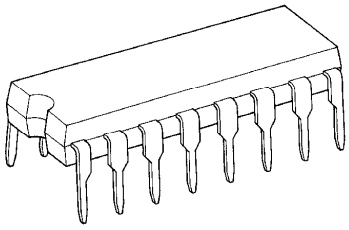
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

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.



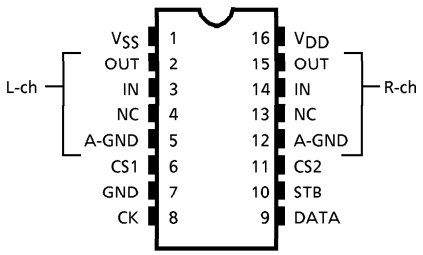
DIP16-P-300-2.54A

Weight : 1.0g (Typ.)

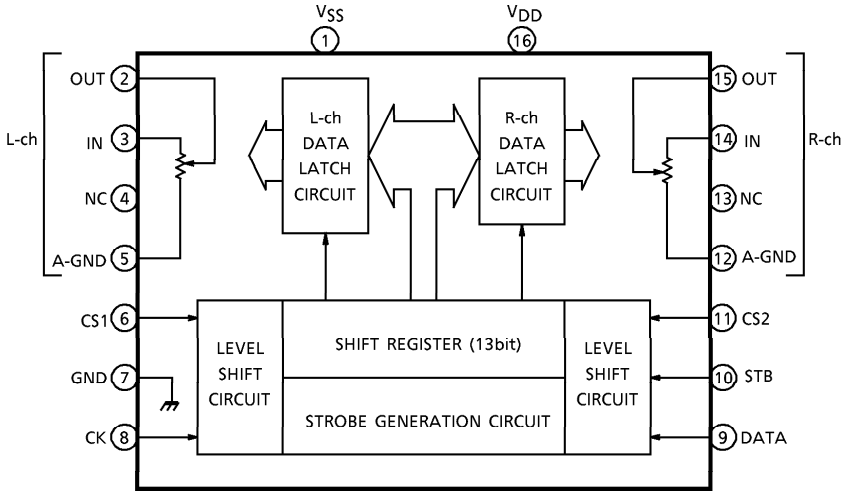
FEATURES

- 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.

PIN CONNECTION

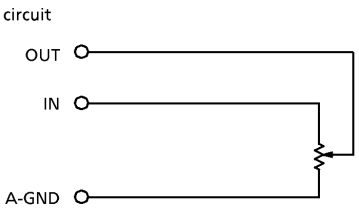


BLOCK DIAGRAM



980910EBA2

PIN FUNCTION

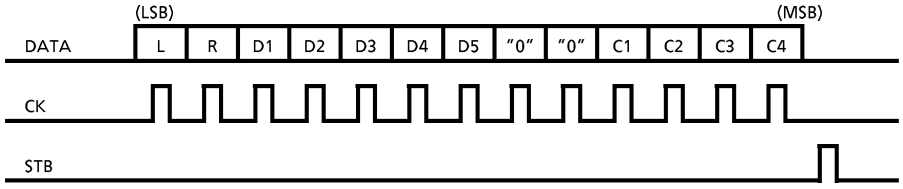
PIN No.	SYMBOL	PIN NAME	FUNCTION AND OPERATION	NOTE
1	V_{SS}	Negative power supply pin	Dual power supply: V_{DD} = 6.0~17V, GND = 0V, V_{SS} = −6.0~−17V	—
7	GND	Digital ground pin		
16	V_{DD}	Positive power supply pin	Single power supply: V_{DD} = 6.0~18V, V_{SS} = GND = 0V	
2	L-OUT	Volume output pins	• 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

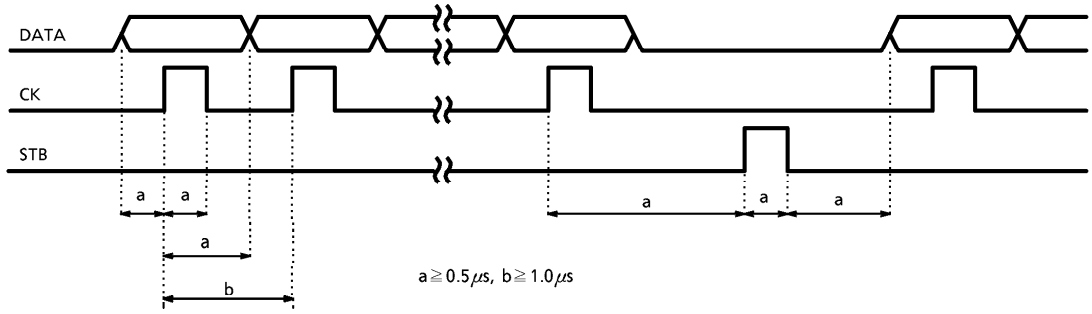
VOLUME VALUE	D1	D2	D3	D4	D5
16dB	0	0	0	0	1
17	1	0	0	0	1
18	0	1	0	0	1
19	1	1	0	0	1
20	0	0	1	0	1
21	1	0	1	0	1
22	0	1	1	0	1
23	1	1	1	0	1
24	0	0	0	1	1
25	1	0	0	1	1
26	0	1	0	1	1
27	1	1	0	1	1
28	0	0	1	1	1
29	1	0	1	1	1
30	0	1	1	1	1
∞	1	1	1	1	1

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

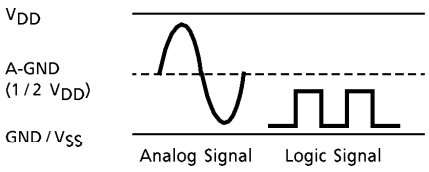
Input CK, DATA and STB according to the following timing.



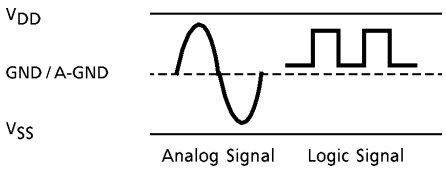
3. Single and dual power supply operation

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



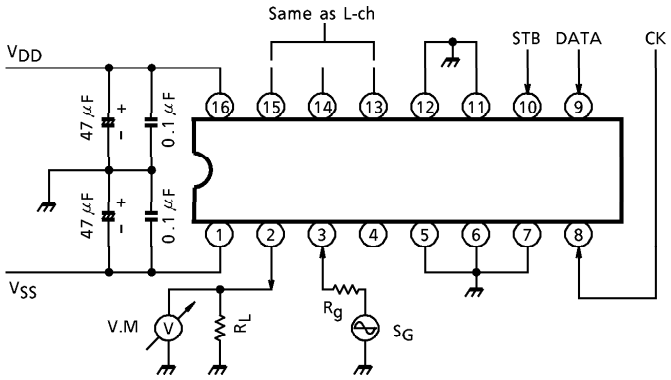
MAXIMUM RATINGS (Ta = 25°C)

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

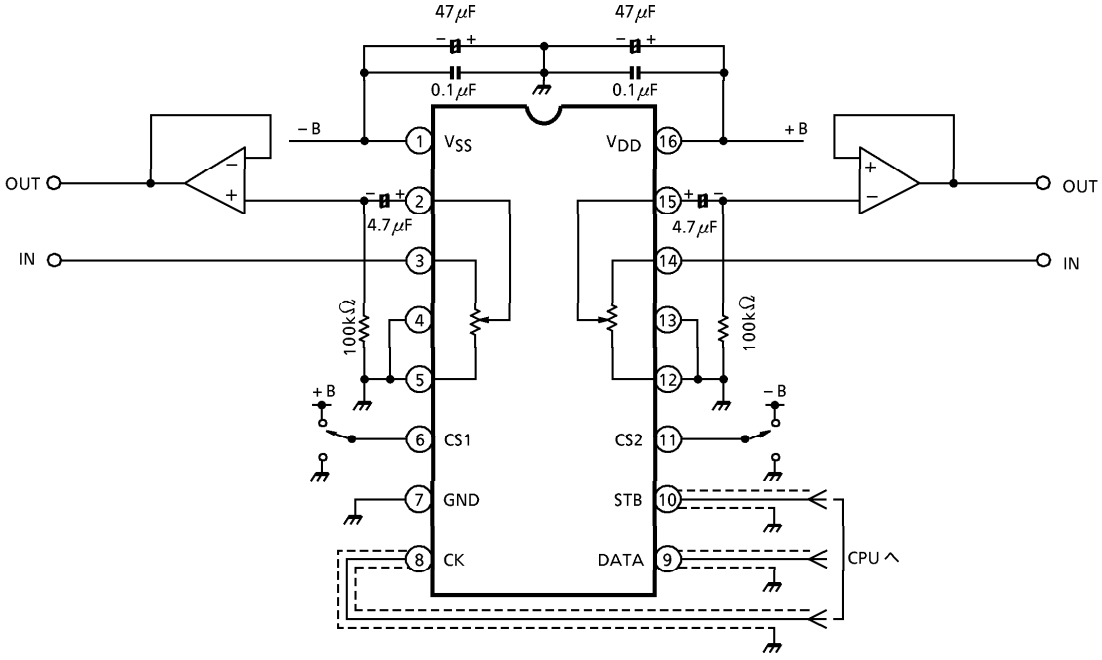
ELECTRICAL CHARACTERISTICS (Unless otherwise specified, V_{DD} = 15V, V_{SS} = −15V, GND = 0V, Ta = 25°C)

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		fop	—	CK, DATA, STB terminal		0	~	1.0	MHz
Minimum Clock Frequency		Tck				0.5	—	—	μs
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

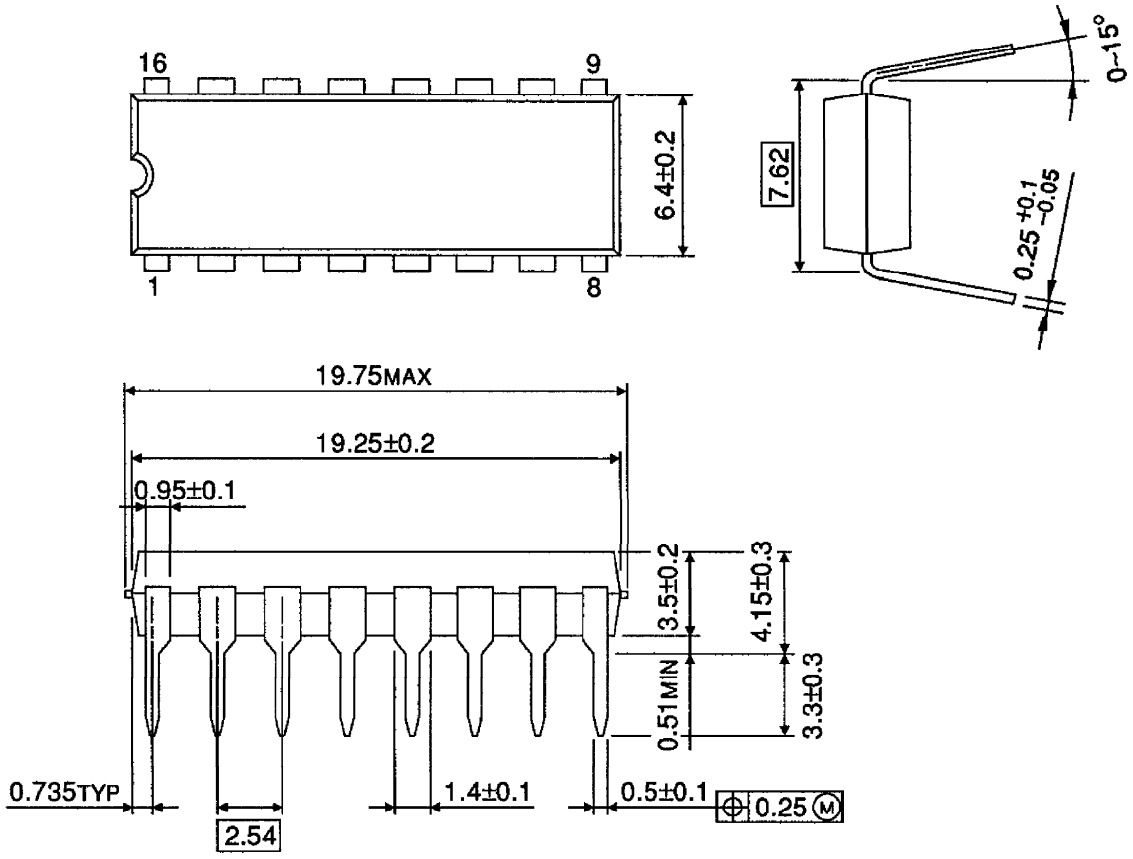


(Note) High-frequency digital signals are input to pins CK, DATA and STB.
Since these signals may cause noise in analog circuits, either use shield wire for CK, DATA, and STB signal lines, or design the pattern so that these signal lines are protected by the ground line.

OUTLINE DRAWING

DIP16-P-300-2.54A

Unit : mm



Weight : 1.0g (Typ.)