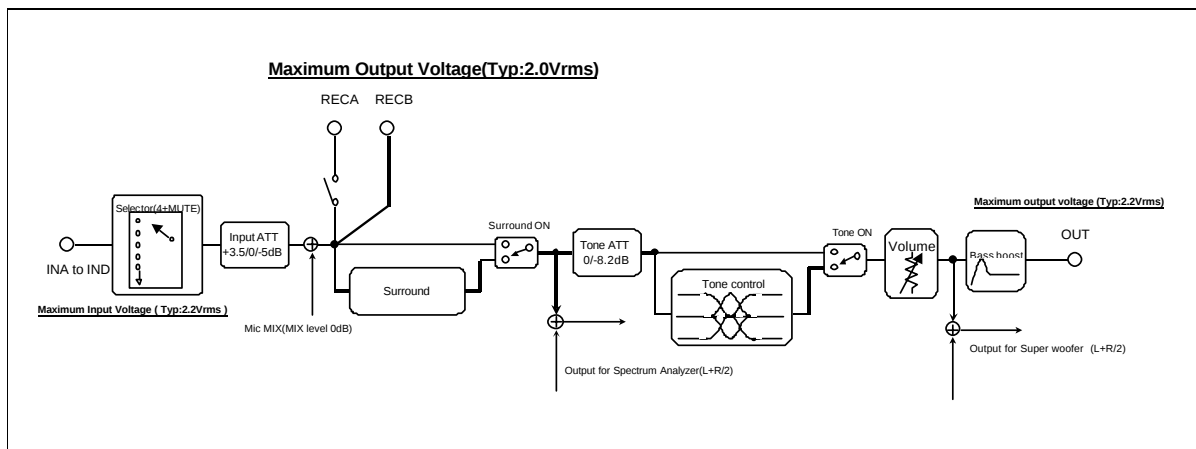


(5) Total equivalent circuit (signal flow diagram)

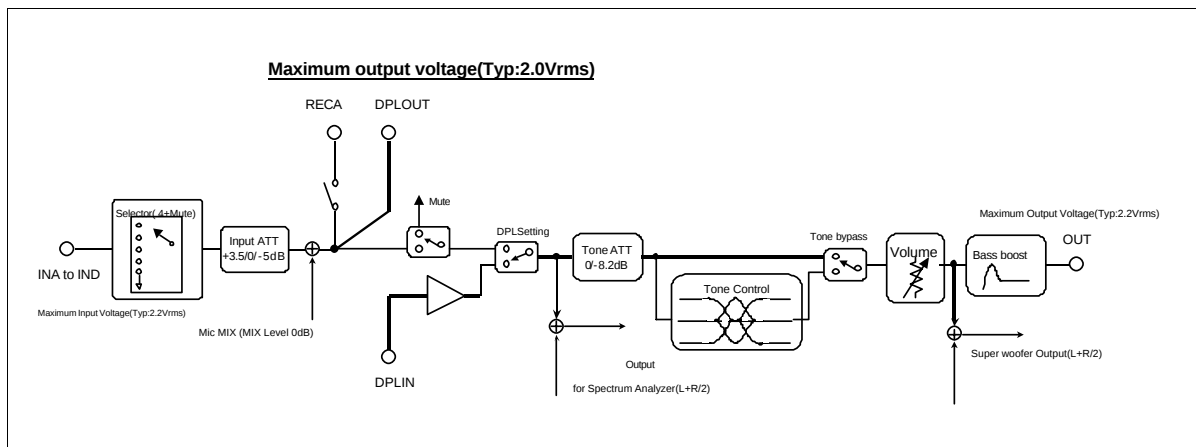
(a) Surround bypass, Tone bypass, Bass boost ON



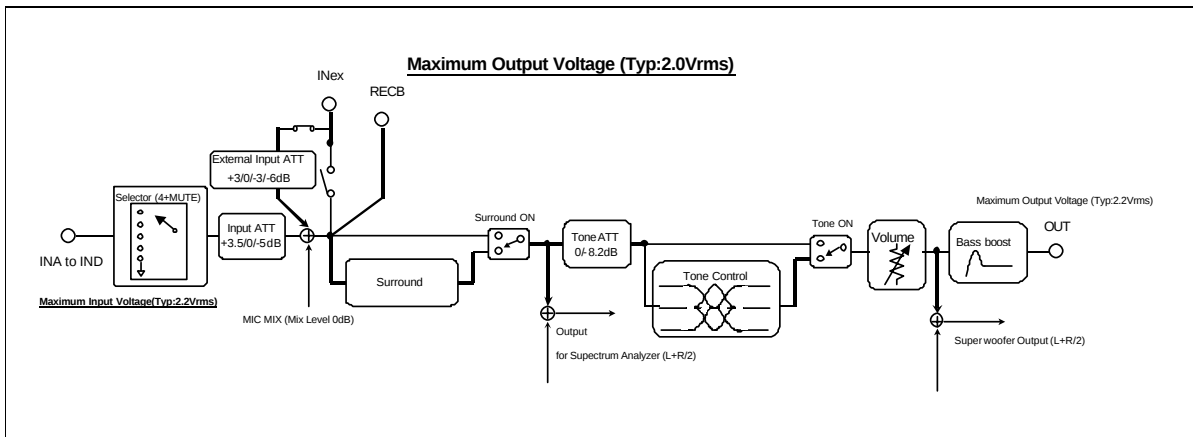
(b) Surround ON, Tone ON, Bass boost ON



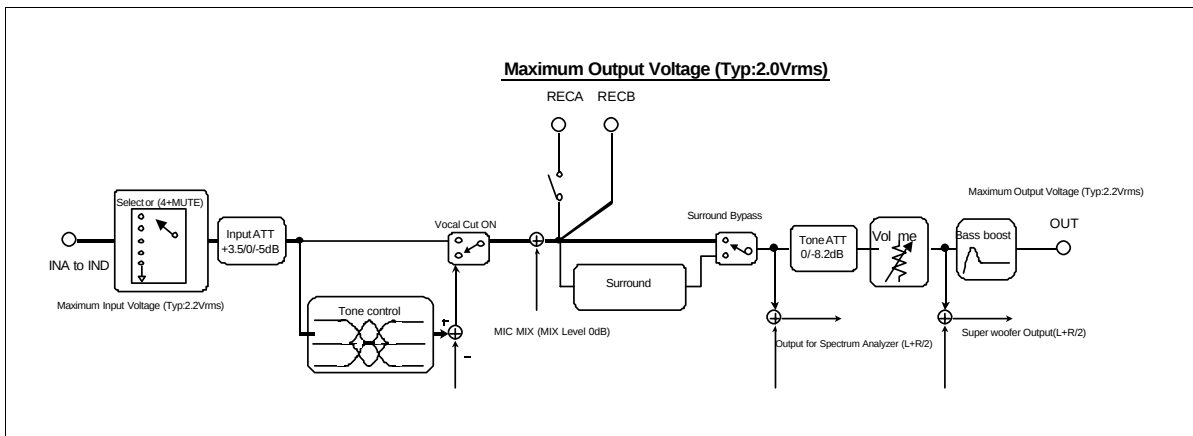
(c) DPL Input setting, Tone bypass, Bass boost ON



(d) External Input Setting, Surround ON, Tone ON, Bass boost ON



(e) Vocal Cut ON, Surround Bypass, Bass boost ON

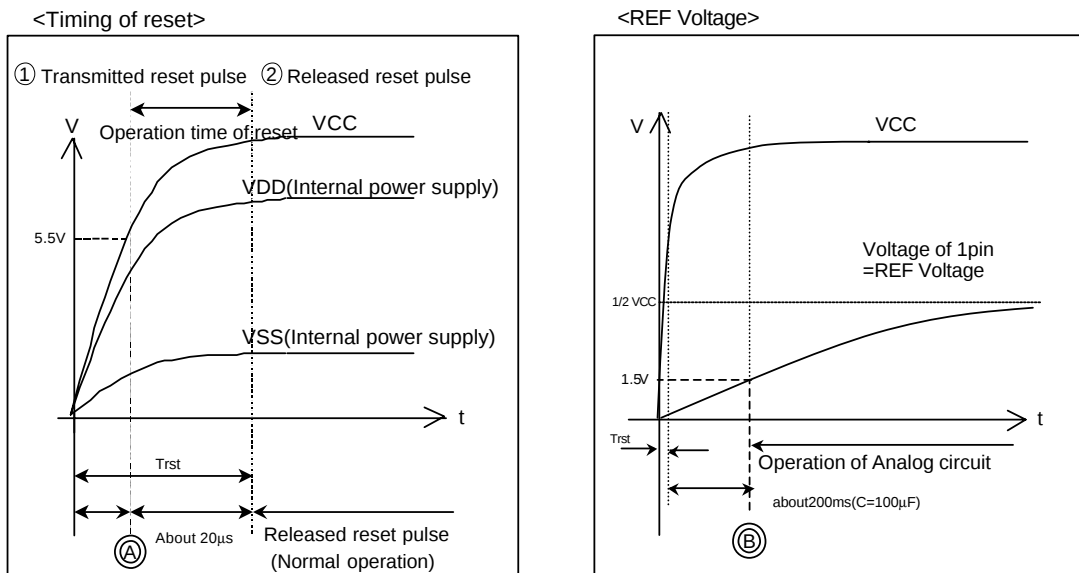


System Reset

(a) IC's condition of power supply turn on

This IC is the system composition which compulsory resetting when power supply turn on.

- Time constant of power supply is used, and reset pulse is formed.
- When V_{CC} exceed 5.5V, reset pulse is transmitted. (Logic circuit ON) [1]
- The operation time of reset is released reset pulse [2] from transmitted reset pulse [1].
- $Trst = [\text{Timing A} + \text{about } 20\mu s]$ is time of released reset pulse.
(Timing A is time of V_{CC} exceed 5.5V.)



The power supply is turned on, and resetting is released after $Trst$, and the reception of the serial data becomes possible in Logic block.

However, REF voltage doesn't operate in less than 1.5V in the analog block. Make REF voltage is to transmit serial data by more than 1.5V.

- REF Voltage $\geq$ Time of REF=1.5V =Timing B
(Timing B is time when analog block operates and to become possible.)

<EX> Capacitor of 1pin =100 μF

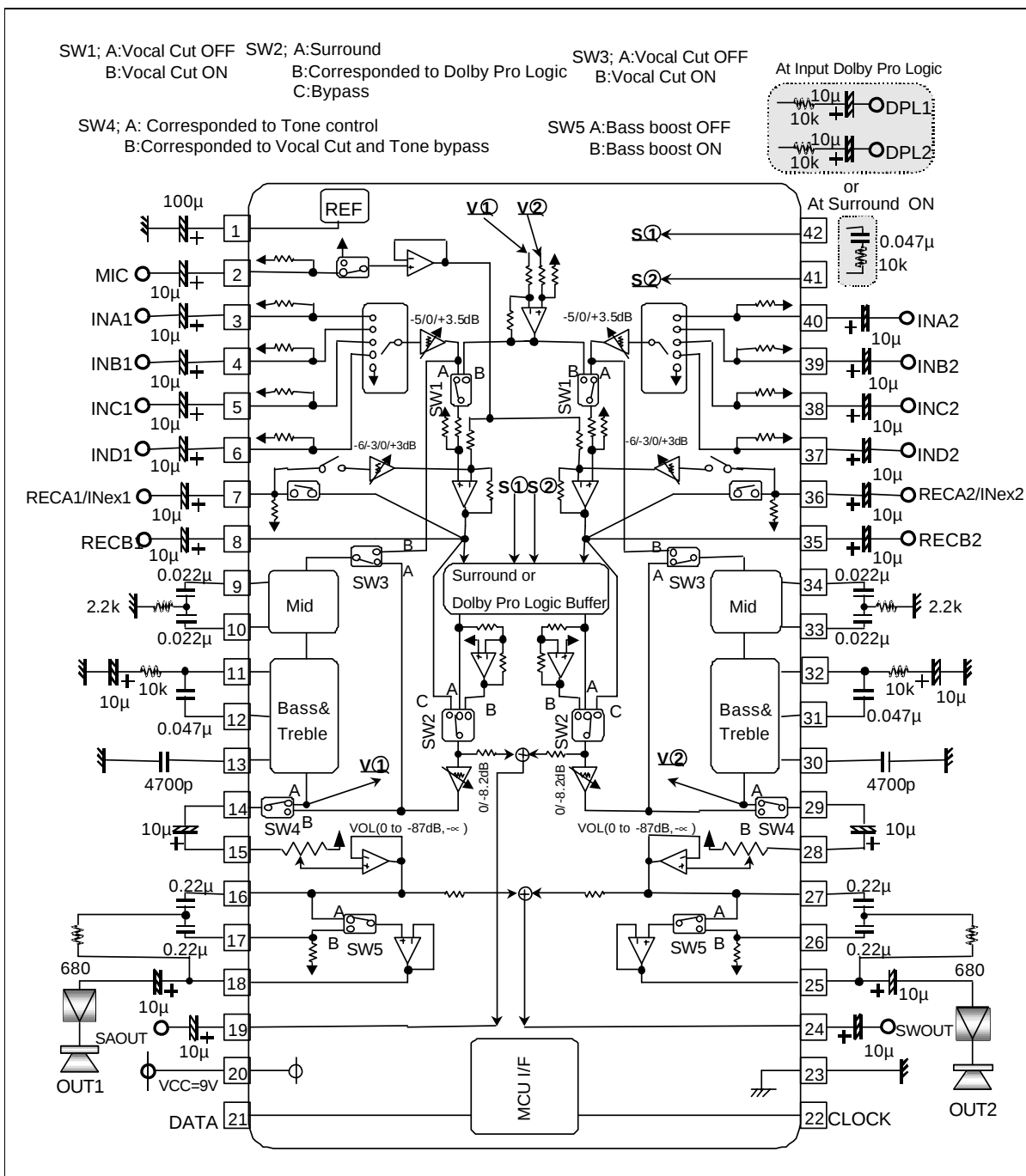
Becomes REF $\geq$ 1.5V in about 200ms.

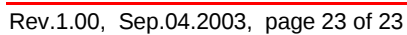
(b) IC's condition of power supply turn off

Internal power supply (V_{DD} , V_{SS}) decreases to V_{CC} together, too.

All the data set up when Logic turned it off become invalid.

Application Example





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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

Renesas Technology Europe GmbH
Dornacher Str. 3, D-85622 Feldkirchen, Germany
Tel: <49> (89) 380 70 0, Fax: <49> (89) 929 30 11

Renesas Technology Hong Kong Ltd.
7/F., North Tower, World Finance Centre, Harbour City, Canton Road, Hong Kong
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Renesas Technology Taiwan Co., Ltd.
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Renesas Technology (Shanghai) Co., Ltd.
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