

TC9188N/F

SINGLE CHIP ELECTRONIC VOLUME SYSTEM

TC9188N/F is an electronic volume system in which the volume necessary for sound volume, balance, fader, bass treble, and loudness is controlled.

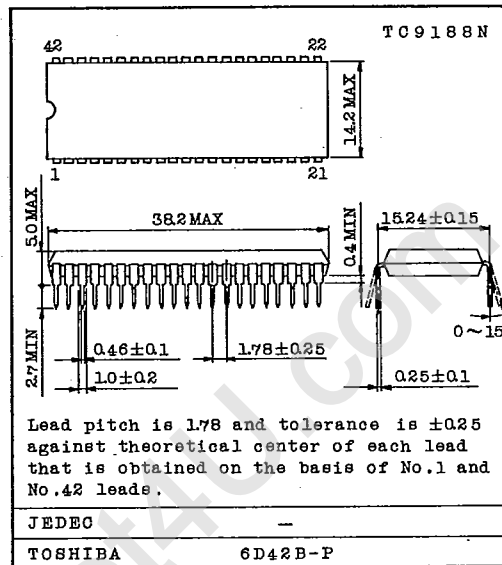
- Selection and control of each volume can be freely made by inputting the specified serial data.
- Volume 0~-79dB (1dB/step)
- Fader 0~-60dB (16 steps)
- Tone Each bass and treble ± 12 dB (2dB/step)
- Loudness
- As logical level of serial data input terminal is 0 to 5V, interface circuit with microcomputer is not required.
- C-MOS construction provides wide operating supply voltage range and low current consumption.
- Peripheral equipment comprises shrink DIP 42 pin (TC9188N) and flat package 44 pin (TC9188F).

MAXIMUM RATINGS (Ta=25°C)

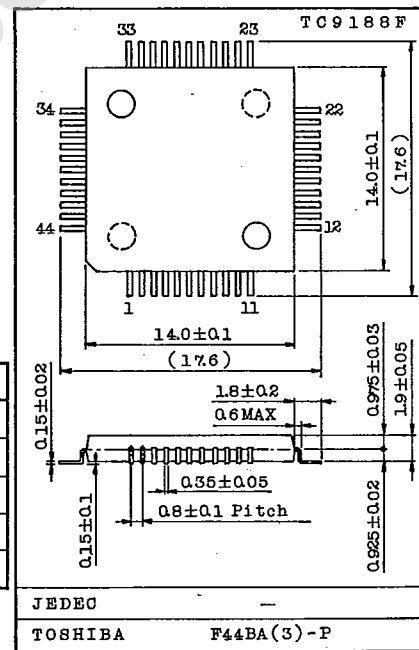
CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V _{DD}	13	V
Input Voltage	V _{IN}	V _{SS} -0.3~V _{DD} +0.3	V
Power Dissipation	P _D	800(300)	mW
Operating Temperature	T _{opr}	-30~75	°C
Storage Temperature	T _{stg}	-55~125	°C

Braketed figure indicates TC9188F.

Unit in mm



Weight: 4.0g



Weight: 0.81g

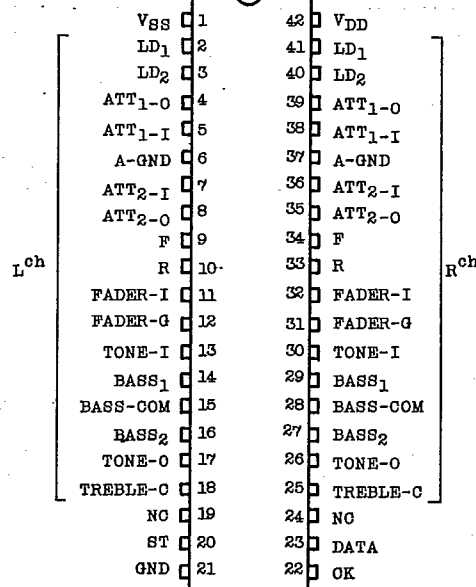
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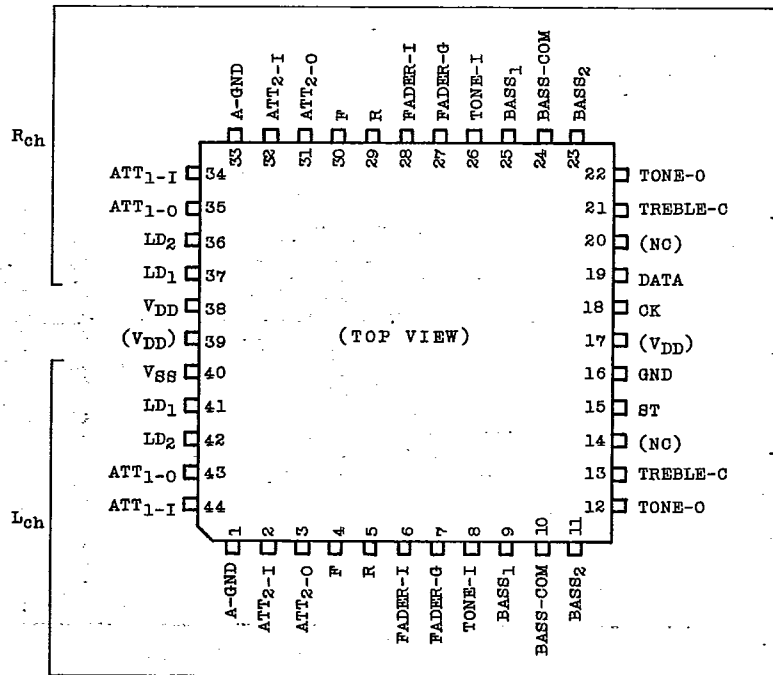
TERMINAL CONNECTION DIAGRAM

(TOP VIEW)

TC9188N



TC9188F

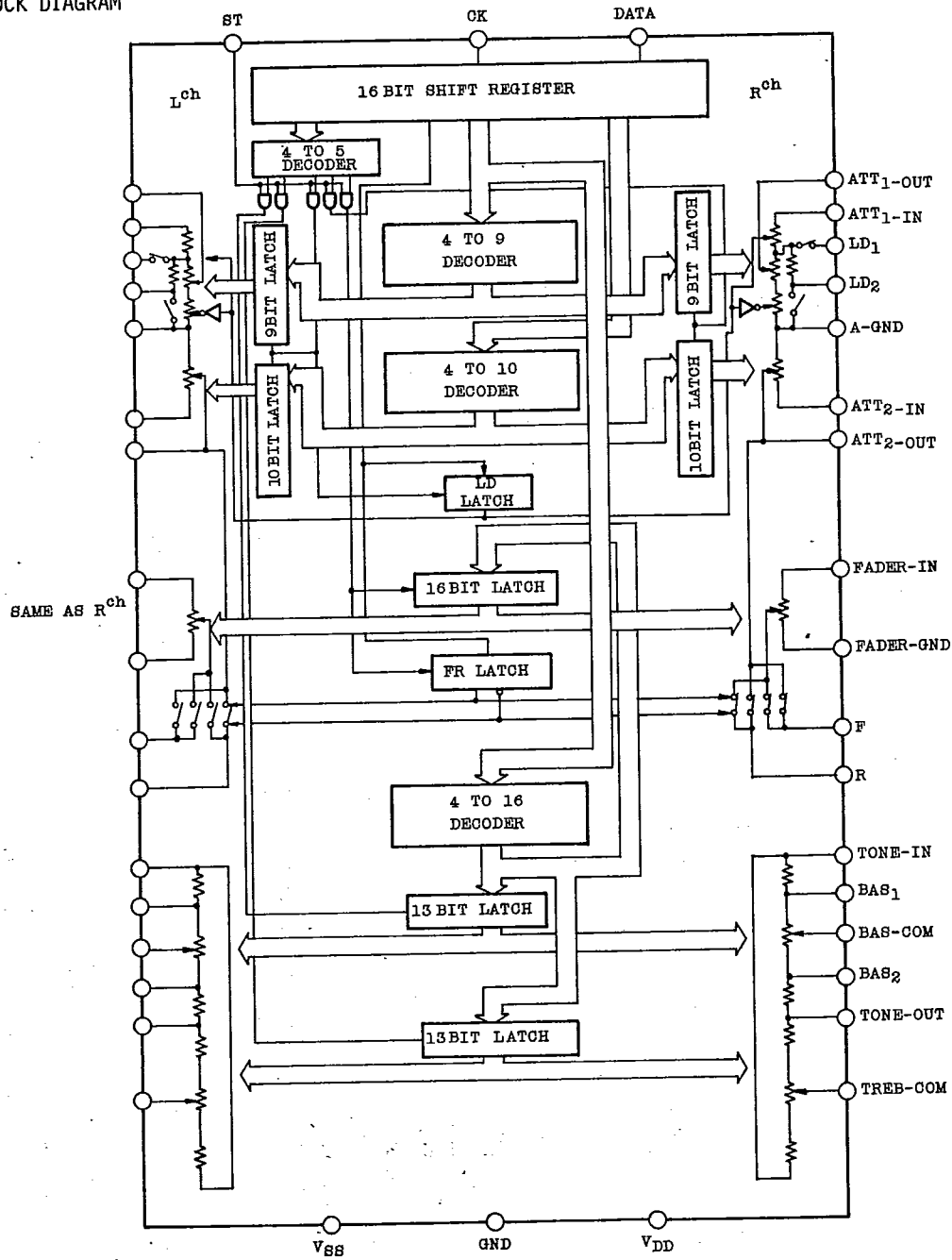


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BLOCK DIAGRAM



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ELECTRICAL CHARACTERISTICS (Unless otherwise specified, $V_{DD}=12V$, $T_a=25^\circ C$)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
Operating Supply Voltage	V_{DD}	-		5.0	~	12	V	
Operating Supply Current	I_{DD}	1	No input no-load	-	1.0	3.0	mA	
Input Voltage	"H" Level	V_{IH1}	$V_{DD}=12V$, $V_{SS}=GND=0V$ CK, DATA, ST Terminal	4.0	~	V_{DD}	V	
	"L" Level	V_{IL1}		GND	~	1.0		
Input Voltage	"H" Level	V_{IH2}	$V_{DD}=6V$, $V_{SS}=-6V$, $GND=0V$ CK, DATA, ST Terminal	3.0	~	V_{DD}	V	
	"L" Level	V_{IL2}		GND	~	0.8		
Input Current	"H" Level	I_{IH}	CK, DATA, ST Terminal	$V_{IH}=12V$ $V_{IL}=0$	-	-	± 1.0	μA
	"L" Level	I_{IL}			-	-	± 1.0	
Volume Resistance Value	ATT1	R_{AT1}	Loudness "ON"	25	50	70	k Ω	
	ATT2	R_{AT2}		10	20	28		
	FADER	R_{FA}		25	50	70		
	BASS	R_{BA}		25	50	70		
	TREBLE	R_{TR}		25	50	70		
Resistance Relative Error	ΔR	-		-5.0	~	5.0	%	
Maximum Attenuation Amount	ATT(MAX)	-	ATT=- ∞	85	90	-	dB	
Crosstalk	C.T.	-	Between Lch and Rch	80	90	-	dB	
Total Harmonic Distortion*	THD	2	$f_{IN}=1kHz$, $V_{IN}=1Vp-p$ $R_L=51k\Omega$, ATT=0dB	-	0.01	0.02	%	
Output Noise Voltage*	V_N	2	$f=20\sim 20kHz$, $R_g=600\Omega$	-	2.0	5.0	μV_{rms}	
Analog Switch On Resistance	R_{ON}	-		-	200	300	Ω	
Maximum Clock Frequency	f_{CK}	-	CK Terminal	-	-	500	kHz	
Minimum Clock Width	f_{CK}	-	CK, ST Terminal	1.0	-	-	μs	

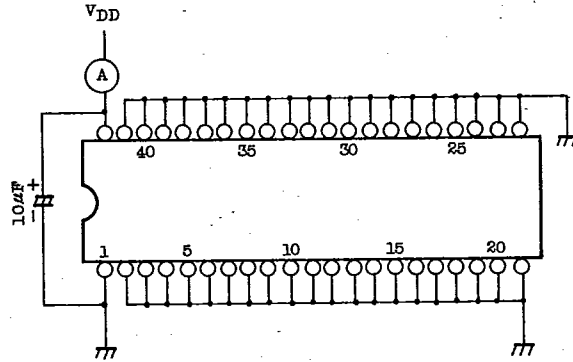
* Total harmonic distortion (THD) and output noise voltage (V_N) are reference data.

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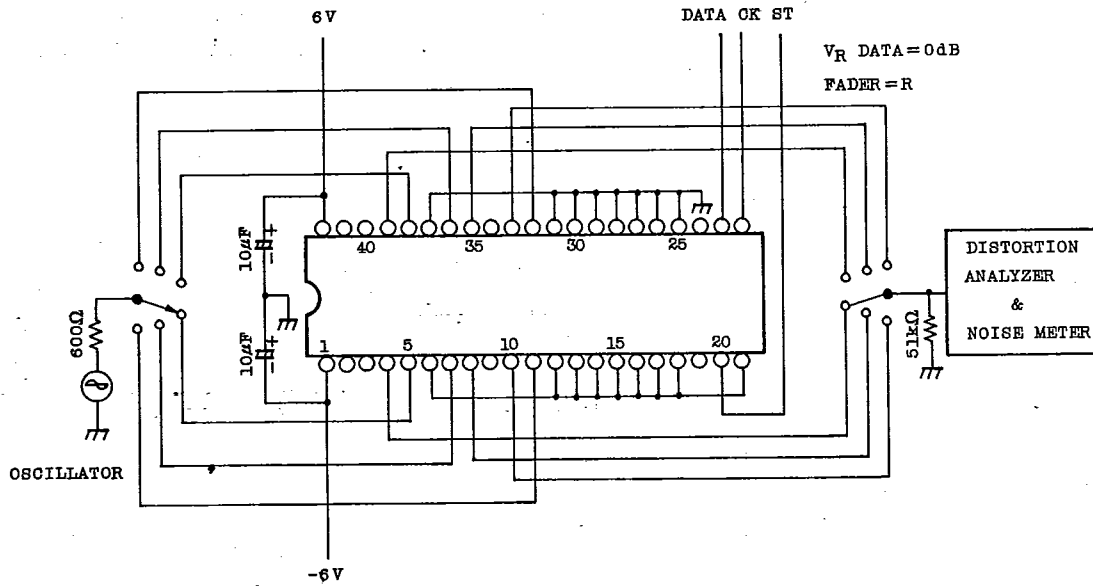
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TEST CIRCUIT-1 (I_{DD}) (PIN-No. is TC9188N)



TEST CIRCUIT-2 (THD/ V_N)



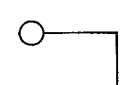
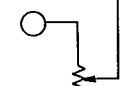
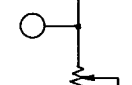
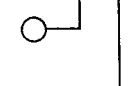
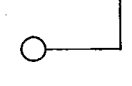
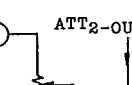
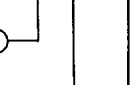
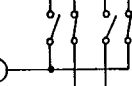

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EXPLANATIONS OF FUNCTIONS OF EACH TERMINAL

Bracketed Terminal Number is TC9188F.

No.	SYMBOL	EXPLANATION OF FUNCTIONS	REMARKS
2(41) 3(42) 40(38) 41(37)	(L) LD1,LD2 (R)	Loudness network connecting terminal.	
4(43) 39(35)	(L) ATT1-OUT (R)	10dB step attenuator output terminal. The signal given to ATT1-IN attenuates with 10dB step at eight stages from 0 to -70dB.	4/39 (43/35) 
5(44) 38(34)	(L) ATT1-IN (R)	10dB step attenuator input terminal.	5/38 (44/34) 
6 (1) 37(33)	(L) A-GND (R)	Analog system GND terminal	6/37 (1/33) 
7 (2) 36(32)	(L) ATT2-IN (R)	1dB step attenuator input terminal.	7/36 (2/32) 
8 (3) 35(31)	(L) ATT2-OUT (R)	1dB step attenuator output terminal. The signal given to ATT2-IN attenuates with 1dB step at Ten stages from 0 to -9dB.	8/35 (3/31) 
9 (4) 34(30)	(L) F (R)	Fader control front output terminal.	11/32 (6/28) 
10 (5) 33(29)	(L) R (R)	Fader control rear output terminal.	12/31 (7/27) 
11 (6) 32(28)	(L) FADER-IN (R)	Fader control input terminal.	9/34 (4/30) 
12 (7) 31(27)	(L) FADER-GND (R)	Fader controlling attenuator GND terminal.	10/33 (5/29) 

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EXPLANATIONS OF FUNCTIONS OF EACH TERMINAL

Bracketed Terminal Number is TC9188F.

No.	SYMBOL	EXPLANATION OF FUNCTION	REMARKS	
13 (8) 30(26)	(L) TONE-IN (R)	Tone control input terminal.		
14 (9) 29(25)	(L) BASS ₁ (R)	Tone control bass tap terminal.		
15(10) 28(24)	(L) BASS-COM (R)	Tone control bass volume common terminal.		
16(11) 27(23)	(L) BASS ₂ (R)	Tone control bass tap terminal.		
17(12) 26(22)	(L) TONE-OUT (R)	Tone control output terminal.		
18(13) 25(21)	(L) TREBLE-COM (R)	Tone control treble volume common terminal.		
19(14) 24(20)	NC	Use is open or GND state.		
20(15)	ST	Strobe input terminal for transferring to the inputted control data. This is low threshold level inverter input together with CK, DATA input.		<p>As low threshold level inverter is contained, theoretical level is 0~5V.</p>
22(18)	CK	Clock input terminal for reading in the control data.		
23(19)	DATA	Input terminal of control data.		
1(40) 21(16) 42(38)	V _{SS} GND V _{DD}	Power impressing terminal.		

Note : Connect 17 and 39 pins of TC9188F to V_{DD} terminal (38 pin).

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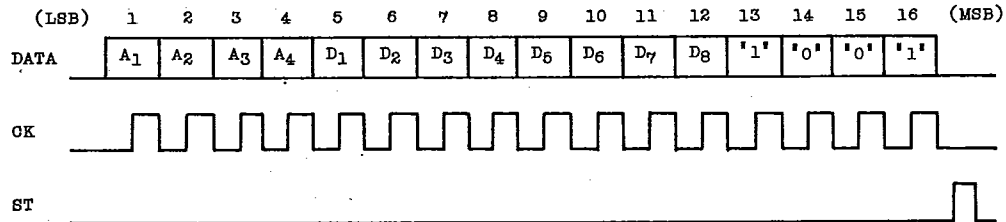
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EXPLANATION OF FUNCTION

1. Data Format

TC9188N/F can be freely controlled by the data from controller.

The data is constituted with 16 bits.

a) A₁~A₄ (bit 1~4)

Data bit 1~4 selects any one of volume L/R, bass, treble or fader.

A ₁	A ₂	A ₃	A ₄	
L	L	L	H	Volume (L)
H	L	L	H	Volume (R)
L	H	L	H	Base
H	H	L	H	Treble
L	L	H	H	Fader

b) D₁~D₈ (bit 5~12)

Data bit 5 to 12 sets step of each volume.

However, at the time of bass, treble, D₁~D₄ are used, while, at the time of fader, D₁~D₄, D₈ are used.

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b-1) Volume

If volume L/R is selected with data bit 1~4 (A₁~A₄), data bit 5~12 (D₁~D₈) becomes the setting of attenuation data of volume.

D₁~D₄ is the data of ATT₂ of 1 dB/step while D₅~D₈ is the data of ATT₁ of 10 dB/step.

D1	D2	D3	D4	ATT2
L	L	L	L	0dB
H	L	L	L	-1dB
L	H	L	L	-2dB
H	H	L	L	-3dB
L	L	H	L	-4dB
H	L	H	L	-5dB
L	H	H	L	-6dB
H	H	H	L	-7dB
L	L	L	H	-8dB
H	L	L	H	-9dB
L	H	L	H	-∞

D5	D6	D7	D8	ATT1
L	L	L	*	0dB
H	L	L	*	-10dB
L	H	L	*	-20dB
H	H	L	*	-30dB
L	L	H	*	-40dB
H	L	H	*	-50dB
L	H	H	*	-60dB
H	H	H	*	-70dB

* Loudness

Note : Bear in mind that if the data other than the above is inputted, steps become unstable.

b-2) Loudness

Data D₈ of volume (L) becomes the data of Loudness ON/OFF.

Loudness turns ON when D₈ is "H", and turns OFF when D₈ is "L".

Loudness turns on and off simultaneously for L/R.

(Data D₈ of volume (R) is not particularly related with "L" or "H").

b-3) Tone control (Bass, Treble)

If bass/treble is selected with data bit 1~4 (A₁~A₄), data bit 5~8 (D₁~D₄) becomes the setting of tone control data.

Setting of bass and treble is made independently.

Setting of L/R cannot be made independently .

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D1	D2	D3	D4	
L	H	H	L	+12dB
H	L	H	L	+10dB
L	L	H	L	+8dB
H	H	L	L	+6dB
L	H	L	L	+4dB
H	L	L	L	+2dB
L	L	L	L	0dB
H	H	H	H	-2dB
L	H	H	H	-4dB
H	L	H	H	-6dB
L	L	H	H	-8dB
H	H	L	H	-10dB
L	H	L	H	-12dB

Note : Bear in mind that if the data other than the above is inputted, steps become unstable.

D1	D2	D3	D4	
L	L	L	L	0
H	L	L	L	-2dB
L	H	L	L	-4dB
H	H	L	L	-6dB
L	L	H	L	-8dB
H	L	H	L	-10dB
L	H	H	L	-12dB
H	H	H	L	-14dB
L	L	L	H	-16dB
H	L	L	H	-18dB
L	H	L	H	-20dB
H	H	L	H	-26dB
L	L	H	H	-35dB
H	L	H	H	-45dB
L	H	H	H	-60dB
H	H	H	H	-∞dB

b-4) Fader

If fader is selected with data bit 1~4 (A₁~A₄), data bit 5~8 (D₁~D₄) becomes the data of fader volume to attenuate either front or rear. Volume is only one set of L and R, and attenuation of either front or rear is selected with data bit 12(D₈). Front attenuates with fader volume when D₈ is "H", and rear attenuates when D₈ is "L".

c) Code Bit (bit 14~16).

Data bit 13~16 is code bit of TC9188N/F, and data is not accepted by other codes.

DATA BIT

13	14	15	16
H	L	L	H

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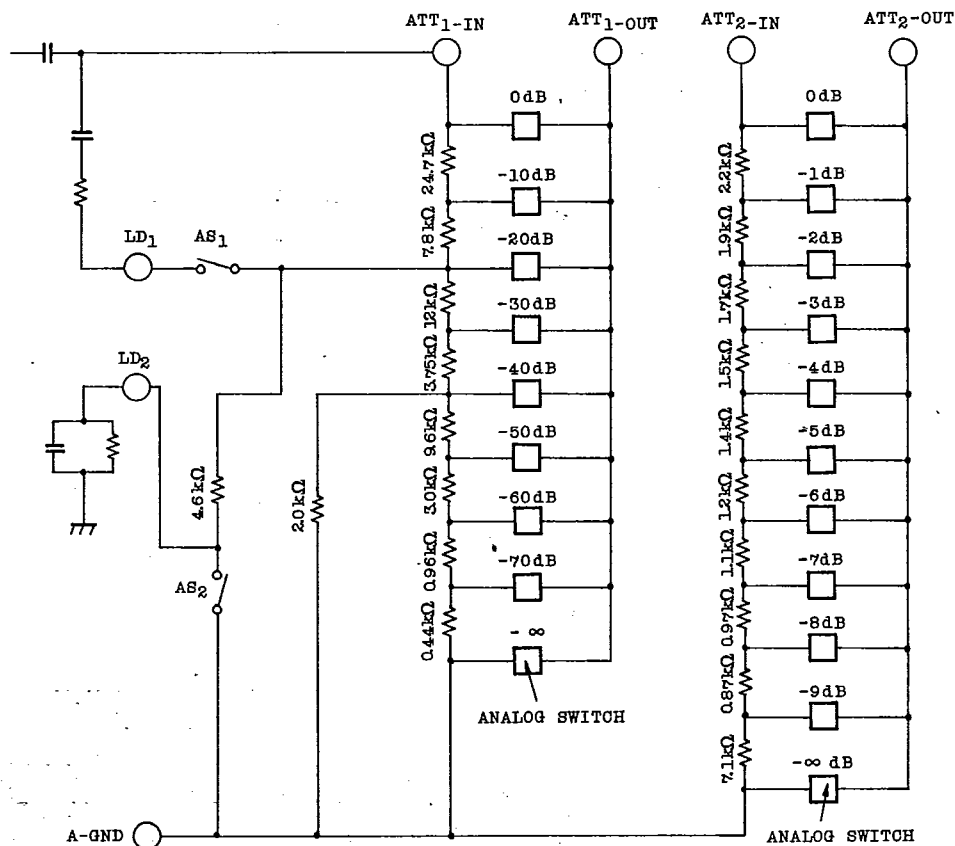
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2. Explanation of Each Volume Block

Each volume is constituted with diffused resistor array and analog switch.

a) Volume block, Loudness

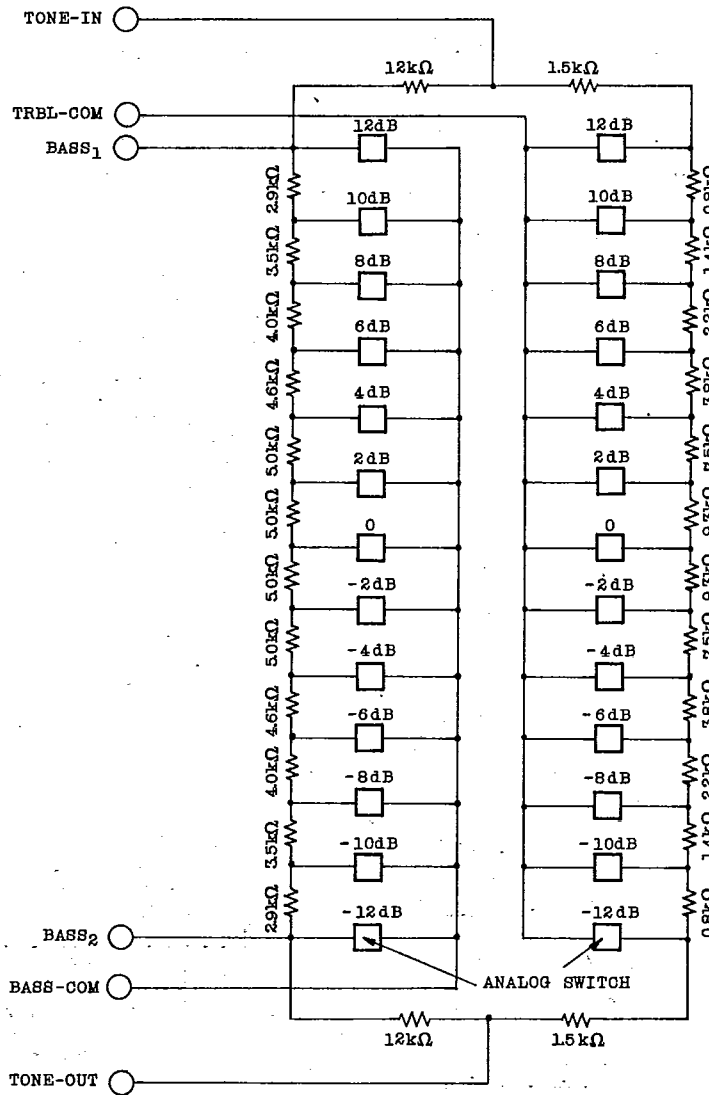


Loudness ON time ; Analog switch	AS ₁	ON
"	AS ₂	OFF
Loudness OFF time ; Analog switch	AS ₁	OFF
"	AS ₂	ON

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b) Tone Control (Bass, Treble) Block

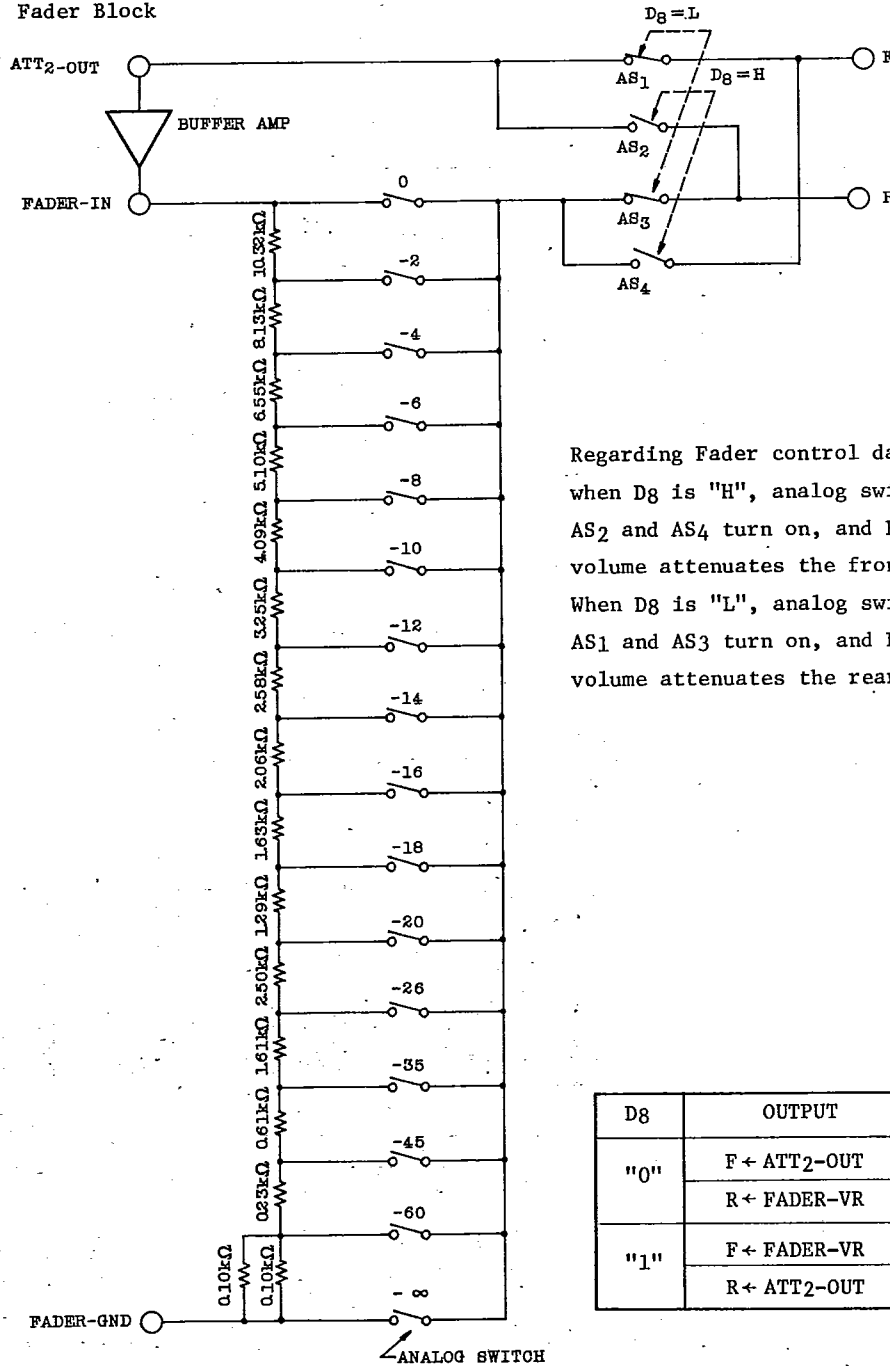


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c) Fader Block



Regarding Fader control data, when D8 is "H", analog switches AS2 and AS4 turn on, and Fader volume attenuates the front. When D8 is "L", analog switches AS1 and AS3 turn on, and Fader volume attenuates the rear.

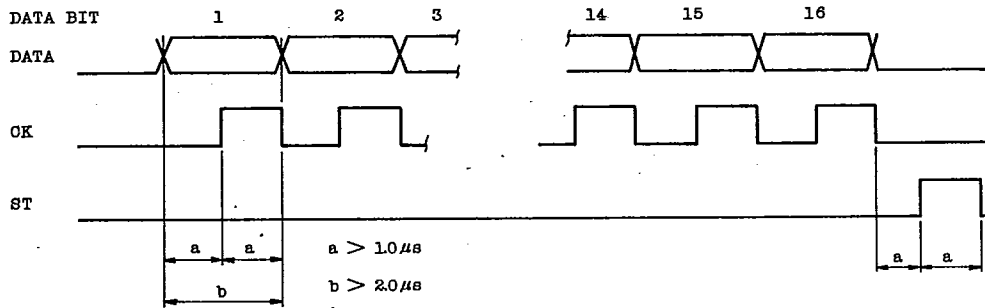
D8	OUTPUT
"0"	F ← ATT2-OUT
	R ← FADER-VR
"1"	F ← FADER-VR
	R ← ATT2-OUT

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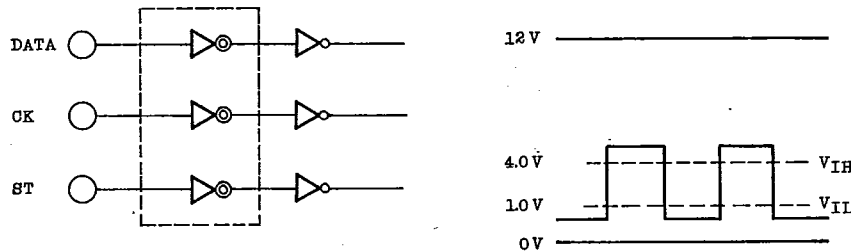
3. Timing of CK, DATA, ST

Input CK, DATA, ST in the following timing.



4. CK, DATA, ST Input

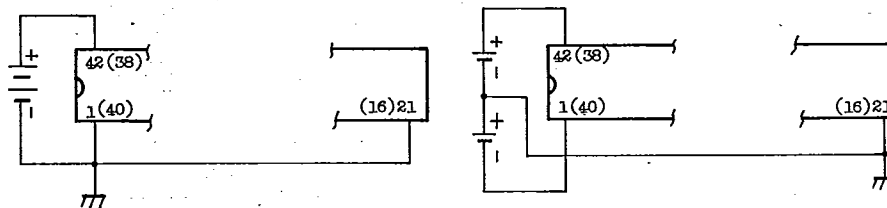
As CK, DATA, ST inputs contain low threshold level inverter, they operate with TTL logical level of 0 to 5V even though used with $V_{DD}=12V$.



5. Power Supply

Normally, TC9188N/F is used with one power source, but it can be used with two power sources.

Even when used with two power sources, CK, DATA, ST operate with TTL logical level of 0~5V as in the case of one power source.

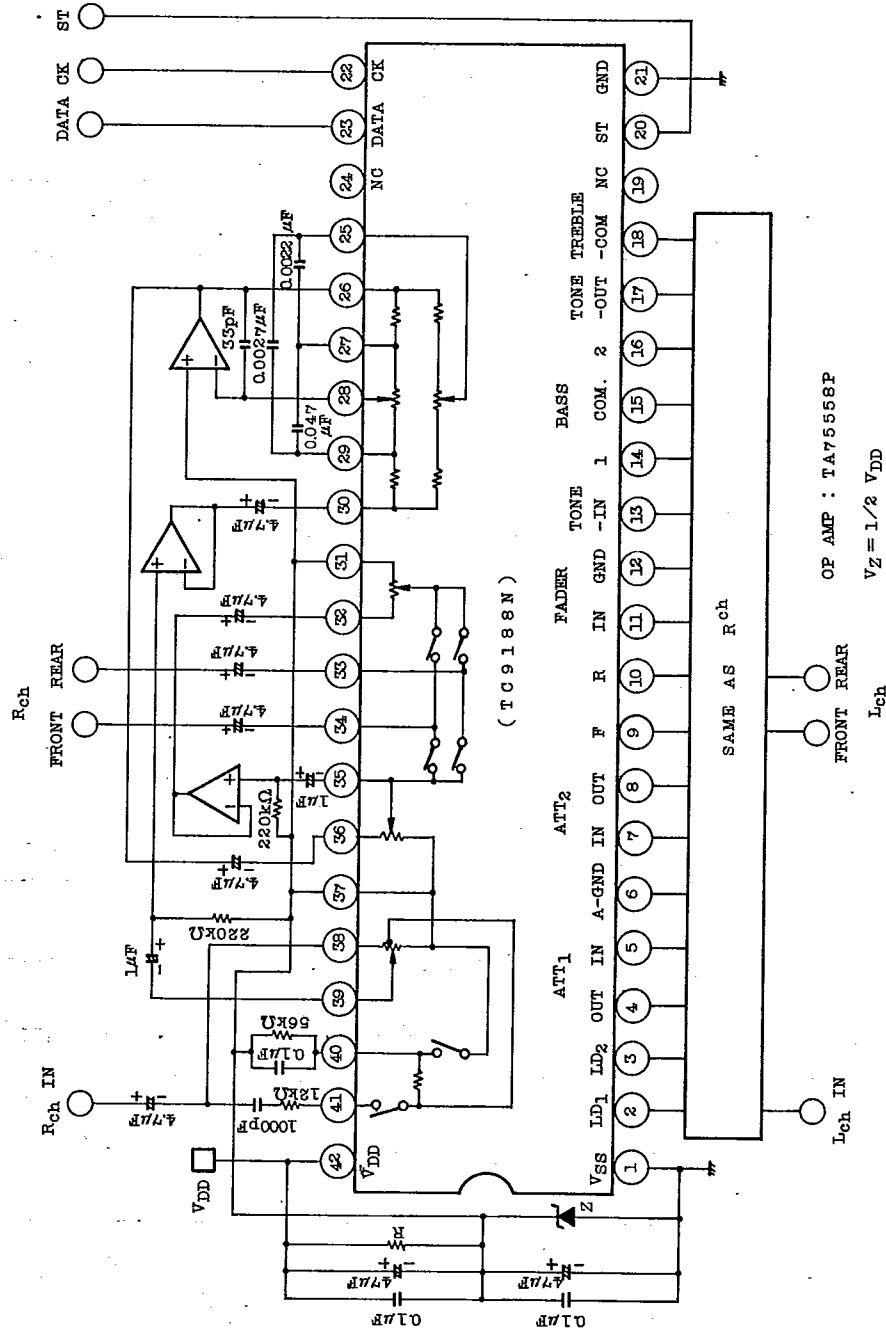


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EXAMPLE OF APPLICATION CIRCUIT (One power source circuit)

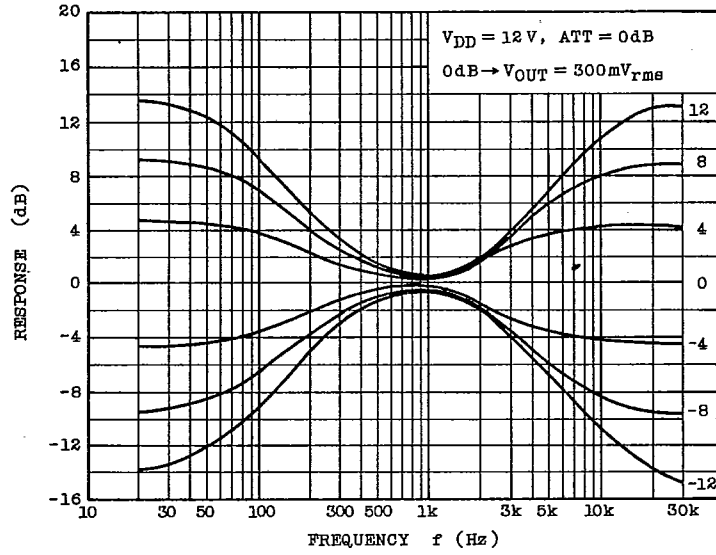


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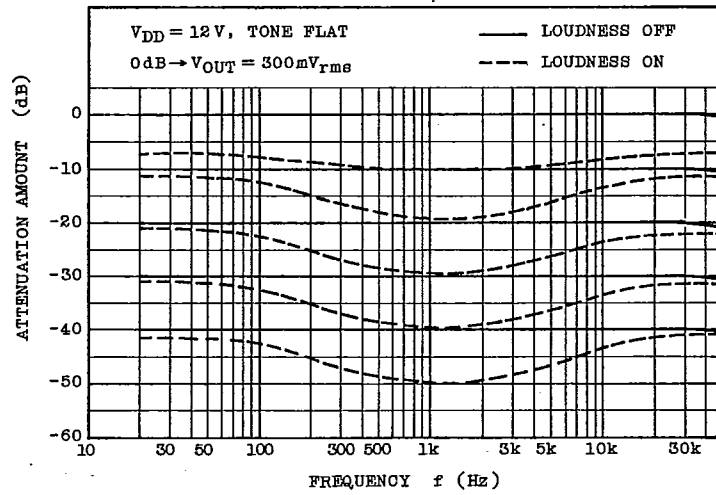
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TONE CONTROL CHARACTERISTICS



LOUDNESS CHARACTERISTICS



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INPUT/OUTPUT CHARACTERISTICS

