

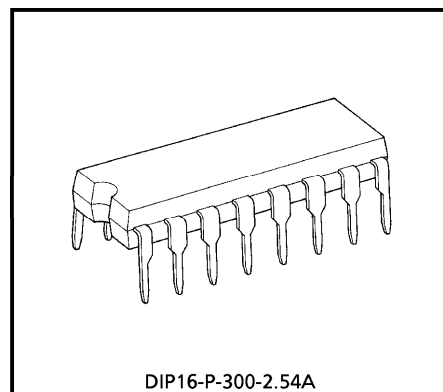
TC9299P

ELECTRONIC VOLUME CONTROL IC

TC9299P is electronic volume control IC developed for use in audio equipment such as home stereo sets. This IC control balance and rear speaker. The volume, balance and loudness circuits can be controlled by serial data which are input externally.

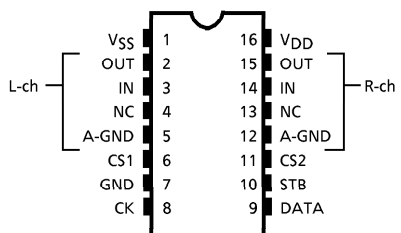
FEATURES

- Thirty-two level volume control in 1dB steps from 0dB to 30dB, ∞ dB.
- The volume circuit features 2 built-in channels which can be controlled independently, thus controlling balance.
- Single and dual power supply operation.
- Chip select input allows control of up to four of these chips on the same bus.
- Polysilicon resistors enables low-distortion, high-performance volume systems.
- Package is DIP16 Pin.

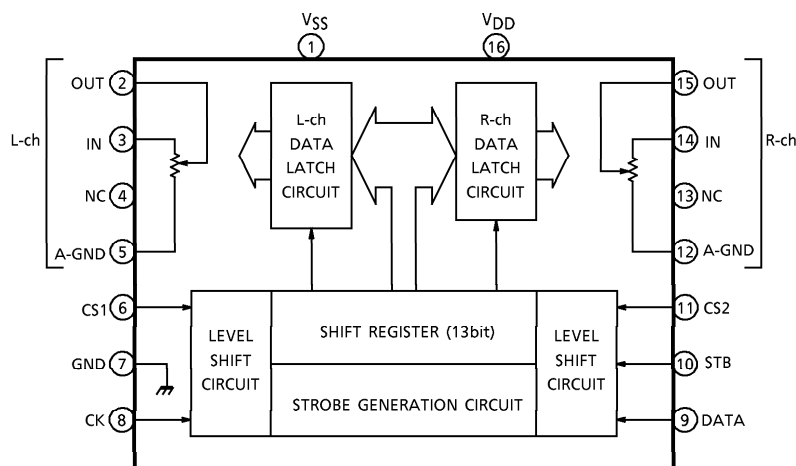


Weight : 1.0g (Typ.)

PIN CONNECTION



BLOCK DIAGRAM



980910EBA2

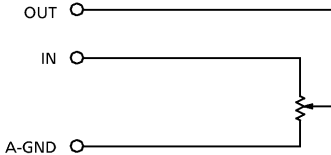
● TOSHIBA is continually working to improve the quality and the reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to observe standards of safety, and to avoid situations in which a malfunction or failure of a TOSHIBA product could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent products specifications. Also, please keep in mind the precautions and conditions set forth in the TOSHIBA Semiconductor Reliability Handbook.

● The products described in this document are subject to the foreign exchange and foreign trade laws.

● The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.

● The information contained herein is subject to change without notice.

PIN FUNCTION

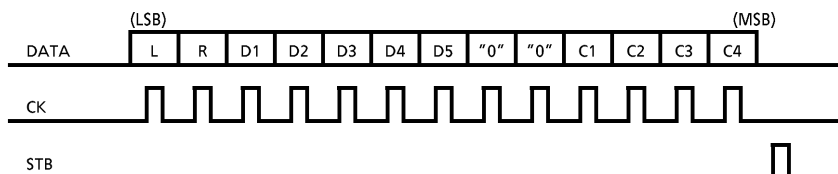
PIN No.	SYMBOL	PIN NAME	FUNCTION AND OPERATION	NOTE
1	V _{SS}	Negative power supply pin	Dual power supply $\left\{ \begin{array}{l} V_{DD} = 6.0 \sim 17V \\ GND = 0V \\ V_{SS} = -6.0 \sim -17V \end{array} \right.$ Single power supply $\left\{ \begin{array}{l} V_{DD} = 6.0 \sim 18V \\ V_{SS} = GND = 0V \end{array} \right.$	—
7	GND	Digital ground pin		
16	V _{DD}	Positive power supply pin		
2	L-OUT	Volume output pins	• Volume circuit 	—
15	R-OUT			
3	L-IN	Volume input pins		
14	R-IN			
5	L-A-GND	Analog ground pins		
12	R-A-GND			
6	CS1	Chip select input pins	Switching chip select code allows control of up to 4 chips simultaneously on one bus.	—
11	CS2			
8	CK	Clock input pin	Clock input for data transfer	Low threshold value input pins
9	DATA	Data input pin	Serial data input for setting volume	
10	STB	Strobe input pin	Strobe input for writing data	
4, 13	NC	Not connected		—

OPERATIONS

1. Setting volume values (Attenuation)

The volume values are set using 13bit serial data.

- Data format



- 1) L is left channel select data, R is right channel select data.
When L = 1, left channel volume is set. When R = 1, right channel volume is set.
(When R=L=1, both channel volumes are set simultaneously)
- 2) 8, 9bit data is set to "0".
- 3) "D1"~"D5" are volume value setting data.

VOLUME VALUE	D1	D2	D3	D4	D5
0dB	0	0	0	0	0
1	1	0	0	0	0
2	0	1	0	0	0
3	1	1	0	0	0
4	0	0	1	0	0
5	1	0	1	0	0
6	0	1	1	0	0
7	1	1	1	0	0
8	0	0	0	1	0
9	1	0	0	1	0
10	0	1	0	1	0
11	1	1	0	1	0
12	0	0	1	1	0
13	1	0	1	1	0
14	0	1	1	1	0
15	1	1	1	1	0

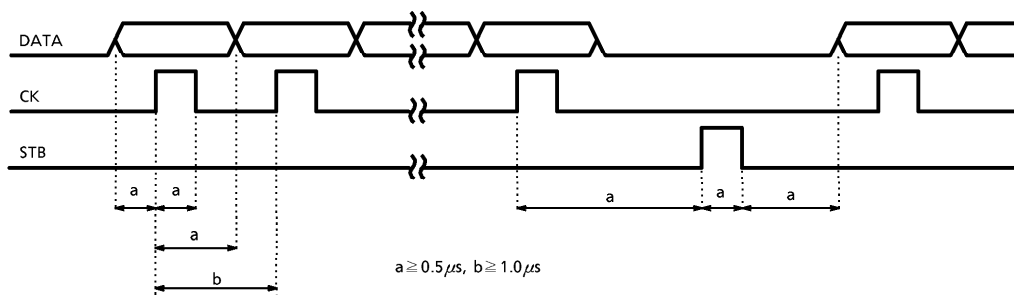
VOLUME VALUE	D1	D2	D3	D4	D5
16dB	0	0	0	0	1
17	1	0	0	0	1
18	0	1	0	0	1
19	1	1	0	0	1
20	0	0	1	0	1
21	1	0	1	0	1
22	0	1	1	0	1
23	1	1	1	0	1
24	0	0	0	1	1
25	1	0	0	1	1
26	0	1	0	1	1
27	1	1	0	1	1
28	0	0	1	1	1
29	1	0	1	1	1
30	0	1	1	1	1
∞	1	1	1	1	1

- 4) "C1"~"C4" are chip select code data.
Code data are set according to CS1 and CS2 input.

CS1	CS2	C1	C2	C3	C4
L	L	0	0	1	1
H	L	1	0	1	1
L	H	0	1	1	1
H	H	1	1	1	1

2. Serial data timing

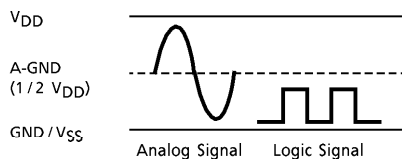
Input CK, DATA and STB according to the following timing.



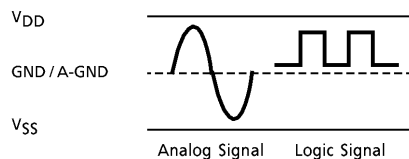
3. Single and dual power supply operation

TC9299P is operate with single or dual power supplies.
With single or dual power supply, serial data logic level can be 0~5V.

- Single power supply operation



- Dual power supply operation



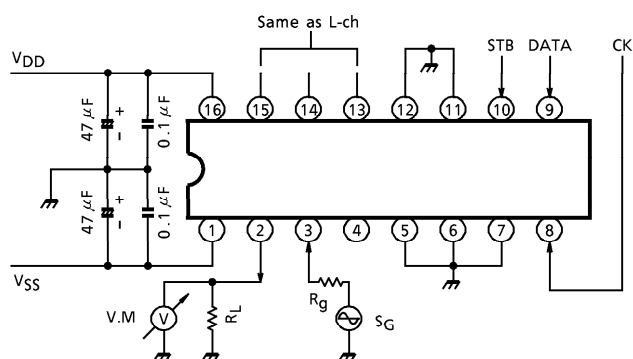
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Power Supply Voltage (1)	V _{DD} -V _{SS}	- 0.3~36	V
Power Supply Voltage (2)	V _{DD} -GND	- 0.3~20	V
GND Input Voltage	V _{IN} (1)	- 0.3~V _{DD} + 0.3	V
V _{SS} Input Voltage	V _{IN} (2)	V _{SS} - 0.3~V _{DD} + 0.3	V
Power Dissipation	P _D	300	mW
Operating Temperature	T _{opr}	- 40~85	°C
Storage Temperature	T _{stg}	- 65~150	°C

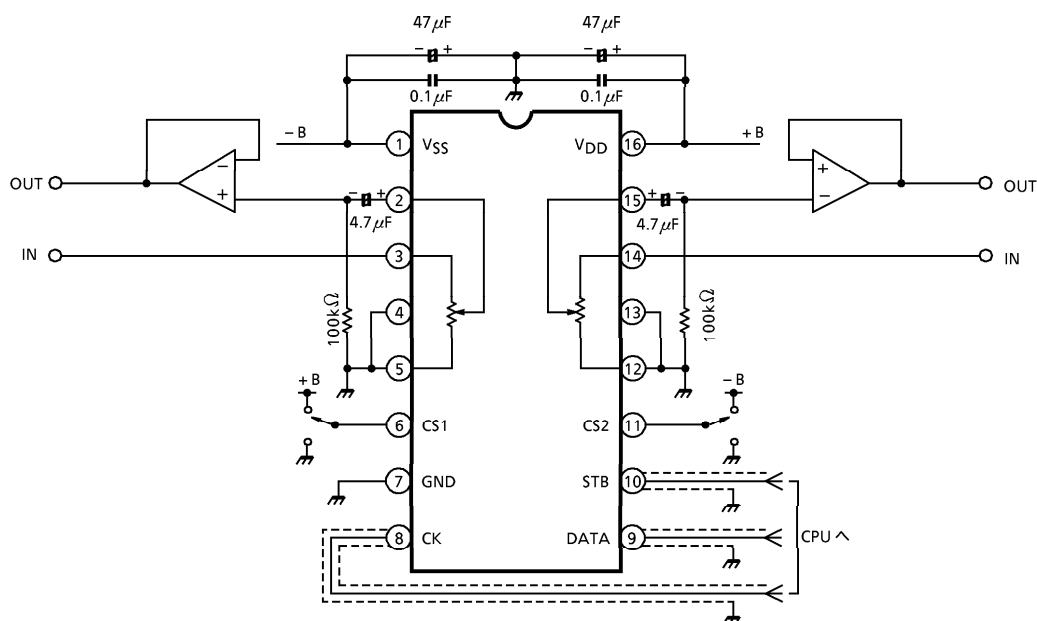
ELECTRICAL CHARACTERISTICS (Unless otherwise specified, V_{DD} = 15V, V_{SS} = - 15V, GND = 0V, Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Supply Voltage (1)	V _{DD} -V _{SS}	—	Dual power supply operation	12.0	~	34	V
Operating Supply Voltage (2)	V _{DD} -GND	—	Single power supply operation	6.0	~	18	V
Operating Supply Current	I _{DD}	1	No load, No input	—	0.5	1.0	mA
Input Voltage	"H" Level	V _{IH} (1)	CK, DATA, STB terminal V _{DD} = 6.0~18V	4.0	~	V _{DD}	V
	"L" Level	V _{IL} (1)		GND	~	1.0	
Input Voltage	"H" Level	V _{IH} (2)	CS1, CS2 terminal	V _{DD} × 0.7	~	V _{DD}	V
	"L" Level	V _{IL} (2)		GND	~	V _{DD} × 0.3	
Input Current	"H" Level	I _{IH}	CK, DATA, STB, CS1, CS2 terminal	V _{IH} = 15V	—	1.0	μA
	"L" Level	I _{IL}		V _{IL} = 0V	- 1.0	—	
Operating Frequency Range	f _{op}	—	CK, DATA, STB terminal	0	~	1.0	MHz
Minimum Clock Frequency	T _{ck}	—		0.5	—	—	
Volume Resistance Value	R _{VR}	—	—	30	43	57	kΩ
Step Deviation	ΔVR	—	Volume step deviation	- 0.5	—	0.5	dB
Analog Switch ON Resistance	R _{ON}	—	Internal analog switch	—	350	600	Ω
Analog Switch OFF Leak Current	I _{OFF}			- 0.1	—	0.1	μA
Total Harmonic Distortion	THD	1	f _{IN} = 1kHz V _{IN} = 1V _{rms} R _g = 600Ω, R _L = 100kΩ BW = 20Hz~20kHz	—	0.005	—	%
Maximum Attenuation	ATT _{MAX}			—	100	—	dB
Output Noise Voltage	V _N			—	1.0	—	μV _{rms}
Cross Talk	C-T			—	100	—	dB

TEST CIRCUIT 1 (I_{DD} / THD / ATT_{MAX} / V_N / C-T)



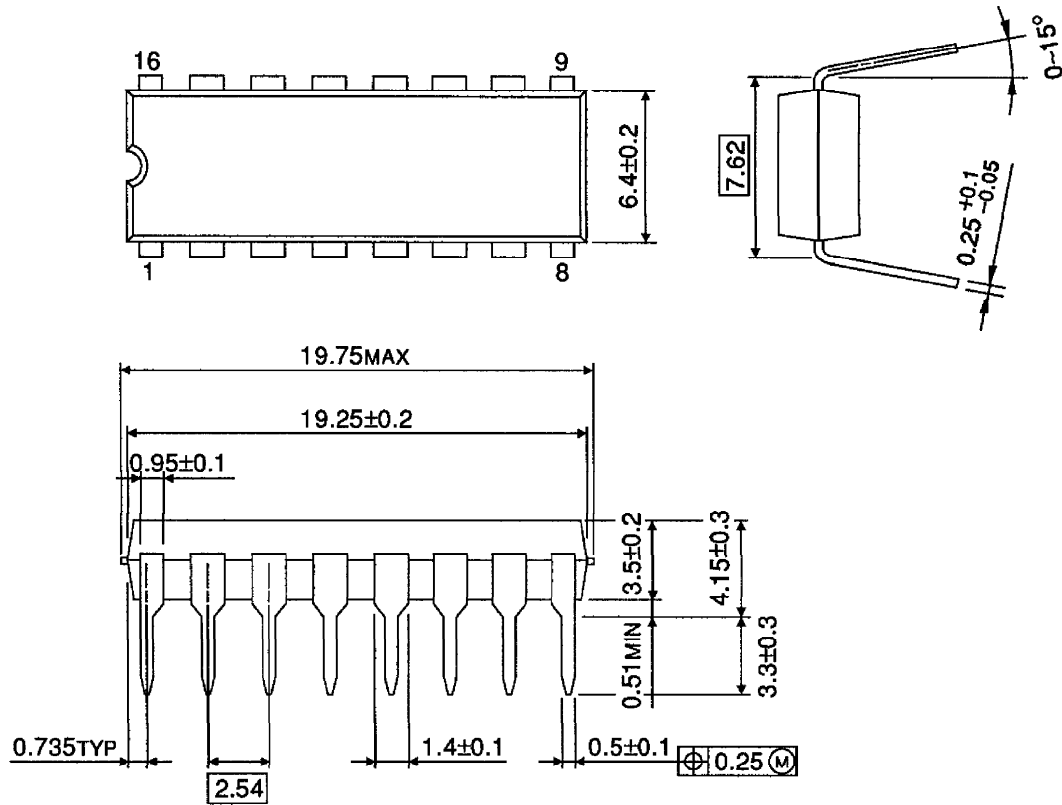
APPLICATION CIRCUIT



(Note) High-frequency digital signals are input to pins CK, DATA and STB. Since these signals may cause noise in analog circuits, either use shield wire for CK, DATA, and STB signal lines, or design the pattern so that these signal lines are protected by the ground line.

OUTLINE DRAWING
DIP16-P-300-2.54A

Unit : mm



Weight : 1.0g (Typ.)