

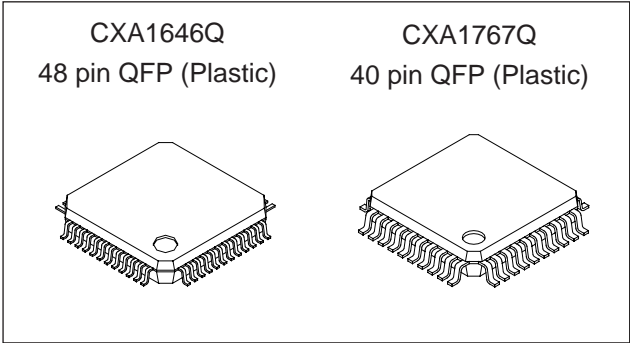
**Electronic Volume**

**Description**

The CXA1646Q/CXA1767Q is a serial control electronic volume IC for car stereos.

**Features**

- Loudness
- Volume control  
(1dB-step from 0dB to -87dB, -∞dB)
- Balance
- Tone control  
(2dB-step 2 band from -14dB to +14dB)
- Fader  
(2dB-step to -20dB, -25dB, -35dB, -45dB, -60dB, -∞dB)
- Input selector (4 channels)
- Serial data control (DATA, CLK, CE)
- Single 8V power supply
- Zero-cross detection circuit



**Structure**

Bipolar IC

**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, 1646Q) |
|                               |                  | 240         | mW (Ta = 85°C, 1767Q) |

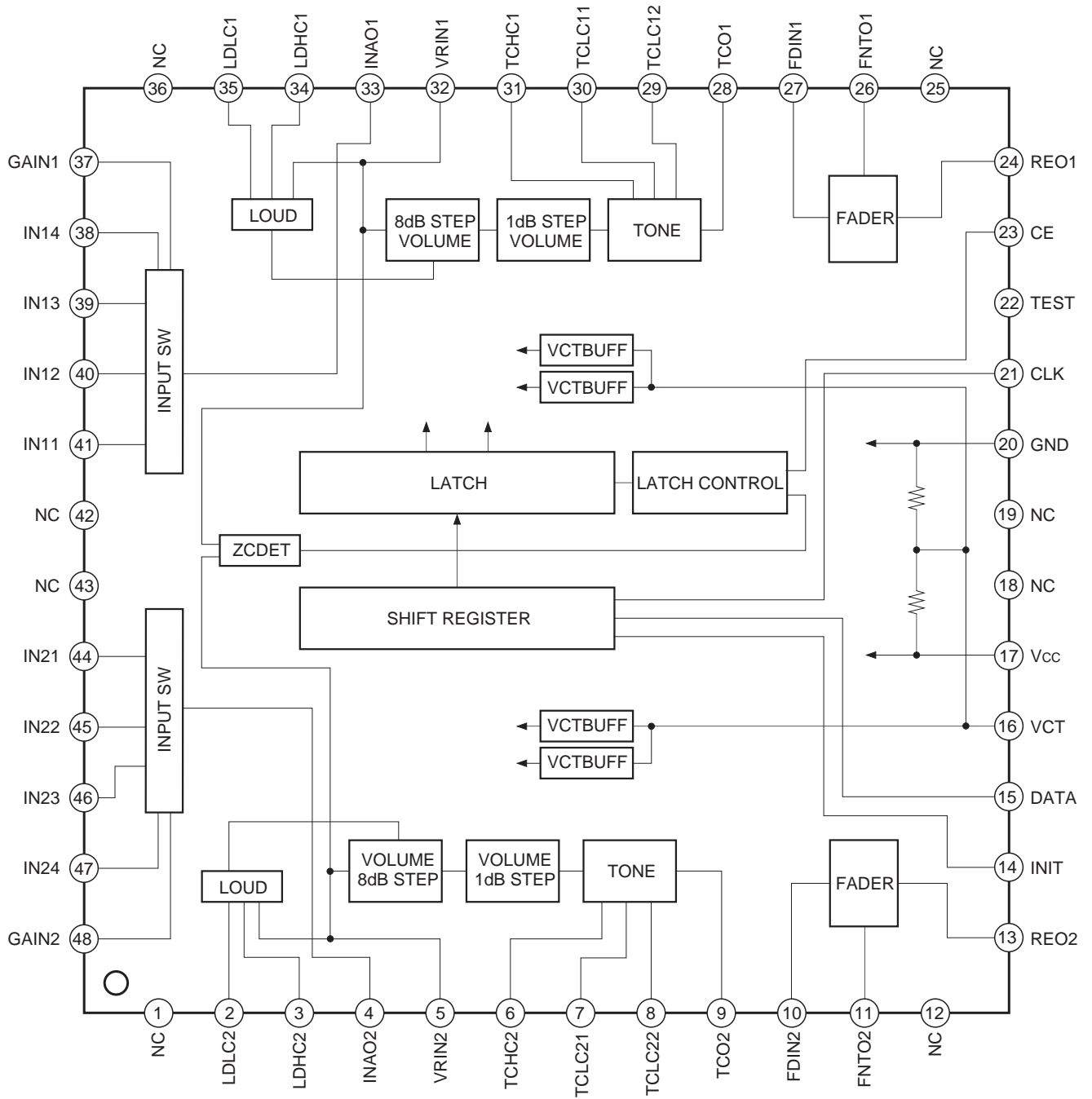
**Recommended Operating Condition**

|                |                 |         |   |
|----------------|-----------------|---------|---|
| Supply voltage | V <sub>CC</sub> | 6 to 12 | V |
|----------------|-----------------|---------|---|

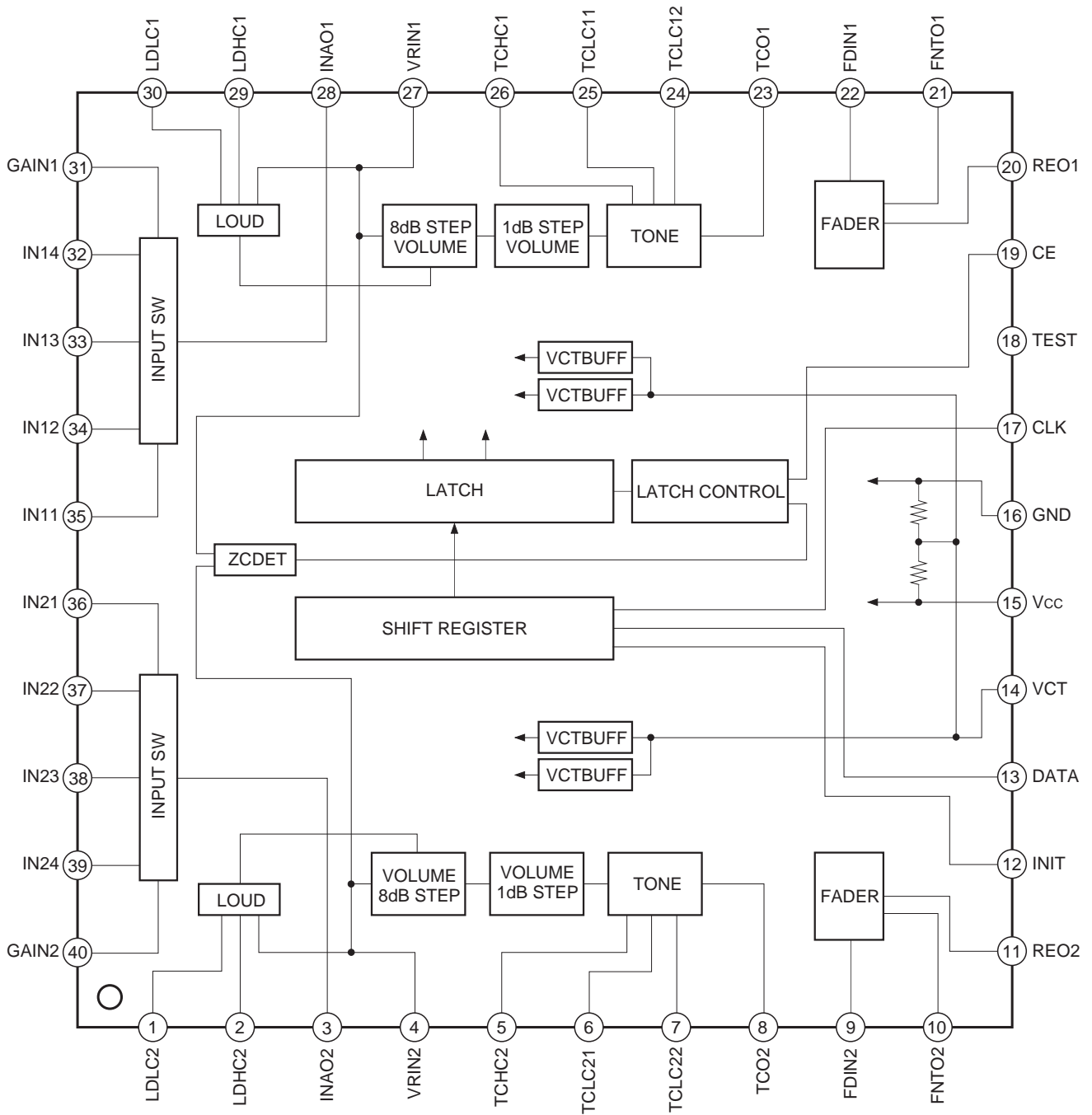
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Block Diagram and Pin Configuration

CXA1646Q

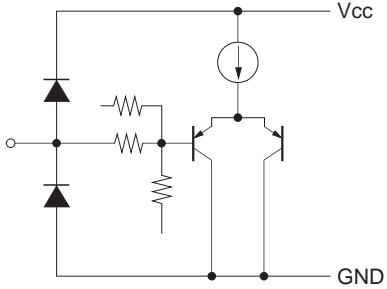
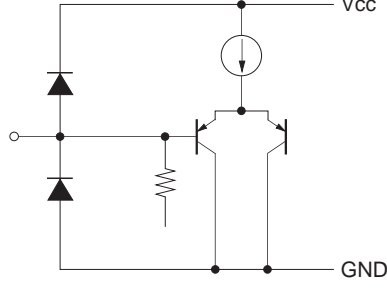
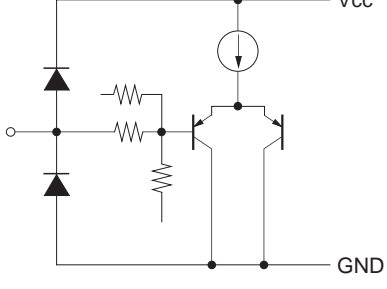
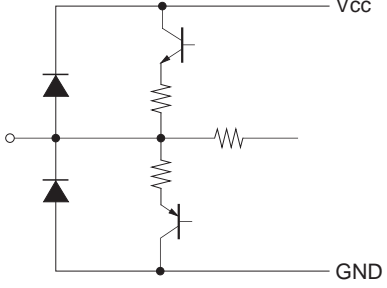


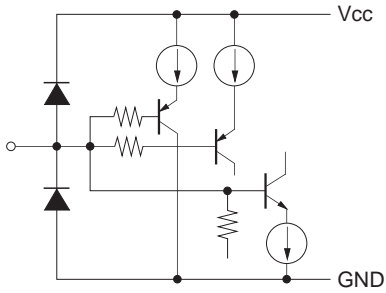
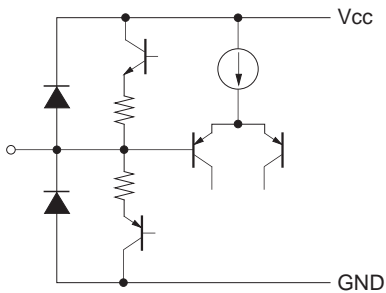
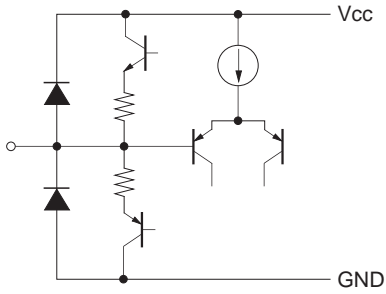
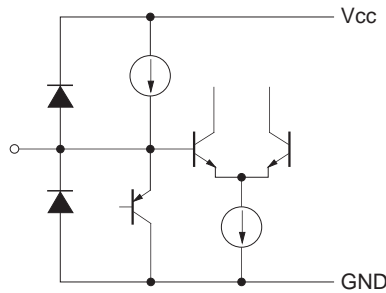
CXA1767Q

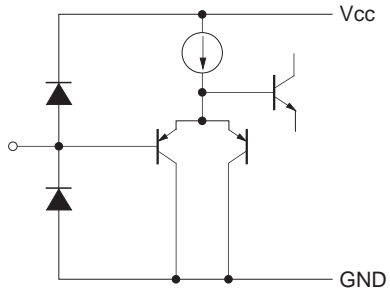
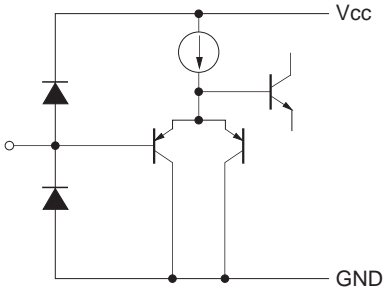
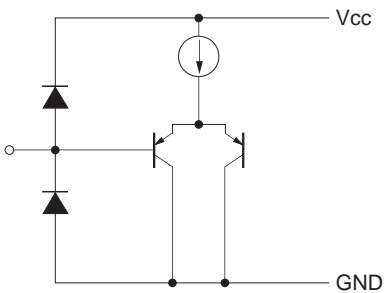


**Pin Description** (Pin No. in the parenthesis is for CXA1767Q.)

| Pin No.          | Symbol         | I/O resistance<br>Pin voltage | Equivalent circuit | Description                           |
|------------------|----------------|-------------------------------|--------------------|---------------------------------------|
| 2 (1)<br>35 (30) | LDLC2<br>LDLC1 | 5.28kΩ<br>VCT                 |                    | Sets loudness low cut-off frequency.  |
| 3 (2)<br>34 (29) | LDHC2<br>LDHC1 | 7.97kΩ<br>VCT                 |                    | Sets loudness high cut-off frequency. |
| 4 (3)<br>33 (28) | INAO2<br>INAO1 | —<br>VCT                      |                    | Input selector output                 |
| 5 (4)<br>32 (27) | VRIN2<br>VRIN1 | 50kΩ<br>VCT                   |                    | Volume input                          |

| Pin No.          | Symbol           | I/O resistance<br>Pin voltage | Equivalent circuit   | Description               |
|------------------|------------------|-------------------------------|--|---------------------------|
| 6 (5)<br>31 (26) | TCHC2<br>TCHC1   | 5kΩ<br>VCT                    |    | Sets tone high frequency. |
| 7 (6)<br>30 (25) | TCLC21<br>TCLC11 | 8kΩ<br>VCT                    |   | Sets tone low frequency.  |
| 8 (7)<br>29 (24) | TCLC22<br>TCLC12 | 8kΩ<br>VCT                    |  | Sets tone low frequency.  |
| 9 (8)<br>28 (23) | TCO2<br>TCO1     | —<br>VCT                      |  | Tone control output       |

| Pin No.            | Symbol         | I/O resistance<br>Pin voltage | Equivalent circuit   | Description  |
|--------------------|----------------|-------------------------------|--|--------------|
| 10 (9)<br>27 (22)  | FDIN2<br>FDIN1 | 24kΩ<br>VCT                   |    | Fader input  |
| 11 (10)<br>26 (21) | FNTO2<br>FNTO1 | —<br>VCT                      |   | Front output |
| 13 (11)<br>24 (20) | REO2<br>REO1   | —<br>VCT                      |  | Rear output  |
| 14 (12)            | INIT           | —<br>—                        |  | System reset |

| Pin No. | Symbol | I/O resistance<br>Pin voltage | Equivalent circuit   | Description          |
|---------|--------|-------------------------------|--|----------------------|
| 15 (13) | DATA   | $\approx \infty$<br>—         |    | Serial data input    |
| 16 (14) | VCT    | —<br>VCT                      |  | $\frac{1}{2} V_{CC}$ |
| 17 (15) | Vcc    | Vcc                           |  | +power supply        |
| 20 (16) | GND    | GND                           |  | GND                  |
| 21 (17) | CLK    | $\approx \infty$<br>—         |   | Serial clock         |
| 22 (18) | TEST   | —<br>—                        |  | Test. Leave open.    |
| 23 (19) | CE     | $\approx \infty$<br>—         |  | Latch enable         |

| Pin No.  | Symbol   | I/O resistance<br>Pin voltage | Equivalent circuit | Description   |
|--|--|-------------------------------|--------------------|---|
| 37 (31)<br>48 (40)   | GAIN1<br>GAIN2   | 10kΩ<br>VCT                   |                    | Sets input amplifier gain to 6dB by connecting to VCT. 0dB at open. |
| 38 (32)<br>39 (33)<br>40 (34)<br>41 (35)<br>44 (36)<br>45 (37)<br>46 (38)<br>47 (39) | IN14<br>IN13<br>IN12<br>IN11<br>IN21<br>IN22<br>IN23<br>IN24 | 50kΩ<br>VCT                   |                    | Signal input  |

**Reset**

Reset is performed by lowering the INIT pin below 1V when CLK is High. Reset is disabled when CLK is Low. The following table shows the reset status.

| Mode        | Set value |
|-------------|-----------|
| INPUT       | 1         |
| VRC1        | -∞        |
| VRF1        | -7dB      |
| VRC2        | -∞        |
| VRF2        | -7dB      |
| LOUD        | OFF       |
| TONE BASS   | 0dB       |
| TONE TREBLE | 0dB       |
| FADER       | 0dB, REAR |



**Data Format**

**(a) Data allocation**

|          |             |              |     |
|----------|-------------|--------------|-----|
| FAST BIT | D1          | NOP          | MSB |
|          | D2          |              |     |
| D3       | ISW         |              |     |
| D4       |             |              |     |
| D5       | LOUD        |              |     |
| D6       | VRC1        |              |     |
| D7       |             |              |     |
| D8       |             |              |     |
| D9       |             |              |     |
| D10      | VRF1        |              |     |
| D11      |             |              |     |
| D12      |             |              |     |
| D13      | VRC2        |              |     |
| D14      |             |              |     |
| D15      |             |              |     |
| D16      |             |              |     |
| D17      | VRF2        |              |     |
| D18      |             |              |     |
| D19      |             |              |     |
| D20      | TONE BASS   |              |     |
| D21      |             |              |     |
| D22      |             |              |     |
| D23      |             |              |     |
| D24      | TONE TREBLE |              |     |
| D25      |             |              |     |
| D26      |             |              |     |
| D27      |             |              |     |
| D28      | FADER       |              |     |
| D29      |             |              |     |
| D30      |             |              |     |
| D31      |             |              |     |
| LAST BIT | D32         | FADER SELECT |     |

**(b) Set table**

• **NOP**

| Set value | D1 | D2 |
|-----------|----|----|
| —         | 0  | 0  |

• **ISW**

| Set value | D1 | D2 |
|-----------|----|----|
| IN14/IN24 | 1  | 1  |
| IN13/IN23 | 1  | 0  |
| IN12/IN22 | 0  | 1  |
| IN11/IN21 | 0  | 0  |

• **LOUD**

| Set value | D5 |
|-----------|----|
| ON        | 1  |
| OFF       | 0  |

• **VRC1/VRC2**

| Set value | D6/D13 | D7/D14 | D8/D15 | D9/D16 |
|-----------|--------|--------|--------|--------|
| 0         | 1      | 1      | 1      | 1      |
| -8        | 1      | 1      | 1      | 0      |
| -16       | 1      | 1      | 0      | 1      |
| -24       | 1      | 1      | 0      | 0      |
| -32       | 1      | 0      | 1      | 1      |
| -40       | 1      | 0      | 1      | 0      |
| -48       | 1      | 0      | 0      | 1      |
| -56       | 1      | 0      | 0      | 0      |
| -64       | 0      | 1      | 1      | 1      |
| -72       | 0      | 1      | 1      | 0      |
| -80       | 0      | 1      | 0      | 1      |
| -∞        | 0      | 1      | 0      | 0      |
| -∞        | 0      | 0      | 0      | 0      |

• **VRF1/VRF2**

| Set value | D10/D17 | D11/D18 | D12/D19 |
|-----------|---------|---------|---------|
| 0         | 1       | 1       | 1       |
| -1        | 1       | 1       | 0       |
| -2        | 1       | 0       | 1       |
| -3        | 1       | 0       | 0       |
| -4        | 0       | 1       | 1       |
| -5        | 0       | 1       | 0       |
| -6        | 0       | 0       | 1       |
| -7        | 0       | 0       | 0       |

## • TONE BASS/TREBLE

| Set value | D20/D24 | D21/D25 | D22/D26 |
|-----------|---------|---------|---------|
| 14        | 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

| Set value | D23/D27 |
|-----------|---------|
| BOOST     | 1       |
| CUT       | 0       |

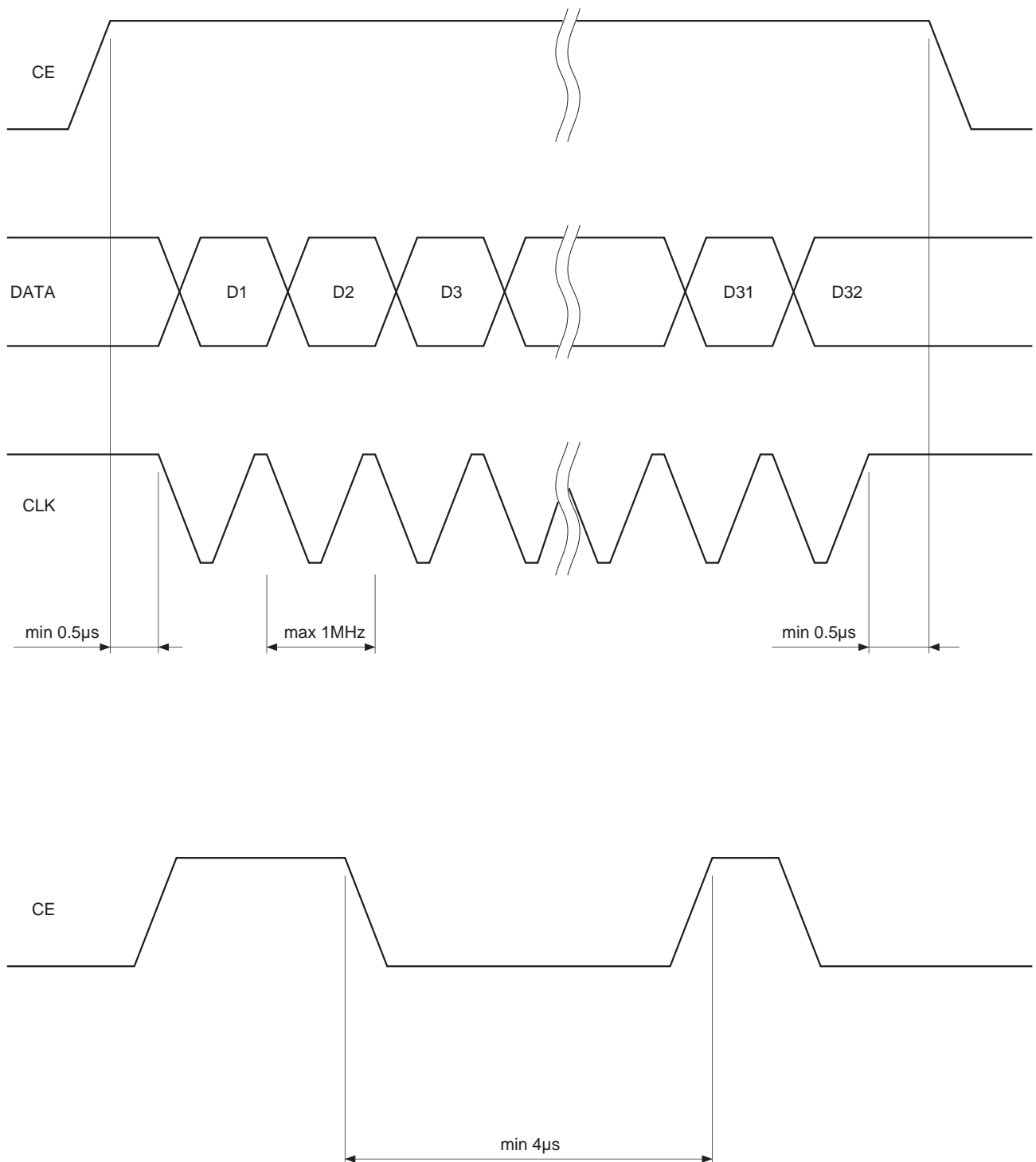
## • FADER

| Set value | D28 | D29 | D30 | D31 |
|-----------|-----|-----|-----|-----|
| $-\infty$ | 1   | 1   | 1   | 1   |
| -60       | 1   | 1   | 1   | 0   |
| -45       | 1   | 1   | 0   | 1   |
| -35       | 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

| Set value                   | D32 |
|-----------------------------|-----|
| Attenuation of front signal | 1   |
| Attenuation of rear signal  | 0   |

• DATA TIMING

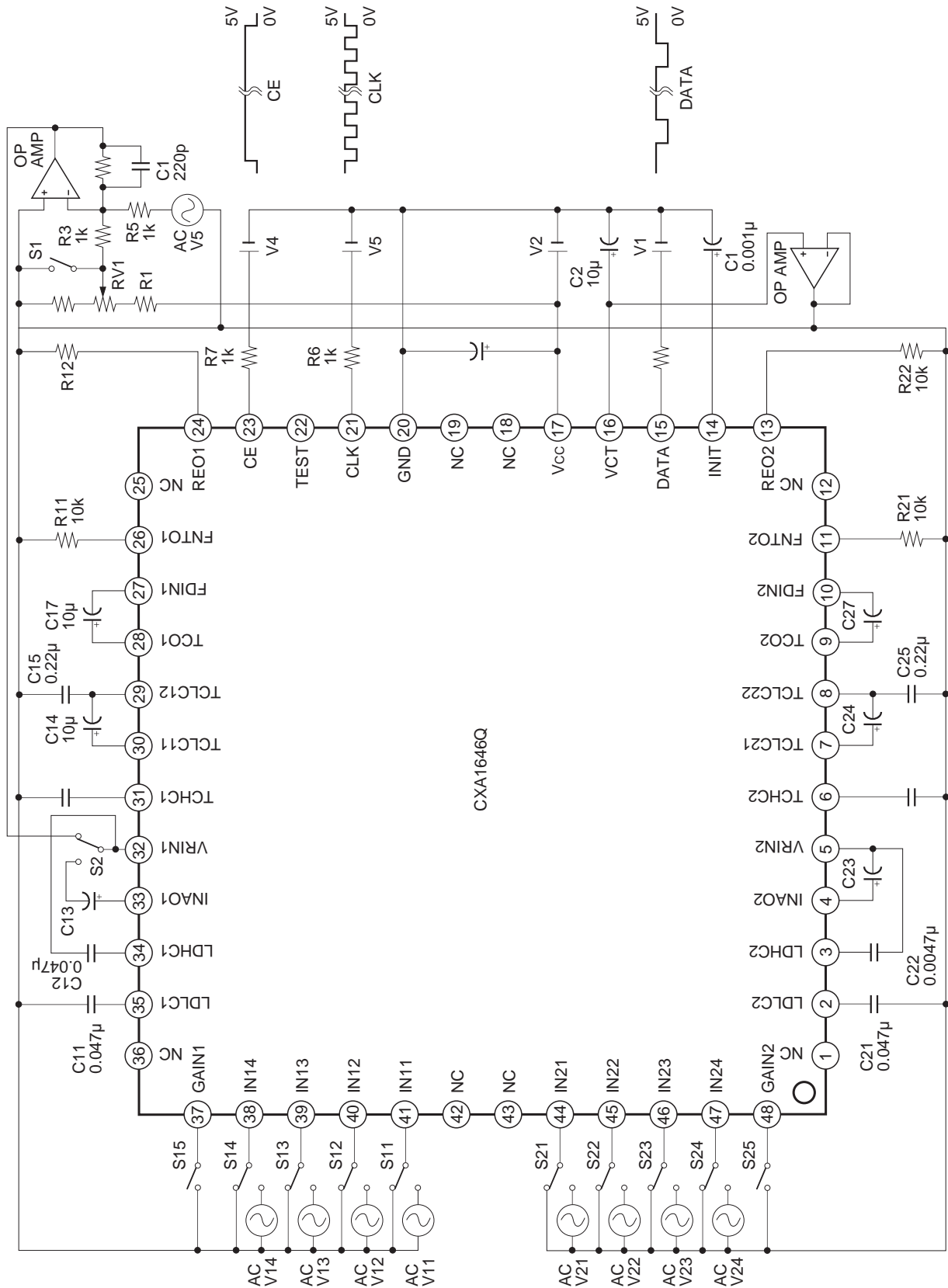


**Electrical Characteristics**

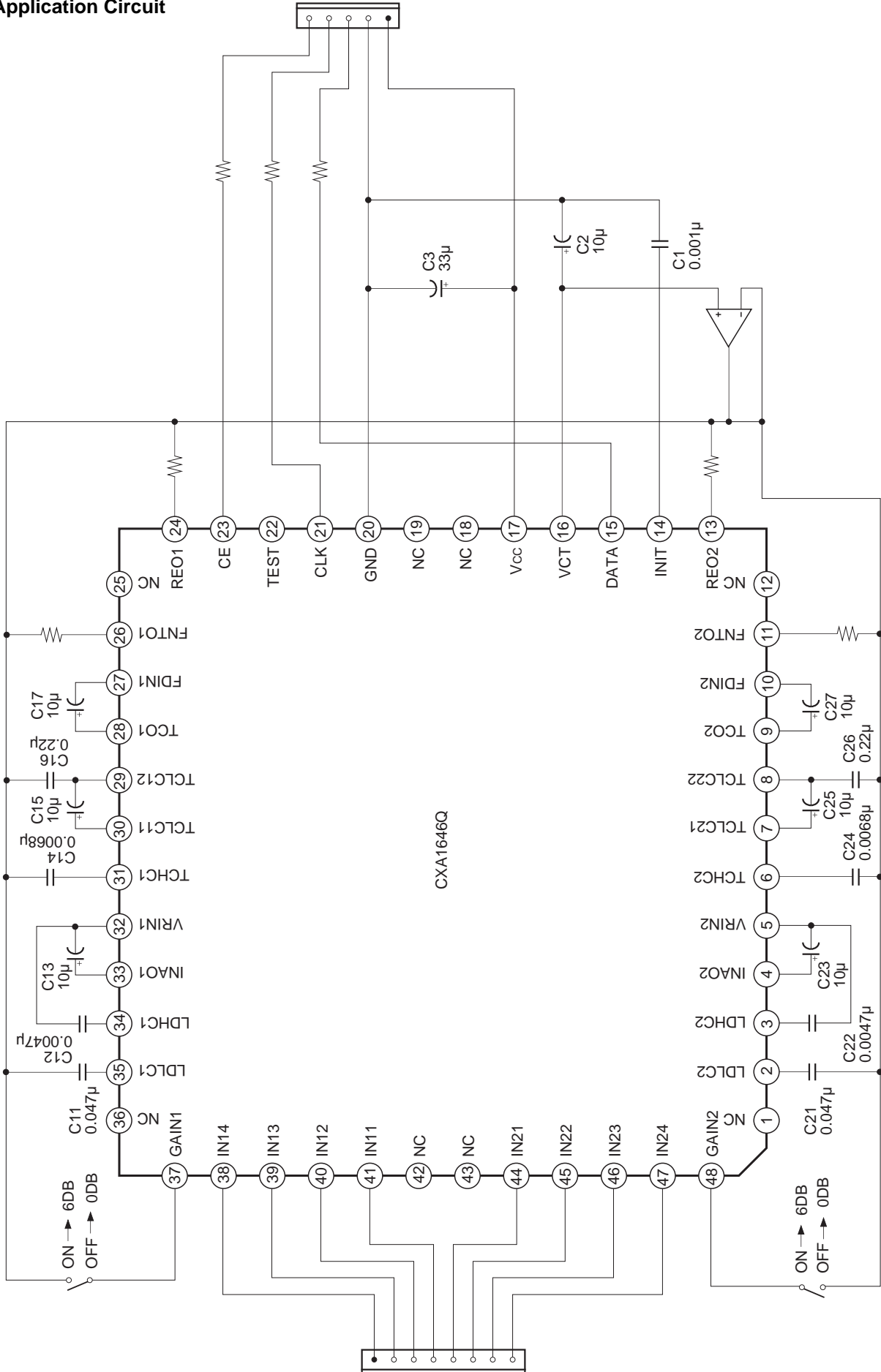
(V<sub>CC</sub> = 8V, T<sub>a</sub> = 25°C unless otherwise specified)

| Item                             |      | Symbol           | Conditions                                       | Min. | Typ.  | Max.                | Unit  |
|----------------------------------|------|------------------|--|------|-------|---------------------|-------|
| Circuit current                  |      | I <sub>CC</sub>  | No signal  | —    | 17    | 21                  | mA    |
| Total harmonic distortion factor |      | THD              | 1kHz, 5dBm                                       | —    | 0.005 | 0.01                | %     |
| Output noise voltage             |      | V <sub>n</sub>   | Shortcircuit at input, Aweight                   | —    | 7     | 10                  | μVrms |
| Maximum output voltage           |      | V <sub>om</sub>  | 1kHz   | 8    | —     | —                   | dBm   |
| Separation                       |      | CS               | 1kHz   | 72   | 90    | —                   | dB    |
| Maximum attenuation factor       |      | ATT <sub>m</sub> |  | 85   | 90    | —                   | dB    |
| Loudness                         | LOW  | G <sub>lb</sub>  | 100Hz, VRC = -16dB                               | 7    | 8     | 9                   | dB    |
|                                  | HIGH | G <sub>lh</sub>  | 10kHz, VRC = -16dB                               | 7    | 8     | 9                   | dB    |
| Bass max. boost gain             |      | G <sub>bb</sub>  |  | 12   | 14    | 16                  | dB    |
| Bass max. cut gain               |      | G <sub>bc</sub>  |  | 12   | 14    | 16                  | dB    |
| Treble max. boost gain           |      | G <sub>tb</sub>  |  | 12   | 14    | 16                  | dB    |
| Treble max. cut gain             |      | G <sub>tc</sub>  |  | 12   | 14    | 16                  | dB    |
| Gain switching                   |      | G <sub>h</sub>   | GAIN = VCT                                       | 5    | 6     | 7                   | dB    |
| Input voltage                    | H    | V <sub>sh</sub>  | DATA, INIT                                       | 3    | —     | 6                   | V     |
|                                  | L    | V <sub>sl</sub>  | CLK, CE  | 0    | —     | 1.5                 | V     |
| 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 | V     |

Electrical Characteristic Test Circuit

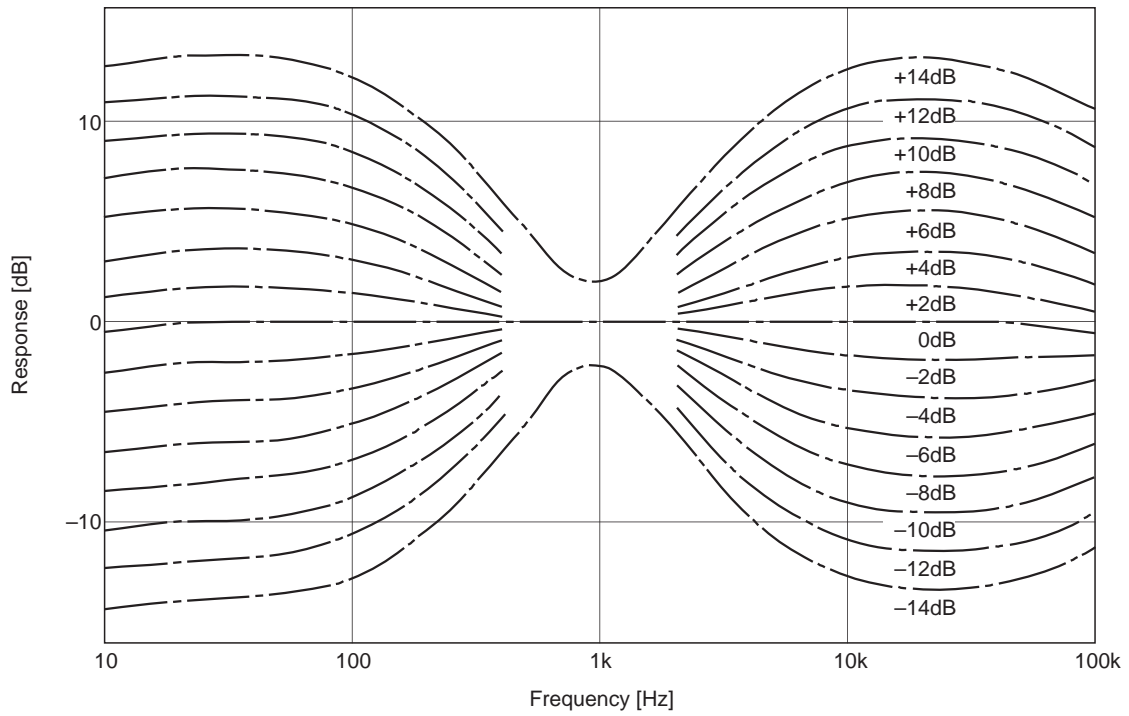


Application Circuit

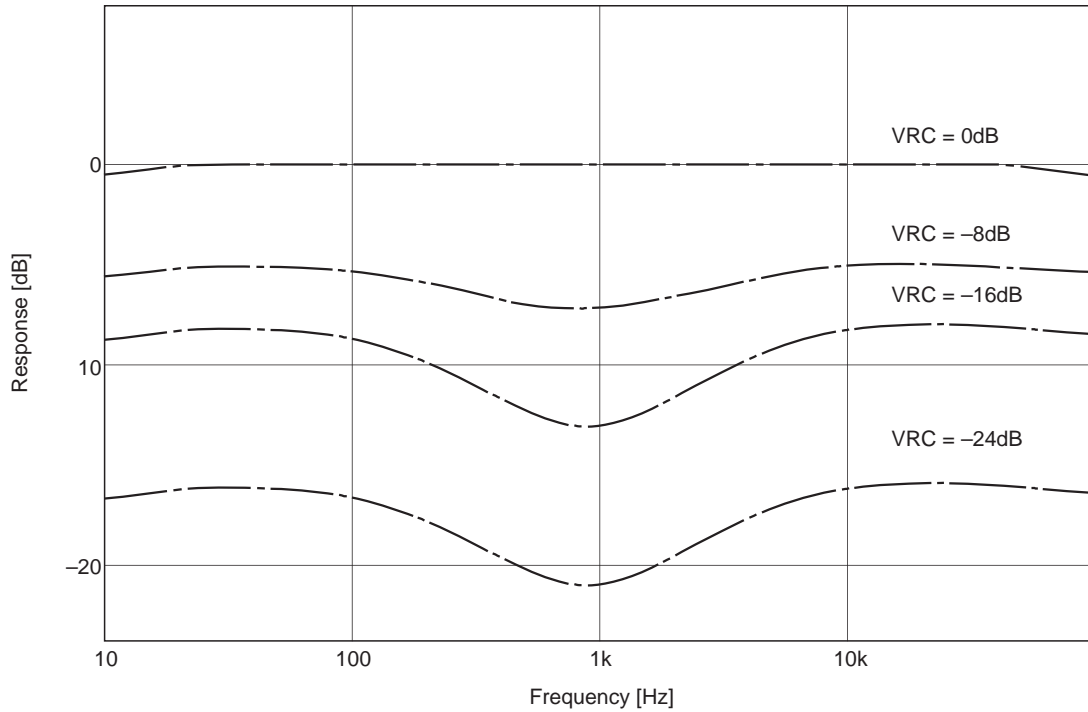


Application circuits shown are typical examples illustrating the operation of the devices. Sony cannot assume responsibility for any problems arising out of the use of these circuits or for any infringement of third party patent and other right due to same.

CXA1646Q/CXA1767Q Tone control characteristics



CXA1646Q/CXA1767Q Loud characteristics





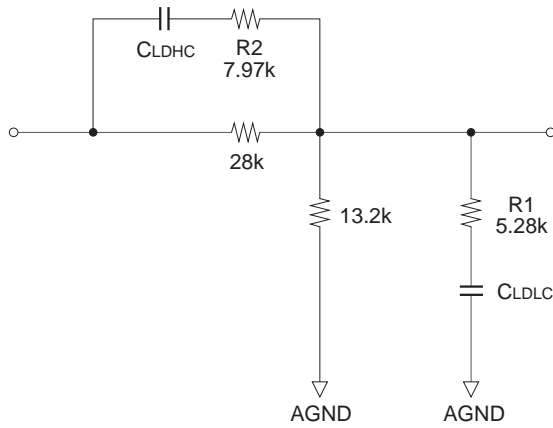
**Setting Constants**

• **LOUD**

The loudness function achieves the necessary frequency characteristics by passing through filter shown below. The resistor is built in the IC so that  $f_L$  and  $f_H$  are set by selecting  $CLDLC$  and  $CLDHC$ .

$$1/f_L = 2\pi \cdot CLDLC \cdot R_1$$

$$1/f_H = 2\pi \cdot CLDHC \cdot R_2$$



• TONE CONTROL

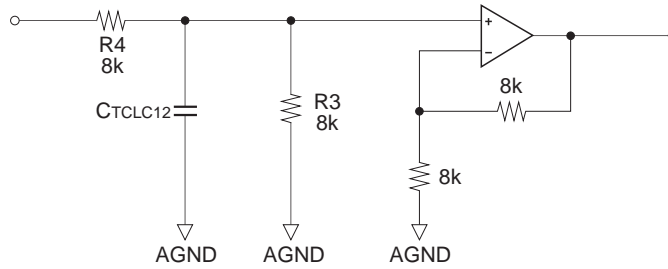
The tone control function achieves the necessary frequency characteristics by passing through LPF and HPF shown below.

The resistor is built in the IC so that  $f_L$  and  $f_H$  are set by selecting  $C_{TCLC12}$  and  $C_{TCHC}$ .

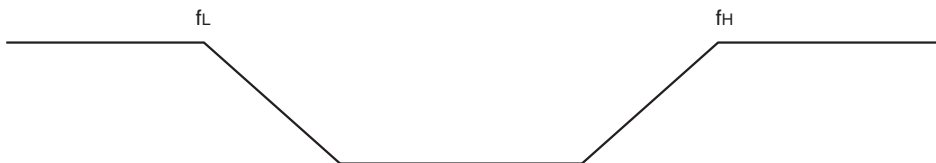
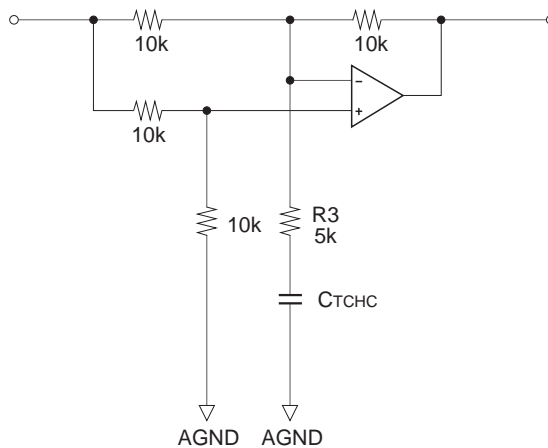
$$1/f_L = 2\pi C_{TCLC12} (R_3 // R_4)$$

$$1/f_H = 2\pi C_{TCHC} R_3$$

LPF



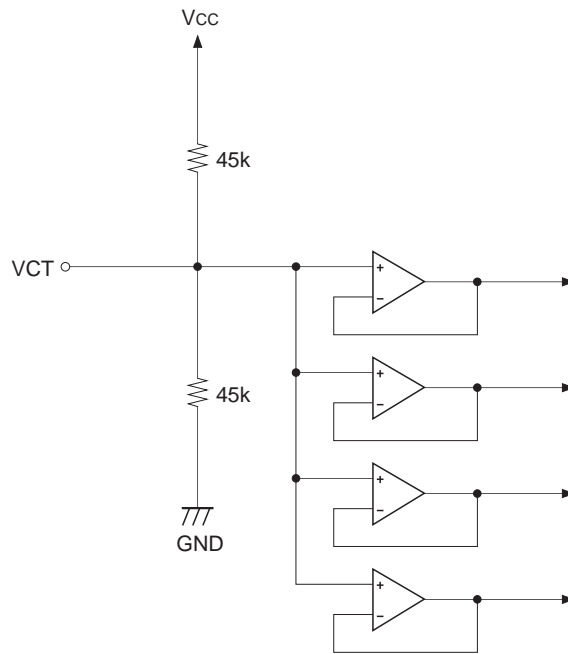
HPF



• VCT pin

The internal circuit of VCT pin has the following structure.

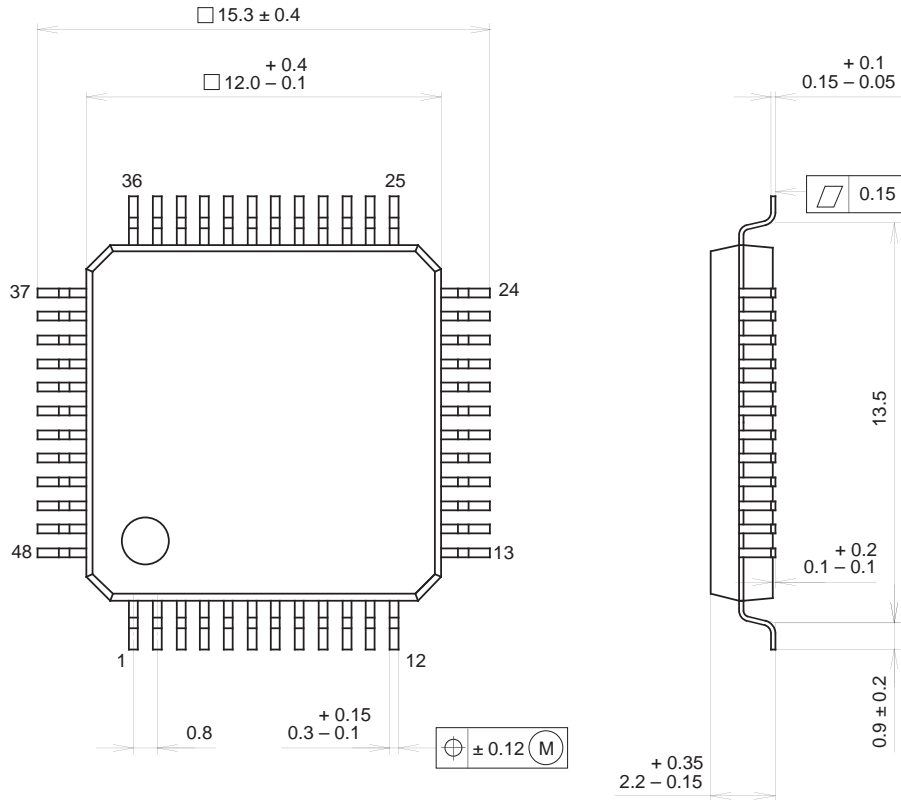
Insert a buffer when using it as a reference voltage for an external circuit.



Package Outline Unit: mm

CXA1646Q

48PIN QFP (PLASTIC)



PACKAGE STRUCTURE

|            |                  |
|------------|------------------|
| SONY CODE  | QFP-48P-L04      |
| EIAJ CODE  | *QFP048-P-1212-B |
| JEDEC CODE | —                |

|                  |                            |
|------------------|----------------------------|
| PACKAGE MATERIAL | EPOXY RESIN                |
| LEAD TREATMENT   | SOLDER / PALLADIUM PLATING |
| LEAD MATERIAL    | COPPER / 42 ALLOY          |
| PACKAGE WEIGHT   | 0.7g                       |

NOTE : PALLADIUM PLATING

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

