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MITSUBISHI LINEAR ICs

M51131L

MITSUBISHI ELEK (LINEAR)

2 CHANNEL ELECTRONIC VOLUME BALANCE

DESCRIPTION

The M51131L is a semiconductor integrated circuit designed for dual-channel electronic volume balance control.

It is housed in a 14-pin plastic molded zig-zag line package and left/right independent volume control or left/right simultaneous volume control plus balance control can be selected by the DC voltages.

Built-in pass through function enables automatic level control in combination with the ALC amplifier circuit.

FEATURES

- Two control modes can be selected.
(Left/right independent volume control mode or left/right simultaneous volume + balance control mode)
Pass through switch is included to output the input signal as it is, irrespective of the volume/balance control voltages.
Shock noise reduction pin is included to reduce pass through switch on/off shock noise.
Built-in reference supply voltage circuit
output current 10mA (typ.)
Maximum permissible input
3.4Vrms (typ.) (f=1kHz, THD=1%)
High attenuation
105dB (typ.) (f=1kHz, Vi=2Vrms, JIS-A)
Low distortion rate
0.005% (typ.) (f=1kHz, Vi=500mVrms, 15kHz LPF)
Good channel separation
102dB (typ.) (f=1kHz, Vo=2Vrms, JIS-A)

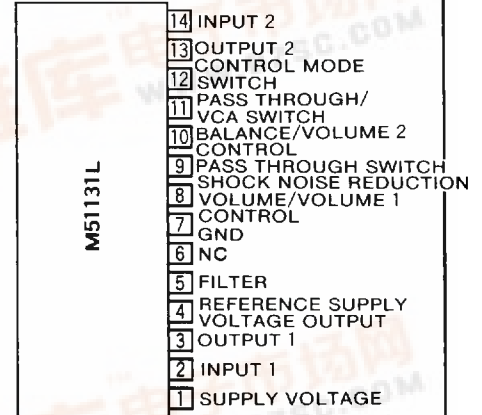
APPLICATION

High-fidelity VTR, Television set, Radio cassette player, Car stereo set, High-fidelity amplifier, Cassette deck player

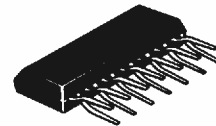
RECOMMENDED OPERATING CONDITIONS

- Rated supply voltage range 8~15V
Rated supply voltage 12V

PIN CONFIGURATION (TOP VIEW)

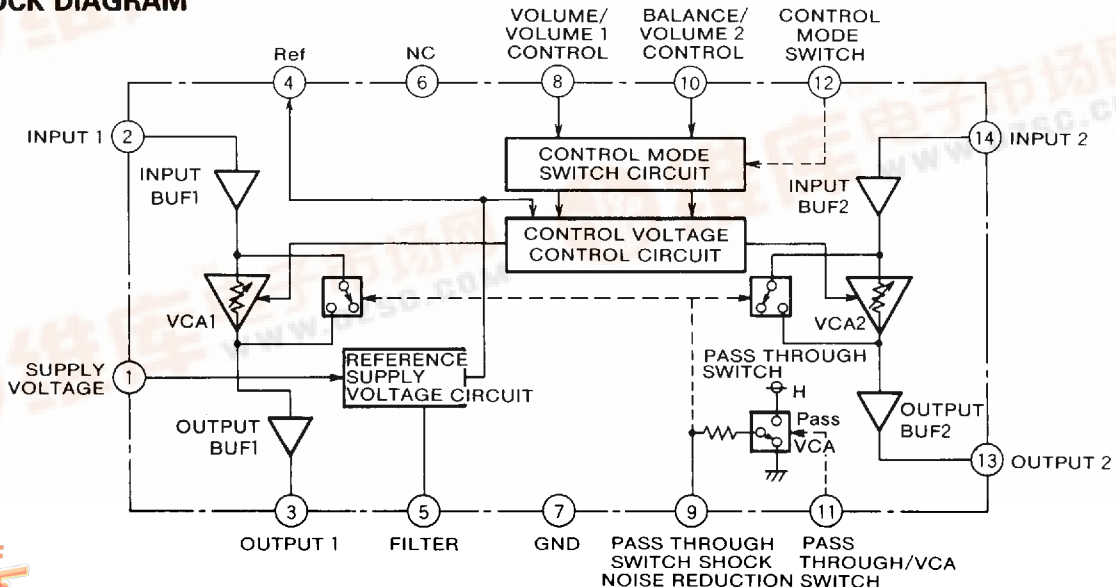


NC : NO CONNECTION



14-pin plastic molded ZIP

BLOCK DIAGRAM



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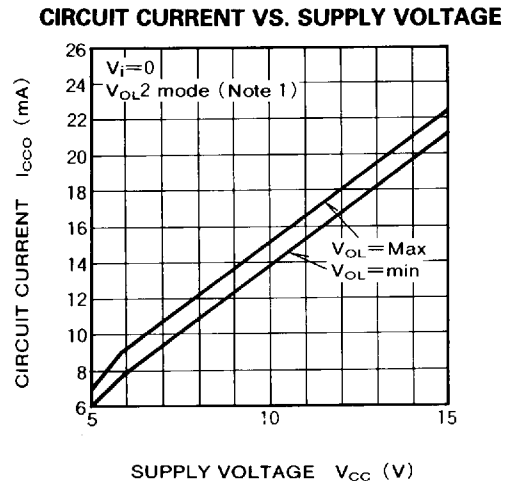
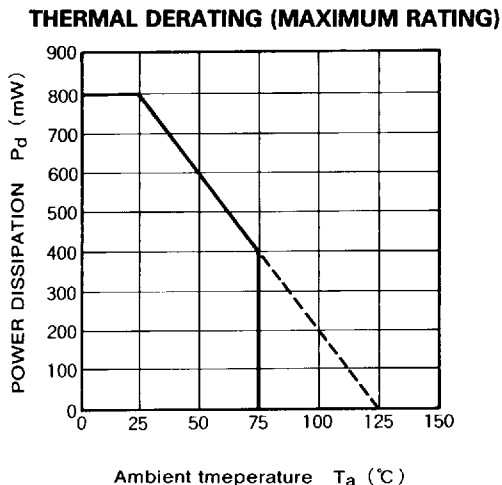
**PIN ASSIGNMENT**

Pin No.	Name	Operation	Typical DC voltage
①	Power supply	DC 8~15V is applied (rated voltage 12V)	
②	Input 1	Maximum permissible input 3.4Vrms (typ.)	5.5V
③	Output 1		4.8V
④	Reference supply voltage output	Maximum output current 10mA (typ.), built-in short circuit protection circuit	5.2V
⑤	Filter		12V
⑥	No connection	Can be used for wire repeater to GND, etc.	
⑦	GND		
⑧	Volume/volume 1 control	Left/right simultaneous volume or channel 1 volume is controlled by this value in the range of 0 to 5.2V DC.	
⑨	Pass through switch shock noise reduction	Transit noise to the ear is softened by slowly switching between pass through and VCA with time constant when the pass through switch is turned on/off. The time constant is determined by externally connected capacitor. $T(\text{Sec})=1.2 \times C \times 20k$	5.2V for pass through and 0V for VCA
⑩	Balance/volume 2 control	Balance or channel 2 volume is controlled with 0 to 5.2V.	
⑪	Pass through/VCA switch	Operates as VCA with 0V, and passes through the input to output with 5.2V.	
⑫	Control mode switch	Operates as channel 1 volume at pin ⑧ and as channel 2 volume at pin ⑩ with 0V. Operates as channel 1 and channel 2 simultaneous volume at pin ⑧ and as balance at pin ⑩ with 5.2V.	
⑬	Output 2		4.8V
⑭	Input 2	Maximum permissible input 3.4Vrms (typ)	5.5V

**ABSOLUTE MAXIMUM RATINGS** ( $T_a=25^\circ\text{C}$ , unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
$V_{CC}$	Supply voltage		15.5	V
$I_{CC}$	Circuit current		40	mA
$P_d$	Power dissipation	When mounted on PC board	800	mW
$K_\theta$	Thermal derating	$T_a \geq 25^\circ\text{C}$	8.0	mW/ $^\circ\text{C}$
$T_{opr}$	Operating temperature		-20~+75	$^\circ\text{C}$
$T_{stg}$	Storage temperature		-40~+125	$^\circ\text{C}$

**TYPICAL CHARACTERISTICS**

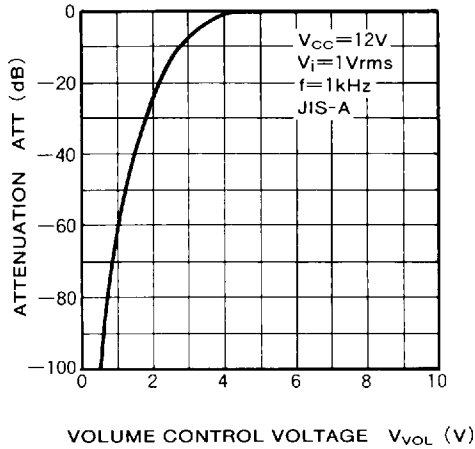


Note 1.  $V_{OL2}$  mode means left/right independent volume control mode.

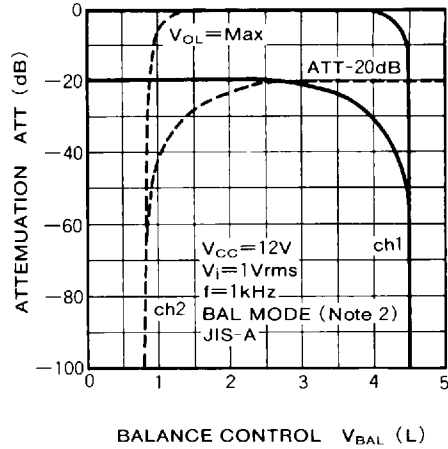
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**2 CHANNEL ELECTRONIC VOLUME BALANCE**

**ATTENUATION VS. VOLUME CONTROL**

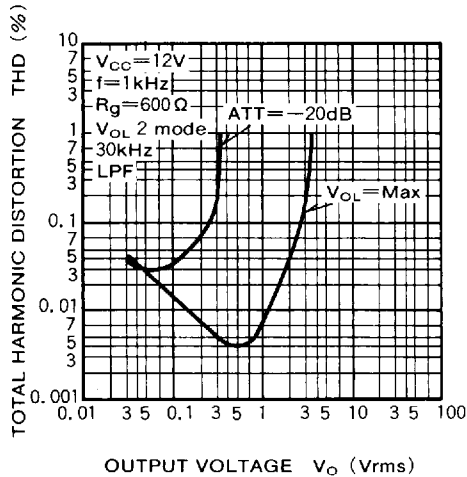


**ATTENUATION VS. BALANCE CONTROL VOLTAGE**

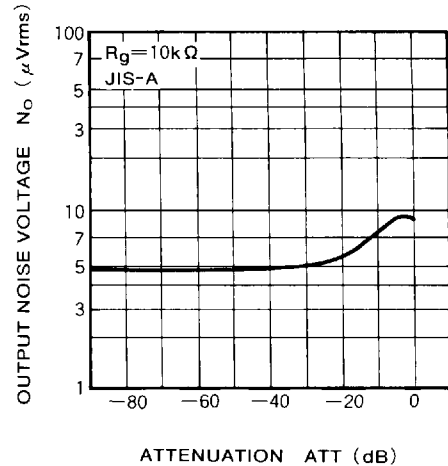


Note 2. BAL mode means left/right simultaneous volume and balance control mode.

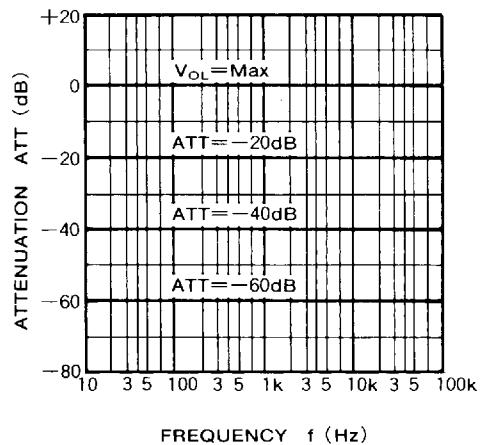
**TOTAL HARMONIC DISTORTION VS. OUTPUT VOLTAGE**



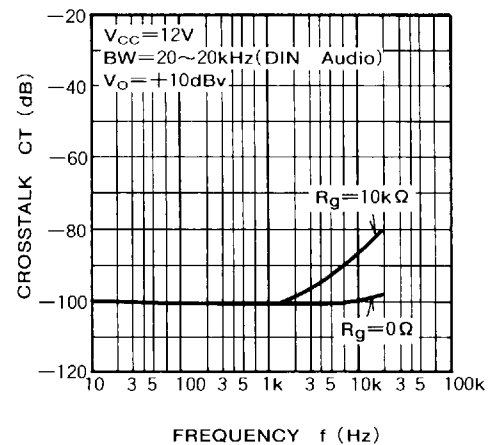
**OUTPUT NOISE VOLTAGE VS. ATTENUATION**



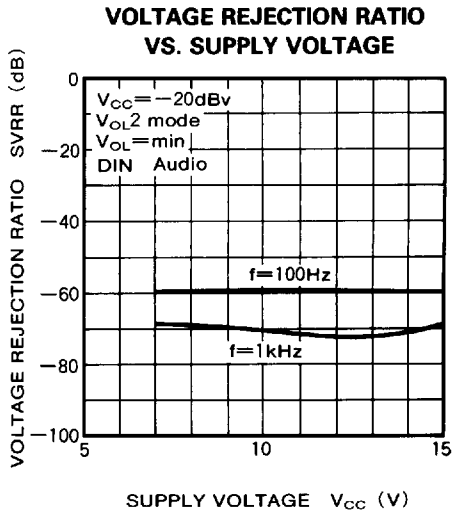
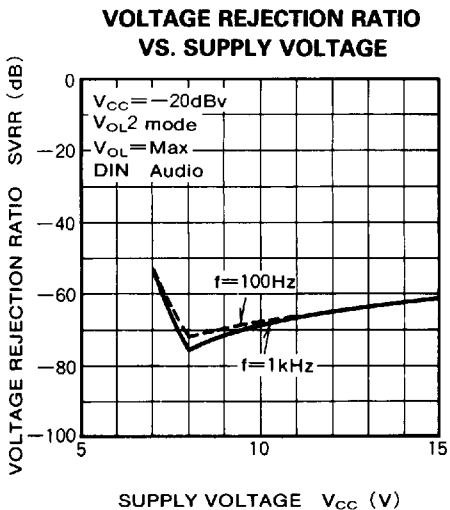
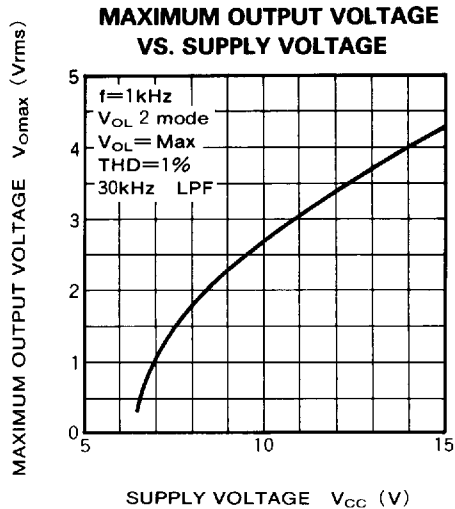
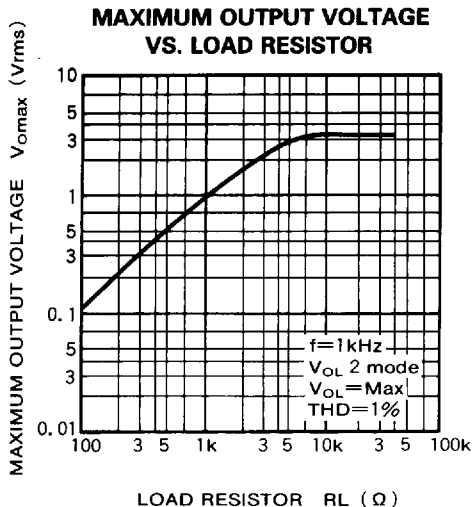
**ATTENUATION VS. FREQUENCY CHARACTERISTICS**



**CROSSTALK VS. FREQUENCY CHARACTERISTICS**



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**2 CHANNEL ELECTRONIC VOLUME BALANCE**

**ELECTRICAL CHARACTERISTICS** ( $T_a=25^\circ\text{C}$ ,  $V_{CC}=12\text{V}$ ,  $f=1\text{kHz}$ ,  $V_i=1\text{Vrms}$ , Volume Max, unless otherwise noted)

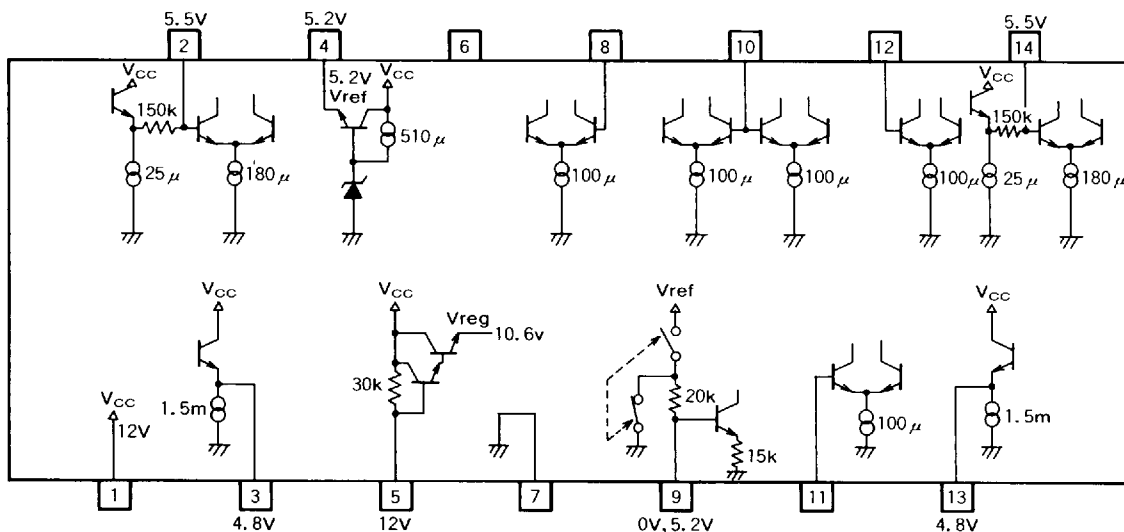
Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
$I_{CCO}$	Circuit current	In quiescent state, volume: min		17		mA
$ATT_o$	Attenuation			0		dB
$Att_{-\infty}$		$V_i=2\text{Vrms}$ , JIS-A, volume: min		-105		dB
CB	Channel balance			0		dB
THD	Total harmonic distortion	15kHz, LPF		0.01		%
$R_i$	Input resistor			150		k $\Omega$
BAL	Balance attenuation	$V_i=2\text{Vrms}$ , JIS-A		-105		dB
$N_{omin}$	Output noise voltage	$R_g=10\text{k}\Omega$ in quiescent state, JIS-A, volume: min		4.8		$\mu\text{Vrms}$
$N_{omax}$		$R_g=10\text{k}\Omega$ in quiescent state, JIS-A		9		$\mu\text{Vrms}$
$V_{imax}$	Maximum input voltage	THD=1%, volume: Center		3.4		Vrms
$V_{omax}$	Maximum output voltage	THD=1%		3.4		Vrms
$C_T$	Crosstalk	$R_g=0\Omega$ , $V_i=2\text{Vrms}$ , JIS-A		-102		dB
$G_{vp}$	Pass through voltage gain	Volume: min		+0.8		dB
$C_{BP}$	Pass through channel balance	Volume: min		0		dB

Note 3. The volume Max means the condition in which the same voltage as  $V_i$  is applied to pin ⑧.

4. The volume Center means the condition in which the same voltage as  $V_i/2$  is applied to pin ⑧.

5. The volume min means the condition in which pin ⑧ is connected to GND.

**I/O TYPE**



Note 6. All resistors, voltages, currents are shown in typical values.

Unit Resistance :  $\Omega$

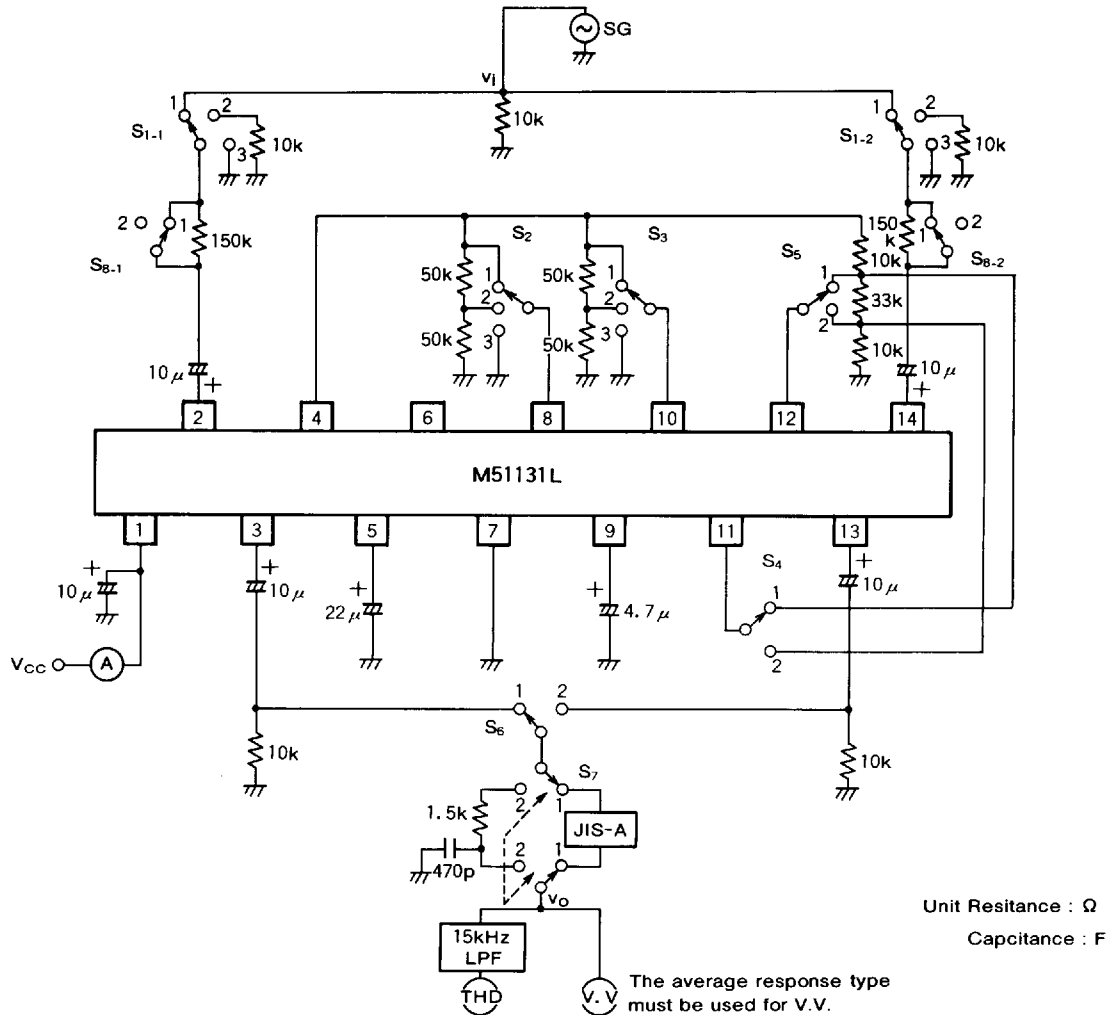
Voltage : V

Current : A

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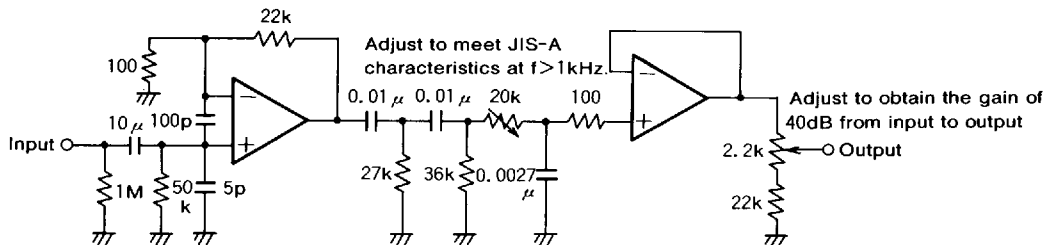
**TEST CIRCUIT**



Unit Resistance : Ω  
Capcitrance : F

The JIS-A filter can be replaced with the following circuit.

Example of JIS-A filter equivalent circuit (Note that the output is multiplied by 100).



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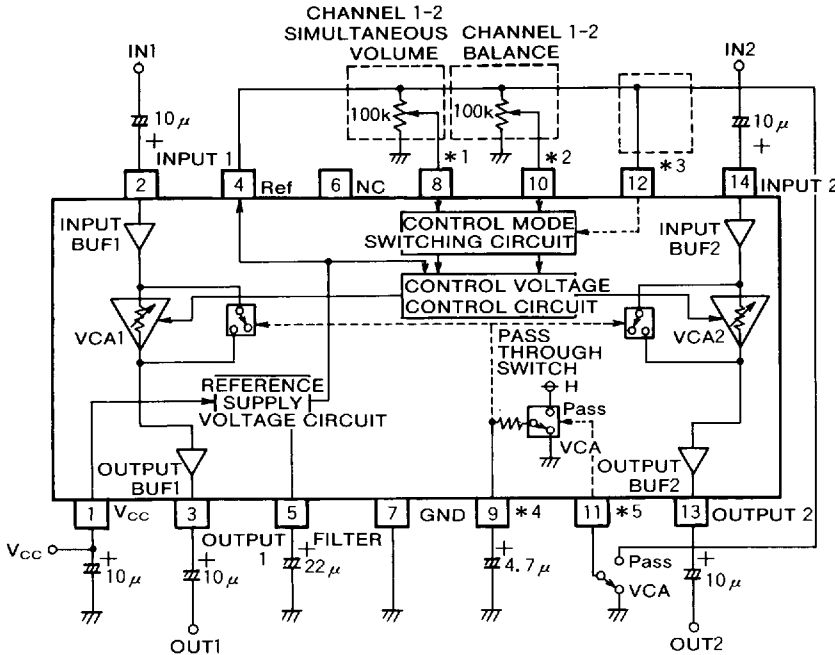
**SWITCH CONDITION AND TEST METHOD**

Symbol	Parameter	Switch										Test method
		S <sub>1-1</sub>	S <sub>1-2</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>	S <sub>5</sub>	S <sub>6</sub>	S <sub>7</sub>	S <sub>8-1</sub>	S <sub>8-2</sub>	
I <sub>CCO</sub>	Circuit current	2	2	3	3	2	2	1	2	1	1	Measure the current flowing to pin ① in quiescent state
ATT <sub>O</sub>	Attenuation	1	1	1	1 2	2	2 1	1/2	2	1	1	Obtain from the equation ATT(dB)=20 log(V <sub>O</sub> /V <sub>I</sub> ). ATT-∞ is JIS-A in
Att-∞		1	1	3	3 2	2	2 1	1/2	1	1	1	
CB	Channel balance	1	1	1	1 2	2	2 1	1→2	2	1	1	CB(dB)=ATT <sub>ch1</sub> -ATT <sub>ch2</sub>
THD	Total harmonic distortion	1	1	1	1 2	2	2 1	1/2	2	1	1	15kHz LPF in
R <sub>i</sub>	Input resistor	1	1	1	1	2	2	1 2	2	1→2 1→2		Given the output as V <sub>O1</sub> when S <sub>8</sub> →1 and the output as V <sub>O2</sub> when S <sub>8</sub> →2, R <sub>i</sub> (kΩ)=150/(V <sub>O1</sub> /V <sub>O2</sub> -1)
BAL	Balance attenuation	1	1	1	1 3	2	1	1 2	1	1	1	BAL(dB)=20 log(V <sub>O</sub> /V <sub>I</sub> )
N <sub>Omin</sub>	Output noise voltage	2	2	3	3 2	2	2 1	1/2	1	1	1	JIS-A in
N <sub>Omax</sub>		2	2	1	1 2	2	2 1	1/2	1	1	1	JIS-A in
V <sub>imax</sub>	Maximum input voltage	1	1	2	2	2	2 1	1/2	2	1	1	Input signal voltage when the output distortion rate is 1%.
V <sub>Omax</sub>	Maximum output voltage	1	1	1	1 2	2	2 1	1/2	2	1	1	Output signal voltage when the output distortion rate is 1%.
C <sub>T</sub>	Crosstalk	3 1	1 3	1	1	2	2	1 2	1	1	1	JIS-A in C <sub>T</sub> (dB)=20 log(V <sub>O</sub> (V <sub>rms</sub> )/2(V <sub>rms</sub> ))
G <sub>vp</sub>	Pass through voltage gain	1	1	3	3	1	2	1/2	2	1	1	G <sub>vp</sub> (dB)=20 log(V <sub>O</sub> /V <sub>I</sub> )
C <sub>BP</sub>	Pass through channel balance	1	1	3	3	1	2	1→2	2	1	1	C <sub>BP</sub> (dB)=G <sub>vpch1</sub> -G <sub>vpch2</sub>

Note 5. If the parameter is separated into two rows, measurement is made for all the switching conditions in the upper row and all the switching conditions in the lower row.

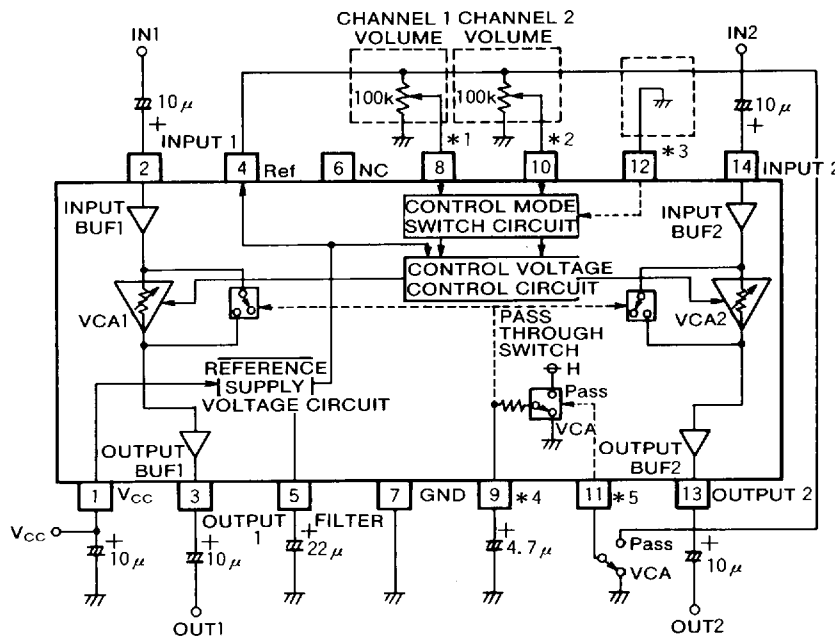
**APPLICATION EXAMPLES**

**(a) To control by left/right simultaneous variable volume and balancer**



- \*1 Volume/volume 1 control
- \*2 Balance/volume 2 control
- \*3 Control mode switch
- \*4 Pass through switch shock noise reduction
- \*5 Pass through/VCA switch

**(b) To control by left/right independent volume**



- \*1 Volume/volume 1 control
- \*2 Balance/volume 2 control
- \*3 Control mode switch
- \*4 Pass through switch shock noise reduction
- \*5 Pass through/VCA switch

**Difference between examples (a) and (b)**

Pin No.	Example (a)	Example (b)
⑧	Volume control	ch1 volume control
⑩	Balance control	ch2 volume control
⑫	Connected to pin ④	GND

Unit Resistance : Ω  
Capacitance : F



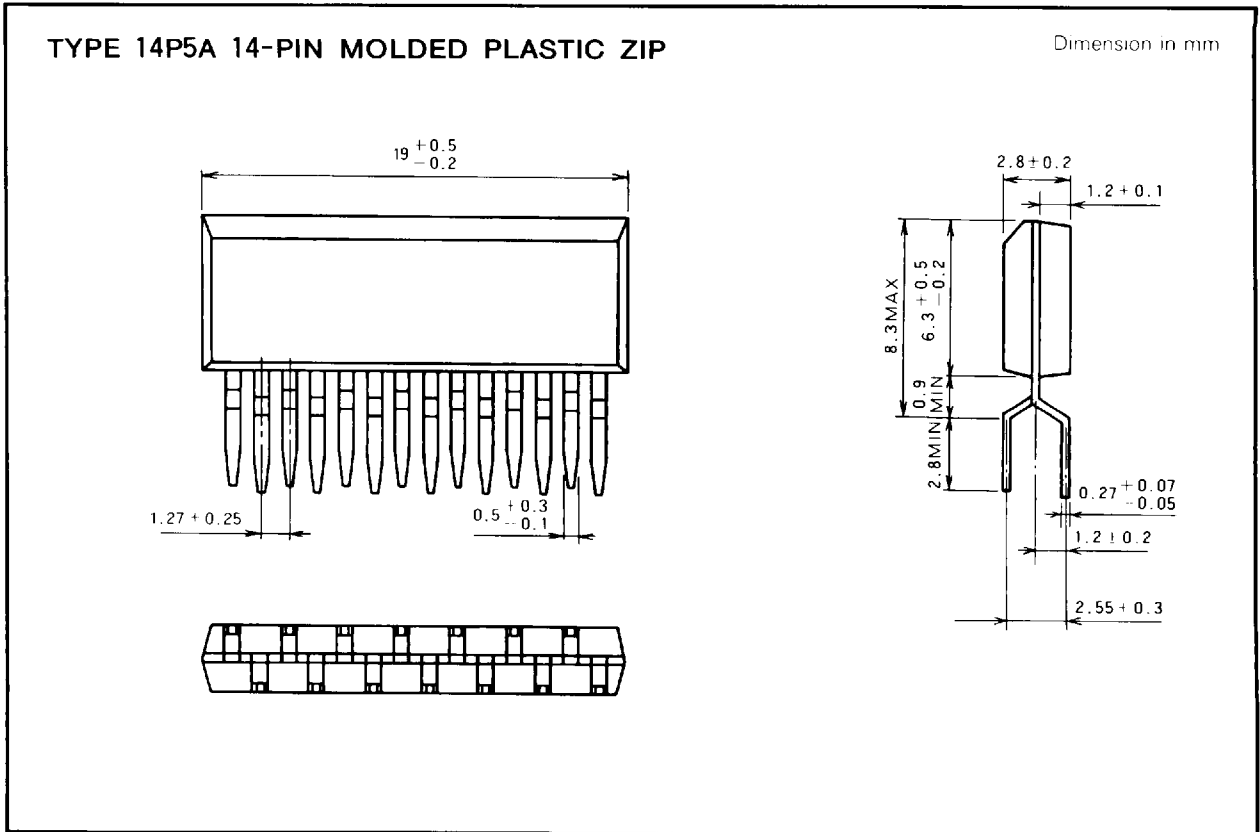
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All values shown in this catalogue are subject to change for product improvement.

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