

## 3-band Electronic Volume

### Description

The CXA2546Q is a 2-channel electronic volume IC. A 34-bit serial data input controls the level and characteristics of the output signal. It may be used in car stereos and general audio systems.

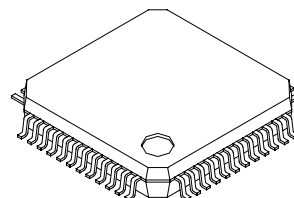
### Features

- Loudness
- Volume control  
(from 0 dB to  $-80$  dB,  $-\infty$  dB : Fine (1 dB-step)  
Coarse (2 dB-step)
- Balance
- Tone control  
(3-band, 2 dB-step from  $-15$  dB to  $+15$  dB)
- Fader  
2 dB-step to  $-20$  dB,  $-25$  dB,  $-30$  dB,  $-45$  dB,  $-60$  dB,  $-\infty$  dB)
- Input and gain selector (4 channels)
- Serial data control (DATA, CLK, CE)
- Single 8 V power supply
- Zero-cross detection circuit  
(L/R independent operation for the volume block)
- Timer
- Power-off mute
- Countermeasure to the noise of the portable telephone

### Structure

Bipolar silicon monolithic IC

48 pin QFP (Plastic)



### Absolute Maximum Ratings (Ta=25 °C)

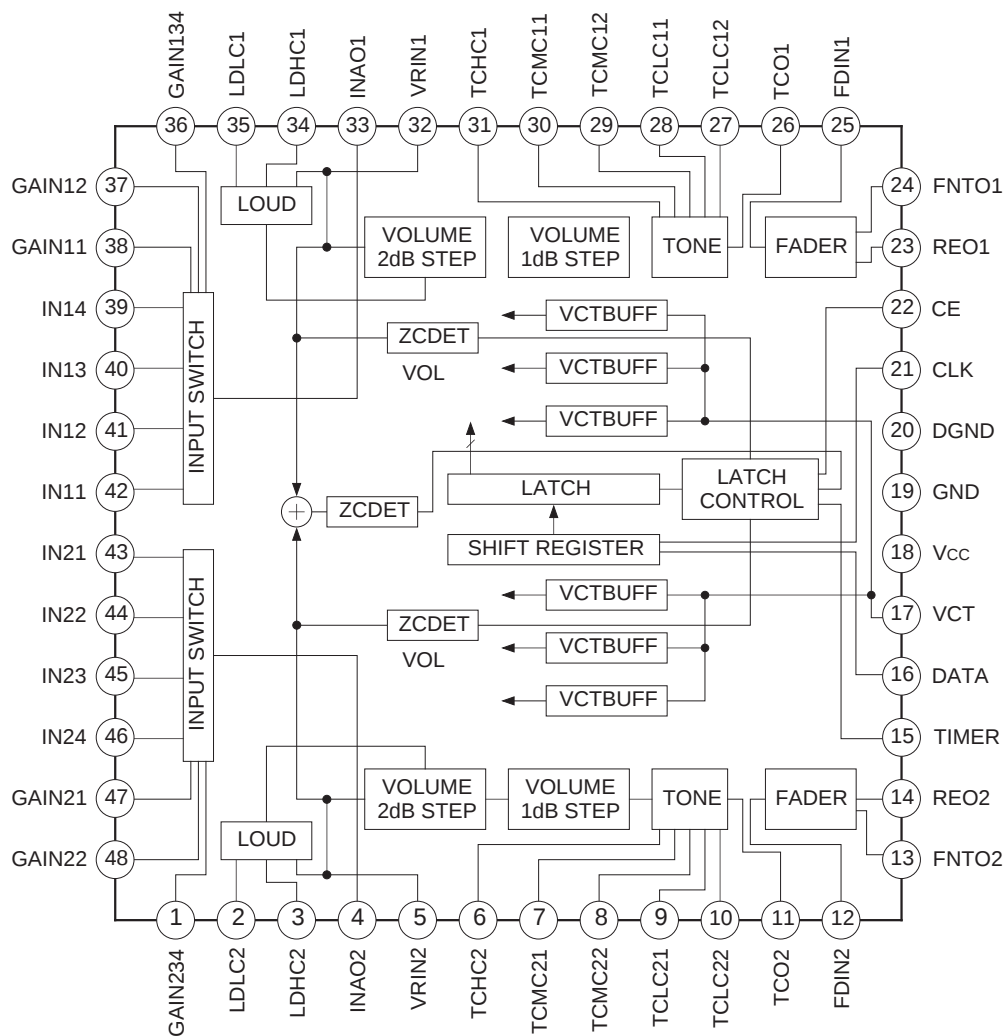
|                               |                  |                 |    |
|-------------------------------|------------------|-----------------|----|
| • Supply voltage              | V <sub>CC</sub>  | 13              | V  |
| • Operating temperature       | T <sub>opr</sub> | $-40$ to $+85$  | °C |
| • Storage temperature         | T <sub>stg</sub> | $-65$ to $+150$ | °C |
| • Allowable power dissipation | P <sub>D</sub>   | 350             | mW |
| (Ta=85 °C)                    |                  |                 |    |

### Recommended Operating Conditions

|                |                 |         |   |
|----------------|-----------------|---------|---|
| Supply voltage | V <sub>CC</sub> | 7 to 12 | V |
|----------------|-----------------|---------|---|

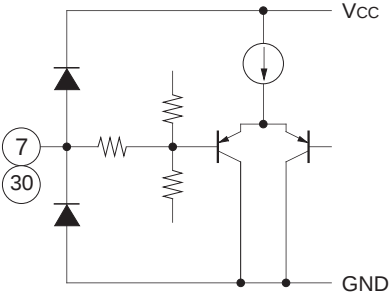
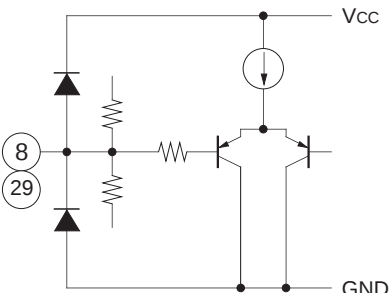
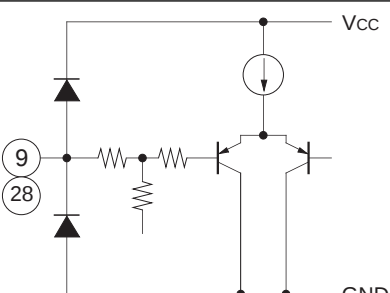
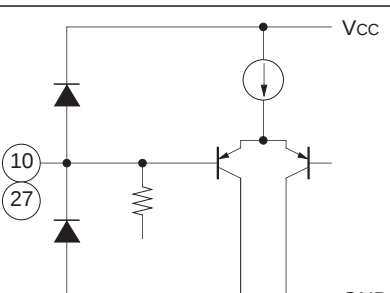
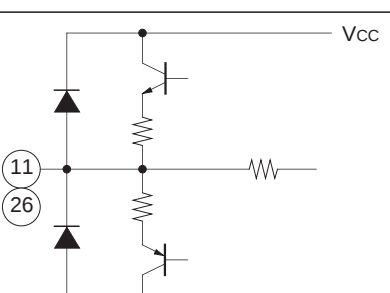
Sony reserves the right to change products and specifications without prior notice. This information does not convey any license by any implication or otherwise under any patents or other right. Application circuits shown, if any, are typical examples illustrating the operation of the devices. Sony cannot assume responsibility for any problems arising out of the use of these circuits.

# Block Diagram and Pin Configuration

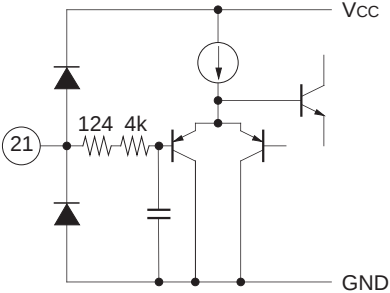
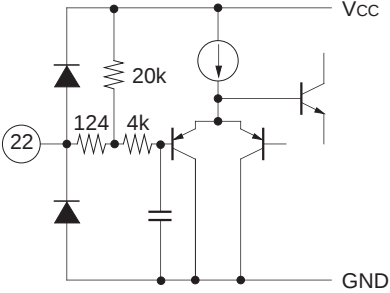
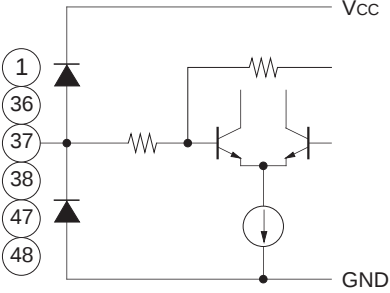
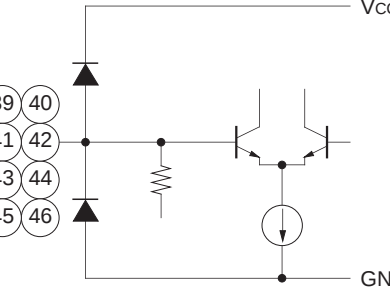


# Pin Description

| Pin No. | Symbol         | I/O resistance<br>Pin voltage | Equivalent circuit | Description                          |
|---------|----------------|-------------------------------|--------------------|--------------------------------------|
| 2<br>35 | LDLC2<br>LDLC1 | 1.08 k<br>VCT                 |                    | Sets loudness low cut-off frequency. |
| 3<br>34 | LDHC2<br>LDHC1 | 24.05 k<br>VCT                |                    | Set loudness high cut-off frequency  |
| 4<br>33 | INAO2<br>INAO1 | —<br>VCT                      |                    | Input selector output                |
| 5<br>32 | VRIN2<br>VRIN1 | 10 k<br>VCT                   |                    | Volume input                         |
| 6<br>31 | TCHC2<br>TCHC1 | 5 k<br>VCT                    |                    | Set tone Treble frequency            |

| Pin No.  | Symbol           | I/O resistance<br>Pin voltage | Equivalent circuit                                                                   | Description              |
|----------|------------------|-------------------------------|--------------------------------------------------------------------------------------|--------------------------|
| 7<br>30  | TCMC21<br>TCMC11 | 4 k<br>VCT                    |    | Sets tone Mid frequency  |
| 8<br>29  | TCMC22<br>TCMC12 | 4 k<br>VCT                    |    | Sets tone Mid frequency  |
| 9<br>28  | TCLC21<br>TCLC11 | 8 k<br>VCT                    |   | Sets tone Bass frequency |
| 10<br>27 | TCLC22<br>TCLC12 | 8 k<br>VCT                    |  | Sets tone Bass frequency |
| 11<br>26 | TCO2<br>TCO1     | —<br>VCT                      |  | Tone control output      |

| Pin No.  | Symbol         | I/O resistance<br>Pin voltage | Equivalent circuit | Description         |
|----------|----------------|-------------------------------|--------------------|---------------------|
| 12<br>25 | FDIN2<br>FDIN1 | 24 k<br>VCT                   |                    | Fader input         |
| 13<br>24 | REO2<br>REO1   | —<br>VCT                      |                    | Rear output         |
| 14<br>23 | FNT02<br>FNT01 | —<br>VCT                      |                    | Front output        |
| 15       | TIMER          | $\approx \infty$<br>—         |                    | Sets timer constant |
| 16       | DATA           | $\approx \infty$<br>—         |                    | Serial data input   |

| Pin No.                                      | Symbol                                                       | I/O resistance<br>Pin voltage | Equivalent circuit                                                                   | Description                                                                     |
|----------------------------------------------|--------------------------------------------------------------|-------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| 17                                           | VCT                                                          | —<br>VCT                      |                                                                                      | 1/2 V <sub>CC</sub>                                                             |
| 18                                           | V <sub>CC</sub>                                              | —<br>V <sub>CC</sub>          |                                                                                      | Power supply input                                                              |
| 19                                           | GND                                                          | —<br>Gnd                      |                                                                                      | Ground                                                                          |
| 20                                           | DGND                                                         | —<br>—                        |                                                                                      | Digital ground                                                                  |
| 21                                           | CLK                                                          | $\approx \infty$<br>—         |    | Serial clock input                                                              |
| 22                                           | CE                                                           | $\approx 20k$<br>—            |   | Latch enable input<br>Take care to set the level as the input impedance is low. |
| 1<br>36<br>37<br>38<br>47<br>48              | GAIN234<br>GAIN134<br>GAIN12<br>GAIN11<br>GAIN21<br>GAIN22   | $\approx \infty$<br>VCT       |  | External gain setting for input amplifier                                       |
| 39<br>40<br>41<br>42<br>43<br>44<br>45<br>46 | IN14<br>IN13<br>IN12<br>IN11<br>IN21<br>IN22<br>IN23<br>IN24 | 50 k<br>VCT                   |  | Signal input                                                                    |

Data Format

|           |     |              |
|-----------|-----|--------------|
| First Bit | D1  | NOP          |
|           | D2  | NOP          |
|           | D3  | ISW          |
|           | D4  |              |
|           | D5  | LOUD         |
|           | D6  | VRC1         |
|           | D7  |              |
|           | D8  |              |
|           | D9  |              |
|           | D10 |              |
|           | D11 |              |
|           | D12 | VRF1         |
|           | D13 | VRC2         |
|           | D14 |              |
|           | D15 |              |
|           | D16 |              |
|           | D17 |              |
|           | D18 |              |
|           | D19 | VRF2         |
|           | D20 | TONE BASS    |
|           | D21 |              |
|           | D22 |              |
|           | D23 |              |
|           | D24 | TONE MID     |
|           | D25 |              |
|           | D26 |              |
|           | D27 |              |
|           | D28 | TONE TREBLE  |
|           | D29 |              |
|           | D30 |              |
|           | D31 |              |
|           | D32 | FADER        |
|           | D33 |              |
|           | D34 |              |
|           | D35 |              |
| Last Bit  | D36 | FADER SELECT |

## ISW

| Mode                       | D3 | D4 |
|----------------------------|----|----|
| IN14/IN24, GAIN134/GAIN234 | 1  | 1  |
| IN13/IN23, GAIN134/GAIN234 | 1  | 0  |
| IN12/IN22, GAIN12/GAIN22   | 0  | 1  |
| IN11/IN21, GAIN11/GAIN21   | 0  | 0  |

## LOUD

| Mode | D5 |
|------|----|
| ON   | 1  |
| OFF  | 0  |

## VRC1/VRC2

| Output (dB) | D6/D13 | D7/D14 | D8/D15 | D9/D16 | D10/D17 | D11/D18 |
|-------------|--------|--------|--------|--------|---------|---------|
| 0           | 1      | 1      | 1      | 1      | 1       | 1       |
| -2          | 1      | 1      | 1      | 1      | 1       | 0       |
| -4          | 1      | 1      | 1      | 1      | 0       | 1       |
| -6          | 1      | 1      | 1      | 1      | 0       | 0       |
| -8          | 1      | 1      | 1      | 0      | 1       | 1       |
| -10         | 1      | 1      | 1      | 0      | 1       | 0       |
| -12         | 1      | 1      | 1      | 0      | 0       | 1       |
| -14         | 1      | 1      | 1      | 0      | 0       | 0       |
| -16         | 1      | 1      | 0      | 1      | 1       | 1       |
| -18         | 1      | 1      | 0      | 1      | 1       | 0       |
| -20         | 1      | 1      | 0      | 1      | 0       | 1       |
| -22         | 1      | 1      | 0      | 1      | 0       | 0       |
| -24         | 1      | 1      | 0      | 0      | 1       | 1       |
| -26         | 1      | 1      | 0      | 0      | 1       | 0       |
| -28         | 1      | 1      | 0      | 0      | 0       | 1       |
| -30         | 1      | 1      | 0      | 0      | 0       | 0       |
| -32         | 1      | 0      | 1      | 1      | 1       | 1       |
| -34         | 1      | 0      | 1      | 1      | 1       | 0       |
| -36         | 1      | 0      | 1      | 1      | 0       | 1       |
| -38         | 1      | 0      | 1      | 1      | 0       | 0       |
| -40         | 1      | 0      | 1      | 0      | 1       | 1       |
| -42         | 1      | 0      | 1      | 0      | 1       | 0       |
| -44         | 1      | 0      | 1      | 0      | 0       | 1       |
| -46         | 1      | 0      | 1      | 0      | 0       | 0       |
| -48         | 1      | 0      | 0      | 1      | 1       | 1       |
| -50         | 1      | 0      | 0      | 1      | 1       | 0       |
| -52         | 1      | 0      | 0      | 1      | 0       | 1       |
| -54         | 1      | 0      | 0      | 1      | 0       | 0       |
| -56         | 1      | 0      | 0      | 0      | 1       | 1       |
| -58         | 1      | 0      | 0      | 0      | 1       | 0       |
| -60         | 1      | 0      | 0      | 0      | 0       | 1       |
| -62         | 1      | 0      | 0      | 0      | 0       | 0       |
| -64         | 0      | 1      | 1      | 1      | 1       | —       |
| -66         | 0      | 1      | 1      | 1      | 0       | —       |
| -68         | 0      | 1      | 1      | 0      | 1       | —       |
| -70         | 0      | 1      | 1      | 0      | 0       | —       |
| -72         | 0      | 1      | 0      | 1      | 1       | —       |
| -74         | 0      | 1      | 0      | 1      | 0       | —       |
| -76         | 0      | 1      | 0      | 0      | 1       | —       |
| -78         | 0      | 1      | 0      | 0      | 0       | —       |
| -80         | 0      | 0      | 1      | —      | —       | —       |
| -∞          | 0      | 0      | 0      | —      | —       | —       |

VRF1/VRF2

| Output (dB) | D12/D19 |
|-------------|---------|
| 0           | 1       |
| -1          | 0       |

BASS/MID/TREBLE

| Output (dB) | D20/D24/D28 | D21/D25/D29 | D22/D26/D30 |
|-------------|-------------|-------------|-------------|
| 15          | 1           | 1           | 1           |
| 12          | 1           | 1           | 0           |
| 10          | 1           | 0           | 1           |
| 8           | 1           | 0           | 0           |
| 6           | 0           | 1           | 1           |
| 4           | 0           | 1           | 0           |
| 2           | 0           | 0           | 1           |
| 0           | 0           | 0           | 0           |

BOOST/CUT

| Mode  | D23/D27/D31 |
|-------|-------------|
| BOOST | 1           |
| CUT   | 0           |

FADER

| Output (dB) | D32 | D33 | D34 | D35 |
|-------------|-----|-----|-----|-----|
| -∞          | 1   | 1   | 1   | 1   |
| -60         | 1   | 1   | 1   | 0   |
| -45         | 1   | 1   | 0   | 1   |
| -30         | 1   | 1   | 0   | 0   |
| -25         | 1   | 0   | 1   | 1   |
| -20         | 1   | 0   | 1   | 0   |
| -18         | 1   | 0   | 0   | 1   |
| -16         | 1   | 0   | 0   | 0   |
| -14         | 0   | 1   | 1   | 1   |
| -12         | 0   | 1   | 1   | 0   |
| -10         | 0   | 1   | 0   | 1   |
| -8          | 0   | 1   | 0   | 0   |
| -6          | 0   | 0   | 1   | 1   |
| -4          | 0   | 0   | 1   | 0   |
| -2          | 0   | 0   | 0   | 1   |
| 0           | 0   | 0   | 0   | 0   |

## FADER SELECT

| Mode  | D36 |
|-------|-----|
| FRONT | 1   |
| REAR  | 0   |

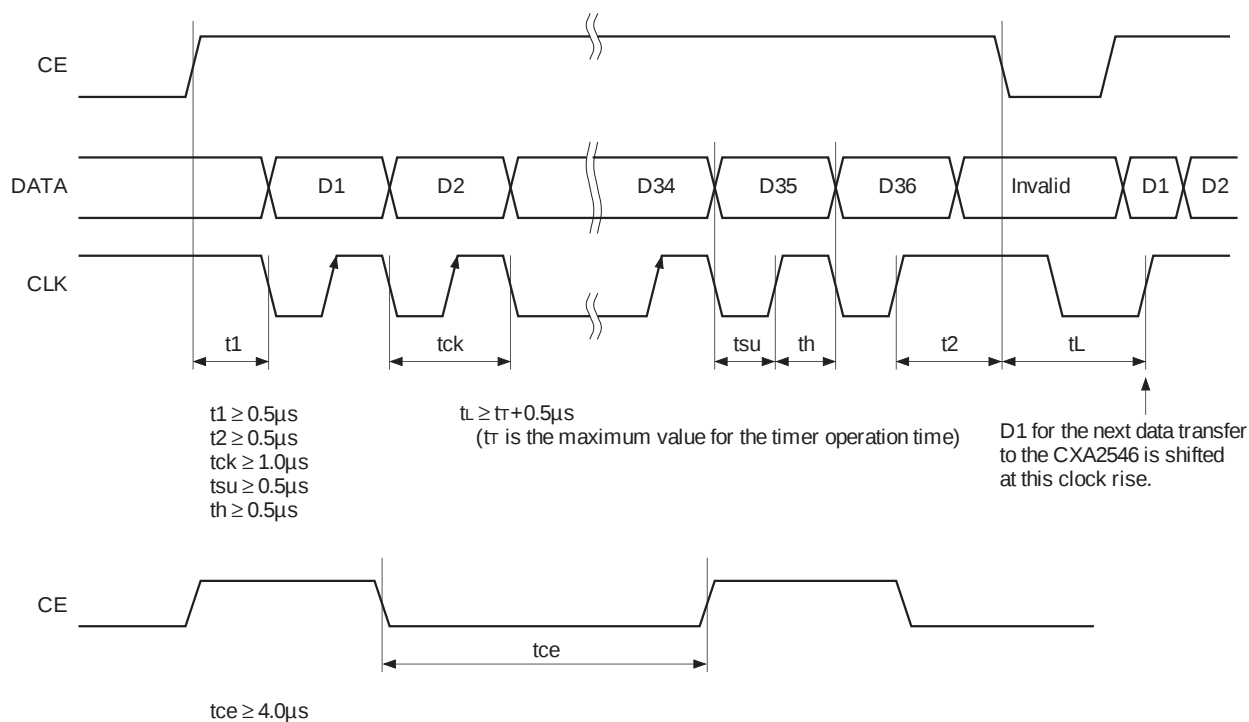
## RESET

Reset is performed automatically when power is first supplied to the IC; there is no reset pin.

The following table shows the respective statuses of various settings after a reset has been performed.

| Mode        | Set value  |
|-------------|------------|
| INPUT       | 1          |
| VRC1        | − ∞ dB     |
| VRF1        | −1 dB      |
| VRC2        | − ∞ dB     |
| VRF2        | −1 dB      |
| LOUD        | OFF        |
| TONE BASS   | 0 dB       |
| TONE MID    | 0 dB       |
| TONE TREBLE | 0 dB       |
| FADER       | 0 dB, REAR |

## Timing Chart

Timer Waiting Period Setting Chart ( $V_{CC}=7$  to  $12$  V, operating temperature= $-40$  °C to  $85$  °C)

| TIMER pin<br>capacitance C | Waiting period |             |             |
|----------------------------|----------------|-------------|-------------|
|                            | Min.           | Typ.        | Max.        |
| C=100 pF                   | 3 $\mu s$      | 5 $\mu s$   | 9 $\mu s$   |
| C=0.001 $\mu F$            | 30 $\mu s$     | 50 $\mu s$  | 90 $\mu s$  |
| C=0.01 $\mu F$             | 300 $\mu s$    | 500 $\mu s$ | 900 $\mu s$ |
| C=0.1 $\mu F$              | 3 ms           | 5 ms        | 9 ms        |
| C=1 $\mu F$                | 30 ms          | 50 ms       | 90 ms       |
| C=10 $\mu F$               | 300 ms         | 500 ms      | 900 ms      |

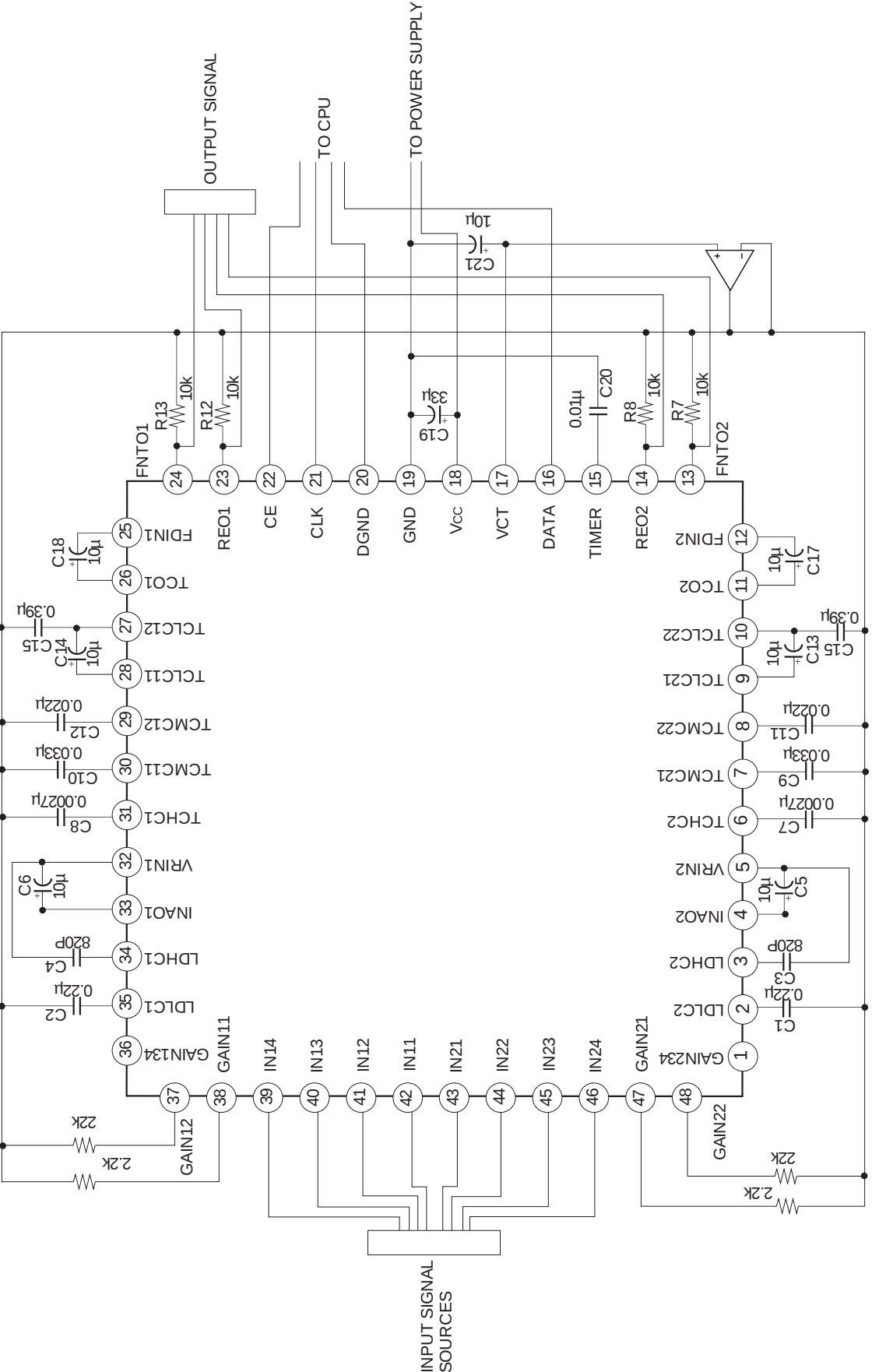
## Electrical Characteristics

V<sub>CC</sub>=8 V, T<sub>a</sub>=25 °C, input=0 dB unless otherwise specified

| Item                      | Symbol           | Conditions                                       | Min. | Typ.  | Max.               | Unit              |
|---------------------------|------------------|--------------------------------------------------|------|-------|--------------------|-------------------|
| Current consumption       | I <sub>CC</sub>  | No signal                                        | —    | 25    | 35                 | mA                |
| Total harmonic distortion | THD              | 1 kHz, 5 dBm output                              | —    | 0.004 | 0.01               | %                 |
| Output noise voltage      | V <sub>n</sub>   | Short-circuit at input, A weight                 | —    | 8     | 10                 | μV <sub>rms</sub> |
| Max. output voltage       | V <sub>om</sub>  | 1 kHz                                            | 8    | —     | —                  | dBm               |
| Separation                | CS               | 1 kHz                                            | 72   | 90    | —                  | dB                |
| Max. attenuation factor   | ATT <sub>m</sub> |                                                  | 85   | 90    | —                  |                   |
| Loudness LOW boost        | Gl <sub>b</sub>  | 100 Hz, VRC=−32 dB                               | 13   | 15    | 17                 |                   |
| Loudness HIGH boost       | Gl <sub>h</sub>  | 10 kHz, VRC=−32 dB                               | 5    | 6     | 7                  |                   |
| Max. Bass boost gain      | G <sub>bb</sub>  |                                                  | 13   | 15    | 17                 |                   |
| Max. Bass cut gain        | G <sub>bc</sub>  |                                                  | 13   | 15    | 17                 |                   |
| Max. Mid boost gain       | G <sub>mb</sub>  |                                                  | 13   | 15    | 17                 |                   |
| Max. Mid cut gain         | G <sub>mc</sub>  |                                                  | 13   | 15    | 17                 |                   |
| Max. Treble boost gain    | G <sub>tb</sub>  |                                                  | 13   | 15    | 17                 |                   |
| Max. Treble cut gain      | G <sub>tc</sub>  |                                                  | 13   | 15    | 17                 |                   |
| Input voltage HIGH        | V <sub>sh</sub>  | DATA, CLK, CE                                    | 3    | —     | 6                  | V                 |
| Input voltage LOW         | V <sub>sl</sub>  | DATA, CLK, CE                                    | 0    | —     | 1.5                |                   |
| Input voltage range       | V <sub>in</sub>  | IN11 to 14<br>IN21 to 24<br>VRIN1, 2<br>FDIN1, 2 | 1    | —     | V <sub>CC</sub> −1 |                   |



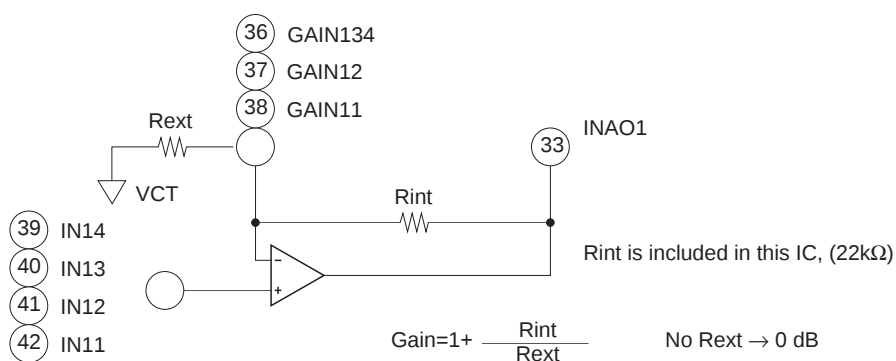
Application Circuit



Application circuits shown are typical examples illustrating the operation of the devices. Sony cannot assume responsibility for any problems arising out of the use of these circuits or for any infringement of third party patent and other right due to same.

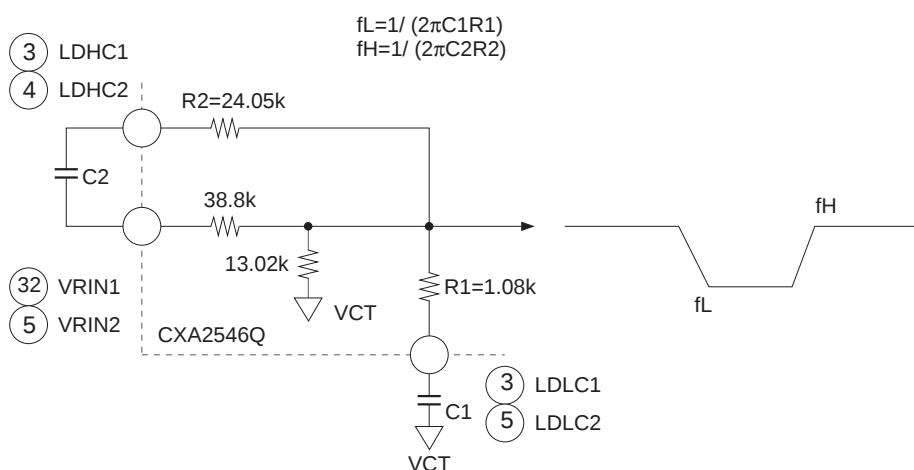
## Description of Operation

### (1) Input amplifier gain



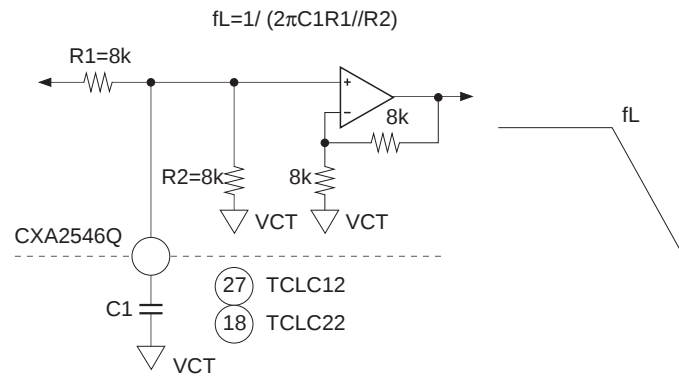
### (2) LOUD

The loudness function achieves the necessary frequency response by using a filter as shown below. The resistors are built in this IC so that  $f_L$  and  $f_H$  can be set by selecting  $C_1$  and  $C_2$ .

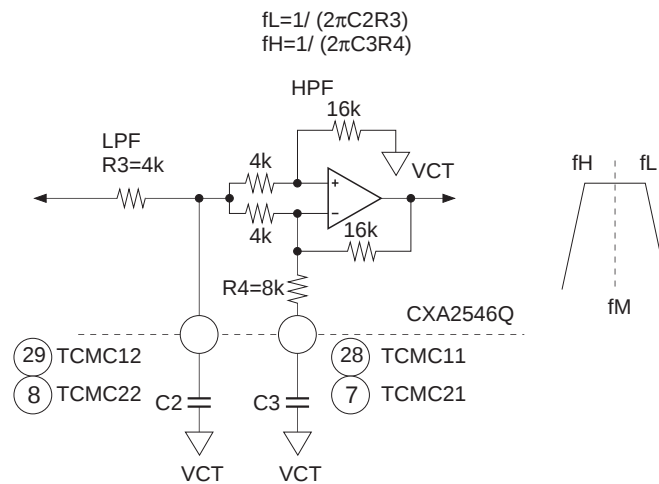


(3) Tone control

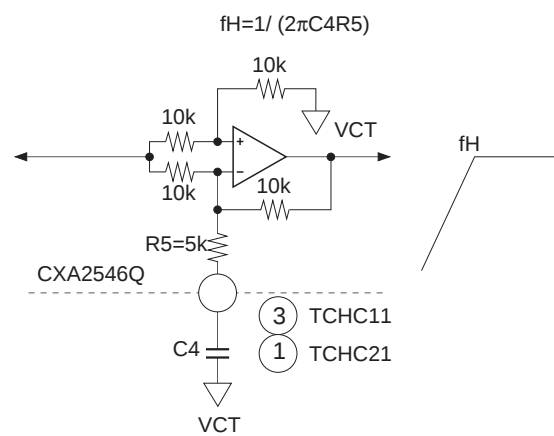
BASS : LPF



MID : BPF



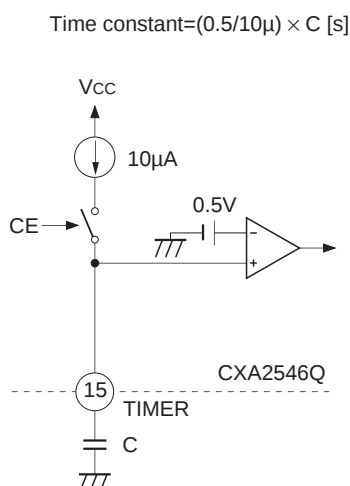
TREBLE : HPF



#### (4) Zero-cross detector and timer

A built-in zero-cross detection circuit is used to detect the zero-cross points of the input signal. When data arrived at the IC, they are executed at the next zero-cross point or when there is no input signal. This is to minimize 'click' noise during the transition of levels.

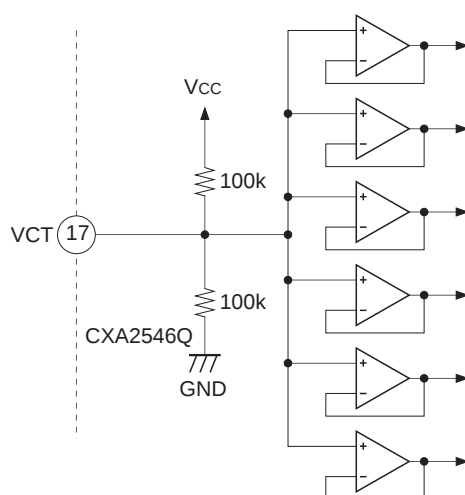
The timer circuit is added to ensure that the data is executed even when a zero-cross point is not detected after a certain period of time from the falling edge of the CE pulse.



#### (5) VCT pin

The internal circuit of VCT pin has the following structure.

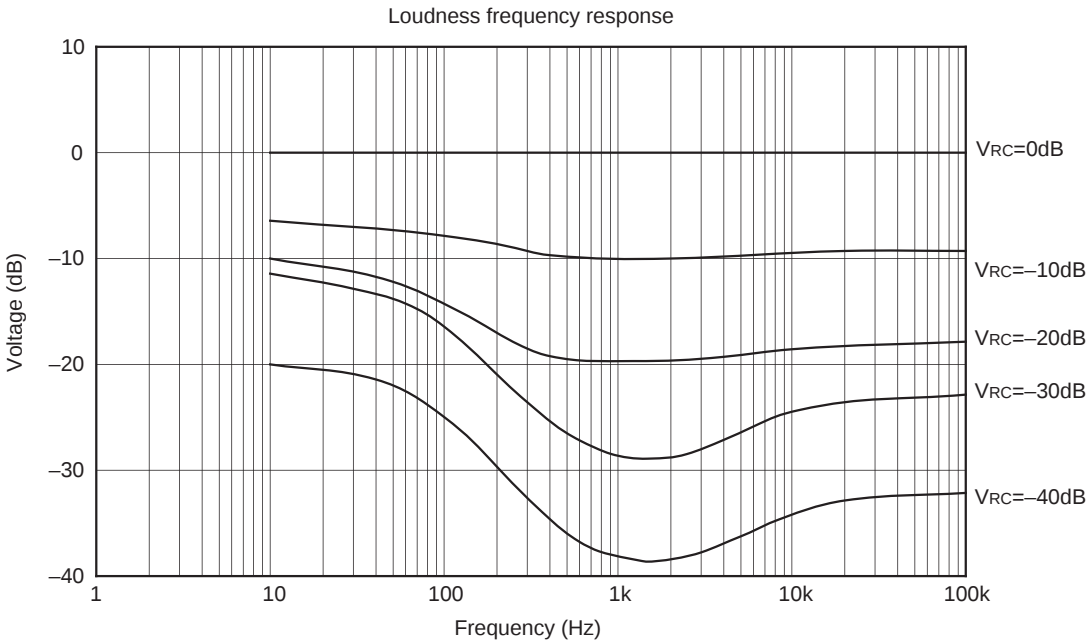
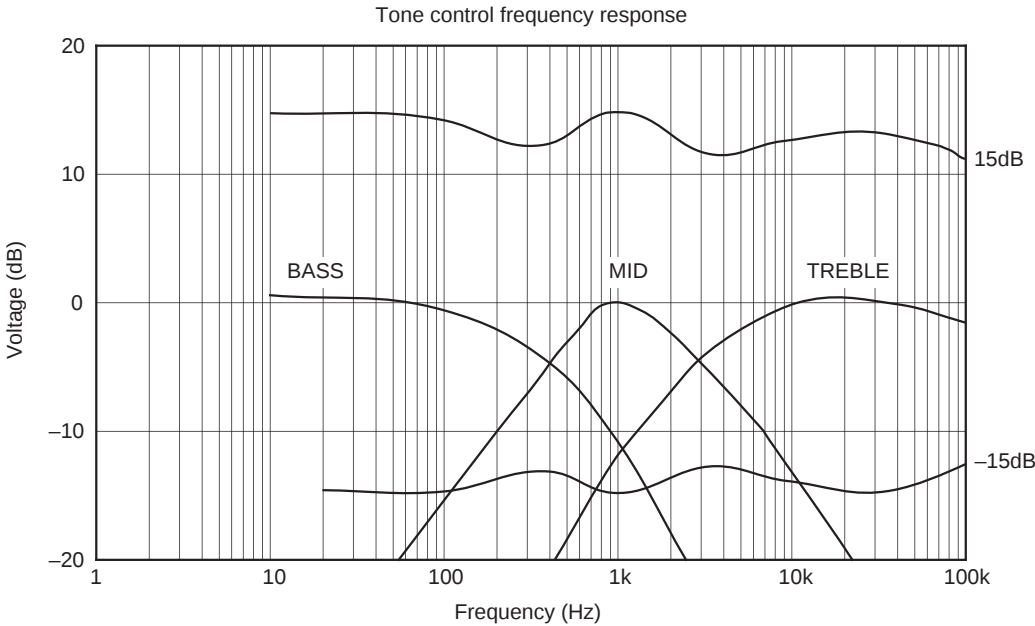
Insert a buffer when using it as a reference voltage for an external circuit.



#### (6) Power-off mute

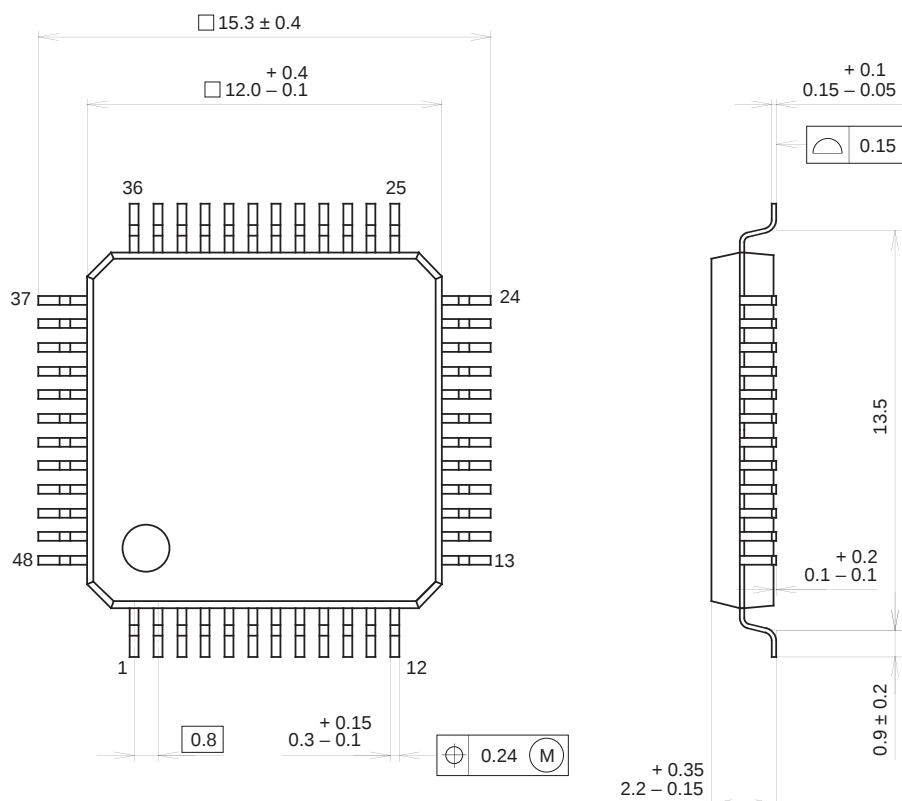
When  $V_{cc}$  goes below 5 V, the output stage bias of the fader output pins FNT01, FNT02, REO1, and REO2 is turned off and the pins go to high impedance. This operation prevents popping noises caused by the output pin potential deviating from  $V_{cc}/2$  when the power is turned off.

Example of Representative Characteristics



**Package Outline**    Unit : mm

## 48PIN QFP (PLASTIC)



## PACKAGE STRUCTURE

|            |               |
|------------|---------------|
| SONY CODE  | QFP-48P-L04   |
| EIAJ CODE  | QFP048-P-1212 |
| JEDEC CODE | _____         |

|                  |                               |
|------------------|-------------------------------|
| PACKAGE MATERIAL | EPOXY RESIN                   |
| LEAD TREATMENT   | SOLDER / PALLADIUM<br>PLATING |
| LEAD MATERIAL    | 42/COPPER ALLOY               |
| PACKAGE MASS     | 0.7g                          |

NOTE : PALLADIUM PLATING

This product uses S-PdPPF (Sony Spec.-Palladium Pre-Plated Lead Frame).