M62414SP

## 2CH, ELECTRONIC VOLUME WITH MICROCOMPUTER INTERFACE/ 4 OUTPUT PORT

DESCRIPTION

The M62414SP voltage controlled amplifier integrated circuit was developed for electronic volume control in audio-visual equipment. It is used as the main volume control in the power amplifier front stage.

This IC has 2 modes : One is connected to a microcomputer interface circuit and controlled by serial data. The other is controlled by external direct current voltage. This IC also has 4 built-in output ports, enabling various applications such as car audio equipment.

FEATURES

■ Built-in VCA circuit for volume control
■ Volume adjustable range ····················· – 105dB to 0dB
■ VCA maximum gain switchable between 0dB or – 6dB
■ VCA can be controlled externally
■ Open collector type output ports (NPN transistors)
■ Maximum allowable input ······························2Vrms
■ Built-in microcomputer interface circuit controlled by 8-bit serial data
■ Communication with microcomputer via two lines (CLOCK and DATA)

RECOMMENDED OPERATING CONDITIONS

Supply voltage range······························· Vcc = 7 to 13V
Rated supply voltage·································Vcc = 9V
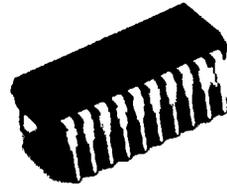
Outline 20P4B
1.778mm pitch 300mil SDIP
(6.3mm × 19.0mm × 3.3mm)

SYSTEM CONFIGURATION
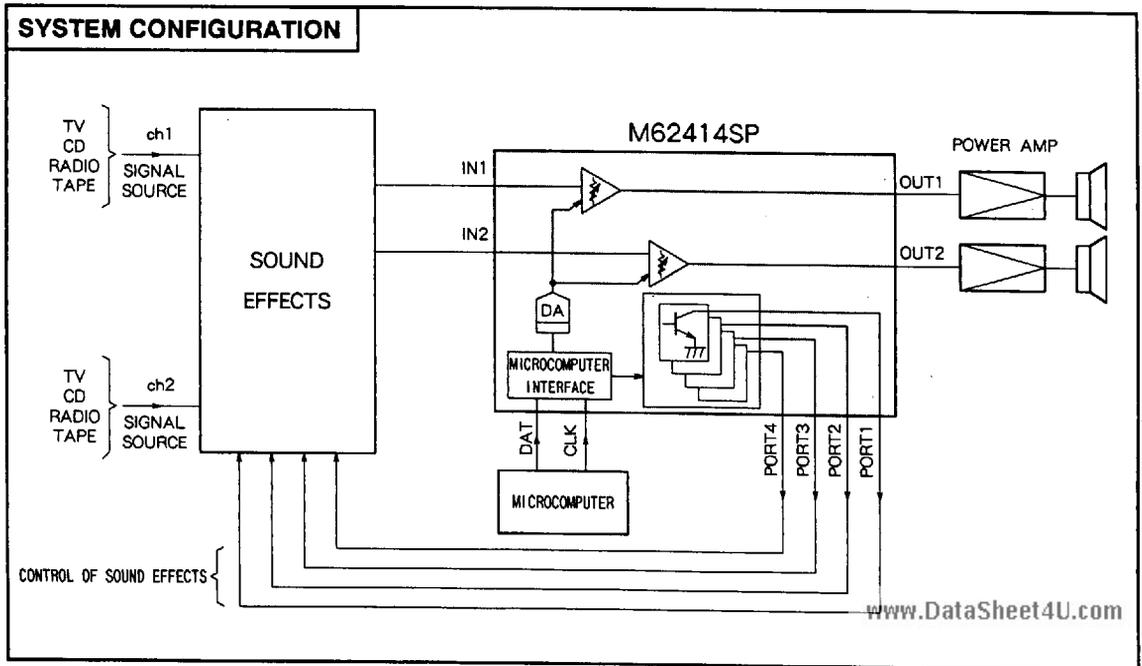
2CH, ELECTRONIC VOLUME WITH MICROCOMPUTER INTERFACE/4 OUTPUT PORT

PIN CONFIGURATION (TOP VIEW)

		M62414SP		
ANALOG POWER SULLPY	1		20	FILTER
VCA INPUT 1	2		19	VCA INPUT 2
VCA GND 1	3		18	VCA GND 2
VCA OUTPUT 1	4		17	VCA OUTPUT 2
SHOCK NOISE REDUCTION	5		16	VCA CONTROL
LOGIC GND	6		15	DAC OUTPUT
DATA	7		14	REFERENCE OUTPUT
CLOCK	8		13	LOGIC POWER SUPPLY
OUTPUT PORT 1	9		12	OUTPUT PORT 4
OUTPUT PORT 2	10		11	OUTPUT PORT 3
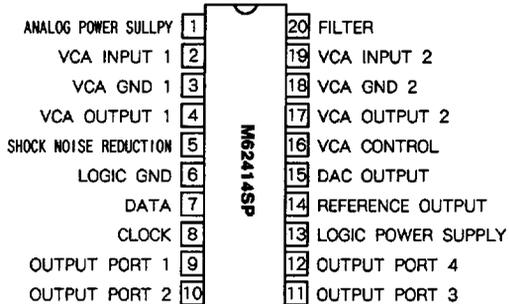
Outline 20P4B

IC INTERNAL BLOCK DIAGRAM
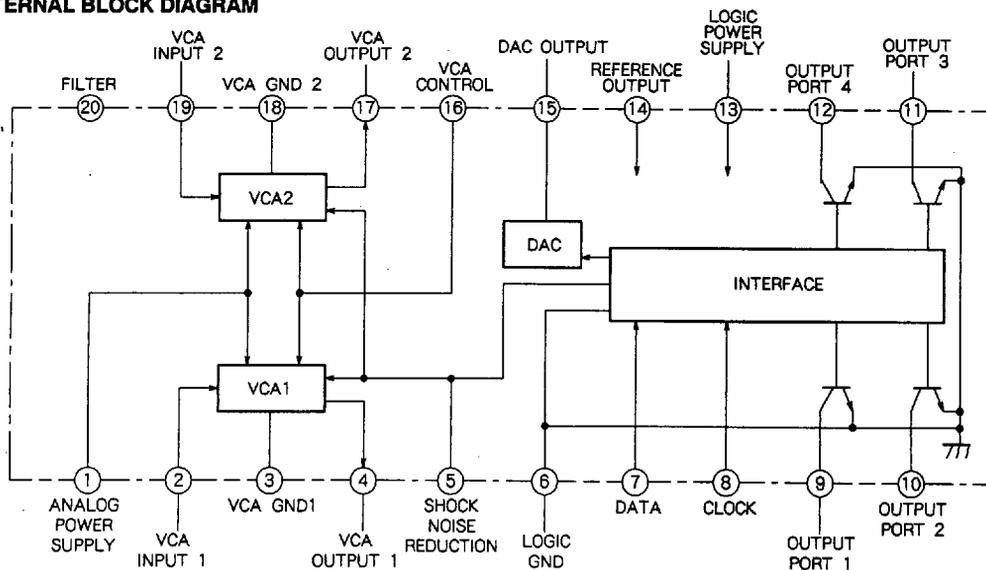
2CH, ELECTRONIC VOLUME WITH MICROCOMPUTER INTERFACE/4 OUTPUT PORT

PIN DESCRIPTION

Pin No.	Name	Function
①	Analog power supply	Applies 7V to 13V.(Rated voltage : 9V)
②	VCA input 1	Channel 1 signal input pin
③	VCA GND1	Grounding
④	VCA output 1	Channel 1 singnal output pin
⑤	Shock noise reduction	Shock noise generated by VCA gain switching is reduced with external capacitor
⑥	Logic GND	Grounding
⑦	DATA	Serial data transimission from microcomputer to IC (LSB first)
⑧	CLOCK	Clock pulses for serial data transmission from microcomputer to IC (LSB first)
⑨	Output port 1	Open collector output pin 1
⑩	Output port 2	Open collector output pin 2
⑪	Output port 3	Open collector output pin 3
⑫	Output port 4	Open collector output pin 4
⑬	Logic power supply	Applies 7V to 13V.(Rated voltage : 9V)
⑭	Reference output	Reference voltage output pin (4V typ)
⑮	DAC output	Voltage output pin for VCA control
⑯	VCA control	VCA control pin (0 to 4V)
⑰	VCA output 2	Channel 2 singnal output pin
⑱	VCA GND2	Grounding
⑲	VCA input 2	Channel 2 signal input pin
⑳	Filter	For power supply ripple removal

ABSOLUTE MAXIMUM RATINGS (Ta = 25℃, unless otherwise noted)

Symbol	Parameter	Ratings	Unit
$V_{CC(max)}$	Supply voltage	+ 15	V
P_d	Power dissipation	1000	mW
K_θ	Thermal derating	10.0	mW/℃
T_{opr}	Operating temperature	− 20 to + 75	℃
T_{stg}	Storage temperature	− 40 to +125	℃

## ELECTRICAL CHARACTERISTICS (Vcc = 9V, f = 1kHz, Vin = 1Vrms, unless otherwise noted)

Block	Symbol	Parameter	Test conditions	Control data 1 Mode select="0"	D0	D1	D2	D3	D4	D5	D6	Min	Typ	Max	Unit
Power supply	I_{ccA}	Circuit current (analog)	No signals	7FH	0	0	0	0	0	0	0	6	13	25	mA
Power supply	I_{ccL}	Circuit current (logic)	No signals	7FH	0	0	0	0	0	0	0	5	11	23	mA
Electronic volume	$ATT_{(min)}$	Minimum attenuation		7FH	0	0	0	0	0	0	0	− 2	0	+ 2	dB
Electronic volume	ATT_{-6}	Attenuation (− 6dB)	VCA GAIN = − 6dB	7FH	0	0	0	0	0	0	1	− 8	− 6	− 4	dB
Electronic volume	$ATT_{(max)}$	Maximum attenuation	Vin = 2Vrms, JIS-A	00H	0	0	0	0	0	0	1	−	− 105	− 85	dB
Electronic volume	CB	Channel balance		7FH	0	0	0	0	0	0	0	− 2	0	+ 2	dB
Electronic volume	THD	Total harmonic distortion	15kHz LPF	7FH	0	0	0	0	0	0	0	−	0.03	0.1	%
Electronic volume	R_i	Input resistance		7FH	0	0	0	0	0	0	0	50	150	−	kΩ
Electronic volume	$N_{o(min)}$	Output noise voltage (min)	Rg=10kΩ, no signals, JIS-A	7FH	0	0	0	0	0	0	0	−	9	20	μVrms
Electronic volume	$N_{o(max)}$	Output noise voltage (max)	Rg=10kΩ, no signals, JIS-A	00H	0	0	0	0	0	0	0	−	4.8	10	μVrms
Electronic volume	V_{imax}	Maximum input voltage	THD = 1 %	7FH	0	0	0	0	0	0	0	1	2	−	Vrms
Electronic volume	V_{omax}	Maximum output voltage	THD = 1 %	7FH	0	0	0	0	0	0	0	1	2	−	Vrms
Electronic volume	CT	Cross talk	Rg=0Ω Vin=2Vrms, JIS-A	7FH	0	0	0	0	0	0	0	−	− 102	− 80	dB
PORT 1~4	I_{OH}	Output port high level current	V_{OH} = 9V	7FH	0	0	0	0	0	0	0	0	−	10	μA
PORT 1~4	V_{OL}	Output port low level voltage	I_{OL} = 5mA	7FH	1	1	1	1	0	0	0	0	0.15	0.5	V
Logic input	I_{CH}	CLOCK input current	VCH = 5V									0.3	1.0	3.0	μA
Logic input	I_{CL}	CLOCK input current	VCL = 0V									− 0.3	0.0	0.3	μA
Logic input	I_{DH}	DATA input current	VDH = 5V									0.3	1.0	3.0	μA
Logic input	I_{DL}	DATA input current	VDL = 0V									− 0.3	0.0	0.3	μA
Logic input	V_{CH}	CLOCK "H" level voltage	Recommended conditions									3.5	−	5.5	V
Logic input	V_{CL}	CLOCK "L" level voltage	Recommended conditions									0.0	−	1.5	V
Logic input	V_{DH}	DATA "H" level voltage	Recommended conditions									3.5	−	5.5	V
Logic input	V_{DL}	DATA "L" level voltage	Recommended conditions									0.0	−	1.5	V

2CH, ELECTRONIC VOLUME WITH MICROCOMPUTER INTERFACE/4 OUTPUT PORT

DIGITAL CONTROL SPECIFICATIONS
Data format

	D7	D6	D5	D4	D3	D2	D1	D0
DATA 1 (MSB)	MODE SELECT 0			DAC DATA (7 bit)				(LSB)
DATA 2 (MSB)	MODE SELECT 1	VCA GAIN	"0"	"0"	OUT4	OUT3	OUT2	OUT1 (LSB)

	Signal name	Function		Signal name	Function
D0	DAC	DAC data (7 bits) For VCA control voltage output 00H to 7FH	D0	OUT1	For control of output port 1 "0" : High impedance "1" : Current intake
D1			D1	OUT2	For control of output port 2 "0" : High impedance "1" : Current intake
D2			D2	OUT3	For control of output port 3 "0" : High impedance "1" : Current intake
D3			D3	OUT4	For control of output port 4 "0" : High impedance "1" : Current intake
D4			D4	Not defined	D4 set to "0" D5 set to "0"
D5			D5		
D6			D6	VCA GAIN	"0" VCA gain···0dB "1" VCA gain··· − 6dB
D7	Mode select	"0" : Data 1 is selected	D7	Mode select	"1" : Data 2 is selected
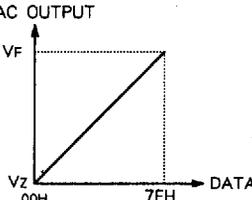
DAC OUTPUT graph: V_F at top, V_Z at bottom, DATA axis from 00H to 7FH.

Note 1. When power is turned on, internal data is reset to "0"

DATA SETTING TABLE

	Data	00	01	-----------	7E	7F
VCA D/A converter	Setting	V_Z	$\dfrac{127V_Z + V_F}{128}$	-----------	$\dfrac{2V_Z + 126V_F}{128}$	$\dfrac{V_Z + 127V_F}{128}$

Note 2. V_Z is in reference to GND potential. V_F is based on the reference output (⑭pin).

2CH, ELECTRONIC VOLUME WITH MICROCOMPUTER INTERFACE/4 OUTPUT PORT

DATA TIMING (Recommended conditions)

* Data communication : LSB first

CLOCK

(LSB)　　　　　　　　　　　　　　　　　　　　　　　　　　　　(MSB)

DATA

D0　D1　D2　D3　D4　D5　D6　D7 →t

Data signal is read at CLOCK rise.

Latch signal is read at CLOCK fall.(Latch signal "H")

V$_{IH}$

CLOCK

V$_{IL}$

8μs min　　8μs min

4μs min　4μs min　　4μs min

V$_{IH}$

DATA

V$_{IL}$

Data signal LOW period data signal latch signal
(when data is not latched)

Eight-bit data is sent.　　Latch signal is sent at final CLOCK fall.
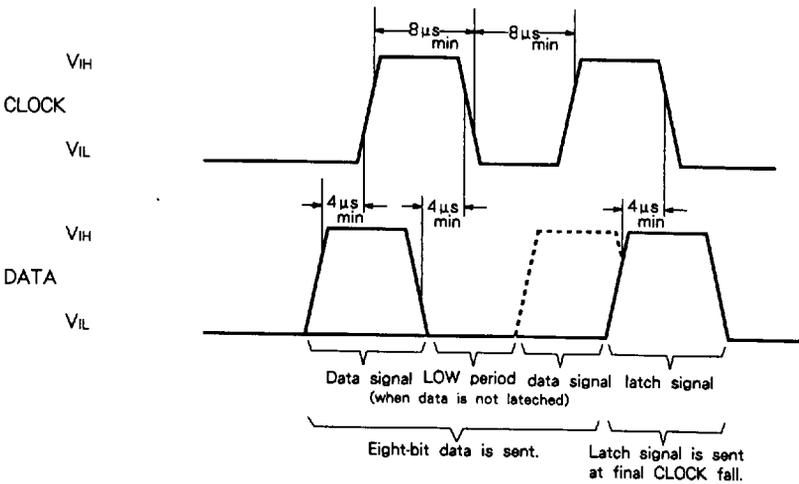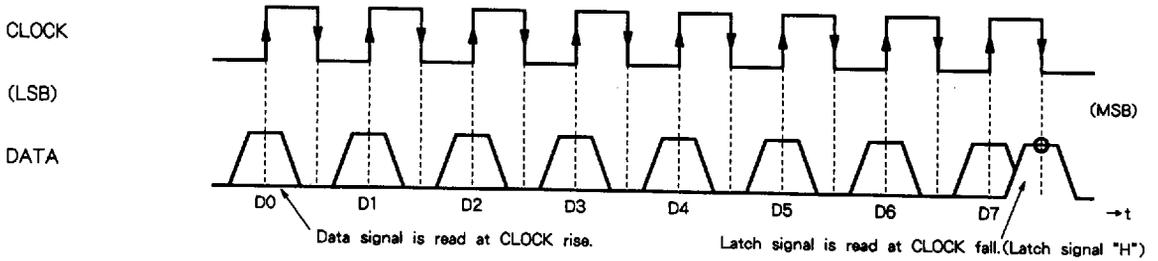
Note 1. Set CLOCK input and DATA input V$_{IL}$ and V$_{IH}$ to between 0V and 5.5V.
　　2. Logic input buffer threshold voltage is approximately 2.5V.

VCA ATTENUATION (Reference)

VCA gain(max = 0dB)	
Control data (D/A converter)	VCA attenuation (dB)
2FH	−14.0
37H	−9.0
3FH	−6.0
47H	−4.0
4FH	−2.5
57H	−1.5
5FH	−1.0
67H	−0.5
6FH	0
7FH	0

Note 3. At the data switching points of 0FH→10H, 1FH→20H, 2FH→30H, 3FH→40H, 4FH→50H, 5FH→60H, 6FH→70H, DAC error becomes large. Care should be taken when these switch points are used continuosly.

VCA gain(max = − 6dB)	
Control data (D/A converter)	VCA attenuation (dB)
0FH	Maximum attenuation
17H	−74
1FH	−61
27H	−52
2FH	−44
37H	−37
3FH	−29
47H	−24
4FH	−20
57H	−17
5FH	−14
67H	−11
6FH	−9
77H	−7
7FH	−6

2CH, ELECTRONIC VOLUME WITH MICROCOMPUTER INTERFACE/4 OUTPUT PORT

BLOCK OPERATION DIAGRAM
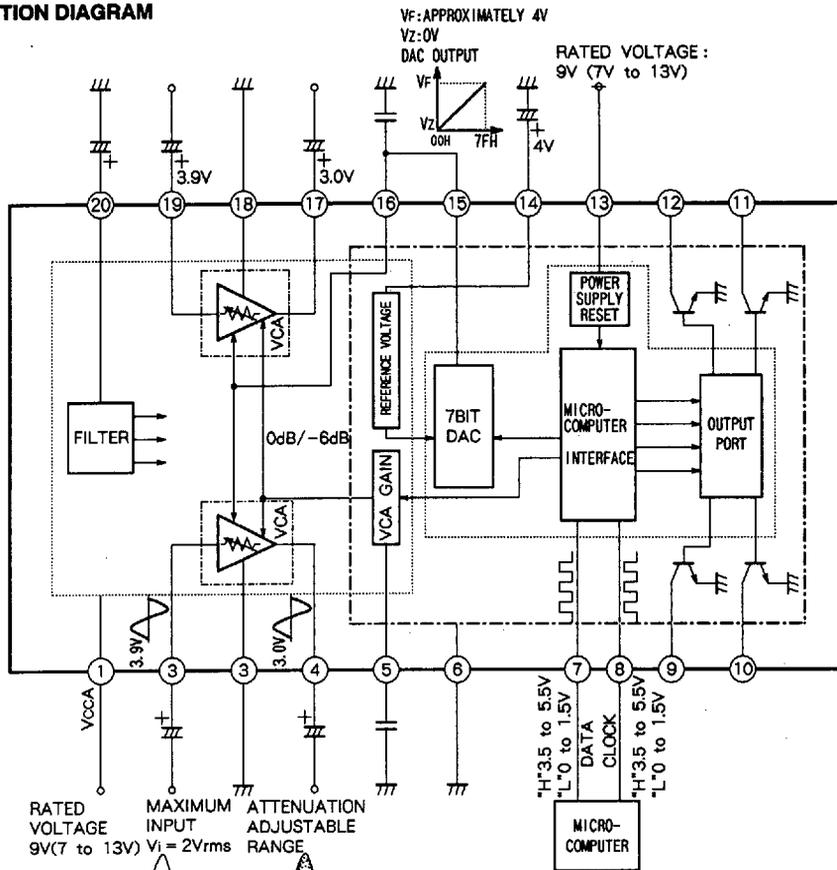
BASIC OPERATION

(1) **VCA block** : This block consists of a VCA circuit, and handles main analog signals.

① Input signals are output after attenuated by the VCA circuit.

② VCA maximum gain can be set to 0dB or −6dB

- MAX gain 0dB : In areas where attenuation is small, signals are attenuated little by little. (In areas where attenuation is large, signals are attenuated largely in response to controlled voltage variation.

- MAX gain −6dB : In areas where attenuation is large, signals are attenuated more modestly in response to controlled voltage variation than when the maximum gain is set to 0dB.

To finely control signals, set maximum gain to 0dB where attenuation is small, and to −6dB where attenuation is large.

③ VCA circuit is controlled by DC voltage applied to pin ⑯. Control DC voltage is output from the 7bit D-A converter in the IC.

(2) **Control block** : This block processes data from microcomputer to control functions.

① When power is turned on, resetting signal is output from reset circuit, and internal logoc is automatically set to the following conditions : DAC control data, 00H (maximum attenuation), VCA gain, 0dB, and output port, high-impedance. Reset is not canceled unitil supply voltage exceeds 4V, therefore, start data transmission after supply voltage reaches the recommended operational range.

② Functions are controlled with 8bit serial data from microcomputer. To control DAC, select data 1 (mode select "0"). To set output port and VCA gain, select data 2 (mode select "1"). For data setting details, refer to digital control specifications on page 9.

(3) **Output port block** : This block includes 4 output ports.

① The ports are the current intake open collector type (NPN transistors).

② After power is turned on, the status of output ports is retained at high impedance until first data arrives.

③ Four output ports can be set independently according to control data.

## 2CH, ELECTRONIC VOLUME WITH MICROCOMPUTER INTERFACE/4 OUTPUT PORT

SWITCHING CONDITIONS AND TEST METHODS

Symbol	Parameter		Switching conditions												Test method
			S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	
IccA	Circuit currnet (analog)		2	1	1	1	1	1	1	1	1	1	1	1	Current that runs at pin① is measured when there are no signals.
ILLL	Circuit current (logic)		1	1	1	1	1	1	1	1	2	1	1	1	Current that runs at pin⑬ is measured when there are no signals.
$A_{TT(min)}$	Minimum attenuation		1	2	1	1	1	1	1	1	1	1	1	2	Measured when $A_{TT}(dB) = 20\log(V_o/V_i)$ $A_{TT(max)}$: IHF-A in
A_{TT-6}	Attenuation (− 6dB)		1	2	1	1	1	1	1	1	1	1	1	2	
$A_{TT(max)}$	Maximum attenuation		1	2	1	3	1	1	1	1	1	3	1	2	
CB	Channel balance		1	2	1	1	1	1	1	1	1	1	1	2	$CB(dB) = A_{TTch1} - A_{TTch2}$
THD	Total harmonic		1	2	1	1	1	1	1	1	1	1	1	2	15kHz LPF in
R_i	Input resistance		1	2	1→2	1	1	1	1	1	1	1	1→2	2	$R_i(k\Omega) = 150/(V_{o1}/V_{o2}-1)$ V_{o1} : S3 and S11→1 V_{o2} : S3 and S11→2
$N_{o(min)}$	Output noise voltage (min)		1	1	1	3	1	1	1	1	1	3	1	1	No signals, IHF-A
$N_{o(max)}$	Output noise voltage (max)		1	1	1	3	1	1	1	1	1	3	1	1	No signals, IHF-A
$V_{i(max)}$	Maximum input voltage		1	2	1	1	1	1	1	1	1	1	1	2	Input signal voltage at 1% output distortion
$V_{o(max)}$	Maximum output voltage		1	2	1	1	1	1	1	1	1	1	1	2	Output signal voltag at 1% output distortion
CT	Crosstalk		1	3 / 2	1	3 / 2	1	1	1	1	1	2 / 3	1	2 / 3	IHF-A in $CT(dB) = 20\log$ $(V_o(Vrms)/2(Vrms))$
I_{OH}	Output port high level current		1	1	1	1	2	2	2	2	1	1	1	1	Current is measured at pins⑨,⑩,⑪ and ⑫ when the status of output ports is "high impedance."
V_{OL}	Output port low level voltage		1	1	1	1	1	1	1	1	1	1	1	1	Current is measured at pins⑨,⑩,⑪ and ⑫ when output ports takes in current.
ICH	LOCK input current		1	1	1	1	1	1	1	1	1	1	1	1	Current is measured at pin⑧.
ICL			1	1	1	1	1	1	1	1	1	1	1	1	Current is measured at pin⑦.
IDH	DATA input current		1	1	1	1	1	1	1	1	1	1	1	1	
IDL			1	1	1	1	1	1	1	1	1	1	1	1	
VCH	CLOCK	H level voltage	1	1	1	1	1	1	1	1	1	1	1	1	
VCL		L level voltage	1	1	1	1	1	1	1	1	1	1	1	1	
VDH	DATA	H level voltage	1	1	1	1	1	1	1	1	1	1	1	1	
VDL		L level voltage	1	1	1	1	1	1	1	1	1	1	1	1	

Note 1. When two switching conditions are specified, the item should be measured under both conditions.

2CH, ELECTRONIC VOLUME WITH MICROCOMPUTER INTERFACE/4 OUTPUT PORT

TEST CIRCUIT

Units Resistance : Ω
Capacitance : F
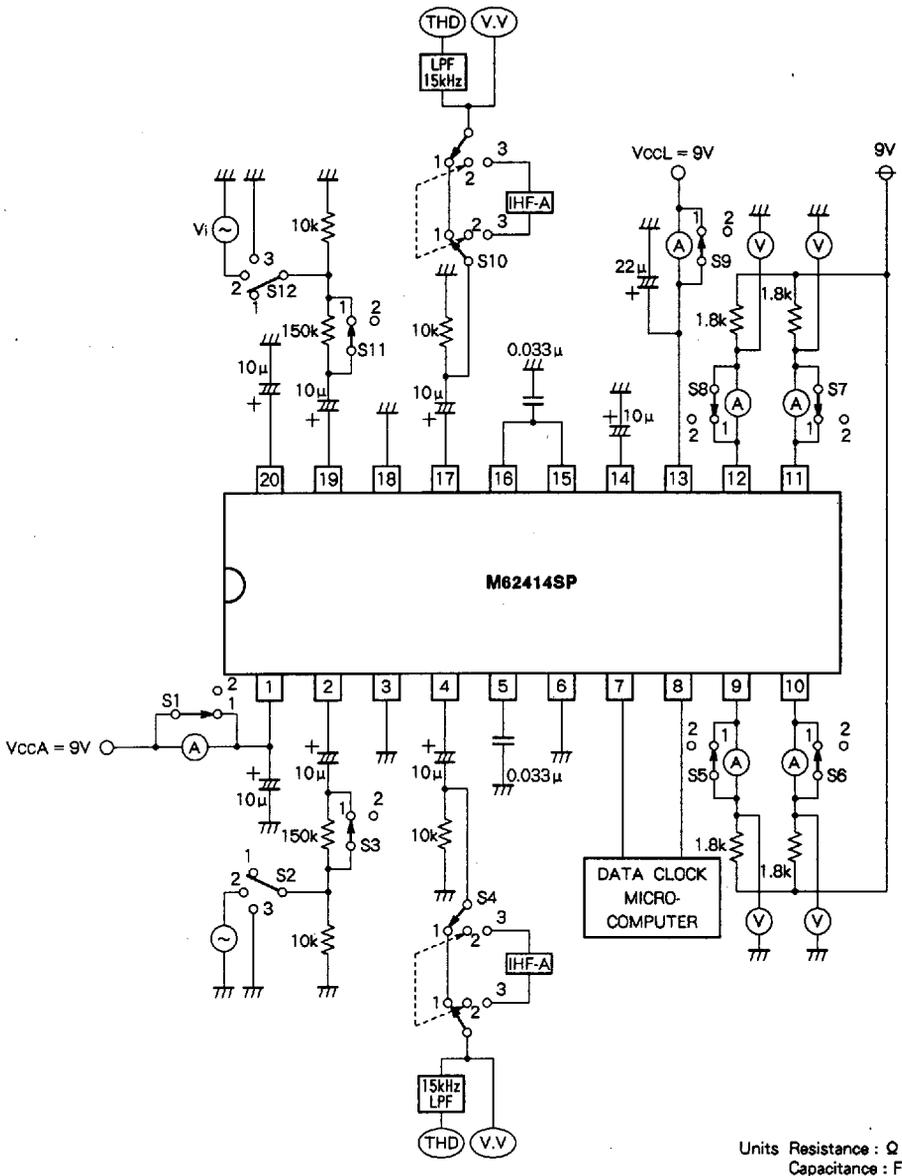
2CH, ELECTRONIC VOLUME WITH MICROCOMPUTER INTERFACE/4 OUTPUT PORT

TYPICAL CHARACTERISTICS

THERMAL DERATING

CIRCUIT CURRENT VS. SUPPLY VOLTAGE

ATTENUATION VS. VOLUME CONTROL VOLTAGE

TOTAL HORMONIC DISTORTION VS. OUTPUT VOLTAGE

ATTENUATION VS. FREQUENCY

OUTPUT NOISE VOLTAGE VS. ATTENUATION
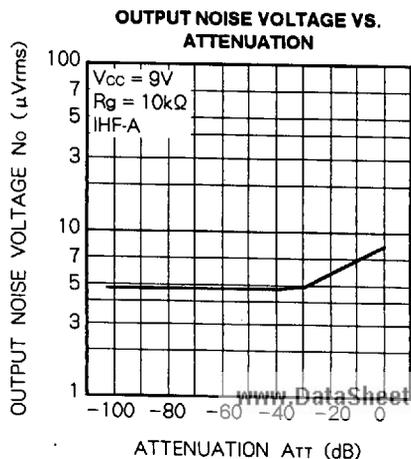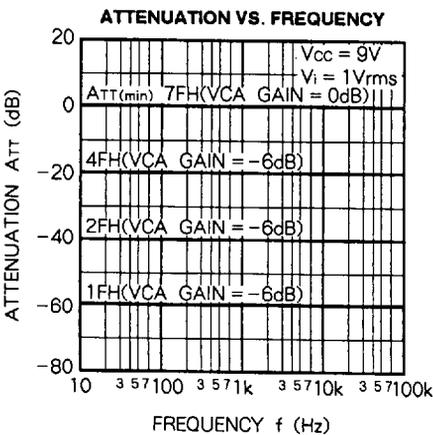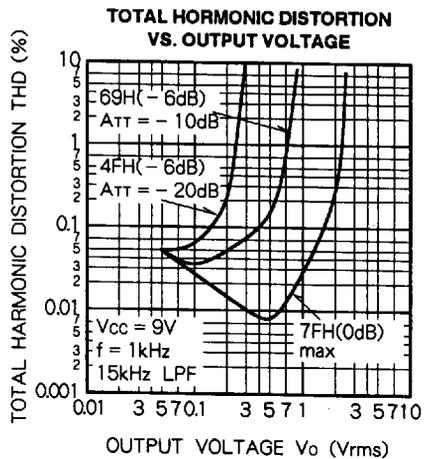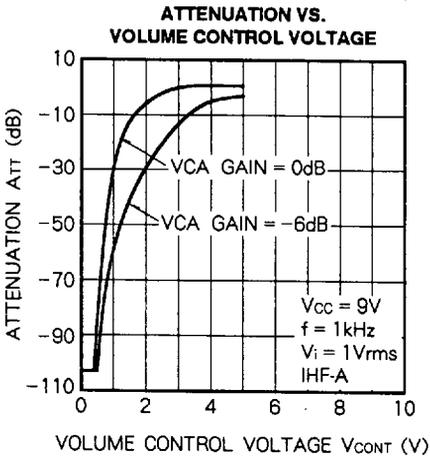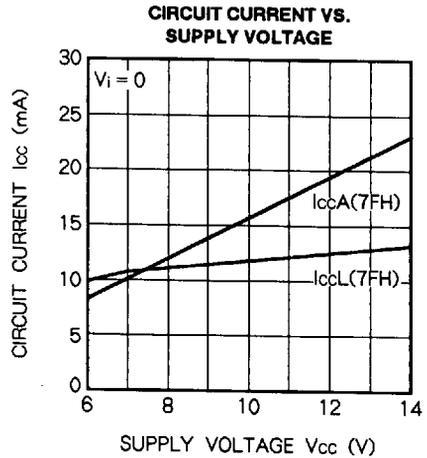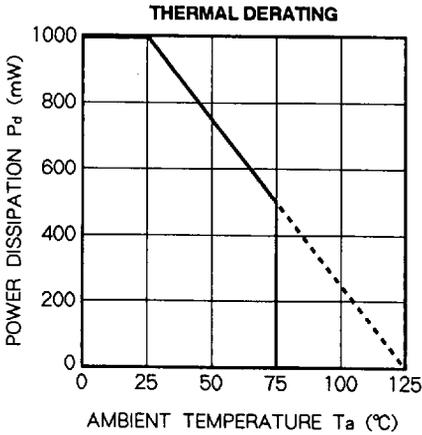
2CH, ELECTRONIC VOLUME WITH MICROCOMPUTER INTERFACE/4 OUTPUT PORT

APPLICATION EXAMPLE

Units Resistance : Ω
Capacitance : F
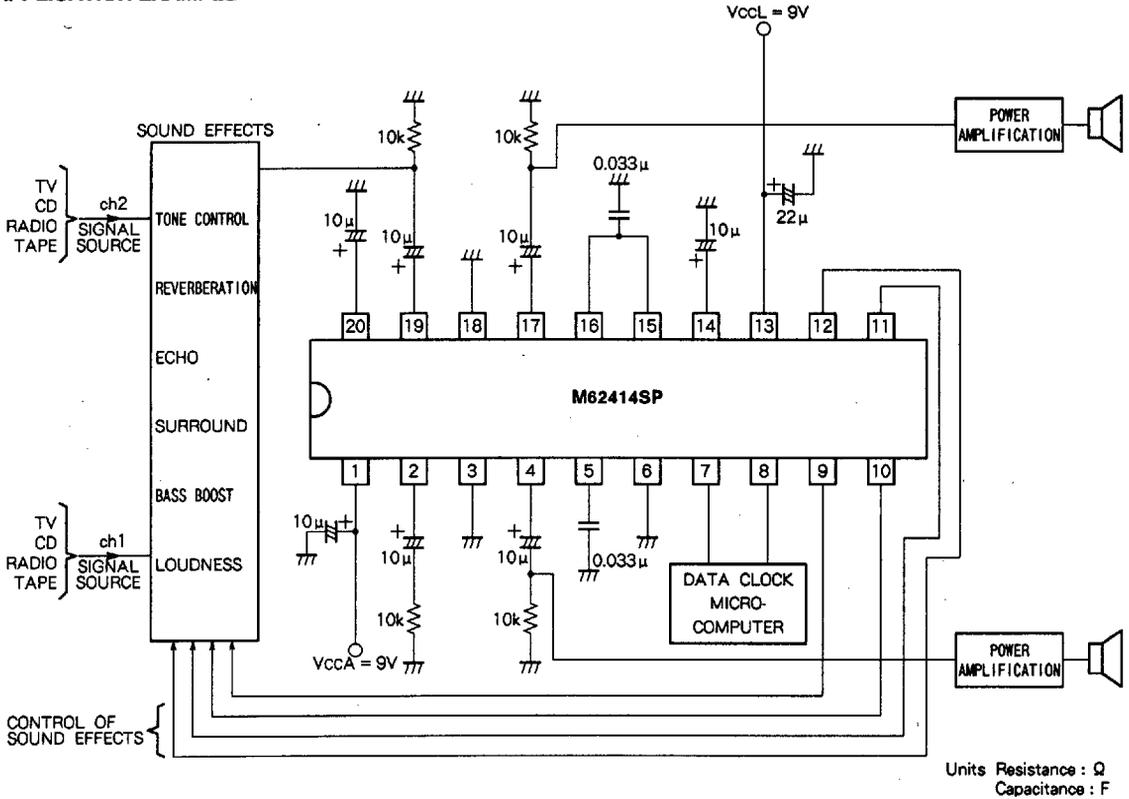
OPERATION DESCRIPTION

(1) Design circuit board to ensure sufficient radiation.

(2) This IC includes an analog section and digital section. Design circuit boards to prevent digital noise jumping and runaround crosstalk.

(3) Set all GND pins to GND potential. Take care that GND pins do not interfere with each other to prevent disconnection between analog section and digital section.

(4) Apply approximately equal voltage to pin① (VccA) pin and pin⑬ (VccL). (Pay attention to power supply rise and fall.)

(5) When supply voltage is low, internal reset circuit is on. Set operational functions after supply voltage reaches the recommended operational range.

(6) When external DC voltage is applied to VCA, set the input voltage to between approximately 0V to 4V. It is recommended that pin⑭ voltage be used as the 4V referebce voltage.

(Example)