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April 1st, 2010
Renesas Electronics Corporation

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# M62446AFP

## 6ch Electronic Volume with Tone Control

REJ03F0212-0201
Rev.2.01
Mar 31, 2008

## Description

The M62446AFP is 6ch electronic volume with tone control. This IC is revised from M62446FP. The extended function of M62446AFP is volume level and tone control level. M62446AFP is easy to use more than M62446FP.

## Features

- 6ch Electric volume
  Volume level: 0 to –95 dB (1 dB/step)* <M62446FP: 0 to –79 dB (1 dB/step)>
- Tone control
  Bass/Treble: –14 dB to +14 dB (2 dB/step)* <M62446FP: –10 dB to +10 dB (2 dB/step)>
- Noise voltage: 1.5 μVrms <M62446FP: 2.2 μVrms>
- 4 Output ports
- Bypass mode is high quality sound.

Note: * is an extended function.

## Application

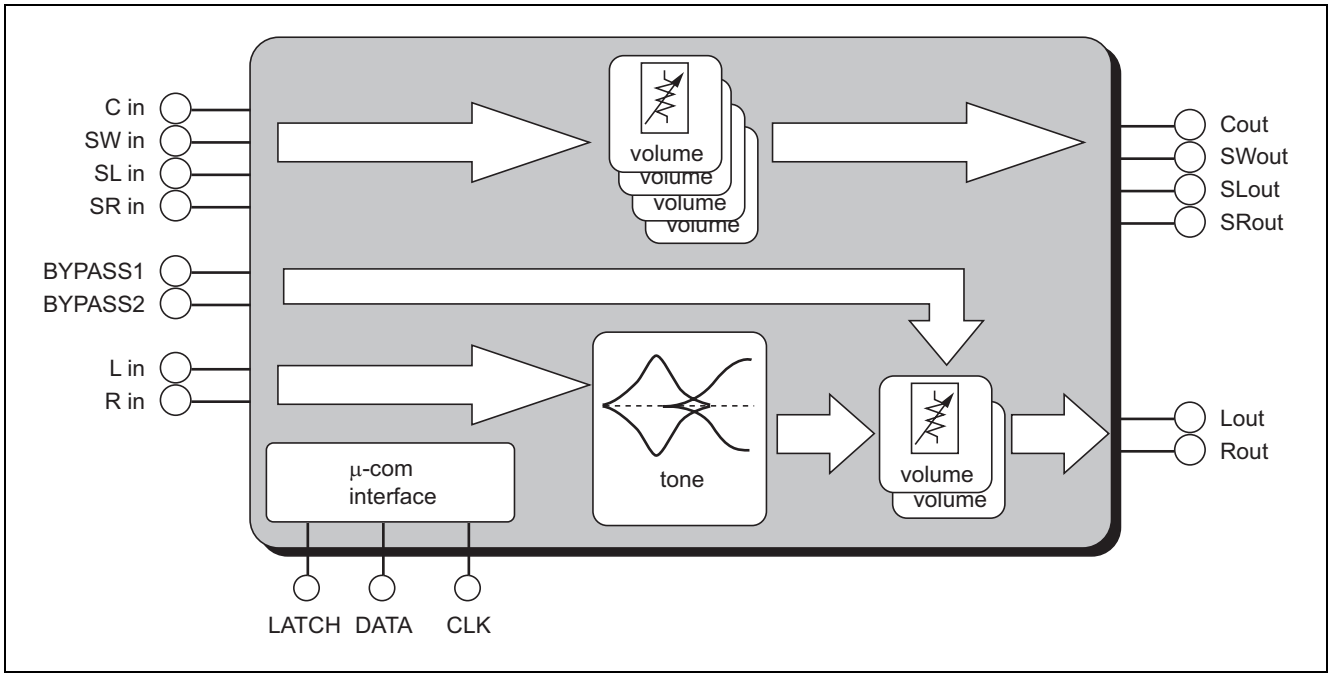
DVD, Home Audio equipment, TV

## Recommended Operating Conditions

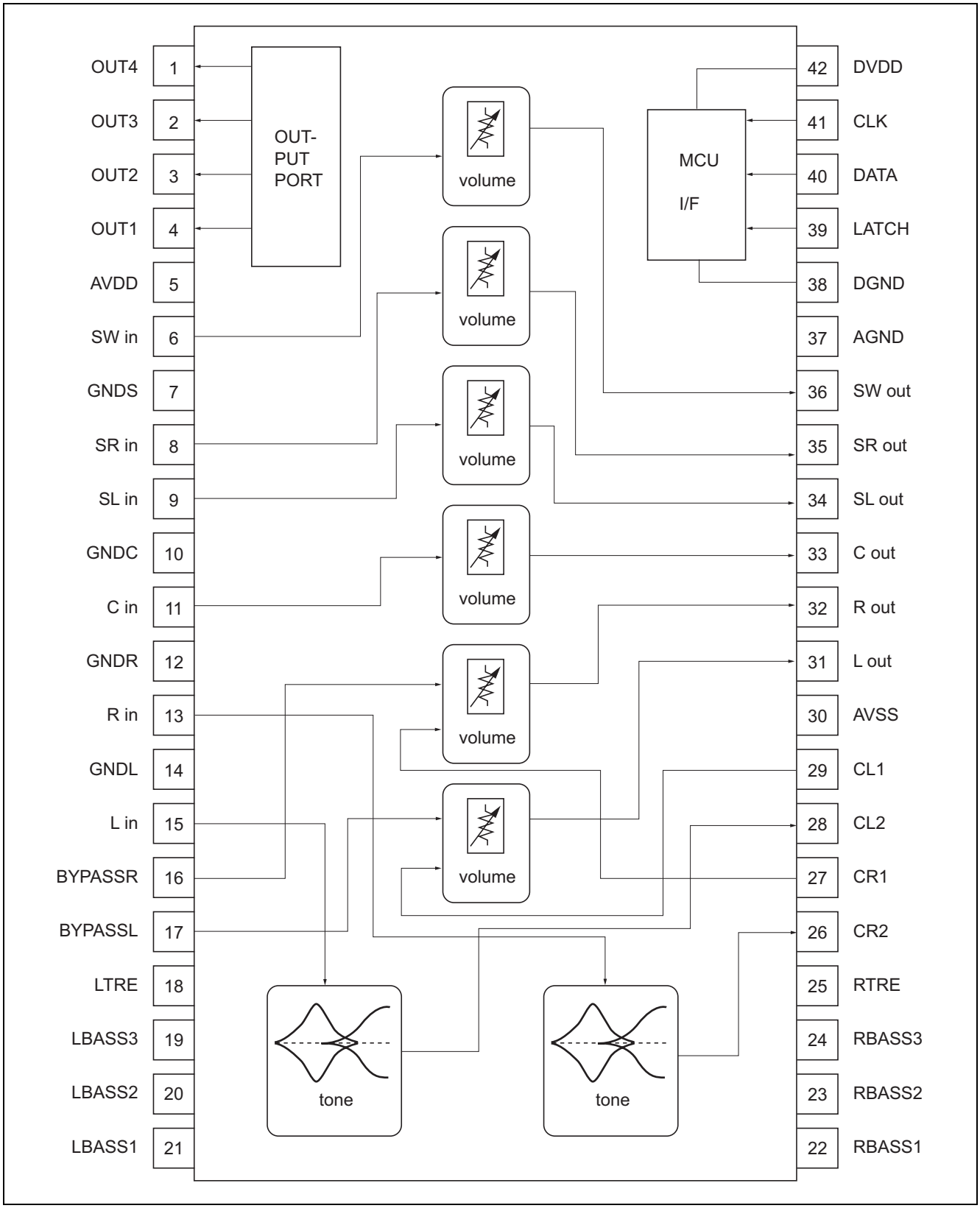
Supply voltage range: ±4.5 to ±7.5 V (analog), 4.5 V to 5.5 V (digital)

Recommended supply voltage: ±7.0 V (analog), 5.0 V (digital)

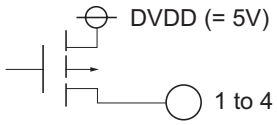
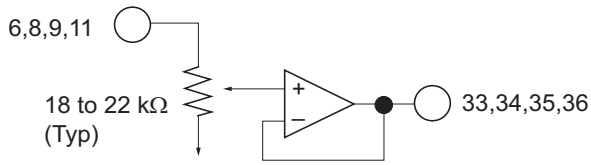
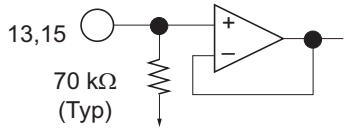
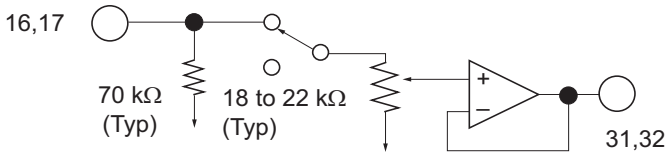
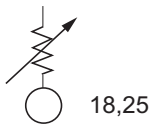
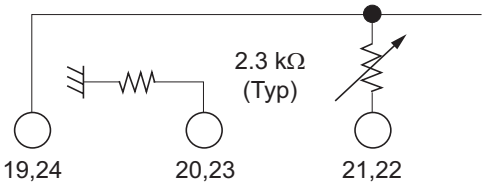
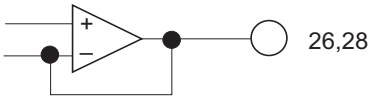
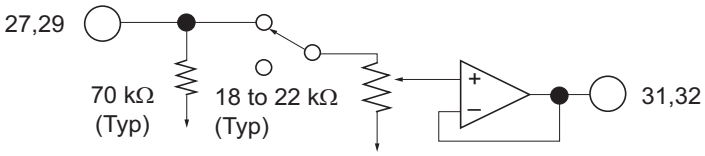
## System Block Diagram

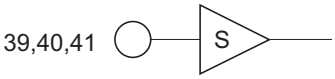


## Pin Configuration and Block Diagram



## Pin Description

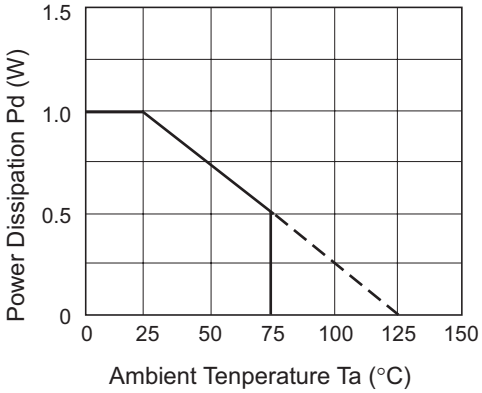
| Pin No. | Symbol | Function | Circuit |
|---|---|---|---|
| 1 | OUT4 | Port OUTPUT | OUTPUT: PMOS Transistor open drain   |
| 2 | OUT3 | | |
| 3 | OUT2 | | |
| 4 | OUT1 | | |
| 5 | AVDD | Analog positive power supply | +7 V |
| 7 | GNDS | GND | Connect to analog GND |
| 10 | GNDC | | |
| 12 | GNDR | | |
| 14 | GNDL | | |
| 6 | SW in | Volume INPUT |   |
| 8 | SR in | | |
| 9 | SL in | | |
| 11 | C in | | |
| 36 | SW out | Volume OUTPUT | |
| 35 | SR out | | |
| 34 | SL out | | |
| 33 | C out | | |
| 13 | R in | Tone INPUT |   |
| 15 | L in | | |
| 16 | BYPASSR | L, R volume INPUT in BYPASS mode |   |
| 17 | BYPASSL | | |
| 31 | L out | L OUTPUT | |
| 32 | R out | R OUTPUT | |
| 18 | LTRE | Tone treble cycle control |   |
| 25 | RTRE | | |
| 19 | LBASS3 | Tone bass cycle control |   |
| 24 | RBASS3 | | |
| 20 | LBASS2 | | |
| 23 | RBASS2 | | |
| 21 | LBASS1 | | |
| 26 | RBASS1 | | |
| 22 | CR2 | Tone OUTPUT |   |
| 28 | CL2 | | |
| 27 | CR1 | L, R volume INPUT |   |
| 29 | CL1 | | |
| 31 | L out | L OUTPUT | |
| 32 | R out | R OUTPUT | |

| Pin No. | Symbol | Function | Circuit |
|---|---|---|---|
| 30 | AVSS | Analog negative power supply | –7 V |
| 37 | AGND | Analog GND | |
| 38 | DGND | Digital GND | |
| 39 | LATCH | Latch INPUT |   INPUT: schmitt trigger type |
| 40 | DATA | Data INPUT | |
| 41 | CLK | Clock INPUT forward data | |
| 42 | DVDD | Digital power supply | +5 V |

## Absolute Maximum Ratings

| Item | Symbol | Ratings | Unit | Condition |
|---|---|---|---|---|
| Supply voltage | Vsupply | 16 | V | AVDD – AVSS |
| | | 7 | | DVDD – DGND |
| Power dissipation | Pd | 1000 | mW | Ta ≤ 25 °C |
| Thermal derating | Kθ | 10 | mW/°C | Ta > 25 °C |
| Operating temperature | Topr | –20 to +75 | °C | |
| Storage temperature | Tstg | –40 to +125 | °C | |

Thermal Derating (Maximum Rating)
(with the standard board)




*Standard board
- board size 70 mm × 70 mm
- board thickness 1.6 mm
- board material glass epoxy
- copper pattern
  copper thickness 18 μm
  copper size 0.25 mm (wide) 30 mm (length/lead)

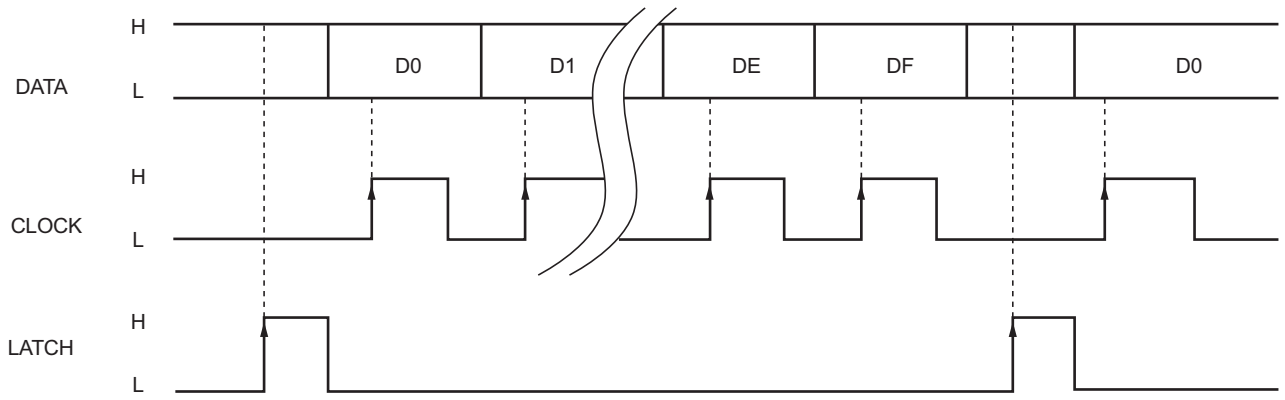
## Recommended Operating Condition

(Ta = 25°C, unless otherwise noted)

| Item | Symbol | Min | Typ | Max | Unit | Condition |
|---|---|---|---|---|---|---|
| Analog positive supply voltage | AVDD | 4.5 | 7.0 | 7.5 | V | |
| Analog negative supply voltage | AVSS | –7.5 | –7.0 | –4.5 | V | |
| Digital supply voltage | DVDD | 4.5 | 5.0 | 5.5 | V | |
| High-level input voltage | VIH | DVDD × 0.7 | — | DVDD | V | |
| Low-level input voltage | VIL | DGND | — | DVDD × 0.3 | V | |

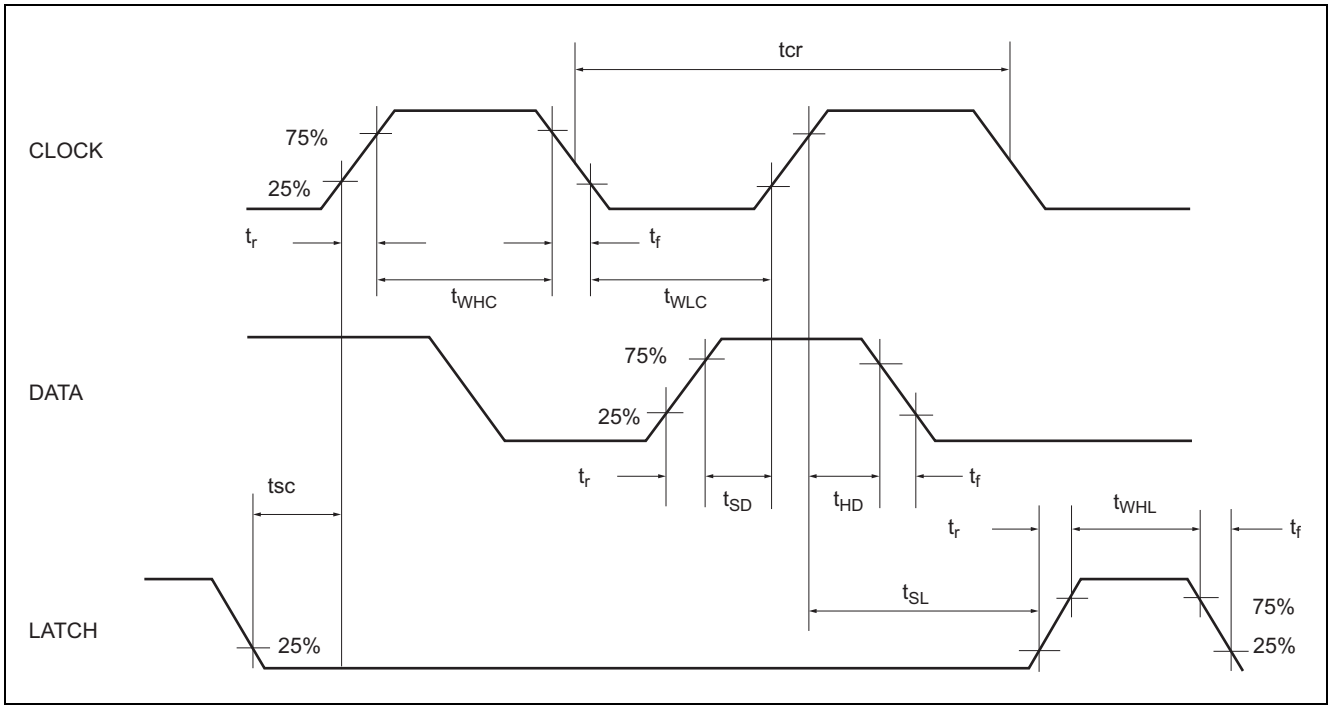
Note: AVSS ≤ DGND < DVDD ≤ AVDD

## Relationship between Data and Clock and Latch




Note: CLOCK and LATCH function at raising edges of pulse.

## Data Timing (Recommended Conditions)




## Digital Block Timing Regulation

| Item | Symbol | Limits | | | Unit |
|---|---|---|---|---|---|
| | | Min | Typ | Max | |
| CLOCK cycle time | $t_{cr}$ | 8 | — | — | µs |
| CLOCK pulse width ("H" level) | $t_{WHC}$ | 3.2 | — | — | |
| CLOCK pulse width ("L" level) | $t_{WLC}$ | 3.2 | — | — | |
| CLOCK, DATA, LATCH rise time | $t_r$ | — | — | 0.8 | |
| CLOCK, DATA, LATCH fall time | $t_f$ | — | — | 0.8 | |
| DATA setup time | $t_{SD}$ | 1.6 | — | — | |
| DATA hold time | $t_{HD}$ | 1.6 | — | — | |
| LATCH setup time | $t_{SL}$ | 2 | — | — | |
| LATCH pulse width | $t_{WHL}$ | 3.2 | — | — | |
| CLOCK start time after LATCH | $t_{SC}$ | 3.2 | — | — | |

## Digital Control Specification

Fore kinds of input format options are available by changing slot settings of DE and DF. (When the IC is powered up, the internal settings are not fixed.)

**(1)**

| D01 | D11 | D21 | D31 | D41 | D51 | D61 | D71 | D81 | D91 | DA1 | DB1 | DC1 | DD1 | DE | DF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TONE CONT TLEBLE | | | | 1 | 2 | 3 | 4 | TONE CONT BASS | | | | 0 | TONE : 0 BYPASS : 1 | 0 | 0 |
| | | | | OUTPUT PORT n CONT High: 1,Low: 0 | | | | | | | | | | | |

**(2)**

| D02 | D12 | D22 | D32 | D42 | D52 | D62 | D72 | D82 | D92 | DA2 | DB2 | DC2 | DD2 | DE | DF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOLUME Lch | | | | | | | VOLUME Rch | | | | | | | 0 | 1 |

**(3)**

| D03 | D13 | D23 | D33 | D43 | D53 | D63 | D73 | D83 | D93 | DA3 | DB3 | DC3 | DD3 | DE | DF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOLUME Cch | | | | | | | VOLUME SWch | | | | | | | 1 | 0 |

**(4)**

| D04 | D14 | D24 | D34 | D44 | D54 | D64 | D74 | D84 | D94 | DA4 | DB4 | DC4 | DD4 | DE | DF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOLUME SLch | | | | | | | VOLUME SRch | | | | | | | 1 | 1 |

## Setting Code

### (1) Tone Control (Bass/Treble)

| ATT | Treble / Bass | D01 / D81 | D11 / D91 | D21 / DA1 | D31 / DB1 |
|---|---|---|---|---|---|
| * –14 dB | | 1 | 1 | 1 | 1 |
| * –12 dB | | 1 | 1 | 0 | 1 |
| –10 dB | | 1 | 1 | 1 | 0 |
| –8 dB | | 1 | 1 | 0 | 0 |
| –6 dB | | 1 | 0 | 1 | 1 |
| –4 dB | | 1 | 0 | 1 | 0 |
| –2 dB | | 1 | 0 | 0 | 1 |
| +0 dB | | 0 | 0 | 0 | 0 |
| +2 dB | | 0 | 0 | 0 | 1 |
| +4 dB | | 0 | 0 | 1 | 0 |
| +6 dB | | 0 | 0 | 1 | 1 |
| +8 dB | | 0 | 1 | 0 | 0 |
| +10 dB | | 0 | 1 | 1 | 0 |
| * +12 dB | | 0 | 1 | 0 | 1 |
| * +14 dB | | 0 | 1 | 1 | 1 |

Note: * is an extended function.

### (2) Port Output

| D41 D51 D61 D71 | |
|---|---|
| Out: H | 1 |
| Out: L | 0 |

### (3) Bypass Control

| DD1 | |
|---|---|
| BYPASS | 1 |
| TONE | 0 |

Note: Do not input other data than the above.

### (4)-1 Volume (0 to –39 dB)

| ATT | Volume | D0X | D1X | D2X | D3X | D4X | D5X | D6X |
|---|---|---|---|---|---|---|---|---|
| | | D7X | D8X | D9X | DAX | DBX | DCX | DDX |
| 0 dB | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| –1 dB | | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| –2 dB | | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| –3 dB | | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| –4 dB | | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| –5 dB | | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| –6 dB | | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| –7 dB | | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| –8 dB | | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| –9 dB | | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| –10 dB | | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| –11 dB | | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| –12 dB | | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| –13 dB | | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| –14 dB | | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| –15 dB | | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| –16 dB | | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| –17 dB | | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| –18 dB | | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| –19 dB | | 0 | 0 | 1 | 0 | 0 | 1 | 1 |
| –20 dB | | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| –21 dB | | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| –22 dB | | 0 | 0 | 1 | 0 | 1 | 1 | 0 |
| –23 dB | | 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| –24 dB | | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| –25 dB | | 0 | 0 | 1 | 1 | 0 | 0 | 1 |
| –26 dB | | 0 | 0 | 1 | 1 | 0 | 1 | 0 |
| –27 dB | | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| –28 dB | | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| –29 dB | | 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| –30 dB | | 0 | 0 | 1 | 1 | 1 | 1 | 0 |
| –31 dB | | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| –32 dB | | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| –33 dB | | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| –34 dB | | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| –35 dB | | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| –36 dB | | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| –37 dB | | 0 | 1 | 0 | 0 | 1 | 0 | 1 |
| –38 dB | | 0 | 1 | 0 | 0 | 1 | 1 | 0 |
| –39 dB | | 0 | 1 | 0 | 0 | 1 | 1 | 1 |

Note: Do not input other data than the above.

### (4)-2 Volume (–40 to –∞ dB)

| ATT / Volume | D0X / D7X | D1X / D8X | D2X / D9X | D3X / DAX | D4X / DBX | D5X / DCX | D6X / DDX |
|---|---|---|---|---|---|---|---|
| –40 dB | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| –41 dB | 0 | 1 | 0 | 1 | 0 | 0 | 1 |
| –42 dB | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| –43 dB | 0 | 1 | 0 | 1 | 0 | 1 | 1 |
| –44 dB | 0 | 1 | 0 | 1 | 1 | 0 | 0 |
| –45 dB | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| –46 dB | 0 | 1 | 0 | 1 | 1 | 1 | 0 |
| –47 dB | 0 | 1 | 0 | 1 | 1 | 1 | 1 |
| –48 dB | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| –49 dB | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| –50 dB | 0 | 1 | 1 | 0 | 0 | 1 | 0 |
| –51 dB | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| –52 dB | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| –53 dB | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| –54 dB | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| –55 dB | 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| –56 dB | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| –57 dB | 0 | 1 | 1 | 1 | 0 | 0 | 1 |
| –58 dB | 0 | 1 | 1 | 1 | 0 | 1 | 0 |
| –59 dB | 0 | 1 | 1 | 1 | 0 | 1 | 1 |
| –60 dB | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| –61 dB | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| –62 dB | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| –63 dB | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| –64 dB | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| –65 dB | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| –66 dB | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| –67 dB | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| –68 dB | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| –69 dB | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| –70 dB | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| –71 dB | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| –72 dB | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| –73 dB | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| –74 dB | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| –75 dB | 1 | 0 | 0 | 1 | 0 | 1 | 1 |
| –76 dB | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| –77 dB | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| –78 dB | 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| –79 dB | 1 | 0 | 0 | 1 | 1 | 1 | 1 |
| –∞ dB | 1 | 0 | 1 | 0 | 0 | 0 | 0 |

Note: Do not input other data than the above.

### (4)-3 VOLUME (–80 to –∞ dB)

This is an extended function from M62446FP.

| ATT / Volume | D0X / D7X | D1X / D8X | D2X / D9X | D3X / DAX | D4X / DBX | D5X / DCX | D6X / DDX |
|---|---|---|---|---|---|---|---|
| –∞ dB | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| –∞ dB | 1 | 0 | 1 | 0 | 0 | 1 | 0 |
| –∞ dB | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| ↓ | | | | | | | |
| ↓ | | | | | | | |
| –∞ dB | 1 | 0 | 1 | 1 | 1 | 1 | 0 |
| –∞ dB | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| –80 dB | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| –81 dB | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| –82 dB | 1 | 1 | 0 | 0 | 0 | 1 | 0 |
| –83 dB | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| –84 dB | 1 | 1 | 0 | 0 | 1 | 0 | 0 |
| –85 dB | 1 | 1 | 0 | 0 | 1 | 0 | 1 |
| –86 dB | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| –87 dB | 1 | 1 | 0 | 0 | 1 | 1 | 1 |
| –88 dB | 1 | 1 | 0 | 1 | 0 | 0 | 0 |
| –89 dB | 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| –90 dB | 1 | 1 | 0 | 1 | 0 | 1 | 0 |
| –91 dB | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| –92 dB | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| –93 dB | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| –94 dB | 1 | 1 | 0 | 1 | 1 | 1 | 0 |
| –95 dB | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| –∞ dB | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| –∞ dB | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| ↓ | | | | | | | |
| ↓ | | | | | | | |
| –∞ dB | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| –∞ dB | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

## Electrical Characteristics

(Ta = 25°C, AVDD/AVSS/DVDD = 7/–7 V/5 V, f = 1 kHz, unless otherwise noted.
Rg = 1 kΩ, RL = 10 kΩ, TONE CONTROL • VOL are set to 0 dB/FLAT.)

### (1) Power Supply Characteristics

| Item | Symbol | Limits | | | Unit | Test Condition |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| Analog positive circuit current | Aldd | — | 22 | 35 | mA | Current at pin 5<br>No signal |
| Analog negative circuit current | Alss | — | 22 | 35 | mA | Current at pin 30<br>No signal |
| Digital circuit current | Dldd | — | 1.0 | 2.0 | mA | Current at pin 42<br>No signal |

### (2) Input/Output Characteristics

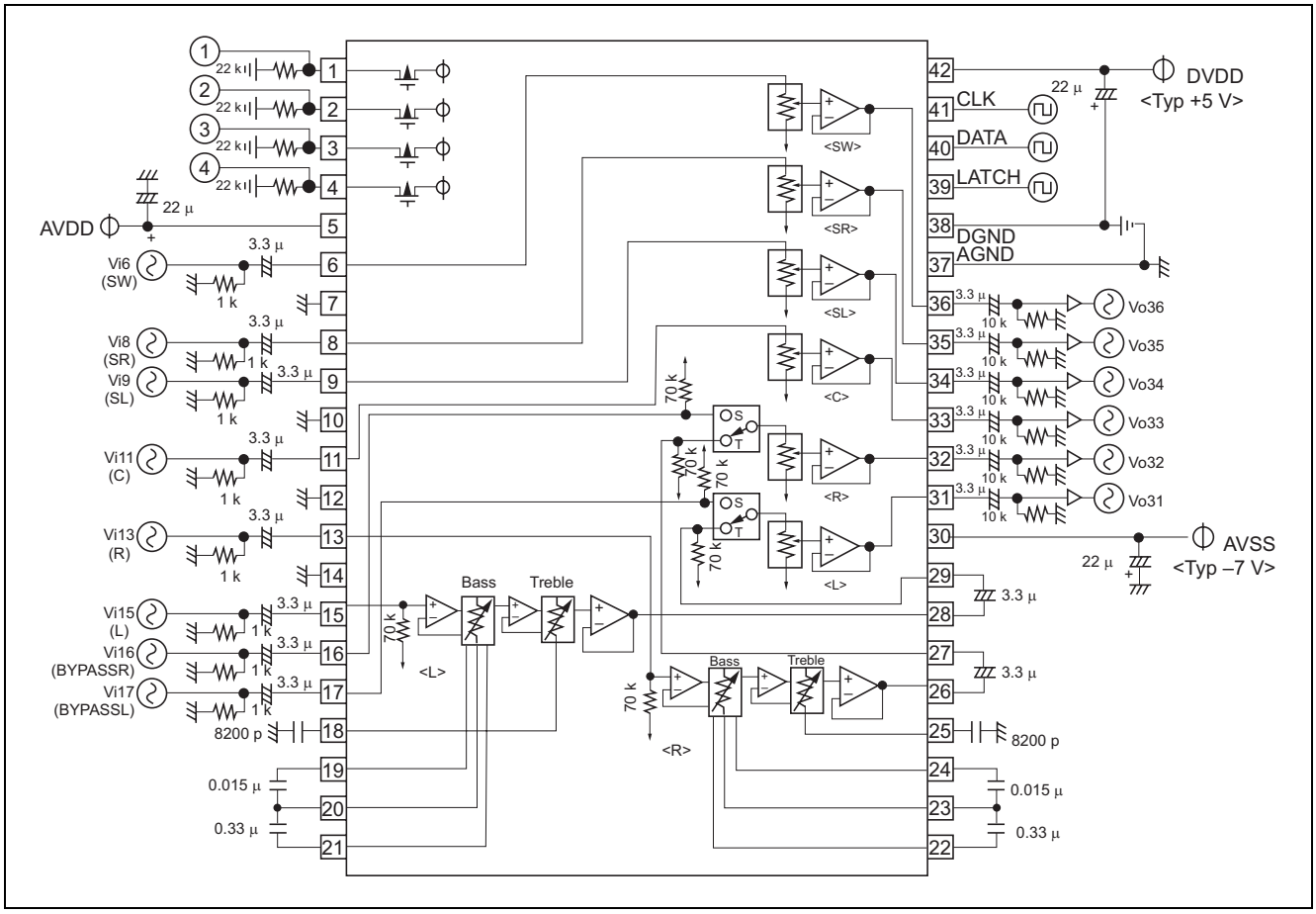
| Item | Symbol | Limits | | | Unit | Test Condition |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| Input resistance | Ri | 35 | 70 | 150 | kΩ | 13, 15, 16, 17, 27, 29 pin |
| Maximum output voltage | VOM | 3.0 | 4.2 | — | Vrms | 6, 8, 9, 11, 13, 15, 16, 17 pin INPUT<br>31 to 36 pin OUTPUT<br>THD = 1% |
| Pass gain | Gv | –2.0 | 0 | 2.0 | dB | Vi = 0.2 Vrms, FLAT<br>8, 9, 11, 13, 15, 16, 17 pin INPUT<br>31 to 36 pin OUTPUT |
| Distortion | THD | — | 0.002 | 0.09 | % | BW = 400 to 30 kHz<br>Vi = 0.2 Vrms, RL = 10 kΩ |
| Output noise voltage | Vn (VOL) | — | 1.5 | 6 | μVrms | 31 to 36 pin, Rg = 0 kΩ, JIS-A,<br>VOL = 0 dB |
| | Vn (tone) | — | 5 | 20 | μVrms | 31, 32 pin<br>JIS-A, VOL = 0 dB |
| Maximum attenuation | ATTmax | — | –100 | –95 | dB | 31 to 36 pin<br>JIS-A, VOL = –∞ dB |
| Volume gain between channels | Dvol | –1.5 | 0 | 1.5 | dB | |
| Crosstalk between channels | CT | — | –80 | –65 | dB | Vo = 0.5 Vrms, RL = 10 kΩ, JIS-A,<br>Rg = 1 kΩ |
| Port output current | IL | 0.2 | — | — | mA | |

### (3) Tone Control Characteristics

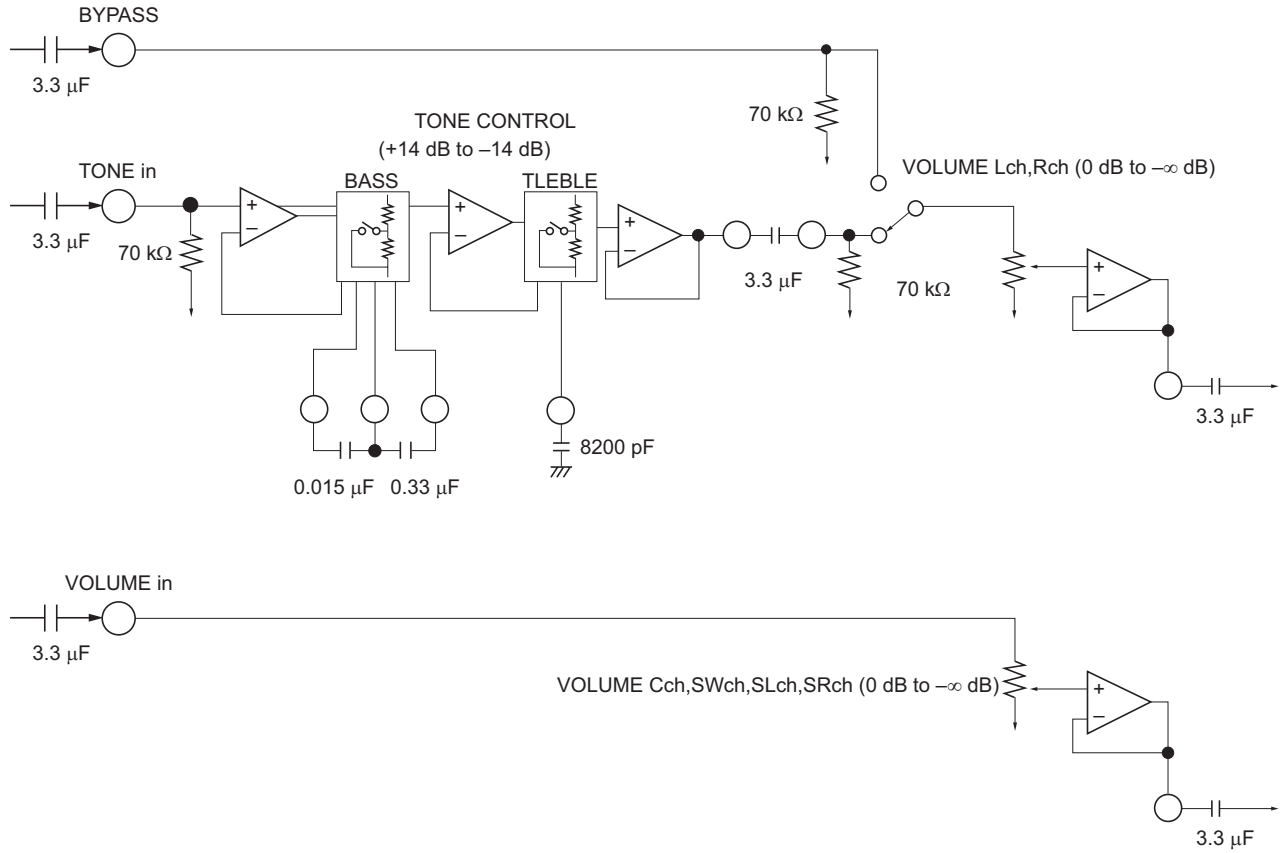
| Item | Symbol | Limits | | | Unit | Test Condition |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| Tone control voltage gain | *T +14 dB | 12 | 14 | 16 | dB | Vo = 0.2 Vrms,<br>TREBLE (f = 10 kHz),<br>BASS (f = 100 Hz),<br><br>Voltage gain<br>(Input to pin 13, 15<br>Output from pin 31, 32)<br><br>INPUT 13, 15 pin<br>OUTPUT 31, 32 pin |
| | *T +12 dB | 10 | 12 | 14 | dB | |
| | T +10 dB | 8 | 10 | 12 | dB | |
| | T +8 dB | 6 | 8 | 10 | dB | |
| | T +6 dB | 4.5 | 6 | 7.5 | dB | |
| | T +4 dB | 2.5 | 4 | 5.5 | dB | |
| | T +2 dB | 1 | 2 | 3 | dB | |
| | T –2 dB | –3 | –2 | –1 | dB | |
| | T –4 dB | –5.5 | –4 | –2.5 | dB | |
| | T –6 dB | –7.5 | –6 | –4.5 | dB | |
| | T –8 dB | –10 | –8 | –6 | dB | |
| | T –10 dB | –12 | –10 | –8 | dB | |
| | *T –12 dB | –14 | –12 | –10 | dB | |
| | *T –14 dB | –16 | –14 | –12 | dB | |
| Balance between channel | BALT | –1.5 | 0 | +1.5 | dB | Input 13, 15 pin Vo = 0.2 Vrms<br>Output 31, 32 pin |

Note: * is an extended function.

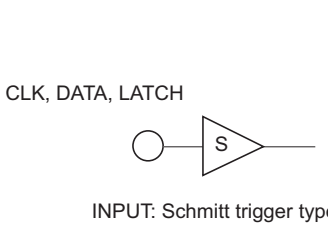
## Test Circuit

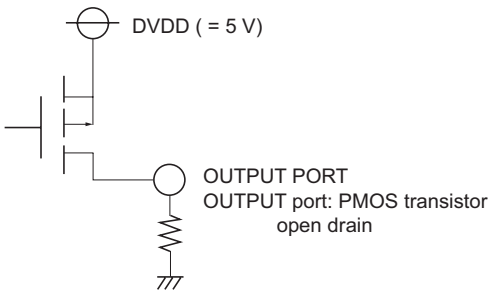


## Signal Processing Diagram



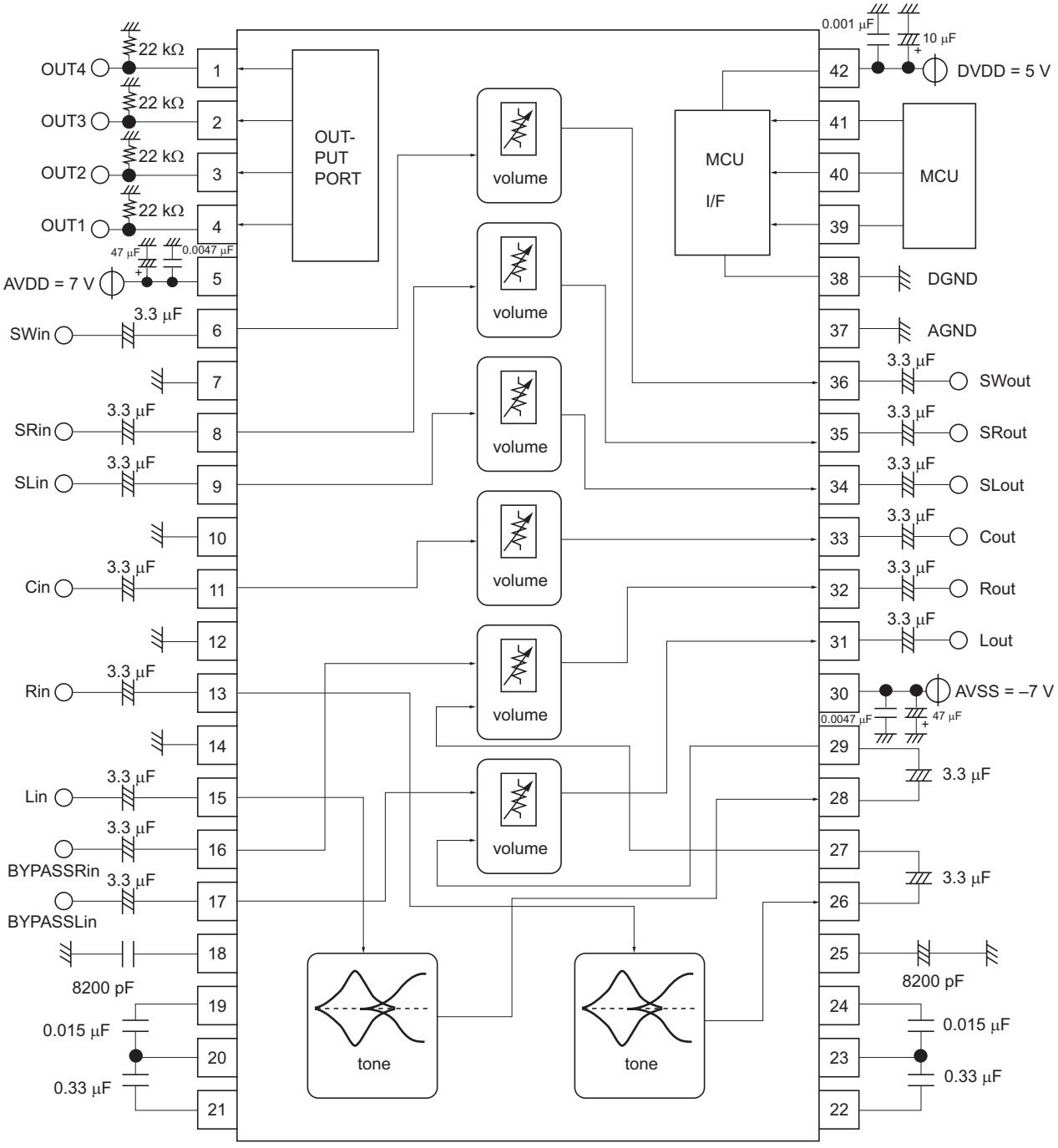

Notes:
1. The resistance value of Volume change about 18 to 22 kΩ by attenuated condition.
2. No built a zero cross circuit.
3. When the mode changed (BYPASS/TONE), it is necessary the muting function.



## Application Example

When using Tone control and Bypass

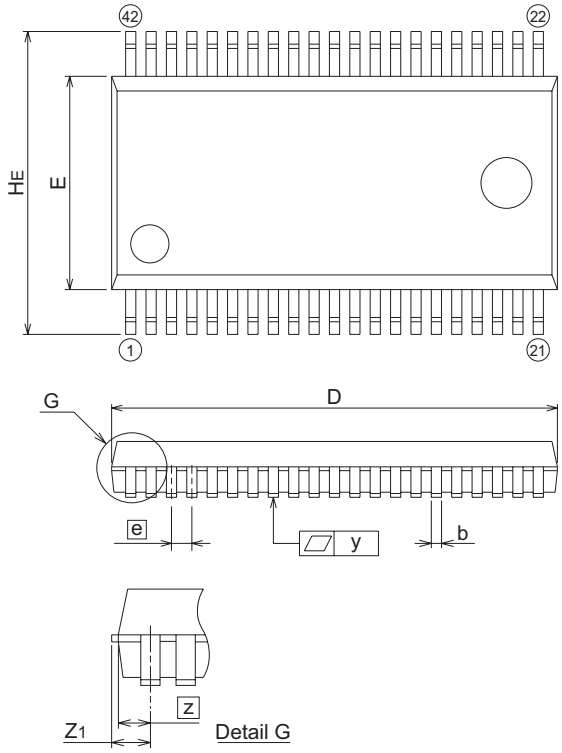


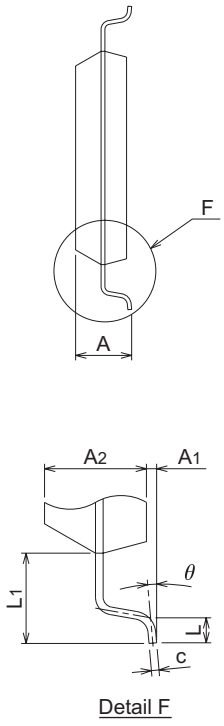
## Package Dimensions

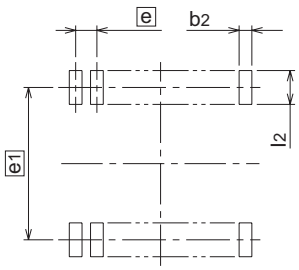
**42P2R-A** (MMP)

**Plastic 42pin 450mil SSOP**

| EIAJ Package Code | JEDEC Code | Weight(g) | Lead Material |
|---|---|---|---|
| SSOP42-P-450-0.80 | — | 0.63 | Alloy 42/Cu Alloy |




Recommended Mount Pad

| Symbol | Dimension in Millimeters | | |
|---|---|---|---|
| | Min | Nom | Max |
| A | — | — | 2.4 |
| $A_1$ | 0.05 | — | — |
| $A_2$ | — | 2.0 | — |
| b | 0.35 | 0.4 | 0.5 |
| c | 0.13 | 0.15 | 0.2 |
| D | 17.3 | 17.5 | 17.7 |
| E | 8.2 | 8.4 | 8.6 |
| e | — | 0.8 | — |
| $H_E$ | 11.63 | 11.93 | 12.23 |
| L | 0.3 | 0.5 | 0.7 |
| $L_1$ | — | 1.765 | — |
| z | — | 0.75 | — |
| $Z_1$ | — | — | 0.9 |
| y | — | — | 0.15 |
| θ | 0° | — | 10° |
| $b_2$ | — | 0.5 | — |
| $e_1$ | — | 11.43 | — |
| $l_2$ | 1.27 | — | — |

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