M62427FP

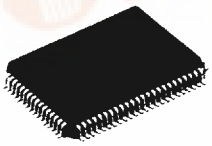
SOUND QUALITY/SOUND FIELD CONTROL DIGITAL SOUND CONTROLLER FOR MINI-COMPONENT STEREO

DESCRIPTION

The M62427FP is an optimum digital sound controller IC for home audio.
This IC contains a 5-element graphic equalizer, master volume, sound and karaoke functions (voice cancel). It can control all of these functions with serial data.
In addition to the tone control function, this IC provides adapter pins for digital surround, microphone mixing and key control and is optimum to the sound quality and sound field control of audio equipment with karaoke function.

FEATURES

- 80-pin QFP package
- Capable of performing the following functions with serial data
  - 5-band tone control (0, ±3, ±6, ±10dB)
  - Bass boost (HPF type) [ON/OFF] (PASS)
  - Surround (using external delay) [ON/OFF]
  - Vocal cancel (stereo) [ON/OFF]
  - Multilingual voice record switching [LCHonly/RCHonly]
  - Electronic volume 32 steps (0dB to -∞)
  - Port output 3 lines
- Supporting digital delay
- Adapter input/output supporting karaoke key control

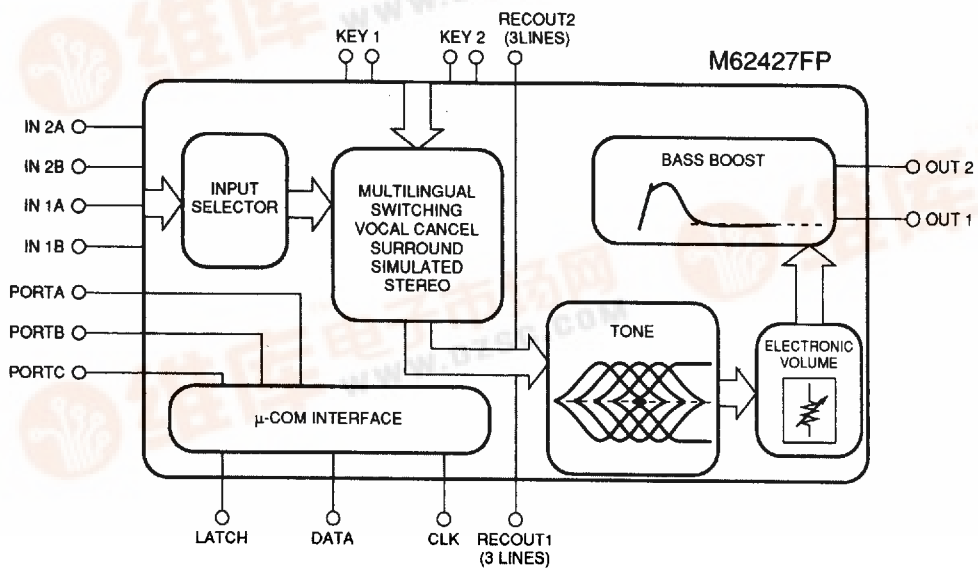


Outline 80P6N-A
0.8mm pitch QFP
(20.0mmX14.0mmX2.8mm)

RECOMMENDED OPERATING CONDITIONS

Supply voltage range..... Vcc=±4.5 to ±7.5V

SYSTEM CONFIGURATION



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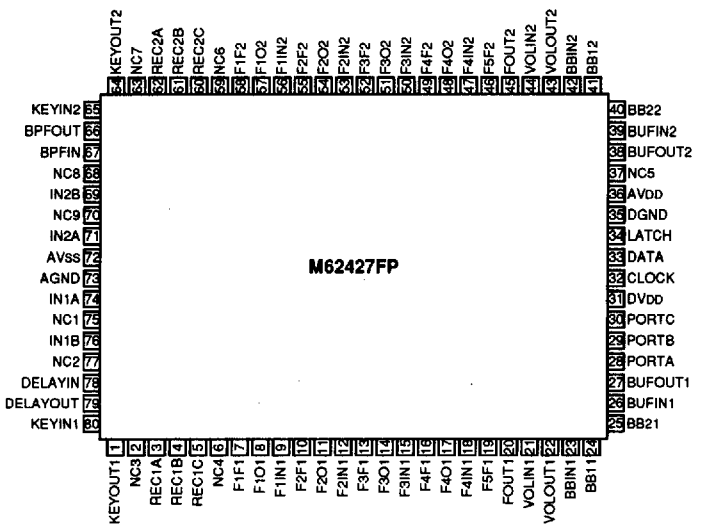
PIN CONFIGURATION (TOP VIEW)



Outline 80P6N-A

NC:NO CONNECTION

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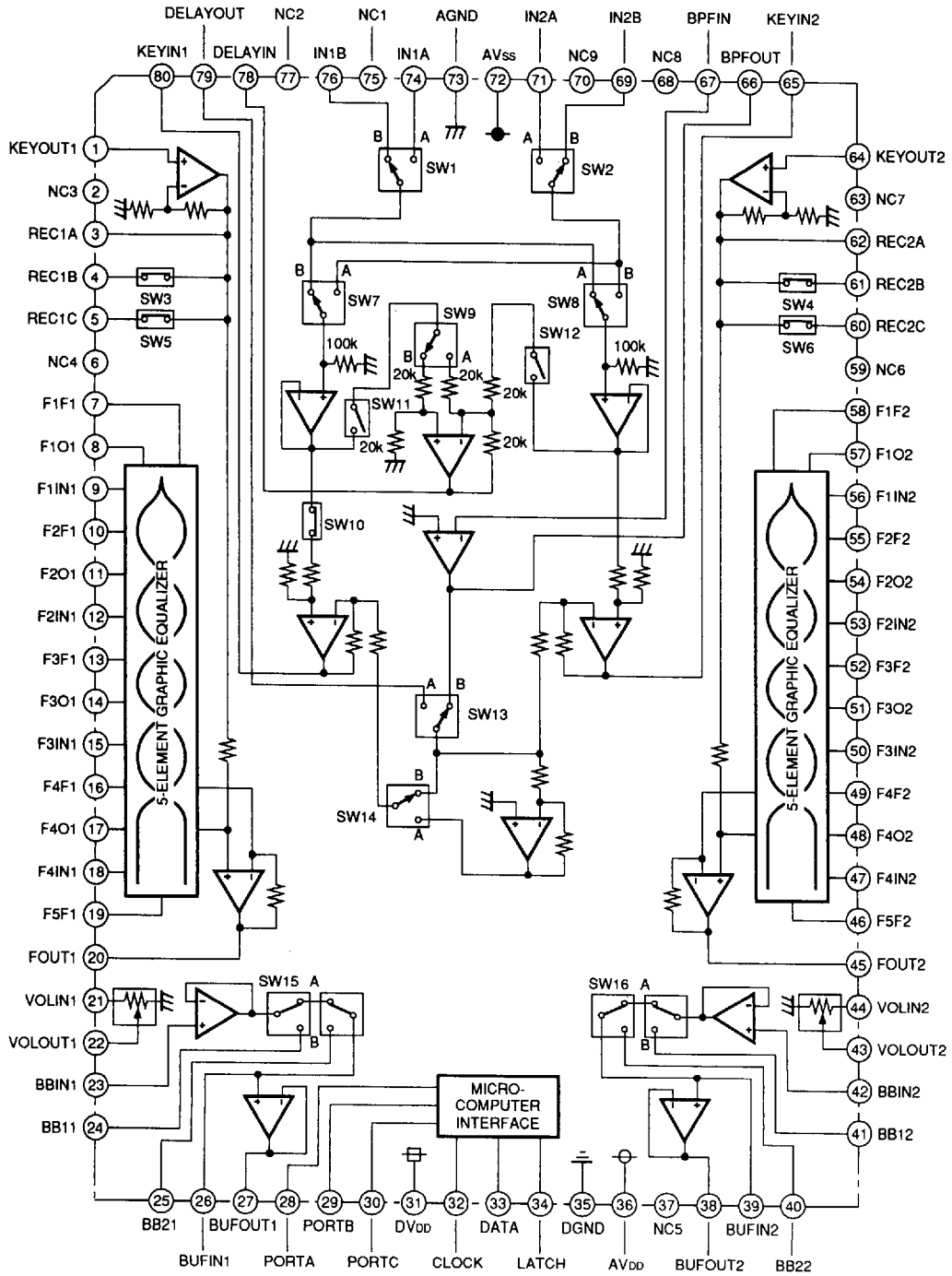
IC INTERNAL BLOCK DIAGRAM



SOUND QUALITY/SOUND FIELD CONTROL DIGITAL SOUND CONTROLLER FOR MINI-COMPONENT STEREO

PIN DESCRIPTION

Pin No.	Symbol	Function	
⑫	AVss	Load power pin of internal analog circuit	
⑬	AGND	Ground pin of internal analog circuit	
⑭ ⑪	IN1A, IN2A	Input pin of channel A	
⑯ ⑨	IN1B, IN2B	Input pin of channel B	
⑱	DELAYIN	(R-L) output pin for surround. Connect to the input of the delay circuit. Total load resistance is 20kΩ	
⑲	DELAYOUT	(R-L) input pin for surround. Connect to the output of the delay circuit.	
⑳ ⑮	KEYIN1, KEYIN2	Key control adapter output pin. Connect to the input of the key control circuit. Total load resistance is 20kΩ	
① ⑭	KEYOUT1, KEYOUT2	Key control adapter input pin. Connect to the output of the key control circuit.	
⑧	BPFOUT	Band pass filter amplifier output pin for vocal cancel	
⑦	BPFIN	Band pass filter amplifier input pin for vocal cancel	
③ ⑫	REC1A, REC2A	REC output pin A	Total load resistance is 20kΩ min.
④ ⑪	REC1B, REC2B	REC output pin B (with mute SW)	
⑤ ⑩	REC1C, REC2C	REC output pin C (with mute SW)	
⑦ ⑧	F1F1, F1F2	(Band filter) connection pin of resonance impedance of the 1st element	
⑧ ⑦	F1O1, F1O2	Output pin of resonance buffer amplifier of the 1st element	
⑨ ⑥	F1IN1, F1IN2	Input pin of resonance buffer amplifier of the 1st element	
⑩ ⑤	F2F1, F2F2	(Band filter) connection pin of resonance impedance of the 2nd element	
⑪ ④	F2O1, F2O2	Output pin of resonance buffer amplifier of the 2nd element	
⑫ ③	F2IN1, F2IN2	Input pin of resonance buffer amplifier of the 2nd element	
⑬ ②	F3F1, F3F2	(Band filter) connection pin of resonance impedance of the 3rd element	
⑭ ①	F3O1, F3O2	Output pin of resonance buffer amplifier of the 3rd element	
⑮ ⑳	F3IN1, F3IN2	Input pin of resonance buffer amplifier of the 3rd element	
⑯ ⑲	F4F1, F4F2	(Band filter) connection pin of resonance impedance of the 4th element	
⑰ ⑱	F4O1, F4O2	Output pin of resonance buffer amplifier of the 4th element	
⑱ ⑰	F4IN1, F4IN2	Input pin of resonance buffer amplifier of the 4th element	
⑲ ⑯	F5F1, F5F2	Band filter connection pin of the 5th element	
⑳ ⑮	FOUT1, FOUT2	Tone output pin. Connect to the next stage with capacitor connection	
㉑ ㉔	VOLIM1, VOLIN2	R rudder volume input pin	
㉒ ㉓	VOLOUT1, VOLOUT2	R rudder volume output pin	
㉓ ㉒	BBIN1, BBIN2	Bass boost input pin	
㉔ ㉑	BB11, BB12	Input pin for high pass filter connection of bass boost	
㉕ ㉐	BB21, BB22	Output pin for high pass filter connection of bass boost	
㉖ ㉙	BUFIN1, BUFIN2	Input pin of bass boost buffer amplifier	
㉗ ㉘	BUFOUT1, BUFOUT2	Output pin of bass boost buffer amplifier	
㉘	PORTA	Output of port A	
㉙	PORTB	Output of port B	
㉚	PORTC	Output of port C	
㉛	DVDD	Power supply of internal logic circuit	
㉜	CLOCK	Clock input pin for serial data transfer	
㉝	DATA	Input pin of control data. Reads data at the rising edge of clock	
㉞	LATCH	Input pin of latch signal. Changes the circuit status at the rising edge of the latch signal	
㉟	DGND	Ground pin of the internal logic circuit	
㊱	AVDD	Positive power pin of the internal analog circuit	
⑤ ⑩	NC1, NC9	Non-connection pin	
⑦ ⑧	NC2, NC8		
② ⑬	NC3, NC7		
⑥ ⑨	NC4, NC6		
㊲	NC5		

SOUND QUALITY/SOUND FIELD CONTROL DIGITAL SOUND CONTROLLER FOR MINI-COMPONENT STEREO

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Ratings	Unit
AV_{DD}, AVss	Analog supply voltage		±7.8	V
DV_{DD}	Digital supply voltage		6.0	V
P_d	Power dissipation	TA≤25°C	1250	mW
K_θ	Thermal derating	Ta>25°C Board installation (Note 1)	12.5	mW/°C
T_{opr}	Operating temperature		-20 to +55	°C
T_{stg}	Storage temperature		-55 to +125	°C

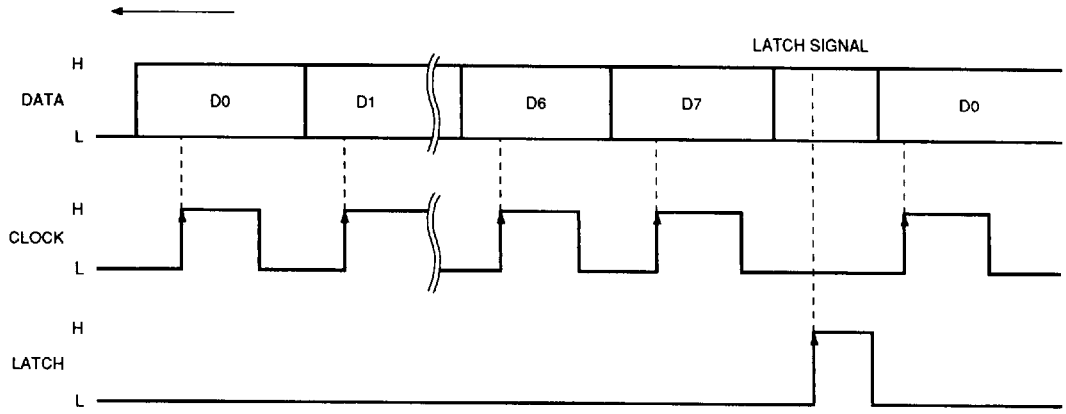
Note 1:Board
Size of printed circuit board (140mm x 140mm)
Thickness of printed circuit board (1.6mm)
Material of printed circuit board (Glass epoxy)
Single side Cu pattern Thickness of Cu (18μm)
Cu pattern dimensions (0.25mm (width) x 50mm (length)/lead)

RECOMMENDED OPERATING CONDITIONS (Ta=25°C, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
AV_{DD}	Analog positive supply voltage	(Note 2)	4.5	7.0	7.5	V
AVss	Analog negative supply voltage	(Note 2)	-4.5	-7.0	-7.5	V
DV_{DD}	Digital supply voltage	DV_{DD}≤AV_{DD}	4.5	5.0	5.5	V
V_{IH}	Logic "H" level input voltage		DV_{DD}-0.7	–	V_{DD}	V
V_{IL}	Logic "L" level input voltage		0	–	DGND+0.7	V

Note 2:After applying AV_{DD}, apply supply voltages in the order of AVss and DV_{DD} for the IC.

RELATIONSHIP BETWEEN DATA AND CLOCK



Data signal is read at the rising edge of clock.
Signal is latched at the rising edge of the latch signal.

SOUND QUALITY/SOUND FIELD CONTROL DIGITAL SOUND CONTROLLER FOR MINI-COMPONENT STEREO

ELECTRICAL CHARACTERISTICS

(Ta=25°C, AV_{DD}=7.0V, AVss =-7.0V, DV_{DD}=5.0V, f=1kHz, unless otherwise noted. In addition, tone control bass boost is 0dB.)

Symbol	Parameter		Test conditions	Limits			Unit
				Min.	Typ.	Max.	
AI_{DD}	Power supply	Analog positive power circuit current	With AV_{DD}=7.0V and AVss=-7.0V, pin ㊱ pin current, when no signal is provided	19	40	55	mA
AIss		Analog negative power circuit current	With AV_{DD}=7.0V and AVss =-7.0V, pin ㉜ pin current, when no signal is provided	-55	-40	-19	mA
DI_{DD}		Digital power circuit current	With DV_{DD}=5V, pin ㉛ pin current, when no signal is provided	–	0.3	1.2	mA
R_{IN}	Input/output	Input resistance	Pins ㉔, ㉖, ㉑ and ㊾, Ta=25°C	100	200	300	kΩ
VIM		Maximum input voltage	(Input to pins ㉔ and ㉖), (input to pins ㉑ and ㊾) Output from pins ㉗ and ㊳, R_L=10kΩ, THD=1%	3.0	4.0	–	Vrms
Vodc		Output pin voltage	Pin ㉗, pin ㊳, when no signal is provided	-0.1	0	0.1	V
Vrecdc			Pin ③, pin ㊷, when no signal is provided	-0.1	0	0.1	V
Gv		Pass gain	V_{IN}=1Vrms, FLAT, (pins ㉔ and ㉖), gain between (pins ㉑ and ㊾) and (pins ㉗ and ㊳)	-20	0	2.0	dB
Vono		Output noise voltage	JIS-A filter, when no signal is provided, Rg=10kΩ, with FLAT (path), Pins ㉗ and ㊳	–	10.0	24	μVrms
Vrecno			Rg=10kΩ, with FLAT (path), Pins ③ and ㊷	–	10.0	20	μVrms
THD		Distortion	Pin ㉗, pin ㊳, BW=400 to 30kHz, V_I=-20dBv, R_L=10kΩ	–	0.01	0.05	%
THDrecA			Pin ③, pin ㊷, BW=400 to 30kHz, V_I=-20dBv, R_L=30kΩ	–	0.01	0.05	%
THDrec B, C			(Pins ④ and ㊶), (pins ⑤ and ㊵), BW=400 to 30 kHz	–	0.01	0.05	%
CT		Cross talk between channels	Vo=0.5Vrms, R_L=10kΩ, JIS-A between pins ㉗ and ㊳, Rg=10kΩ	–	-55	-45	dB
CTrec			Vo=0.5Vrms, R_L=30kΩ, JIS-A between pins ③ and ㊷, Rg=10kΩ	–	-55	-45	dB
Gboost1	Tone control	Tone control voltage gain	3dB, f=1kHz, Vo=1Vrms, Gain between input pins ①, ㊹ and output pins ⑳, ㊺	1.5	3	4.5	dB
Gboost2			6dB	4.5	6	7.5	dB
Gboost3			9dB	7.0	9	11.0	dB
Gcut1			-3dB	-4.5	-3	-1.5	dB
Gcut2			-6dB	-7.5	-6	-4.5	dB
Gcut3			-9dB	-11.0	-9	-7.0	dB
BALton		Balance between channels	f=1kHz, Vo=1Vrms, Input to pins ①, ㊹ Output from pins ⑳, ㊺, each boost With +10 and -10dB	-1.5	0	+1.5	dB
VPA	Port output	Port output	R_L=10kΩ	6.0	7.0	–	V
VPB							
VPC							

DATA INPUT FORMAT

Four types of input formats can be selected by changing the D6/D7 slot setting status.

(Initialize all data of the four formats when power is turned on.)

← Input direction

Input format selection slot

(1)

D01	D11	D21	D31	D41	D51	D6	D7
Rec out B SW3, 4 1:Mute 0:Through	Rec out C SW5, 6 1:Mute 0:Through	Voice switching mode SW7 1:Side A 0:Side B		SW8 1:Side A 0:Side B	SW9 1:Side A 0:Side B	SW10 1:ON 0:OFF	0	0

(2)

D02	D12	D22	D32	D42	D52	D6	D7
SW11, 12 1:ON 0:OFF	SW13 1:Side A 0:Side B	SW14 1:Side A 0:Side B	Port A 1:H 0:L	Port output Port B 1:H 0:L	Port C 1:H 0:L	0	1

(3)

D03	D13	D23	D33	D43	D53	D6	D7
* Refer to the slot setting list (5) for tone control Bass boost SW15, 16 Side A/Side B			* Refer to the slot setting code list (6) for tone boost/cut			1	0

(4)

D04	D14	D24	D34	D44	D54	D6	D7
* Refer to the slot setting code list (7) for master volume					Input selector SW1, 2 1:Side A 0:Side B	1	1

(5) Setting code (tone control)

		D03	D13	D23
Tone 1 (F1)		0	0	1
Tone 2 (F2)		0	1	0
Tone 3 (F3)		0	1	1
Tone 4 (F4)		1	0	0
Tone 5 (F5)		1	0	1
Bass boost	OFF	1	1	0
	ON	1	1	1

(6) Setting code (tone boost/cut)

		D33	D43	D53
Boost	+0dB	0	0	0
	+3dB	0	0	1
	+6dB	0	1	0
	+10dB	0	1	1
Cut	-0dB	1	0	0
	-3dB	1	0	1
	-6dB	1	1	0
	-10dB	1	1	1

(7) Setting codes (master volume)

Amount of ATT	D04	D14	D24	D34	D44
- 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
-38.0dB	1	1	0	0	1
-40.0dB	0	0	1	0	1
-42.0dB	1	0	1	0	1
-44.0dB	0	1	1	0	1
-48.0dB	1	1	1	0	1
-52.0dB	0	0	0	1	1
-56.0dB	1	0	0	1	1
-60.0dB	0	1	0	1	1
-64.0dB	1	1	0	1	1
-68.0dB	0	0	1	1	1
-72.0dB	1	0	1	1	1
-76.0dB	0	1	1	1	1
-∞	1	1	1	1	1

(8) Port output setting codes

Data		Port output
D32	0	Port A is set to L
	1	Port A is set to H
D42	0	Port B is set to L
	1	Port B is set to H
D52	0	Port C is set to L
	1	Port C is set to H

(9) Other setting codes

Voice cancel	
D41=1	SW9:Side A
D51=1	SW10:ON
D02=1	SW11, 12:ON
D12=0	SW13:Side B
D22=0	SW14:Side B

Sound	
D41=0	SW9:Side B
D51=1	SW10:ON
D02=1	SW11, 12:ON
D12=1	SW13:Side A
D22=1	SW14:Side A

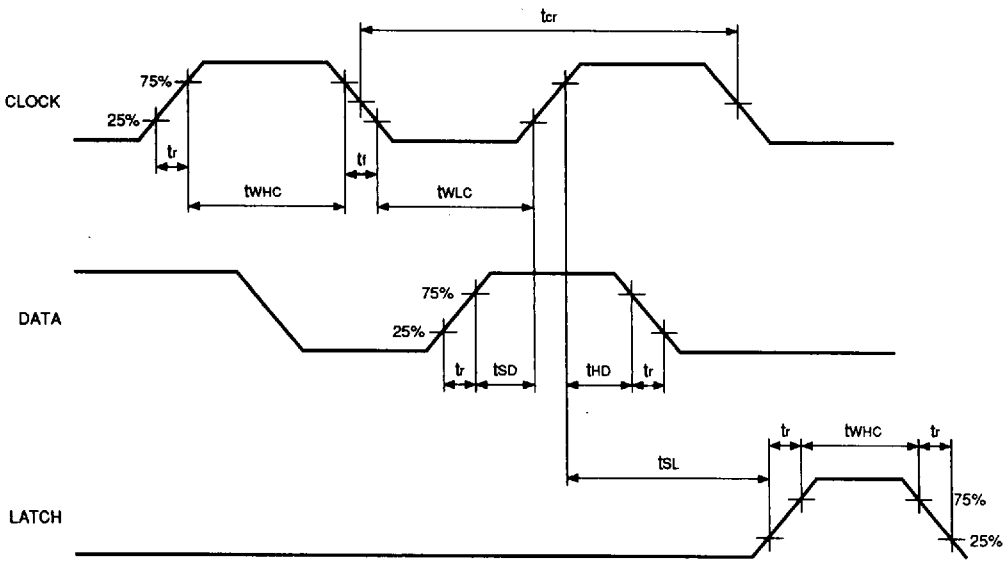
Simulated stereo	
D41=1	SW9:Side A
D51=0	SW10:OFF
D02=1	SW11, 12:ON
D12=0	SW13:Side B
D22=0	SW14:Side B

Multilingual record supported			
Rch (1ch)		Lch (2ch)	
D21=0	SW7:Side B	D21=1	SW7:Side A
D31=1	SW8:Side A	D31=0	SW8:Side B

TIMING DEFINITION OF DIGITAL BLOCK

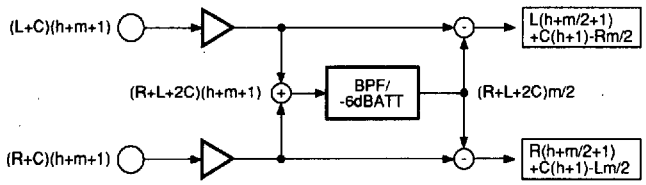
Symbol	Parameter	Limits			Unit
		Min.	Typ.	Max.	
t_{cr}	Clock cycle time	4	–	–	µs
t_{WHC}	Clock pulse width ("H" level)	1.6	–	–	µs
t_{WLC}	Clock pulse width ("L" level)	1.6	–	–	µs
t_r	Rising time of clock, data and latch	–	–	0.4	µs
t_f	Falling time of clock, data and latch	–	–	0.4	µs
t_{SD}	Data setup time	0.8	–	–	µs
t_{HD}	Data hold time	0.8	–	–	µs
t_{SL}	Latch setup time	1	–	–	µs
t_{WHL}	Latch pulse width	1.6	–	–	µs

CLOCK AND DATA TIMINGS

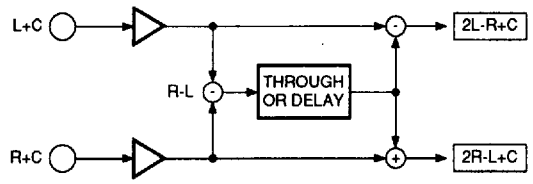


FUNCTION DESCRIPTION

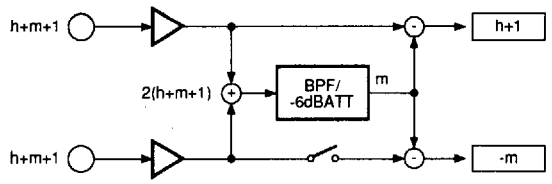
(1) Equivalent circuit with vocal cancel



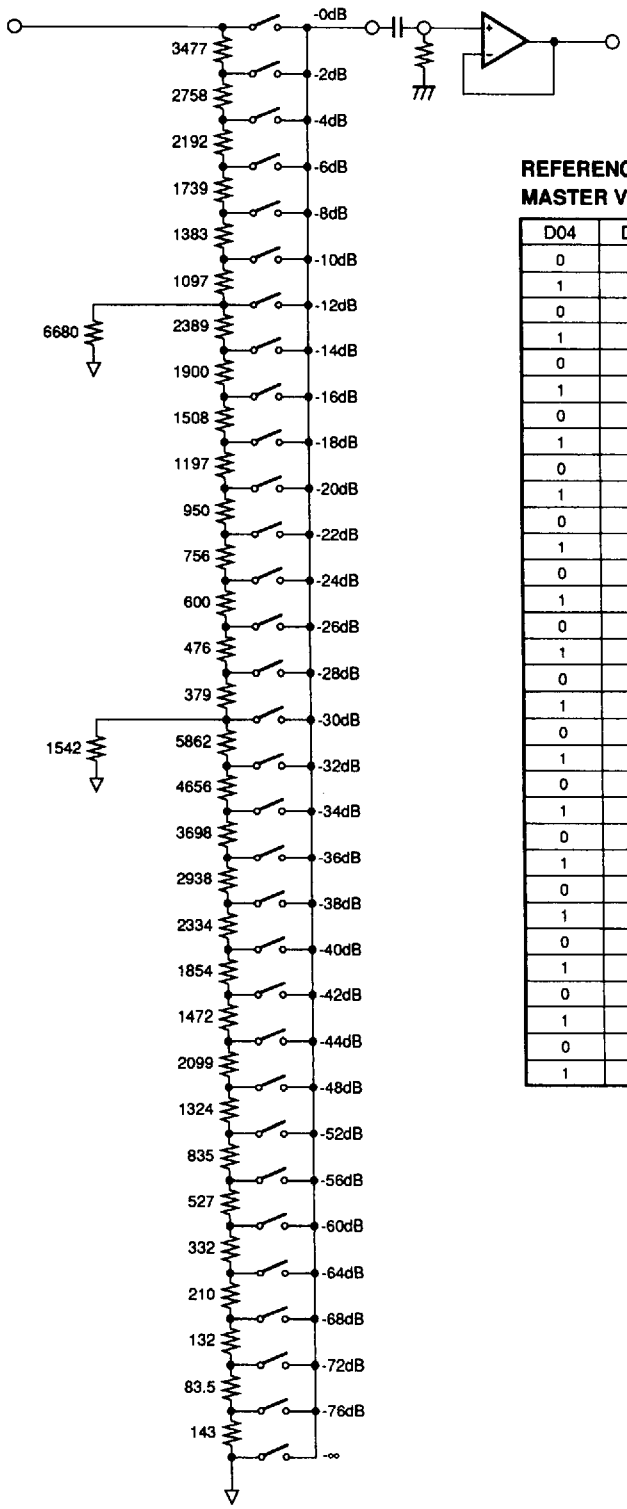
(2) Equivalent circuit with surround



(3) Equivalent circuit with simulated stereo



(4) Master volume equivalent circuit



REFERENCE VALUES FOR MASTER VOLUME ATTENUATION

D04	D14	D24	D34	D44	Amount of ATT
0	0	0	0	0	- 0.0dB
1	0	0	0	0	- 2.0dB
0	1	0	0	0	- 4.0dB
1	1	0	0	0	- 6.0dB
0	0	1	0	0	- 8.0dB
1	0	1	0	0	-10.0dB
0	1	1	0	0	-12.0dB
1	1	1	0	0	-14.0dB
0	0	0	1	0	-16.0dB
1	0	0	1	0	-18.0dB
0	1	0	1	0	-20.0dB
1	1	0	1	0	-22.0dB
0	0	1	1	0	-24.0dB
1	0	1	1	0	-26.0dB
0	1	1	1	0	-28.0dB
1	1	1	1	0	-30.0dB
0	0	0	0	1	-32.0dB
1	0	0	0	1	-34.0dB
0	1	0	0	1	-36.0dB
1	1	0	0	1	-38.0dB
0	0	1	0	1	-40.0dB
1	0	1	0	1	-42.0dB
0	1	1	0	1	-44.0dB
1	1	1	0	1	-48.0dB
0	0	0	1	1	-52.0dB
1	0	0	1	1	-56.0dB
0	1	0	1	1	-60.0dB
1	1	0	1	1	-64.0dB
0	0	1	1	1	-68.0dB
1	0	1	1	1	-72.0dB
0	1	1	1	1	-76.0dB
1	1	1	1	1	-∞

(5) Equivalent circuit of tone control resonance circuit block

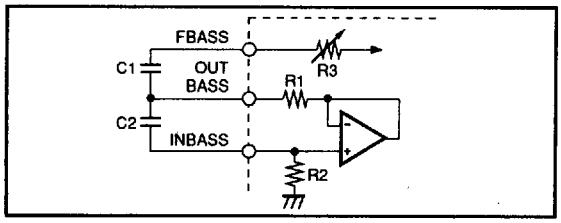


Fig.1 Internal resonance equivalent circuit

Center frequency

$fo=1/2\pi \sqrt{C1 \cdot C2 \cdot R1 \cdot R2}$ (Hz)

$Q=\sqrt{(C2 \cdot R2)/(C1 \cdot R1)}$

(Example) Bass band (f=150Hz)

R1=1.5kΩ, R2=56kΩ

C1=1.5μ, C2=0.01μ

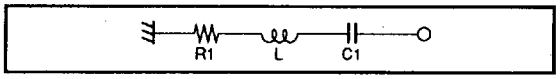
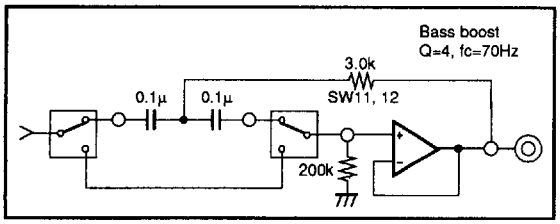


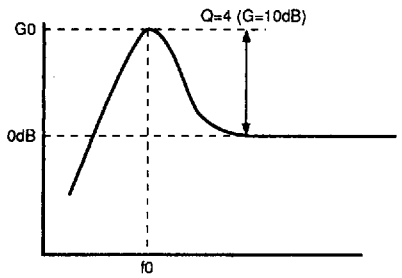
Fig.2 Equivalent circuit using I

Figure 1 means Figure 2 in equivalence. The part constant is converted by the following formula.

$L=C2 \cdot R1 \cdot R2$

(6) Equivalent circuit of bass boost circuit block





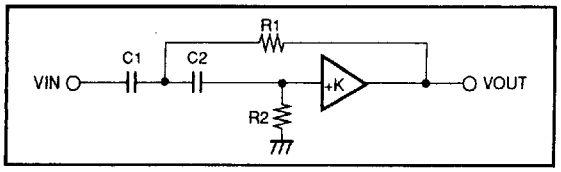


Fig.3 Positive feedback type secondary high pass filter circuit of bass boost block

Amplitude characteristics of secondary high pass filter(forreference)

Q	G0
1	0 to 1dB
2	6 dB
4	10 dB
5	13 dB
10	20 dB

The transmission function is given by the following formula.

$$\frac{V_{OUT}}{V_{IN}} = \frac{Ks^2}{S^2+S\left[\frac{1}{R2C1}+\frac{1}{R2C2}+(1-K)\frac{1}{R1C1}\right]+\frac{1}{R1R2C1C2}}$$

$$\omega 0^2 = \frac{1}{R1R2C1C2}$$

$$Q = \frac{1}{\sqrt{\frac{R1C1}{R2C2}}+\sqrt{\frac{R1C2}{R2C1}}+(1-K)\sqrt{\frac{R2C2}{R1C1}}}$$

The bass boost block consists of the positive feedback type secondary high pass circuit shown in Figure 3.

A design calculation example of the bass boost block is shown below.

If C1=C2=Cf and K=+1 are assumed, the following are found with the above formula.

$Rf=1/(\omega 0Cf)$.....(1)

$R1=Rf/2Q$.....(2)

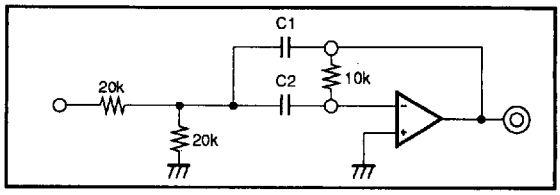
$R2=2QRf$.....(3)

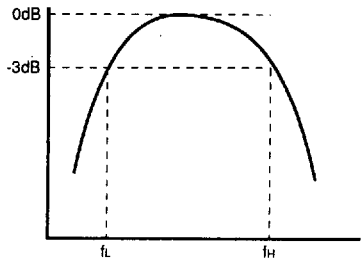
If the cut-off frequency is 70Hz, and Q is 4, $\omega 0=2\pi$ X 70Hz, and Q=4 are assumed.

With C1=C2=Cf=0.1μF, R1 and R2 are approximately 3.0kΩ and 200kΩ, respectively, because of (1), (2) and (3).

Rf=22.7kΩ
R1=2.84kΩ
R2=182kΩ

(7) Equivalent circuit of band pass filter block





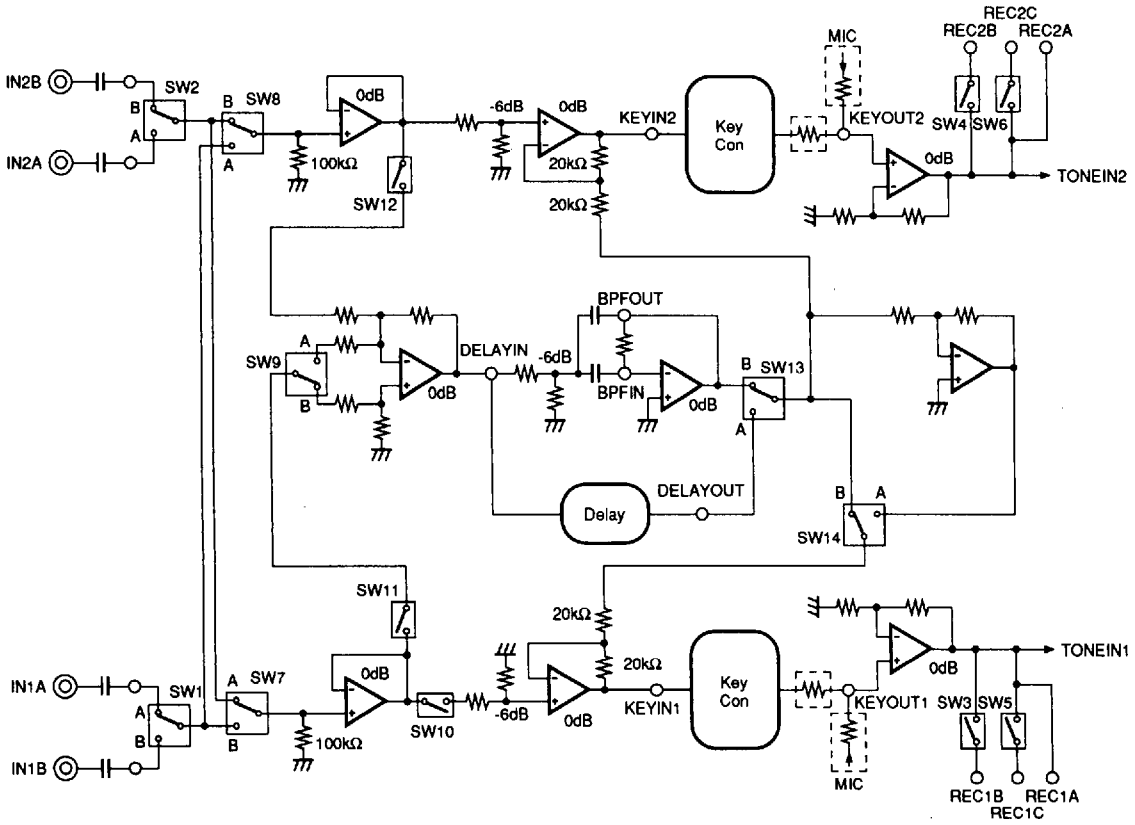
(Band pass filter design formula)

f_H (Cut-off frequency at side H)$=\frac{1}{2\pi C1 \cdot 10k}$

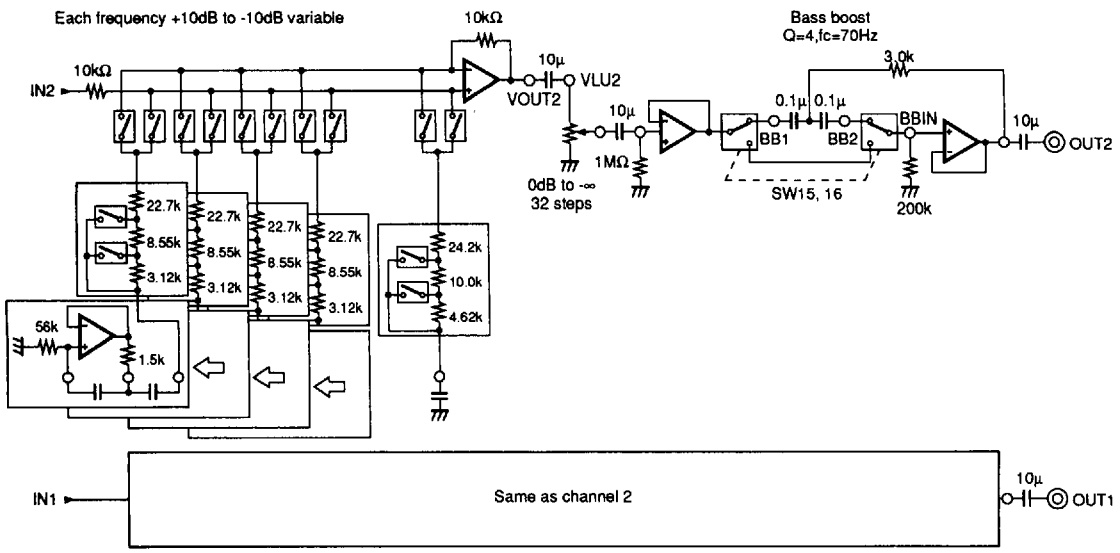
f_L (Cut-off frequency at side L)$=\frac{1}{2\pi C2 \cdot 10k}$

SOUND QUALITY/SOUND FIELD CONTROL DIGITAL SOUND CONTROLLER FOR MINI-COMPONENT STEREO

SIGNAL TRANSMISSION BLOCK DIAGRAM (1)

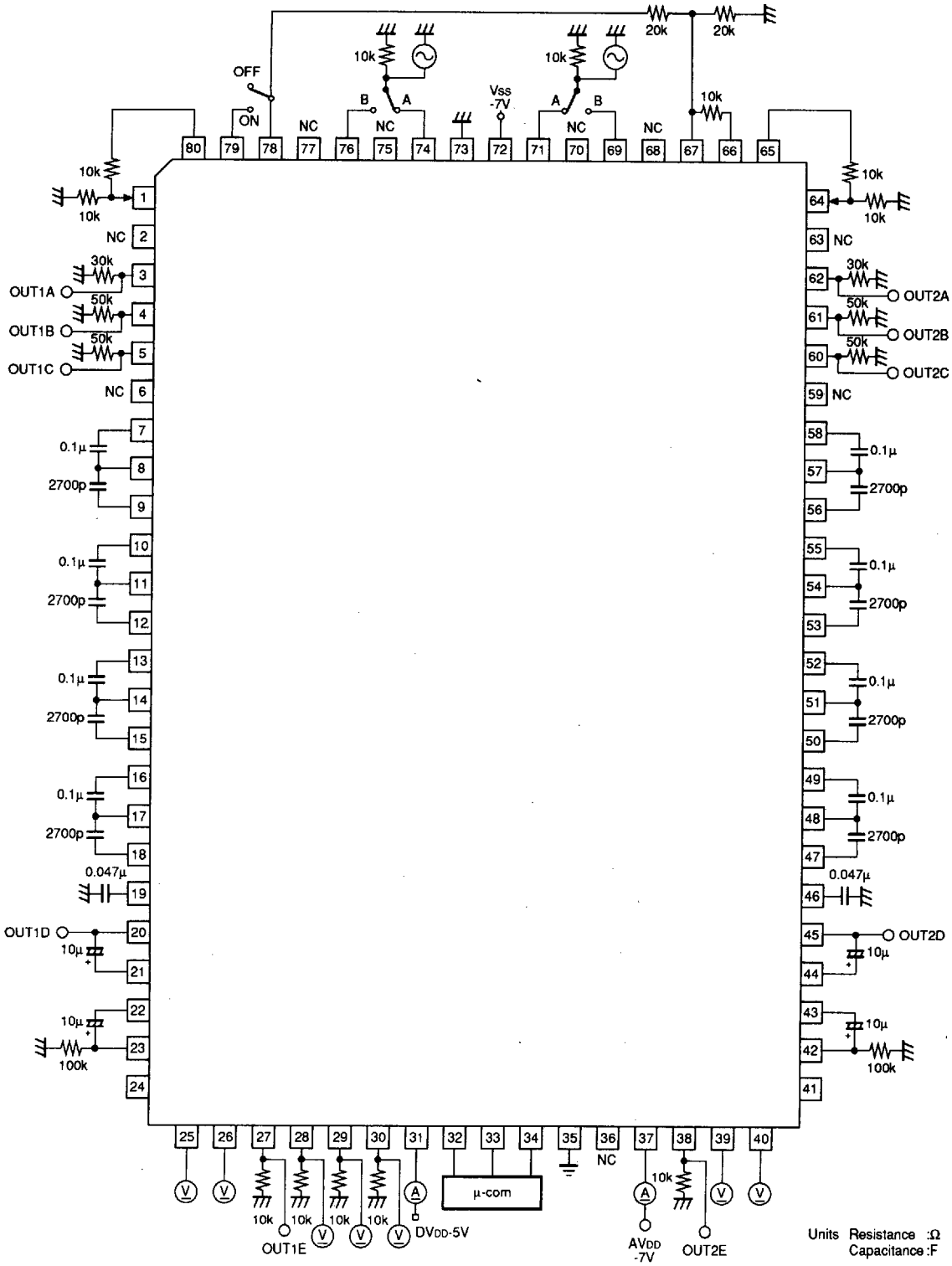


SIGNAL TRANSMISSION BLOCK DIAGRAM (2)



SOUND QUALITY/SOUND FIELD CONTROL DIGITAL SOUND CONTROLLER FOR MINI-COMPONENT STEREO

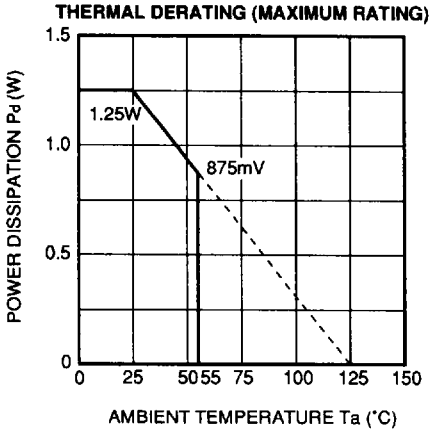
TEST CIRCUIT



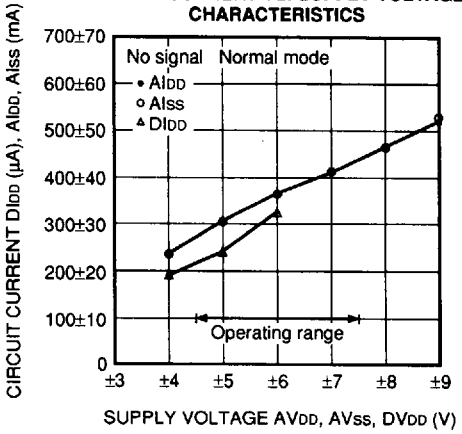
SOUND QUALITY/SOUND FIELD CONTROL DIGITAL SOUND CONTROLLER FOR MINI-COMPONENT STEREO

TYPICAL CHARACTERISTICS

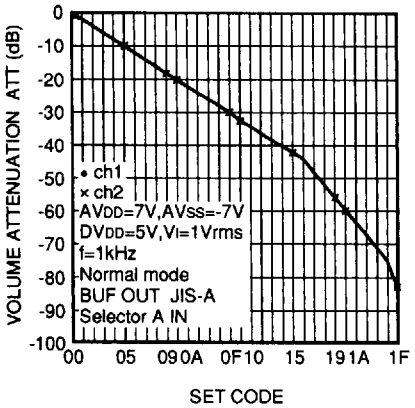
THERMAL DERATING (MAXIMUM RATING)



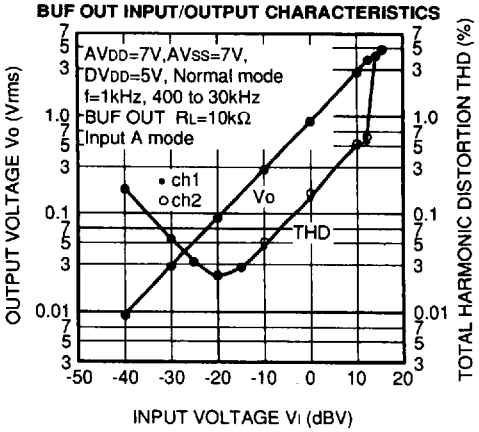
CIRCUIT CURRENT VS. SUPPLY VOLTAGE CHARACTERISTICS



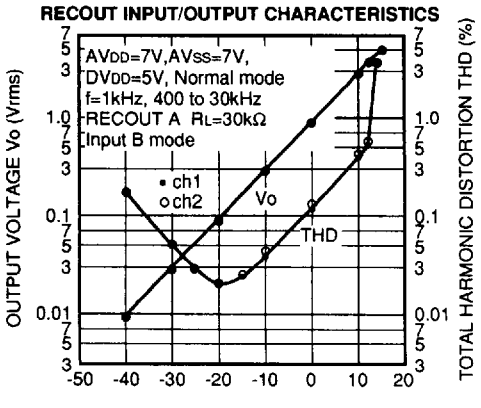
VOLUME CONTROL CHARACTERISTICS



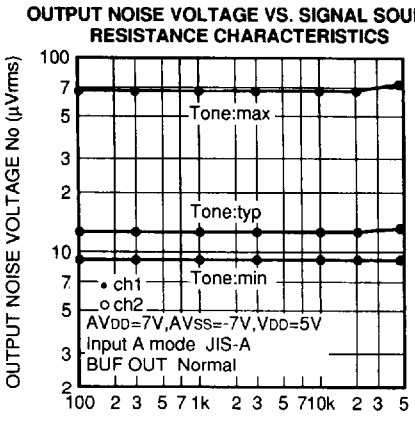
BUF OUT INPUT/OUTPUT CHARACTERISTICS



RECOUT INPUT/OUTPUT CHARACTERISTICS

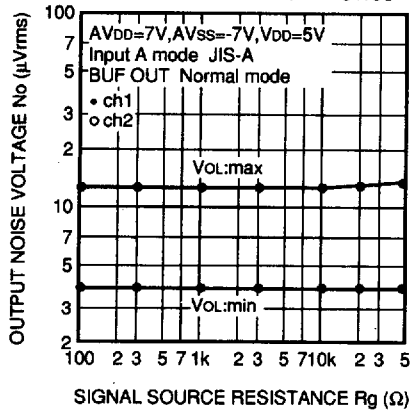


OUTPUT NOISE VOLTAGE VS. SIGNAL SOURCE RESISTANCE CHARACTERISTICS

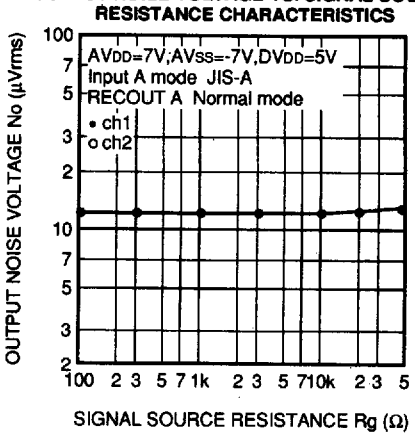


SOUND QUALITY/SOUND FIELD CONTROL DIGITAL SOUND CONTROLLER FOR MINI-COMPONENT STEREO

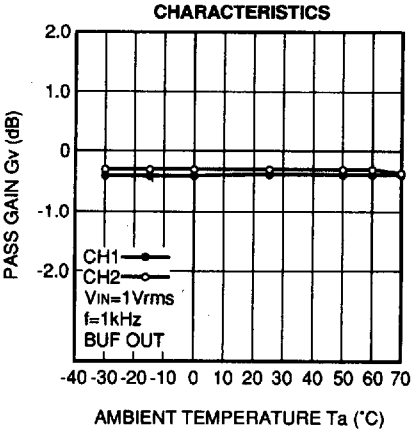
OUTPUT NOISE VOLTAGE VS. SIGNAL SOURCE RESISTANCE CHARACTERISTICS



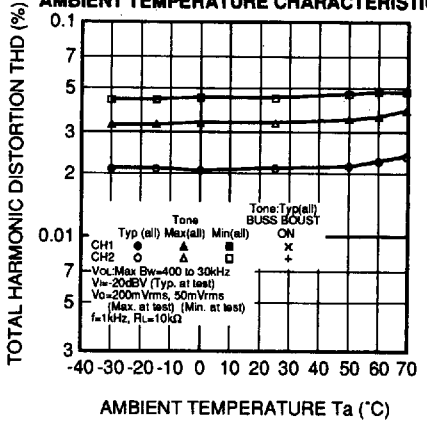
OUTPUT NOISE VOLTAGE VS. SIGNAL SOURCE RESISTANCE CHARACTERISTICS



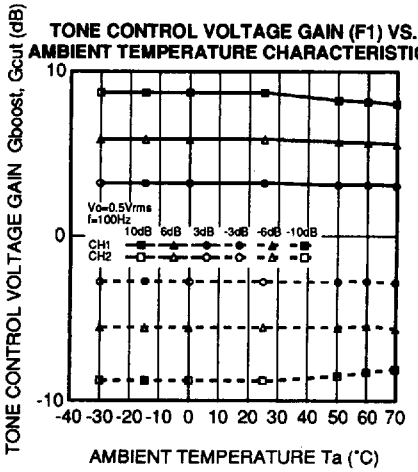
PASS GAIN VS. AMBIENT TEMPERATURE CHARACTERISTICS



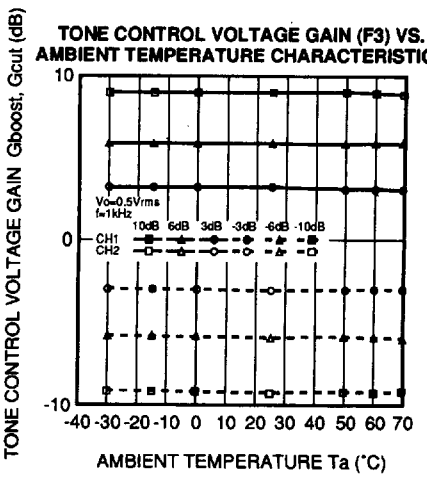
TOTAL HARMONIC DISTORTION (BUF OUT) VS. AMBIENT TEMPERATURE CHARACTERISTICS



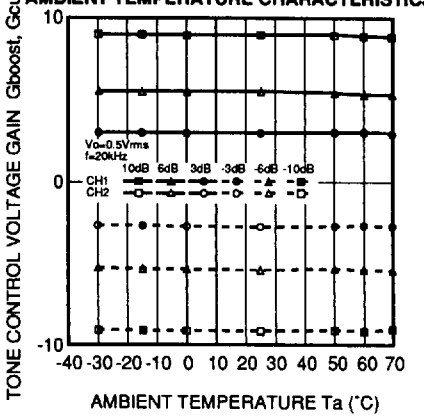
TONE CONTROL VOLTAGE GAIN (F1) VS. AMBIENT TEMPERATURE CHARACTERISTICS



TONE CONTROL VOLTAGE GAIN (F3) VS. AMBIENT TEMPERATURE CHARACTERISTICS

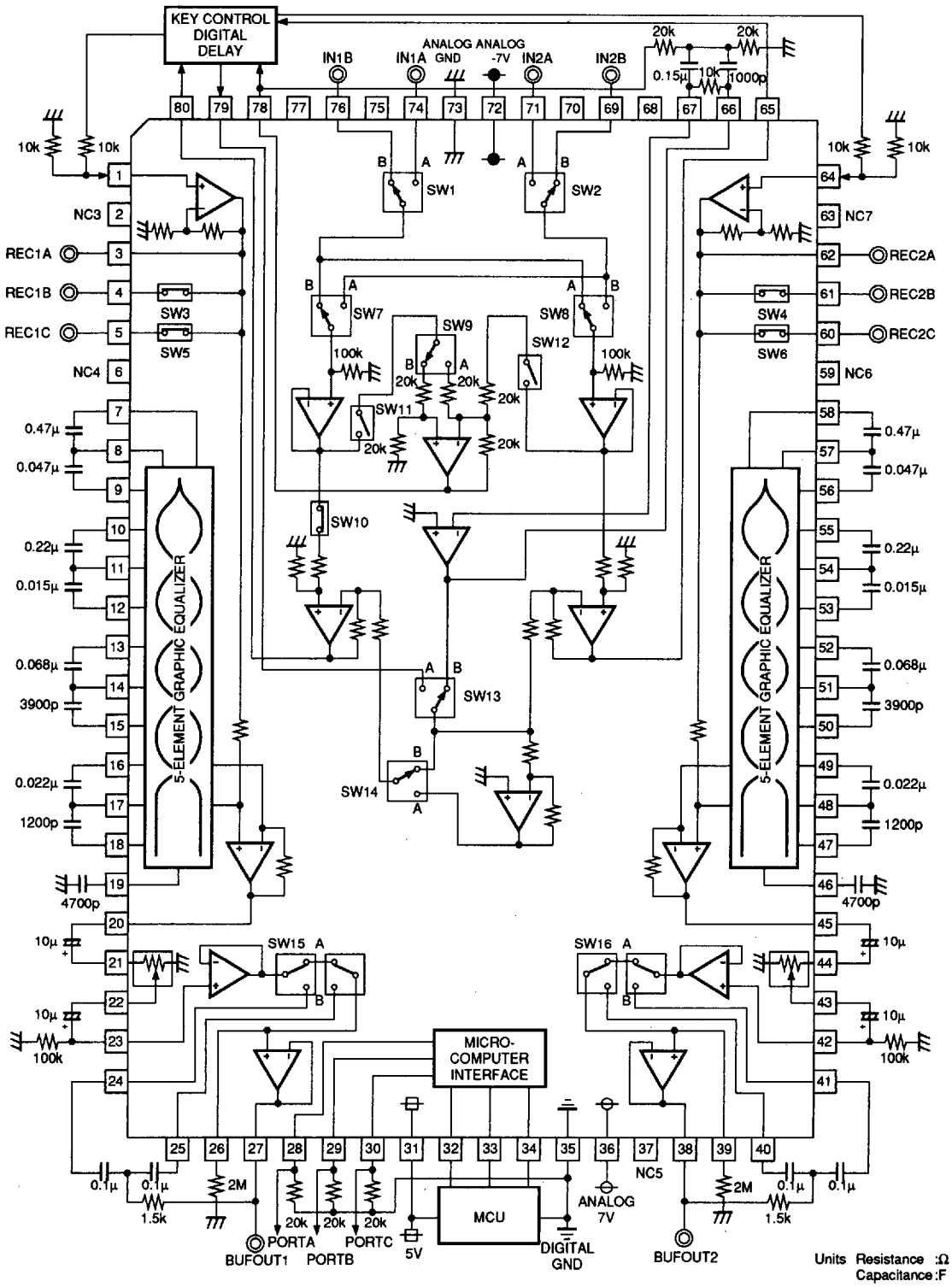


TONE CONTROL VOLTAGE GAIN (F5) VS.
AMBIENT TEMPERATURE CHARACTERISTICS



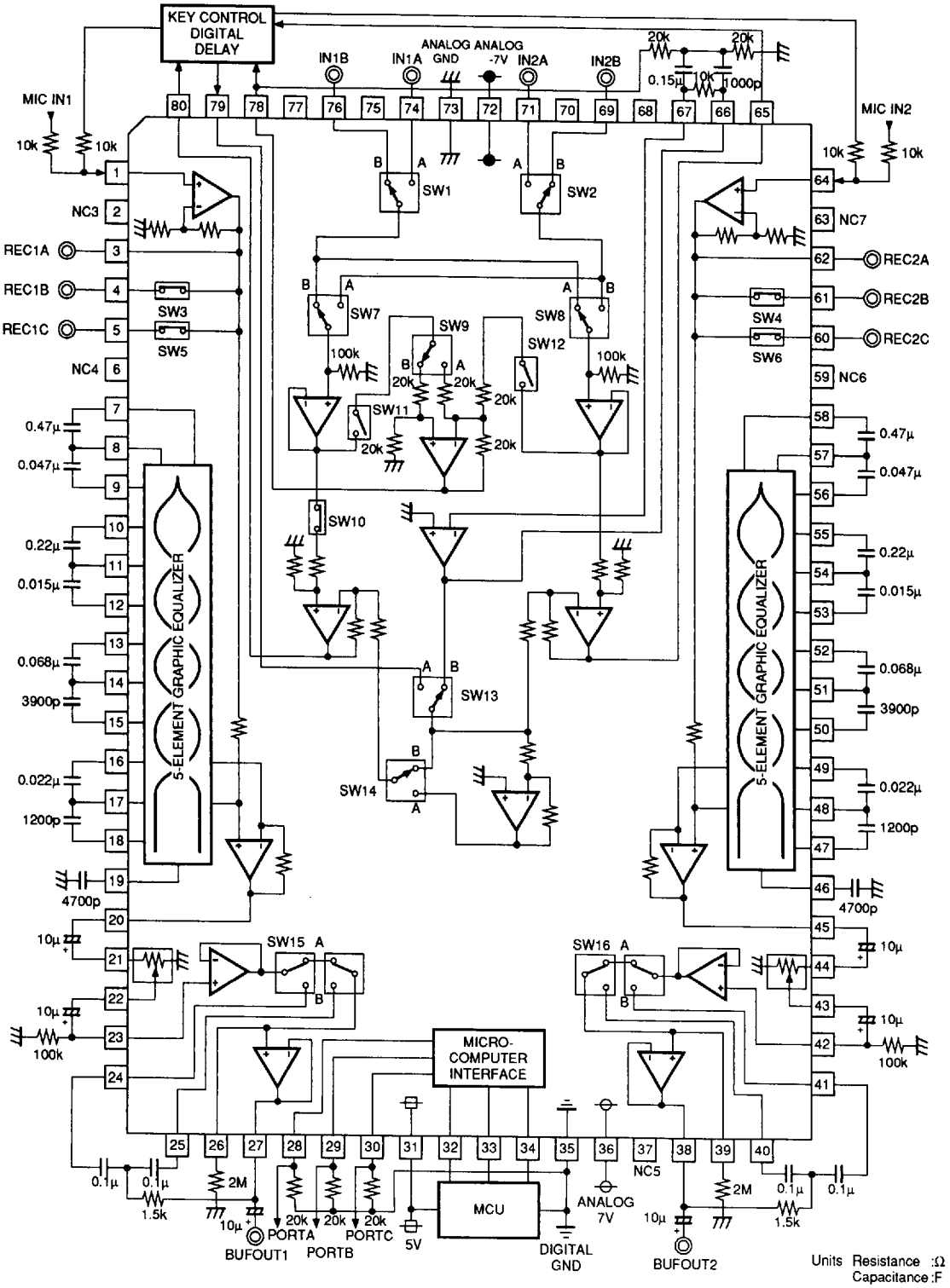
SOUND QUALITY/SOUND FIELD CONTROL DIGITAL SOUND CONTROLLER FOR MINI-COMPONENT STEREO

APPLICATION EXAMPLE 1



SOUND QUALITY/SOUND FIELD CONTROL DIGITAL SOUND CONTROLLER FOR MINI-COMPONENT STEREO

APPLICATION EXAMPLE 2



APPLICATION EXAMPLE 3 (Single power supply)