# M61508FP

## The Electric Volume of Build-in Non Fader Volume with Tone Control

REJ03F0203-0200
Rev.2.00
Sep 14, 2006

### Application

- This IC can be used Analog Signal processing of Power Amp.  front stage
- This IC can be used Car Audio System, Home Audio System and TV.

### Features

- This IC is unnecessary for outside putting CR by using SCF for Loudness and Tone Control.
  Bass: +16 dB to –12 dB/2 dBstep. f0, Q = variable. f0 = 50 Hz, 80 Hz, 120 Hz Q = 1, 1.25, 1.5, 2
  Mid: +12 dB to –12 dB/2 dBstep. f0, Q = variable. f0 = 700 Hz, 1 kHz, 2 kHz, 10 kHz Q = 1.5, 2
  Treble: +12 dB to –12 dB/2 dBstep. f0 = variable. f0 = 8 kHz, 12 kHz
  Loudness: f0 = variable. f0 = 60 Hz, 80 Hz, 100 Hz
- Build-in Non Fader Volume
  +12 dB to –12 dB/2 dB step, –∞ dB
- Build-in Zero-Crossing Detector Circuit for Changing Noise Measure.
- Build-in Differential Input and Differential Output
- Build-in Input Selector (4 input + Differential Input)
- Build-in Input Gain Control
  0 dB to +18.75 dB/1.25 dB step
- Build-in Master Volume and Fader Volume (Front, Rear)
  Volume: 0 dB to –83 dB, –∞ dB/1 dB step
  Fader: 0 dB, –1 dB, –2 dB, –3 dB, –4 dB, –6 dB, –8 dB, –12 dB, –16 dB, –20 dB, –30 dB, –45 dB, –60 dB, –∞ dB/16 step
- Serial Data Control of 2 lines formula.

### Recommended Operating Conditions

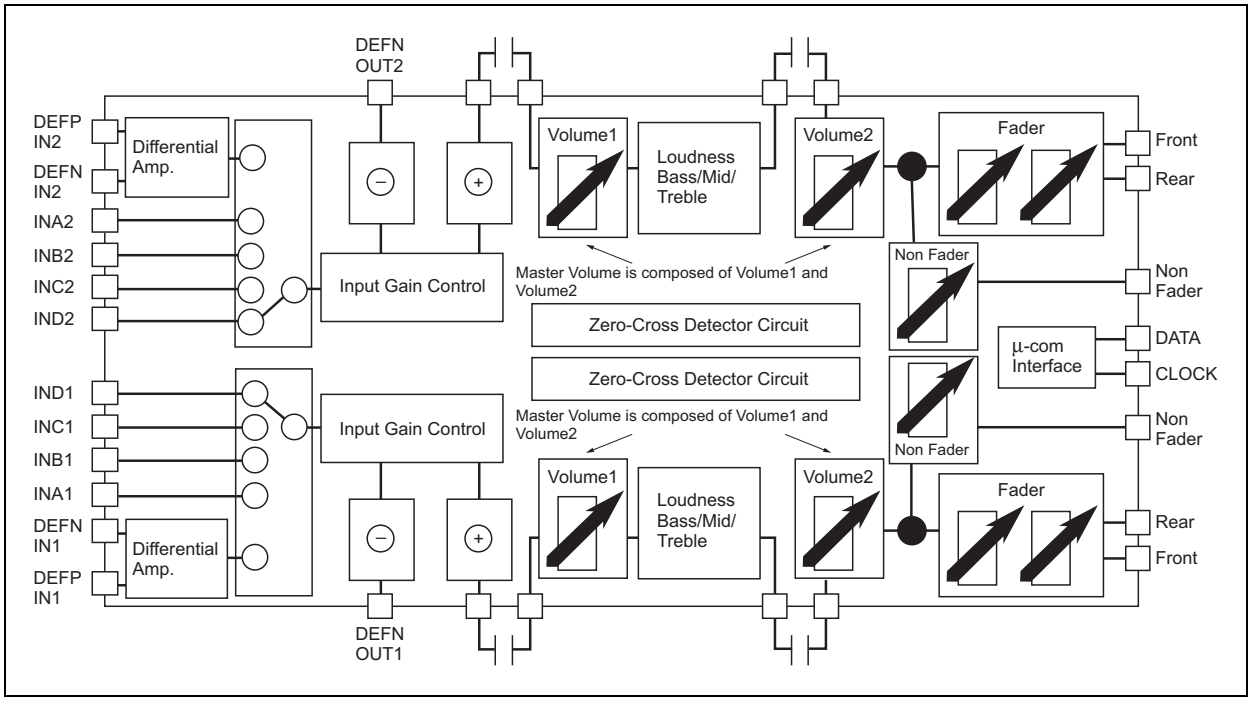
Supply voltage range… $V_{CC}$ = 7 V to 9 V

$V_{DD}$ = 4.5 V to 5.5 V

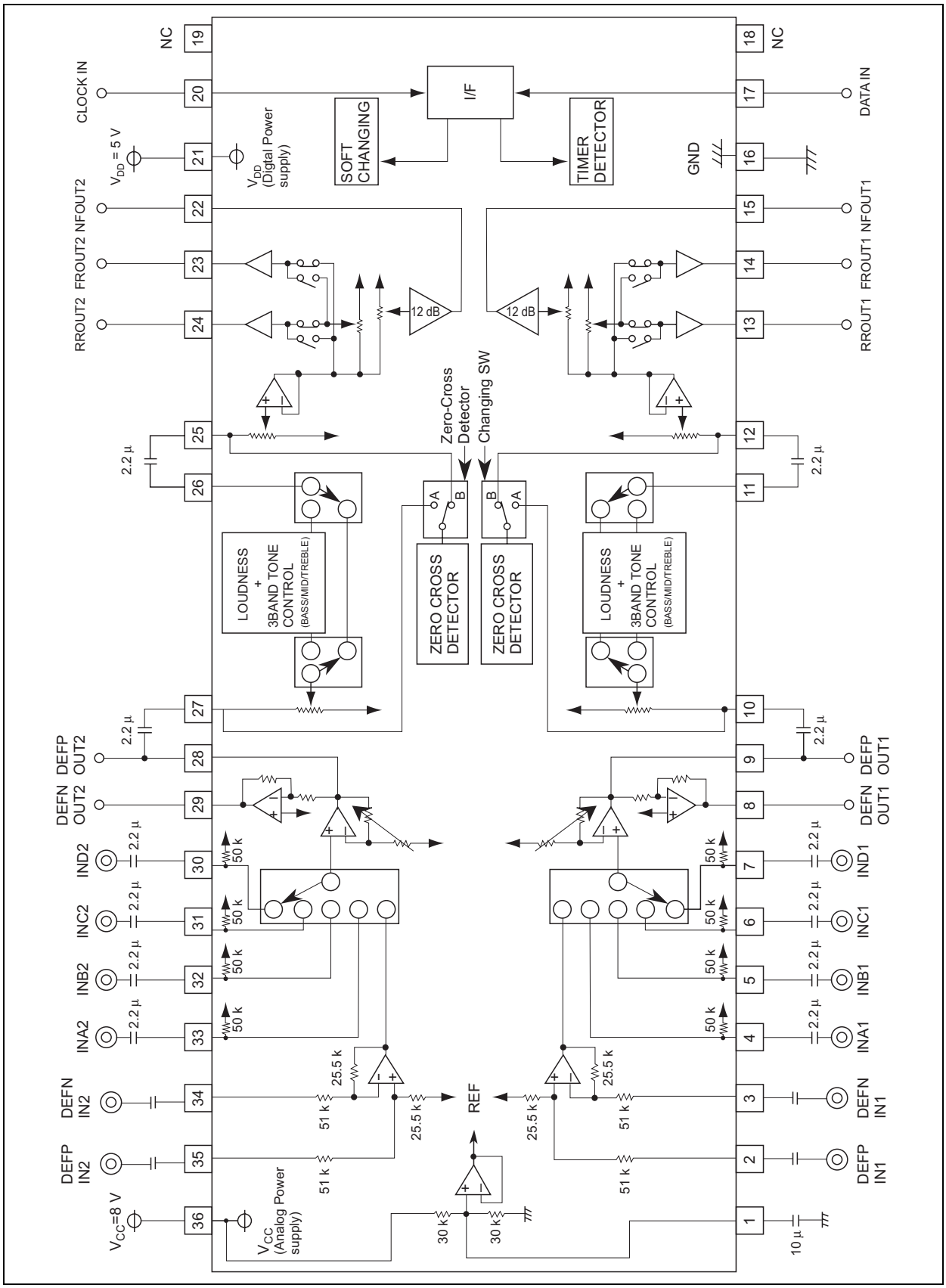
Rated supply voltage… $V_{CC}$ = 8 V

$V_{DD}$ = 5 V

## System Block Diagram



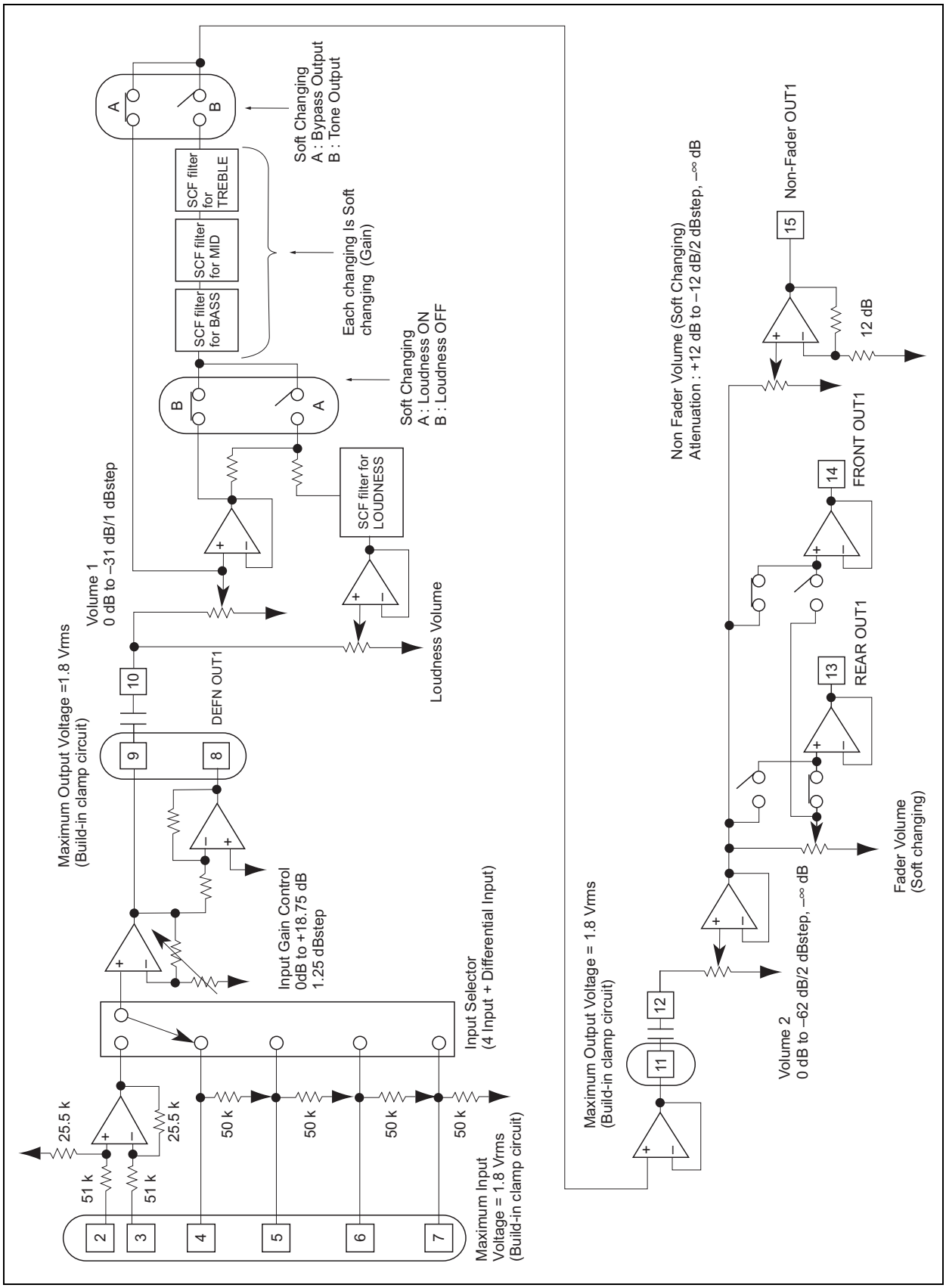
## IC Internal Block Diagram



## Pin Description

| Pin No. | Symbol | Function |
|---|---|---|
| 1 | REF | Signal Ground of IC. Grounding about 10 μF |
| 2 | DEFP IN1 | Positive Input pin of Differential Amp. |
| 3 | DEFN IN1 | Negative Input pin of Differential Amp. |
| 4 | INA1 | Input pin of Channel 1 for Input Selector SW |
| 5 | INB1 | |
| 6 | INC1 | |
| 7 | IND1 | |
| 8 | DEFN OUT1 | Output pin (–) of Differential Amp. |
| 9 | SEL OUT1 | Output pin of Input Selector |
| 10 | VOL IN1 | Input pin of Volume1 |
| 11 | TONE OUT1 | Output pin of Tone |
| 12 | FADER IN1 | Input pin of Volume2 |
| 13 | REAR OUT1 | Output pin of Fader Volume (rear) |
| 14 | FRONT OUT1 | Output pin of Fader Volume (front) |
| 15 | Non Fader OUT1 | Output pin of Non Fader Volume |
| 16 | GND | Ground Pin |
| 17 | DATA | Input pin of Control Data.<br>It synchronized at CLOCK and inputted Data |
| 18 | N.C. | N.C. Pin |
| 19 | N.C. | N.C. Pin |
| 20 | CLOCK | Clock Input pin for Serial Data Transmission |
| 21 | $V_{DD}$ | Digital Power Supply pin |
| 22 | Non Fader OUT2 | Output pin of Non Fader Volume |
| 23 | FRONT OUT2 | Output pin of Fader Volume (front) |
| 24 | REAR OUT2 | Output pin of Fader Volume (rear) |
| 25 | FADER IN2 | Input pin of Volume2 |
| 26 | TONE OUT2 | Output pin of Tone |
| 27 | VOL IN2 | Input pin of Volume1 |
| 28 | SEL OUT2 | Output pin of Input Selector |
| 29 | DEFN OUT1 | Output pin (–) of Differential Amp. |
| 30 | IND2 | Input pin of Channel 2 for Input Selector SW |
| 31 | INC2 | |
| 32 | INB2 | |
| 33 | INA2 | |
| 34 | DEFN IN1 | Negative Input pin of Differential Amp. |
| 35 | DEFP IN1 | Positive Input pin of Differential Amp. |
| 36 | $V_{CC}$ | Analog Power Supply pin |

## Signal Communication Diagram (Channel 1 side only)

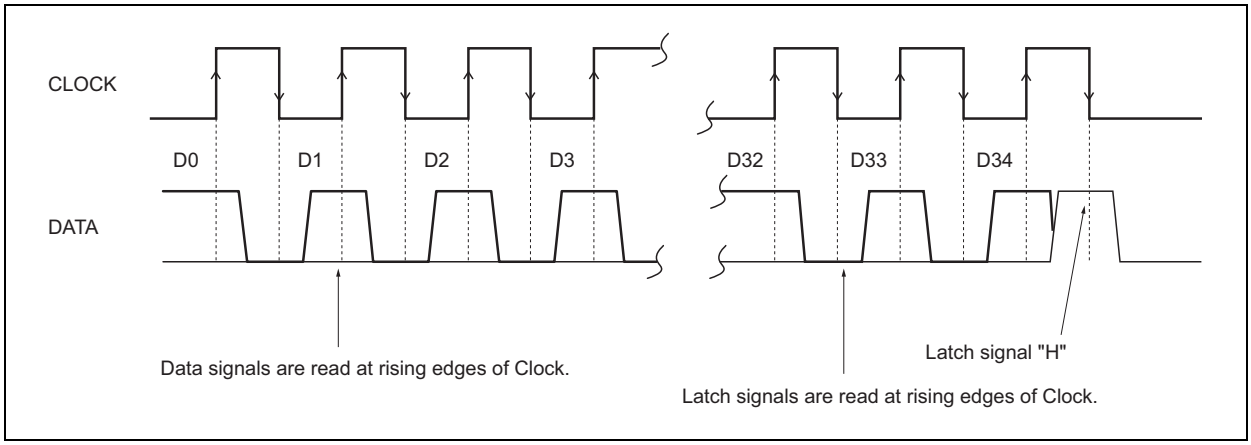


## Electrical Characteristics

(Ta = 25 °C, $V_{CC}$ = 8 V, $V_{DD}$ = 5 V, Input Gain/Volume/Tone/fader = 0 dB, Loudness = OFF, unless otherwise noted.)

| Item | Symbol | Limits | | | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| Circuit current | $I_{CC}$ | — | — | 40 | mA | No signal setting |
| Pass gain | Gv | –2 | 0 | +2 | dB | — |
| Volume maximum Attenuation quantity | $A_{TT}$ (VOL) | — | –90 | –80 | dB | Vi = 1 Vrms, f = 1 kHz<br>ATT (VOL) = –∞ dB |
| Crosstalk between Channels | $\Delta A_{TT}$ (VOL) | –2 | 0 | +2 | dB | ATT (VOL) = 0 dB |
| Maximum input voltage | $V_{IM}$ | — | — | 1.8 | Vrms | f = 1 kHz, DIN-AUDIO<br>THD = 1% |
| Boost quantity (Bass) | G (Bass) B | 13 | 16 | 19 | dB | f = 100 Hz |
| Cut quantity (Bass) | G (Bass) C | –15 | –12 | –9 | dB | f = 100 Hz |
| Boost quantity (Mid) | G (MID) B | 9 | 12 | 15 | dB | f = 1 kHz |
| Cut quantity (Mid) | G (MID) C | –15 | –12 | –9 | dB | f = 1 kHz |
| Boost quantity (Treble) | G (Tre) B | 9 | 12 | 15 | dB | f = 10 kHz |
| Cut quantity (Treble) | G (Tre) C | –15 | –12 | –9 | dB | f = 10 kHz |
| Fader maximum attenuation quantity | $A_{TT}$ (FED) | — | –90 | –80 | dB | Vi = 1 Vrms, f = 1 kHz, DIN-AUDIO<br>ATT (FED) = –∞ dB |
| Maximum input voltage | $V_{OM}$ | 1.8 | — | — | Vrms | f = 1 kHz, DIN-AUDIO<br>THD = 1% |
| Output noise voltage | Vno 1 | — | 12 | — | μVrms | Rg = 0, DIN-AUDIO |
| | Vno 2 | — | 5 | — | | Bypass setting<br>Rg = 0, DIN-AUDIO |
| | Vno 3 | — | 3.5 | — | | ATT (VOL) = –∞ dB<br>Rg = 0, DIN-AUDIO |
| Total harmonic distortion | THD | — | 0.01 | 0.05 | % | f = 1 kHz, $V_0$ = 0.5 Vrms<br>BW : 400 Hz to 30 kHz |
| Channel separation | CS | — | –90 | –75 | dB | f = 1 kHz, DIN-AUDIO |
| Input selector crosstalk | CT | — | –75 | –60 | dB | f = 1 k Hz, DIN-AUDIO |
| Loudness voltage gain | Gv (LOUD) | 10 | 13 | 16 | dB | Loudness ON, f = 100 Hz<br>VOL1 = –30 dB, VOL2 = 0 dB<br>LOUD_VOL = –20 dB |
| Input gain control | Gv (GAIN) | 15.75 | 18.75 | 21.75 | dB | Gv (GAIN) = +18.75 dB |
| Common mode rejection ratio | CMRR | 15.75 | 50 | 21.75 | dB | 2, 3 pin/34, 35 pin<br>Common mode signal input setting |

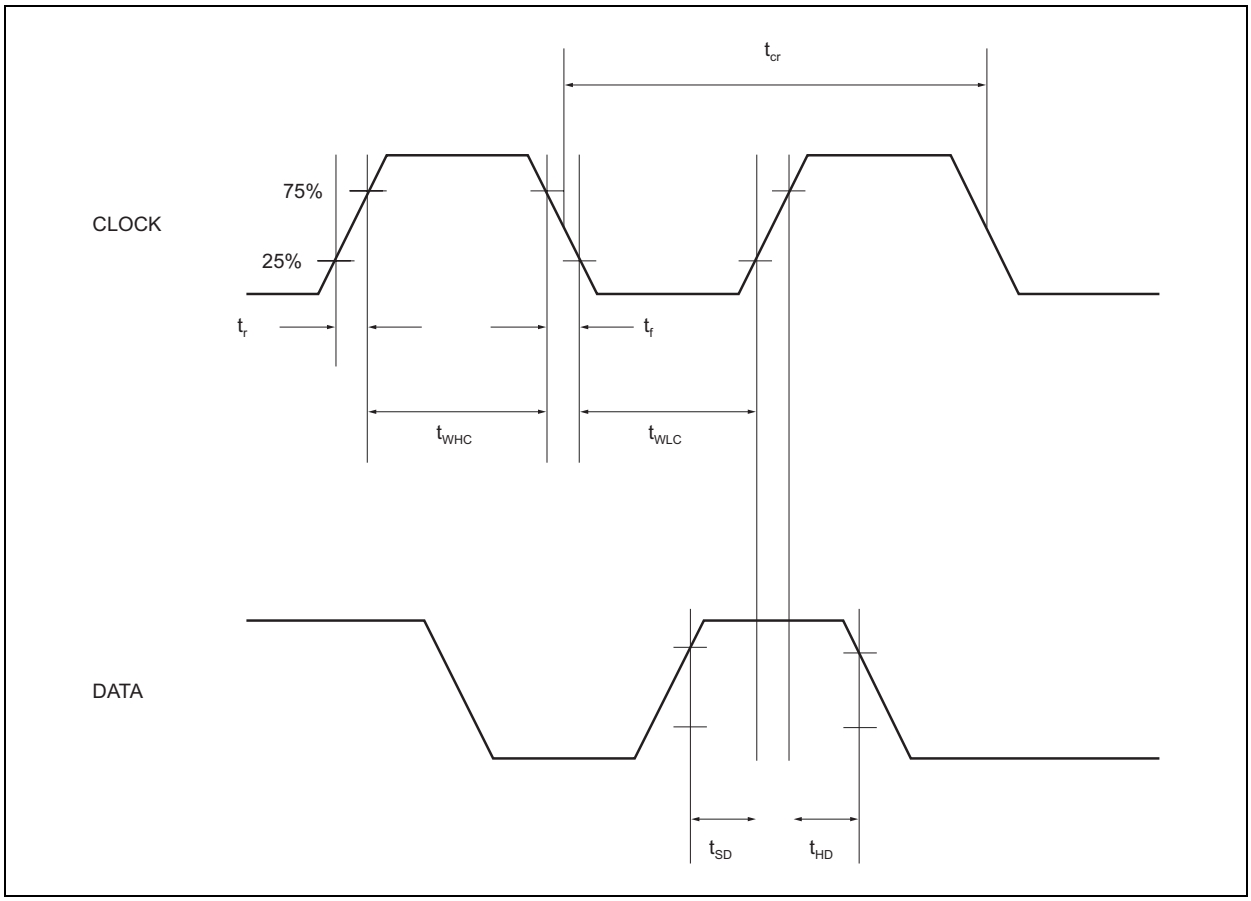
## Connection of Data and Clock




## Digital Block Direct Current Characteristic

| Item | Symbol | Limits | | | Unit | Test Conditions | |
|---|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | | |
| "L" Level Input Voltage | $V_{IL}$ | 0 | ~ | 1.0 | V | $V_{DD}$ = 5 V setting | |
| "H" Level Input Voltage | $V_{IH}$ | 4.0 | ~ | 5.0 | | DATA, CLOCK Pin | |
| "L" Level Input Electric Current | $I_{IL}$ | –10 | — | 10 | µA | V = 0 V | DATA, CLOCK Pin |
| "H" Level Input Electric Current | $I_{IH}$ | — | — | 10 | | V = 5 V | |

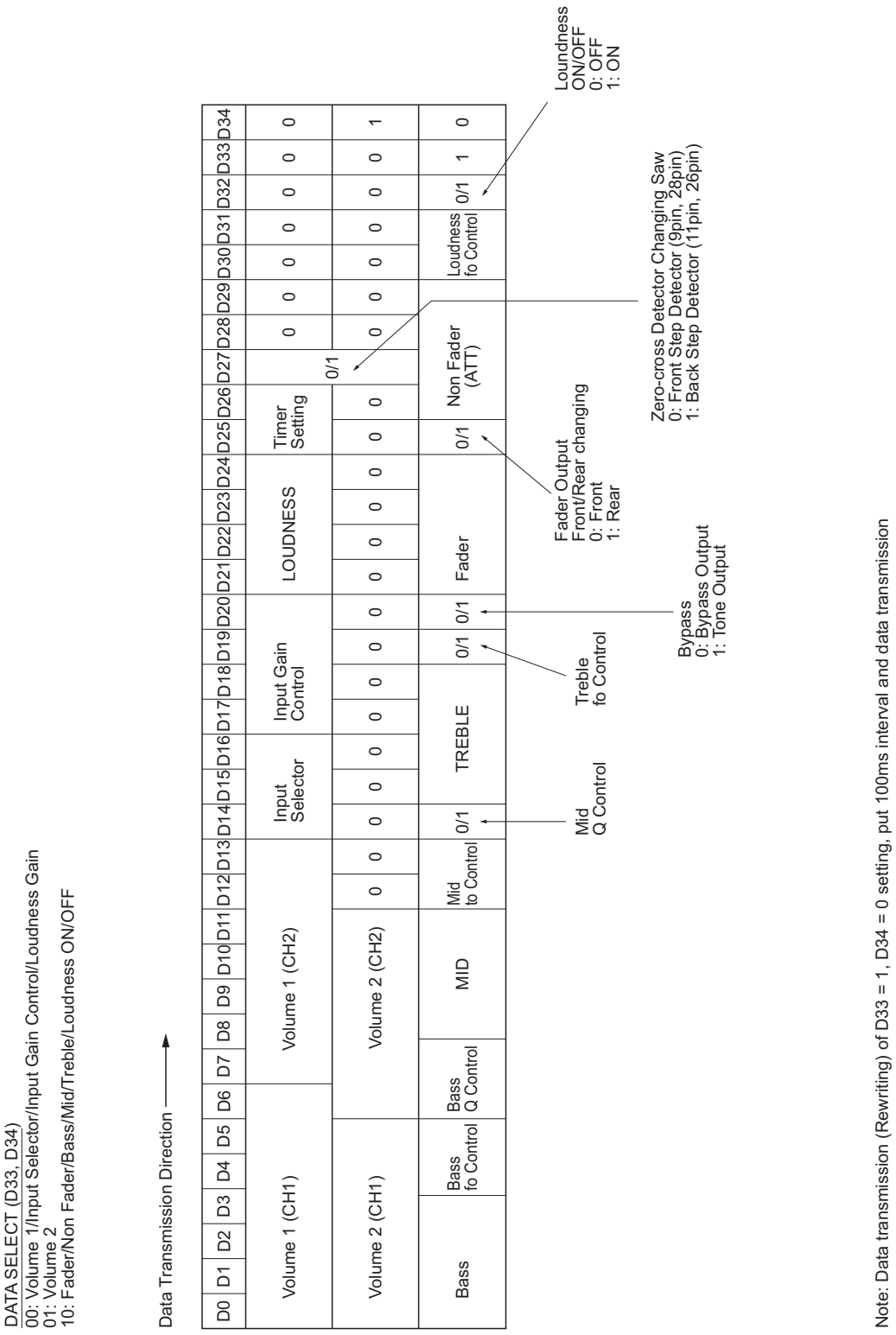
## Clock and Data Timing




## Digital Block Alternating Current Characteristic

| Item | Symbol | Limits | | | Unit |
|---|---|---|---|---|---|
| | | Min | Typ | Max | |
| CLOCK Cycle Time | $t_{cr}$ | 4 | — | — | µs |
| CLOCK Pulse Width ("H" level) | $t_{WHC}$ | 1.6 | — | — | |
| CLOCK Pulse Width ("L" level) | $t_{WLC}$ | 1.6 | — | — | |
| CLOCK Rise Time | $t_r$ | — | — | 0.4 | |
| CLOCK Hall Time | $t_f$ | — | — | 0.4 | |
| DATA Setup Time | $t_{SD}$ | 0.8 | — | — | |
| DATA Hold Time | $t_{HD}$ | 0.8 | — | — | |

## Data Input Format



## Volume 1 Code

| ATTVA1 | CH1 / CH2 | D0 / D7 | D1 / D8 | D2 / D9 | D3 / D10 | D4 / D11 |
|---|---|---|---|---|---|---|
| 0 dB | | 0 | 0 | 0 | 0 | 1 |
| –1 dB | | 1 | 1 | 1 | 1 | 0 |
| –2 dB | | 0 | 1 | 1 | 1 | 0 |
| –3 dB | | 1 | 0 | 1 | 1 | 0 |
| –4 dB | | 0 | 0 | 1 | 1 | 0 |
| –5 dB | | 1 | 1 | 0 | 1 | 0 |
| –6 dB | | 0 | 1 | 0 | 1 | 0 |
| –7 dB | | 1 | 0 | 0 | 1 | 0 |
| –8 dB | | 0 | 0 | 0 | 1 | 0 |
| –9 dB | | 1 | 1 | 1 | 0 | 0 |
| –10 dB | | 0 | 1 | 1 | 0 | 0 |
| –11 dB | | 1 | 0 | 1 | 0 | 0 |
| –12 dB | | 0 | 0 | 1 | 0 | 0 |
| –16 dB | | 1 | 1 | 0 | 0 | 0 |
| –20 dB | | 0 | 1 | 0 | 0 | 0 |
| –24 dB | | 1 | 0 | 0 | 0 | 0 |
| –28 dB | | 0 | 0 | 0 | 0 | 0 |

| ATTVA2 | CH1 / CH2 | D5 / D12 | D6 / D13 |
|---|---|---|---|
| 0 dB | | 1 | 1 |
| –1 dB | | 0 | 1 |
| –2 dB | | 1 | 0 |
| –3 dB | | 0 | 0 |

ATTVA2 fixed to 0dB
when 0 dB to –12 dB setting.

## Volume 2 Code

| ATTVB1 | CH1 / CH2 | D0 / D6 | D1 / D7 | D2 / D8 | D3 / D9 |
|---|---|---|---|---|---|
| 0 dB | | 0 | 1 | 1 | 1 |
| –2 dB | | 1 | 0 | 1 | 1 |
| –4 dB | | 0 | 0 | 1 | 1 |
| –6 dB | | 1 | 1 | 0 | 1 |
| –8 dB | | 0 | 1 | 0 | 1 |
| –10 dB | | 1 | 0 | 0 | 1 |
| –12 dB | | 0 | 0 | 0 | 1 |
| –14 dB | | 1 | 1 | 1 | 0 |
| –16 dB | | 0 | 1 | 1 | 0 |
| –24 dB | | 1 | 0 | 1 | 0 |
| –32 dB | | 0 | 0 | 1 | 0 |
| –40 dB | | 1 | 1 | 0 | 0 |
| –48 dB | | 0 | 1 | 0 | 0 |
| –56 dB | | 1 | 0 | 0 | 0 |
| –∞ dB | | 0 | 0 | 0 | 0 |

| ATTVB2 | CH1 / CH2 | D4 / D10 | D5 / D11 |
|---|---|---|---|
| 0 dB | | 1 | 1 |
| –2 dB | | 0 | 1 |
| –4 dB | | 1 | 0 |
| –6 dB | | 0 | 0 |

ATTVB2 fixed to 0 dB
when 0 dB to –16 dB setting.

## Timer Setting Code

| Timer | D25 | D26 |
|---|---|---|
| 5 ms | 1 | 1 |
| 10 ms | 0 | 1 |
| 15 ms | 1 | 0 |
| 20 ms | 0 | 0 |

## Tone Code

| Mid | D8 | D9 | D10 | D11 |
|---|---|---|---|---|
| Treble | D15 | D16 | D17 | D18 |
| 12 dB | 0 | 1 | 1 | 0 |
| 10 dB | 1 | 0 | 1 | 0 |
| 8 dB | 0 | 0 | 1 | 0 |
| 6 dB | 1 | 1 | 0 | 0 |
| 4 dB | 0 | 1 | 0 | 0 |
| 2 dB | 1 | 0 | 0 | 0 |
| 0 dB | 0 | 0 | 0 | 0/1 |
| –2 dB | 1 | 0 | 0 | 1 |
| –4 dB | 0 | 1 | 0 | 1 |
| –6 dB | 1 | 1 | 0 | 1 |
| –8 dB | 0 | 0 | 1 | 1 |
| –10 dB | 1 | 0 | 1 | 1 |
| –12 dB | 0 | 1 | 1 | 1 |

| Bass | D0 | D1 | D2 | D3 |
|---|---|---|---|---|
| 16 dB | 0 | 0 | 0 | 1 |
| 14 dB | 1 | 1 | 1 | 0 |
| 12 dB | 0 | 1 | 1 | 0 |
| 10 dB | 1 | 0 | 1 | 0 |
| 8 dB | 0 | 0 | 1 | 0 |
| 6 dB | 1 | 1 | 0 | 0 |
| 4 dB | 0 | 1 | 0 | 0 |
| 2 dB | 1 | 0 | 0 | 0 |
| 0 dB | 0 | 0 | 0 | 0 |
| –2 dB | 1 | 0 | 0 | 1 |
| –4 dB | 0 | 1 | 0 | 1 |
| –6 dB | 1 | 1 | 0 | 1 |
| –8 dB | 0 | 0 | 1 | 1 |
| –10 dB | 1 | 0 | 1 | 1 |
| –12 dB | 0 | 1 | 1 | 1 |

## Loudness Volume Code

| Loudness | D21 | D22 | D23 | D24 |
|---|---|---|---|---|
| –2 dB | 1 | 1 | 1 | 1 |
| –4 dB | 0 | 1 | 1 | 1 |
| –6 dB | 1 | 0 | 1 | 1 |
| –8 dB | 0 | 0 | 1 | 1 |
| –10 dB | 1 | 1 | 0 | 1 |
| –12 dB | 0 | 1 | 0 | 1 |
| –14 dB | 1 | 0 | 0 | 1 |
| –16 dB | 0 | 0 | 0 | 1 |
| –18 dB | 1 | 1 | 1 | 0 |
| –20 dB | 0 | 1 | 1 | 0 |
| –22 dB | 1 | 0 | 1 | 0 |
| –24 dB | 0 | 0 | 1 | 0 |
| –26 dB | 1 | 1 | 0 | 0 |
| –28 dB | 0 | 1 | 0 | 0 |
| –30 dB | 1 | 0 | 0 | 0 |
| –∞ dB | 0 | 0 | 0 | 0 |

Please refer to 21, 22 page for Loudness gain setting.

## Loudness f0 Control

| Loudness f0 Control | D30 | D31 |
|---|---|---|
| f0 = 60 Hz | 1 | 1 |
| f0 = 80 Hz | 0 | 1 |
| f0 = 100 Hz | 1 | 0 |

## Tone f0, Q Control Code

| Bass f0 Control | D4 | D5 |
|---|---|---|
| f0 = 50 Hz | 1 | 1 |
| f0 = 80 Hz | 0 | 1 |
| f0 = 120 Hz | 1 | 0 |

| Mid f0 Control | D12 | D13 |
|---|---|---|
| f0 = 700 Hz | 1 | 1 |
| f0 = 1 kHz | 0 | 1 |
| f0 = 2 kHz | 1 | 0 |
| f0 = 10 kHz | 0 | 0 |

| Treble f0 Control | D19 |
|---|---|
| f0 = 8 kHz | 1 |
| f0 = 12 kHz | 0 |

| Bass Q Control | D6 | D7 |
|---|---|---|
| Q = 2 | 1 | 1 |
| Q = 1.5 | 0 | 1 |
| Q = 1.25 | 1 | 0 |
| Q = 1 | 0 | 0 |

| Mid Q Control | D14 |
|---|---|
| Q = 1.5 | 1 |
| Q = 2 | 0 |

## Selector Code

| Selector | D14 | D15 | D16 |
|---|---|---|---|
| INA | 0 | 0 | 1 |
| INB | 1 | 1 | 0 |
| INC | 0 | 1 | 0 |
| IND | 1 | 0 | 0 |
| Differential Input | 0 | 0 | 0 |

## Non Fader Code

| ATT | D26 | D27 | D28 | D29 |
|---|---|---|---|---|
| +12 dB | 1 | 0 | 1 | 1 |
| +10 dB | 0 | 0 | 1 | 1 |
| +8 dB | 1 | 1 | 0 | 1 |
| +6 dB | 0 | 1 | 0 | 1 |
| +4 dB | 1 | 0 | 0 | 1 |
| +2 dB | 0 | 0 | 0 | 1 |
| 0 dB | 1 | 1 | 1 | 0 |
| –2 dB | 0 | 1 | 1 | 0 |
| –4 dB | 1 | 0 | 1 | 0 |
| –6 dB | 0 | 0 | 1 | 0 |
| –8 dB | 1 | 1 | 0 | 0 |
| –10 dB | 0 | 1 | 0 | 0 |
| –12 dB | 1 | 0 | 0 | 0 |
| –∞ dB | 0 | 0 | 0 | 0 |

## Input Gain Control Code

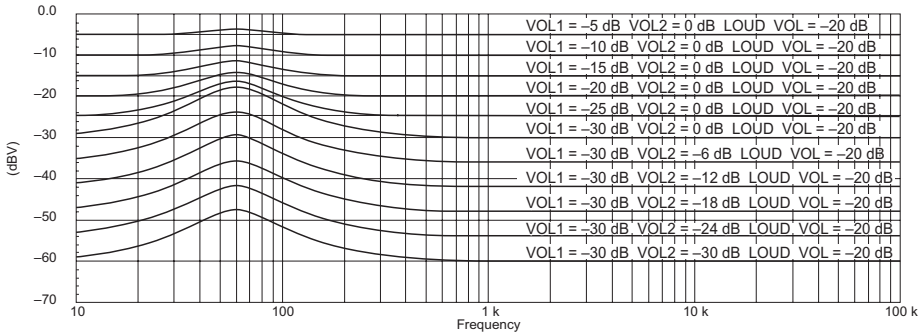
| Input Gain Control | D17 | D18 | D19 | D20 |
|---|---|---|---|---|
| 0 dB | 1 | 1 | 1 | 1 |
| 1.25 dB | 0 | 1 | 1 | 1 |
| 2.50 dB | 1 | 0 | 1 | 1 |
| 3.75 dB | 0 | 0 | 1 | 1 |
| 5.00 dB | 1 | 1 | 0 | 1 |
| 6.25 dB | 0 | 1 | 0 | 1 |
| 7.50 dB | 1 | 0 | 0 | 1 |
| 8.75 dB | 0 | 0 | 0 | 1 |
| 10.00 dB | 1 | 1 | 1 | 0 |
| 11.25 dB | 0 | 1 | 1 | 0 |
| 12.50 dB | 1 | 0 | 1 | 0 |
| 13.75 dB | 0 | 0 | 1 | 0 |
| 15.00 dB | 1 | 1 | 0 | 0 |
| 16.25 dB | 0 | 1 | 0 | 0 |
| 17.50 dB | 1 | 0 | 0 | 0 |
| 18.75 dB | 0 | 0 | 0 | 0 |

## Fader Code

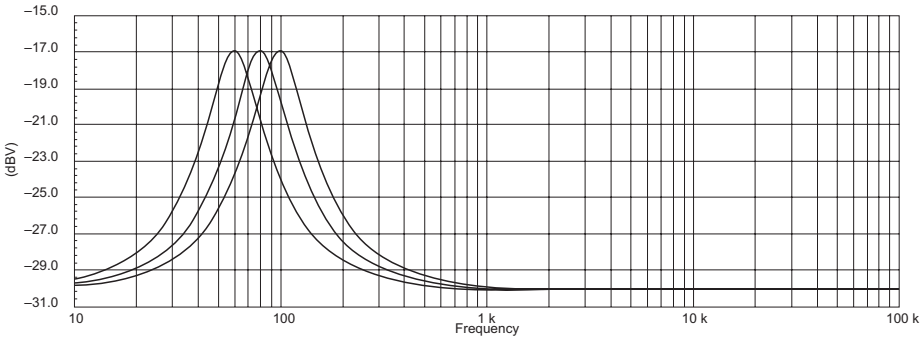
| Fader | D21 | D22 | D23 | D24 |
|---|---|---|---|---|
| 0 dB | 1 | 1 | 1 | 1 |
| –1 dB | 0 | 1 | 1 | 1 |
| –2 dB | 1 | 0 | 1 | 1 |
| –3 dB | 0 | 0 | 1 | 1 |
| –4 dB | 1 | 1 | 0 | 1 |
| –6 dB | 0 | 1 | 0 | 1 |
| –8 dB | 1 | 0 | 0 | 1 |
| –10 dB | 0 | 0 | 0 | 1 |
| –12 dB | 1 | 1 | 1 | 0 |
| –14 dB | 0 | 1 | 1 | 0 |
| –16 dB | 1 | 0 | 1 | 0 |
| –20 dB | 0 | 0 | 1 | 0 |
| –30 dB | 1 | 1 | 0 | 0 |
| –45 dB | 0 | 1 | 0 | 0 |
| –60 dB | 1 | 0 | 0 | 0 |
| –∞ dB | 0 | 0 | 0 | 0 |

## Loudness, Tone Control Frequency Characteristic

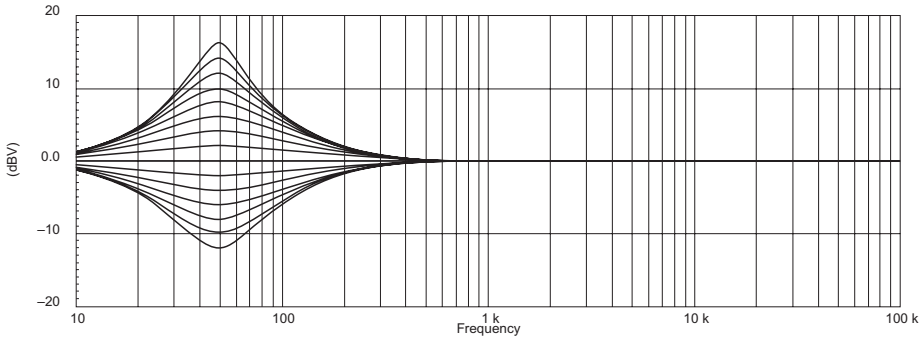
### Figure 1 Loudness Frequency Characteristic




### Figure 2 Loudness Frequency Characteristic (VOL = –30 dB, Loudness = –20 dB, f0 = Variable)




### Figure 3 Bass Frequency Characteristic (f0 = 50 Hz, Q = 2, Gv = Variable)




### Figure 4 Bass Frequency Characteristic (Gv = +16 dB, f0 = Variable, Q = 2)

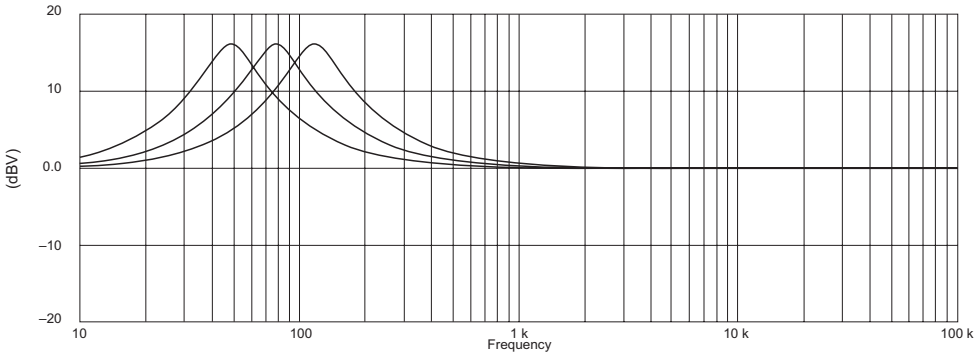


**Figure 5 Bass Frequency Characteristic (Gv = +16 dB, Q = Variable, f0 = 50 Hz)**

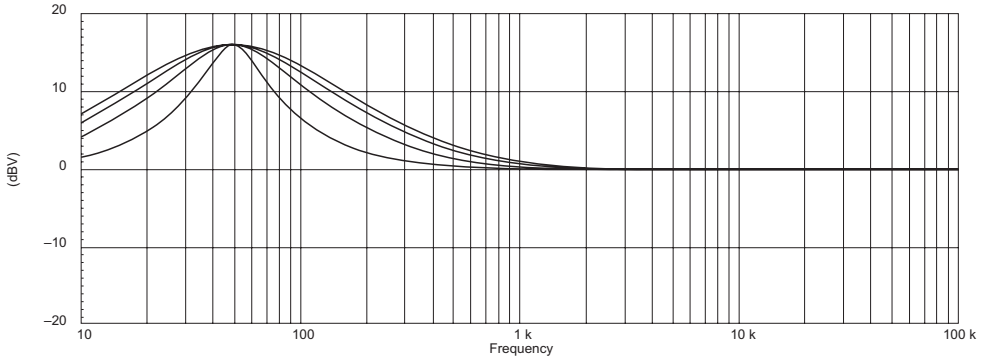



**Figure 6 Mid Frequency Characteristic (f0 = 1 kHz, Q = 2, Gv = Variable)**

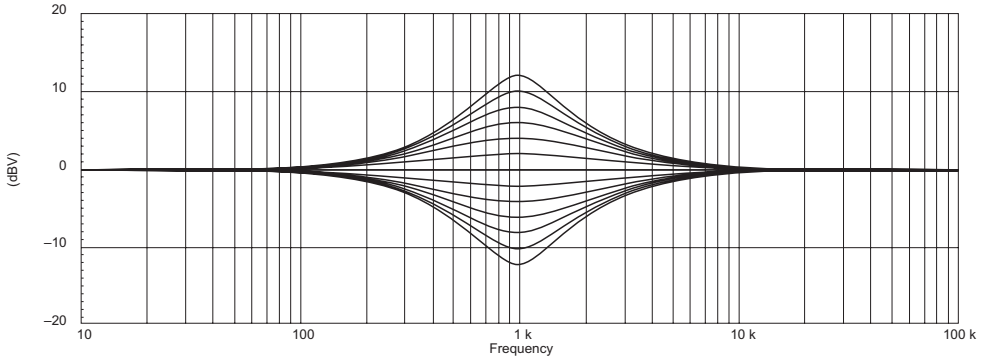



**Figure 7 Mid Frequency Characteristic (Gv = +12 dB, Q = 2, f0 = Variable)**

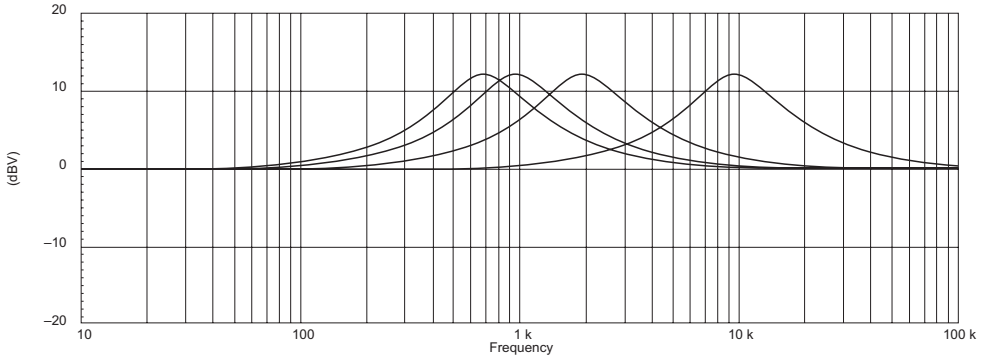



**Figure 8 Mid Frequency Characteristic (Gv = +12 dB, f0 = 1 kHz, Q = Variable)**

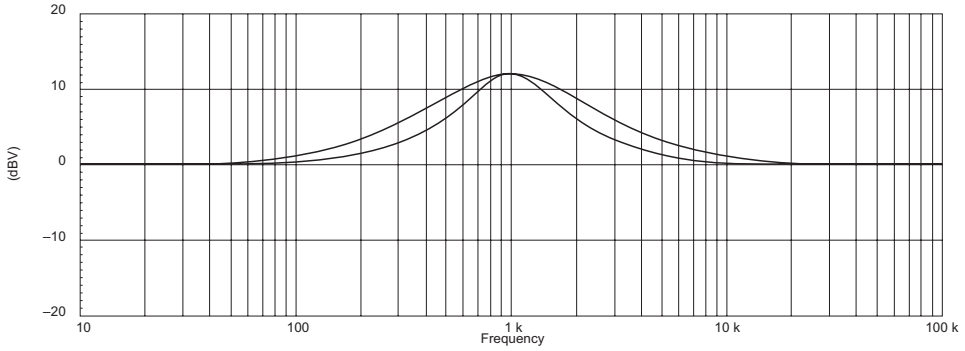


**Figure 9 Treble Frequency Characteristic (Gv = Variable)**

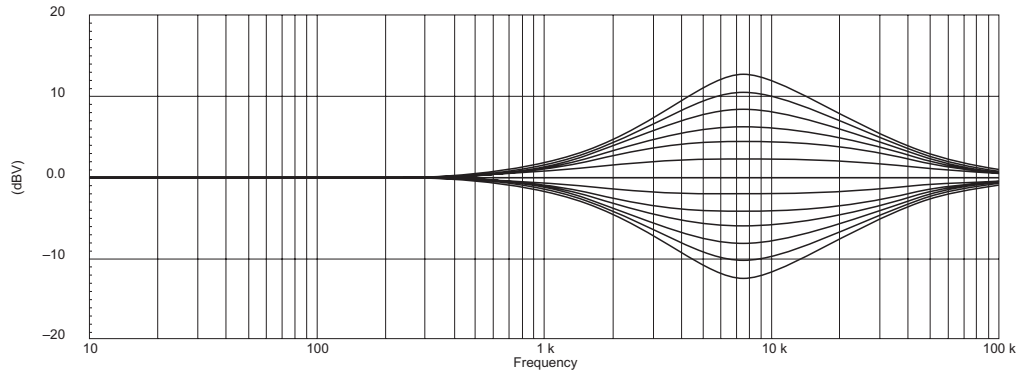
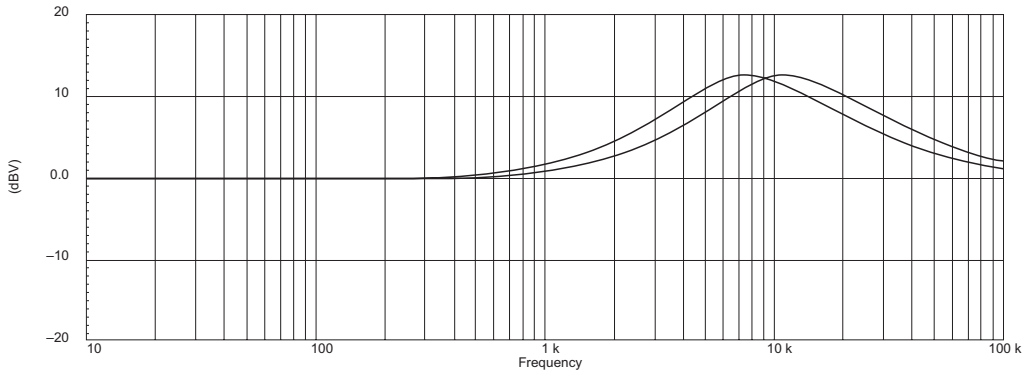


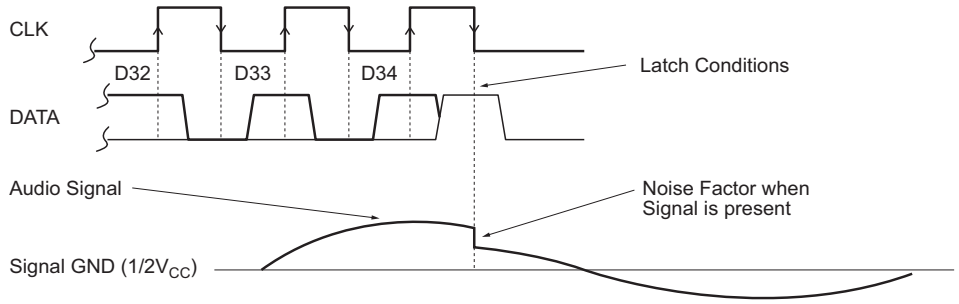

**Figure 10 Treble Frequency Characteristic (Gv = +12 dB, f0 = Variable)**



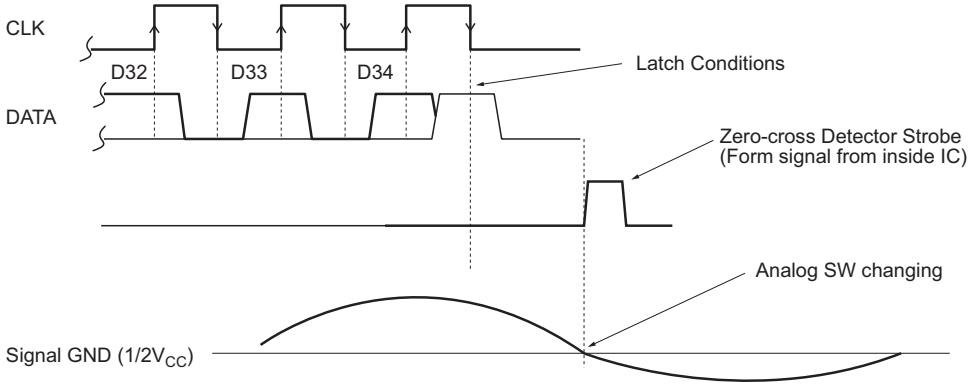
## Zero-Crossing Detection Circuit

### 1. Meaning of Zero-Crossing Detection Circuit

In the conventional Serial Data Control Type Volume, Analog SW inside switches over simultaneously with Latch Condition Detector. And the operation completes.




In this case the changing noise occurs at the time of Latch Condition Detector, the Analog SW switches over (Zero-cross Detector Strobe occurs) in the moment that the Analog Signal cross Signal Ground (1/2$V_{CC}$).



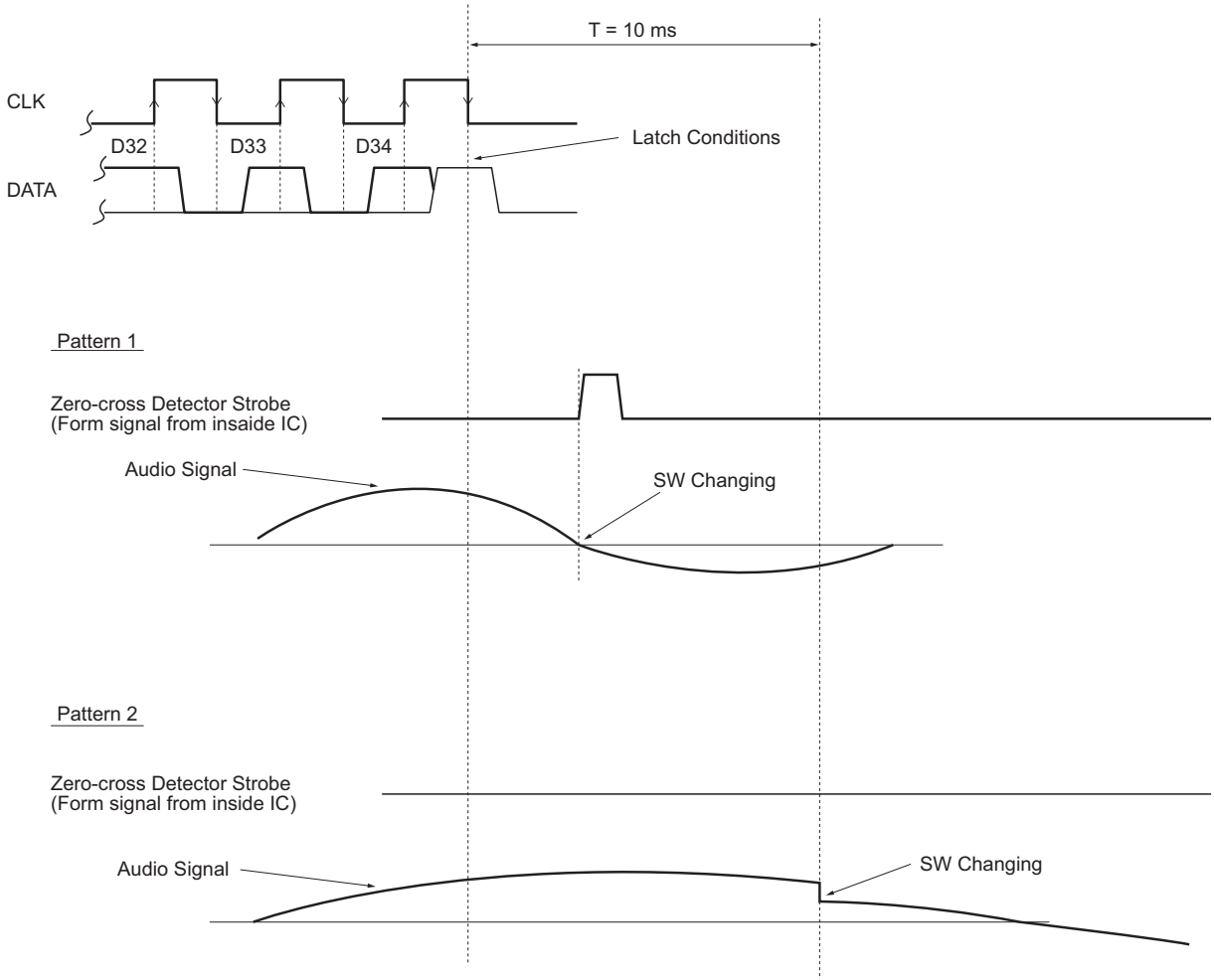

Other, In the case of Audio Signal isn't inputted (No signal), even if only Zero-cross Detector Circuit detects Latch Condition, Analog SW doesn't switch over for the Audio Signal never cuts Signal Ground (1/2$V_{CC}$).

The Time Function switches the Analog SW after some time T.

The Timer Time can setting with the Serial Data of 5 ms, 10 ms, 15 ms, 20 ms.

## 2. Connection of Zero-Crossing Detector and Timer Setting

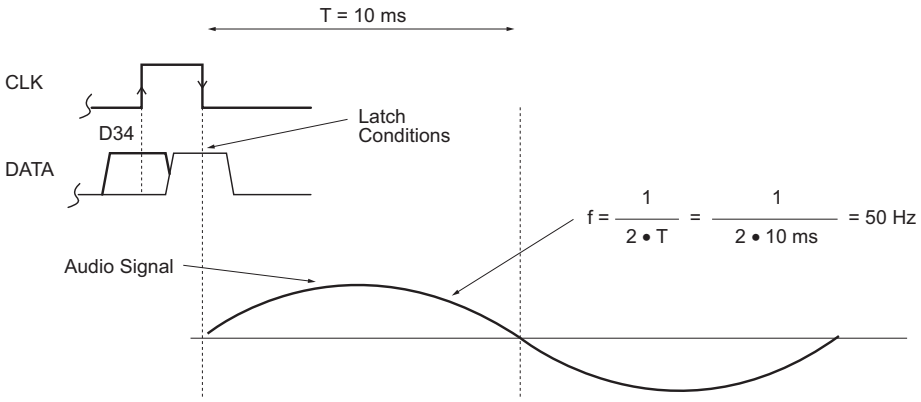
"OR" of [Zero-cross Detector Strobe] or [Compulsion SW of Timer Circuit] moves Internal Analog SW. When for example, suppose that it set to T = 10 ms.




In case of Pattern 1, the Zero-cross Detector Strobe occurs with the Zero-cross Detector Function, and SW is switched. But in case of Pattern 2, the Timer Function switches the Analog SW after T = 10 ms, for the Audio Input Signal didn't cut the Signal Ground after T = 10 ms which were set with the timer.

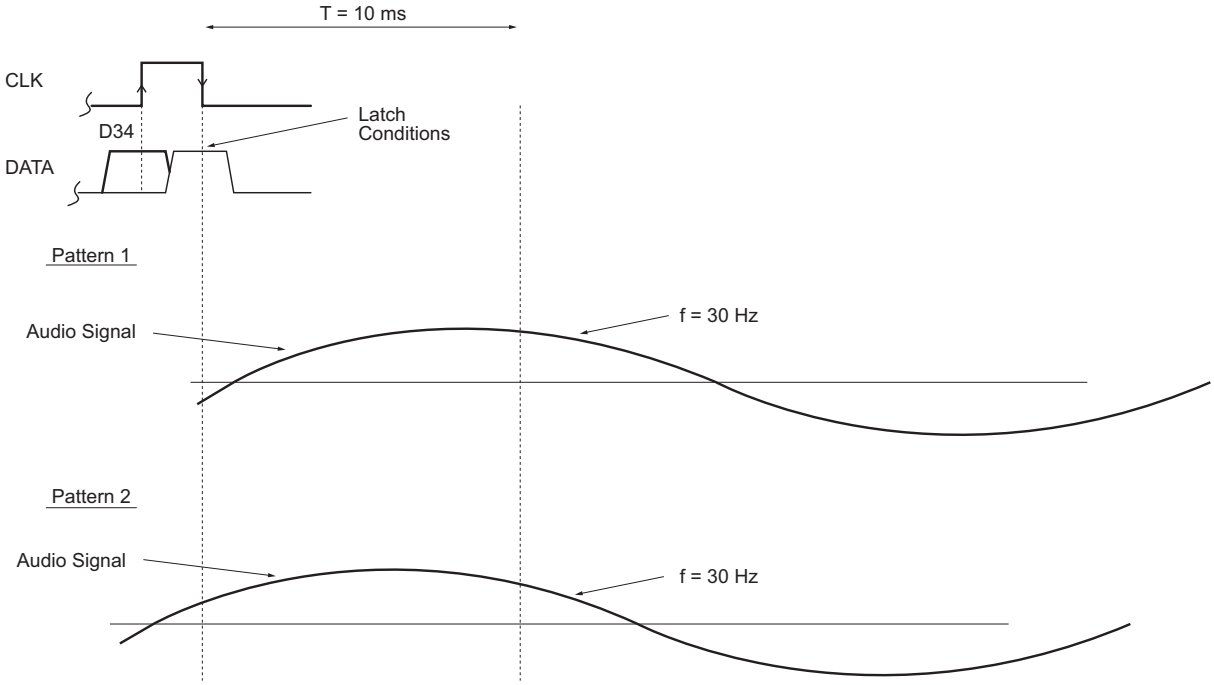
Timer Setting Time setting for Frequency band of Input Audio Signal.

### 3. Timer Setting System




In case of Timer Setting Time/T = 10 ms setting

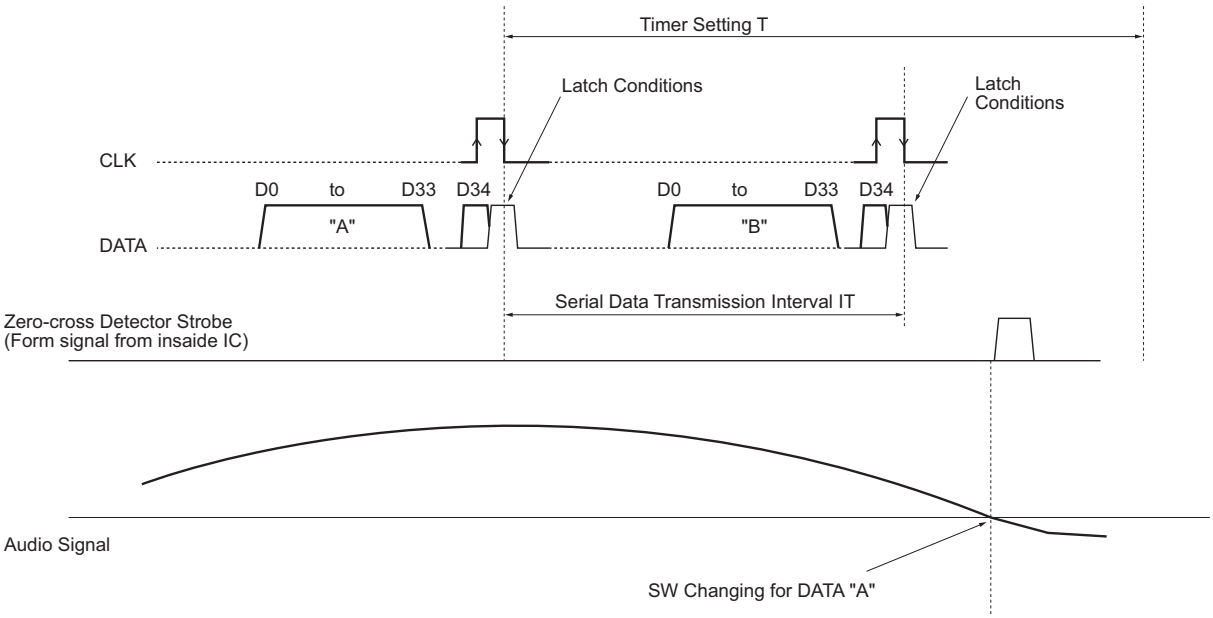
| Audio Signal | Zero-cross Detector | |
|---|---|---|
| 50 Hz < | 100% | Upper fig. |
| 50 Hz > | 100% | Pattern 1 |
| | 0% | Pattern 2 |




The Timer Setting Time T makes T = 20 ms (Zero-cross detect of 25 Hz is 100%) maximum and it is setting by it.

### 4. Connection of Data Transmission and Timer Setting

M61508FP has the function to make the Serial Data invalid until it generation the Zero-cross Detector Strobe in IC, after the Latch Condition detected.




* In case of upper figurative. The order of DATA "B" is invalid.

In to make the Serial Data Transmission Interval IT from MCU (microcomputer) to M61508FP

Serial Data Transmission Interval = IT > Timer Setting = T

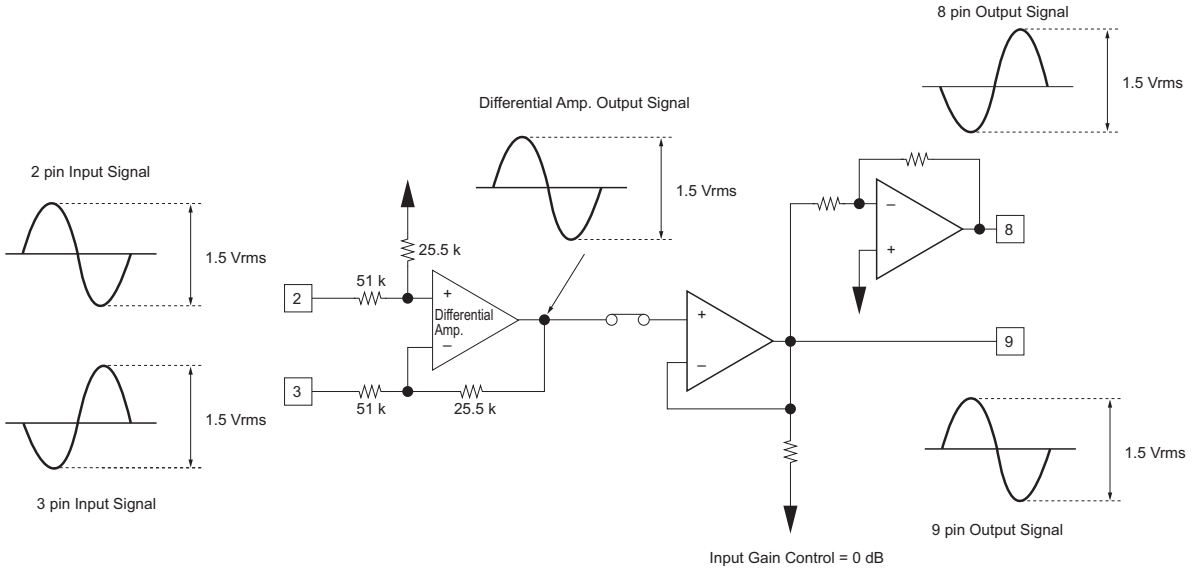
the reading error of the data doesn't occur.

* Serial Data Transmission Interval IT = Interval of between Latch Condition and Latch Condition

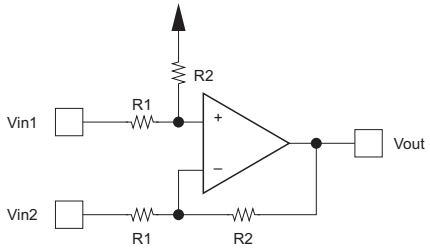
## The Others

### 1. Differential Amp.

The lower fig. is Equalizing Circuit, Output Signal/Output Voltage of each point.




● Differential Amp. Gain Calculation Formula

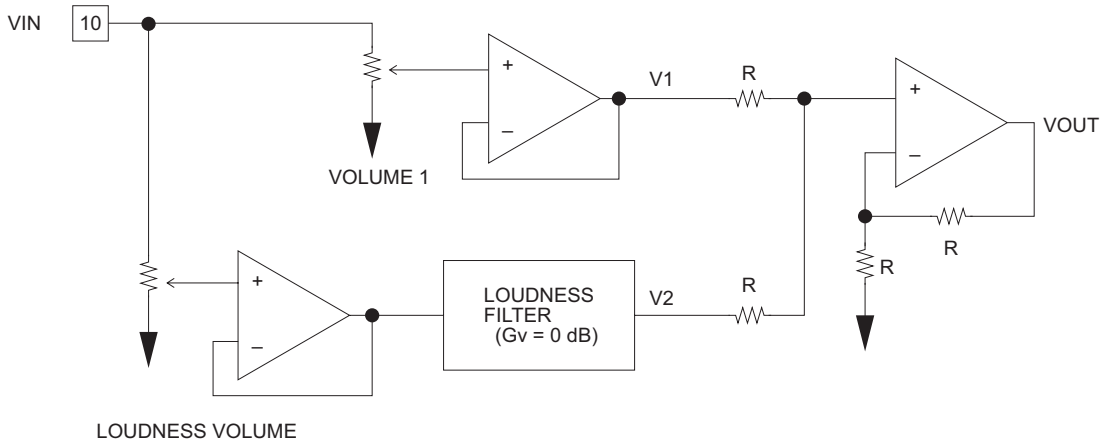



$$Vout = \frac{R2}{R1} (Vin1 - Vin2)$$

$$Gv = 20 \log \frac{R2}{R1}$$

## 2. Loudness Gain Setting

Lower Figure is Structure of Loudness Circuit.




Output Voltage (VOUT) of Setting Structure of Upper Figure

It is noted as Volume 1 Output Voltage = V1, Loudness Filter Output Voltage = V2, VOUT and Gv (Boost quantity) is given at the lower formula

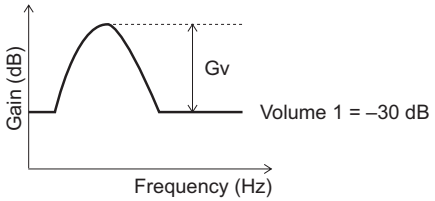
$$VOUT = V1 + V2 \text{ (Vrms)}$$

$$Gv = 20 \log \frac{(V1 + V2)}{VIN} - \text{(Volume 1 attenuation quantity) (dB)}$$

ex.) VIN = 1Vrms/60 Hz, Volume1 = –30 dB,
Output Volutage and Boost Quantity of 60 Hz of Loudness Volume = –20 dB setting

From: Volume1, Loudness Volume attenuation quantity
Become: V1 = 31.6 mVrms
V2 = 100 mVrms

If the sub situdes the equation for the upper formula,
the following equation is given,




$$VOUT = 31.6\text{ m} + 100\text{ m}$$

$$= 131.6 \text{ mVrms}$$

$$Gv = 20 \log \frac{(31.6\text{ m} + 100\text{ m})}{1} - (-30 \text{ dB})$$

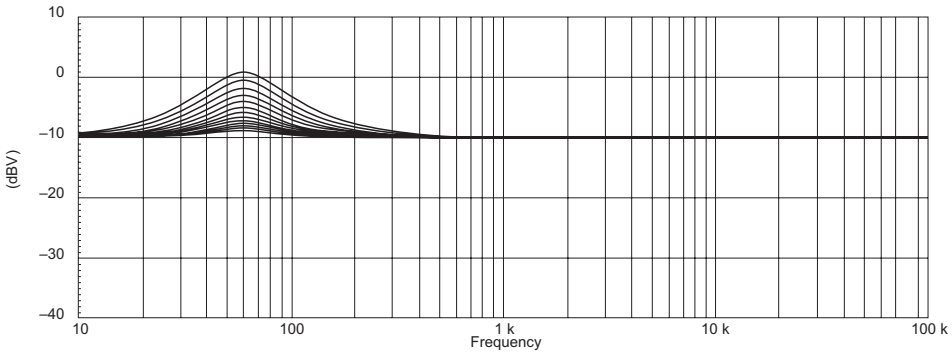
$$= 12.4 \text{ dB is obtained}$$

In the item, the Loudness Gain Setting example is shown, when Volume 1 fixation and doing the Loudness Volume variably. Please refer to Plan.

## Loudness Gain Setting Example

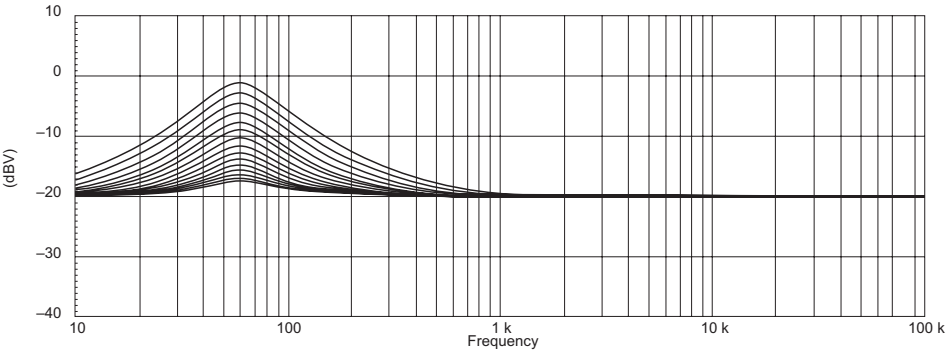
### 1. Volume 1 = –10 dB

| Loudness Volume | Loudness Gain |
|---|---|
| –2 dB | 10.9 dB |
| –4 dB | 9.5 dB |
| –6 dB | 8.2 dB |
| –8 dB | 7.1 dB |
| –10 dB | 6.0 dB |
| –12 dB | 5.1 dB |
| –14 dB | 4.2 dB |
| –16 dB | 3.5 dB |
| –18 dB | 2.9 dB |
| –20 dB | 2.4 dB |
| –22 dB | 1.9 dB |
| –24 dB | 1.6 dB |
| –26 dB | 1.3 dB |
| –28 dB | 1.0 dB |
| –30 dB | 0.8 dB |
| –∞ dB | 0 dB |



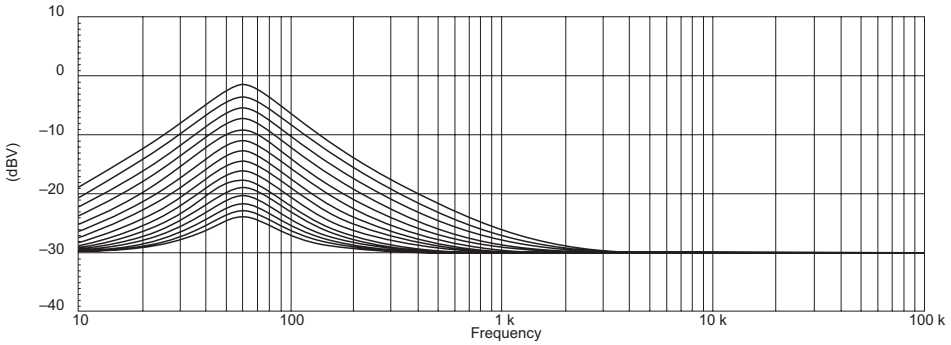

### 2. Volume 1 = –20 dB

| Loudness Volume | Loudnes s Gain |
|---|---|
| –2 dB | 19.0 dB |
| –4 dB | 17.3 dB |
| –6 dB | 15.6 dB |
| –8 dB | 13.9 dB |
| –10 dB | 12.4 dB |
| –12 dB | 10.9 dB |
| –14 dB | 9.5 dB |
| –16 dB | 8.2 dB |
| –18 dB | 7.1 dB |
| –20 dB | 6.0 dB |
| –22 dB | 5.1 dB |
| –24 dB | 4.2 dB |
| –26 dB | 3.5 dB |
| –28 dB | 2.9 dB |
| –30 dB | 2.4 dB |
| –∞ dB | 0 dB |



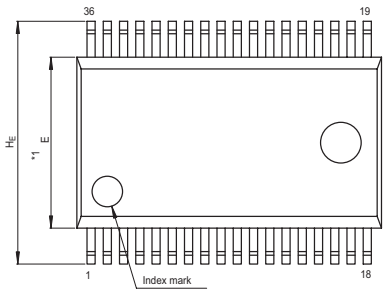
### 3. Volume 1 = –30dB

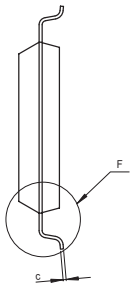
| Loudness Volume | Loudness Gain |
|---|---|
| –2 dB | 28.3 dB |
| –4 dB | 26.4 dB |
| –6 dB | 24.5 dB |
| –8 dB | 22.7 dB |
| –10 dB | 20.8 dB |
| –12 dB | 19.0 dB |
| –14 dB | 17.3 dB |
| –16 dB | 15.6 dB |
| –18 dB | 13.9 dB |
| –20 dB | 12.4 dB |
| –22 dB | 10.9 dB |
| –24 dB | 9.5 dB |
| –26 dB | 8.2 dB |
| –28 dB | 7.1 dB |
| –30 dB | 6.0 dB |
| –∞dB | 0 dB |



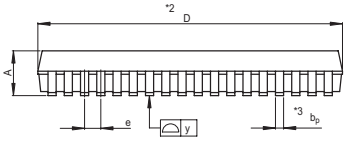
## Package Dimensions

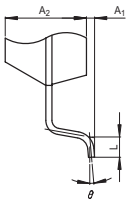
| JEITA Package Code | RENESAS Code | Previous Code | MASS[Typ.] |
|---|---|---|---|
| P-SSOP36-8.4x15-0.80 | PRSP0036GA-A | 36P2R-A | 0.5g |




NOTE)
1. DIMENSIONS "*1" AND "*2" DO NOT INCLUDE MOLD FLASH.
2. DIMENSION "*3" DOES NOT INCLUDE TRIM OFFSET.




Detail F

| Reference Symbol | Dimension in Millimeters | | |
|---|---|---|---|
| | Min | Nom | Max |
| D | 14.8 | 15.0 | 15.2 |
| E | 8.2 | 8.4 | 8.6 |
| $A_2$ | — | 2.0 | — |
| A | — | — | 2.4 |
| $A_1$ | 0.05 | — | — |
| $b_p$ | 0.35 | 0.4 | 0.5 |
| c | 0.13 | 0.15 | 0.2 |
| θ | 0° | — | 10° |
| $H_E$ | 11.63 | 11.93 | 12.23 |
| e | 0.65 | 0.8 | 0.95 |
| y | — | — | 0.15 |
| L | 0.3 | 0.5 | 0.7 |

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