

**DD Dolby\* B-C Type Noise Reduction System with Playback Equalizer Amplifier**

**Description**

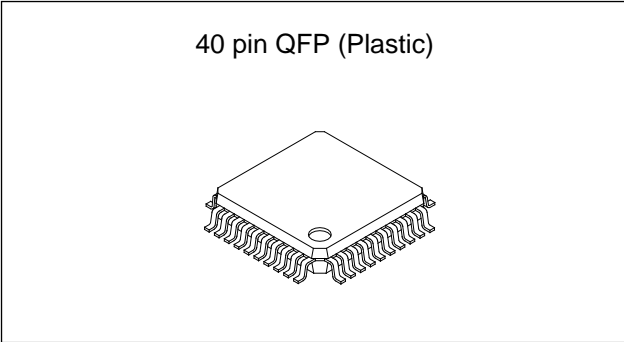
The CXA2561Q is an IC designed for use in car stereo cassette decks. Functions include Dolby B-C type noise reduction (NR) system, playback equalizer amplifier and music sensor into a single chip.

**Features**

- Few external parts
- Small package (40-pin QFP)
- Same pin configuration as for the Dolby B type NR system (CXA2560Q) and no Dolby NR system (CXA2559Q)
- Dolby B-C type NR and playback equalizer amplifier into a single chip
- FORWARD/REVERSE head select switch
- Mute function
- Music signal interval detection level can be set by the external resistors/capacitors (2 modes).
- High-frequency cut-off of the music sensor circuit can be adjusted by the external capacitance.

**Applications**

- Car stereo cassette decks
- Playback-only cassette decks



**Structure**

Bipolar silicon monolithic IC

**Absolute Maximum Ratings**

|                         |                  |             |    |
|-------------------------|------------------|-------------|----|
| • Supply voltage        | V <sub>CC</sub>  | 12          | V  |
| • Operating temperature | T <sub>opr</sub> | -40 to +85  | °C |
| • Storage temperature   | T <sub>stg</sub> | -65 to +150 | °C |
| • Power dissipation     | P <sub>D</sub>   | 430         | mW |

**Operating Condition**

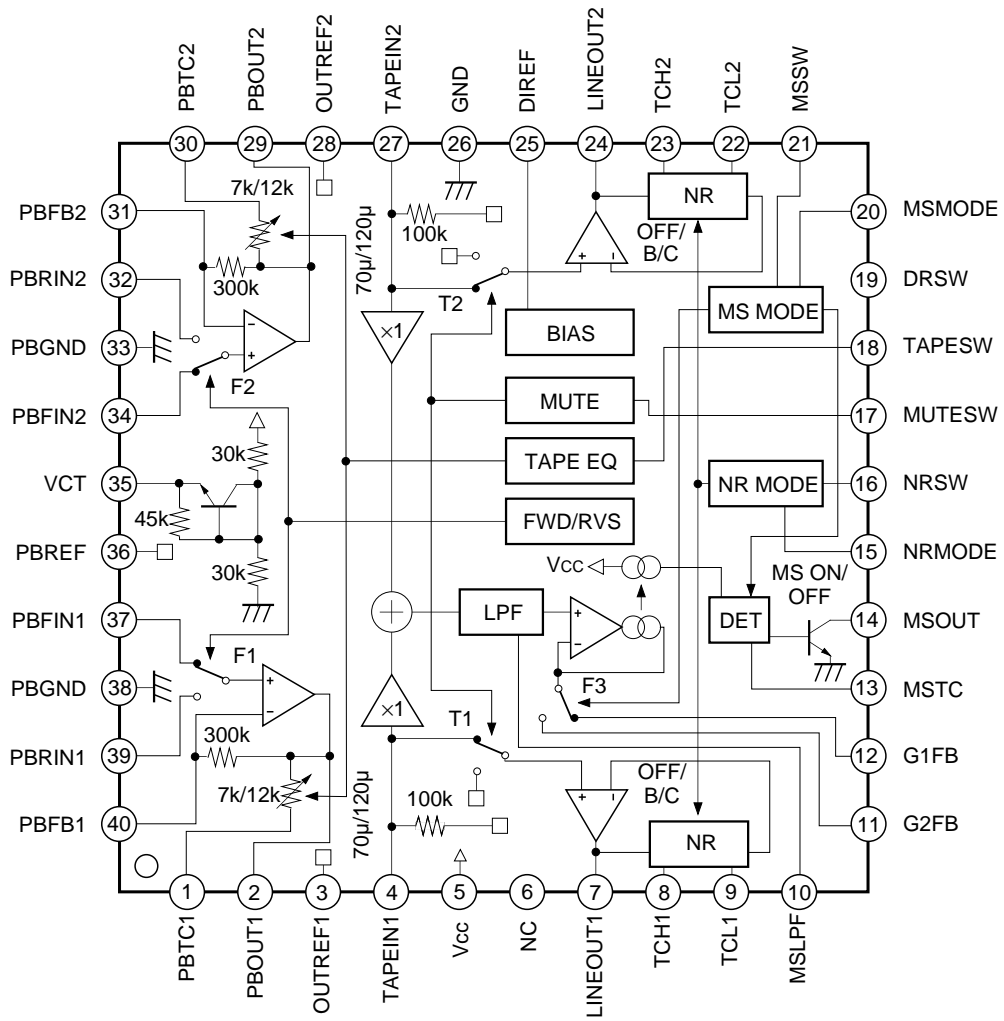
|                |                 |           |   |
|----------------|-----------------|-----------|---|
| Supply voltage | V <sub>CC</sub> | 7.8 to 11 | V |
|----------------|-----------------|-----------|---|

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Block Diagram and Pin Configuration



Pin Description

(Ta = 25°C, Vcc = 8.0V, DVcc = 5.0V)

| Pin No. | Symbol             | Typical pin voltage |        | I/O | I/O resistance | Equivalent circuit | Description                               |
|---------|--------------------|---------------------|--------|-----|----------------|--------------------|---|
|         |                    | DC                  | AC     |     |                |                    |   |
| 1<br>30 | PBTC1<br>PBTC2     | 4.0V                | —      | —   | —              |                    | Playback equalizer amplifier capacitance. |
| 2<br>29 | PBOUT1<br>PBOUT2   | 4.0V                | -25dBm | O   | —              |                    | Playback equalizer amplifier output.      |
| 3<br>28 | OUTREF1<br>OUTREF2 | 4.0V                | —      | O   | —              |                    | Output reference. (Vcc/2 output)          |
| 4<br>27 | TAPEIN1<br>TAPEIN2 | 4.0V                | -30dBm | I   | 100kΩ          |                    | TAPE input.                               |
| 5       | Vcc                | 8.0V                | —      | —   | —              |                    | Power supply.                             |

(Ta = 25°C, Vcc = 8.0V, DVcc = 5.0V)

| Pin No. | Symbol               | Typical pin voltage |       | I/O | I/O resistance | Equivalent circuit | Description   |
|---------|----------------------|---------------------|-------|-----|----------------|--------------------|---|
|         |                      | DC                  | AC    |     |                |                    |   |
| 7<br>24 | LINEOUT1<br>LINEOUT2 | 4.0V                | -6dBm | O   | —              |                    | Line output.  |
| 8<br>23 | TCH1<br>TCH2         | 0.3V                | —     | —   | —              |                    | Time constant for the HLS.                            |
| 9<br>22 | TCL1<br>TCL2         | 0.3V                | —     | —   | —              |                    | Time constant for the LLS.                            |
| 10      | MSLPF                | 4.0V                | —     | —   | 100k           |                    | Cut-off frequency adjustment of the music sensor LPF. |

(Ta = 25°C, Vcc = 8.0V, DVcc = 5.0V)

| Pin No.  | Symbol       | Typical pin voltage   |    | I/O | I/O resistance | Equivalent circuit | Description  |
|----------|--------------|---|----|-----|----------------|--------------------|--|
|          |              | DC  | AC |     |                |                    |  |
| 11<br>12 | G2FB<br>G1FB | 4.0V  | —  | —   | —              |                    | Music signal interval detection level setting.                           |
| 13       | MSTC         | —   | —  | —   | —              |                    | Time constant for detecting the music signal interval.                   |
| 14       | MSOUT        | 0.2V when a signal is detected;<br>DVcc when no signal is detected. | —  | O   | —              |                    | Music sensor output.   |
| 15       | NRMODE       | 0.0V when open.   | —  | I   | 100kΩ          |                    | Dolby NR mode control.<br>Low (open):<br>Dolby B NR<br>High: Dolby C NR  |
| 17       | MUTESW       |   |    |     |                |                    | Mute function control.<br>Low (open):<br>Mute OFF<br>High: Mute ON       |
| 18       | TAPESW       |   |    |     |                |                    | Playback equalizer amplifier control.<br>Low (open): 70μs<br>High: 120μs |
| 21       | MSSW         |   |    |     |                |                    | Music sensor control.<br>Low (open): MS ON<br>High: MS OFF               |

(Ta = 25°C, Vcc = 8.0V, DVcc = 5.0V)

| Pin No.  | Symbol           | Typical pin voltage |        | I/O | I/O resistance | Equivalent circuit | Description  |
|----------|------------------|---------------------|--------|-----|----------------|--------------------|--|
|          |                  | DC                  | AC     |     |                |                    |  |
| 16       | NRSW             | 0.0V when open.     | —      | I   | 100kΩ          |                    | Dolby NR control.<br>Low (open): NR OFF<br>High: NR ON   |
| 19       | DRSW             |                     |        |     |                |                    | Head select control.<br>Low (open): FORWARD<br>High: REVERSE   |
| 20       | MSMODE           | 0.0V when open.     | —      | I   | 100kΩ          |                    | Music sensor mode control.<br>Low (open): G1<br>High: G2   |
| 25       | DIREF            | 1.2V                | —      | —   | —              |                    | Resistance for setting the reference current.<br>(Connects 20kΩ between DIREF pin and GND for the standard setting.) |
| 26       | GND              | 0.0V                | —      | —   | —              |                    | Ground.  |
| 31<br>40 | PBFB2<br>PBFB1   | 4.0V                | -70dBm | I   | —              |                    | Playback equalizer amplifier feedback.   |
| 32<br>39 | PBRIN2<br>PBRIN1 |                     |        |     |                |                    | Playback equalizer amplifier input.<br>(REVERSE head connected)  |
| 34<br>37 | PBFIN2<br>PBFIN1 |                     |        |     |                |                    | Playback equalizer amplifier input.<br>(FORWARD head connected)  |

(Ta = 25°C, Vcc = 8.0V, DVcc = 5.0V)

| Pin No.  | Symbol | Typical pin voltage |    | I/O | I/O resistance | Equivalent circuit | Description  |
|----------|--------|---------------------|----|-----|----------------|--------------------|--|
|          |        | DC                  | AC |     |                |                    |  |
| 33<br>38 | PBGND  | 0.0V                | —  | —   | —              |                    | Playback equalizer amplifier ground.<br>(Connect to ground.) |
| 35       | VCT    | 4.0V                | —  | O   | —              |                    | Center.<br>(Vcc/2 output)                                    |
| 36       | PBREF  | 4.0V                | —  | O   | —              |                    | Playback equalizer amplifier reference.<br>(Vcc/2 output)    |
| 6        | NC     | —                   | —  | —   | —              |                    | No connected.  |

## Electrical Characteristics

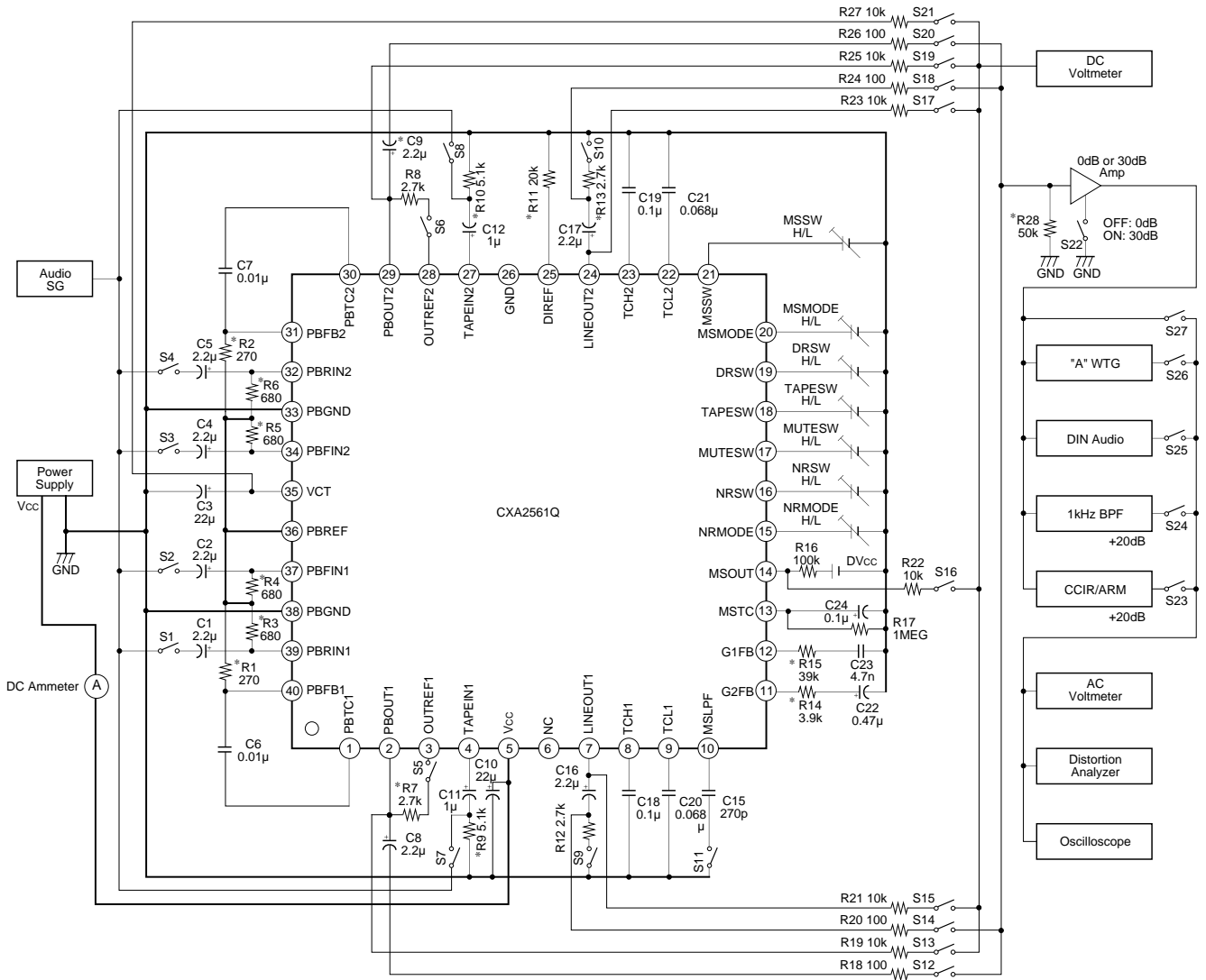
(Ta = 25°C, Vcc = 8.0V, DVcc = 5.0V)

| Item  | Symbol | Measurement conditions                            | Min.  | Typ.  | Max.  | Unit |
|---|--------|---|-------|-------|-------|------|
| Operating voltage                             | Vopr   |   | 7.8   | 8.0   | 11.0  | V    |
| Current consumption                           | Icc    | No signal, NR OFF, MUTE OFF, 70μs, MS ON          | 13.0  | 19.2  | 25.0  | mA   |
| Dolby NR (0dB = Dolby level LINEOUT of -6dBm) |        |   |       |       |       |      |
| TAPEIN input sensitivity                      | VTIN   | TAPEIN 1kHz, LINEOUT 0dB, NR OFF                  | -32.0 | -30.0 | -28.0 | dBm  |
| B type decode boost characteristics 1         | BP1    | TAPEIN 500Hz, LINEOUT -25dB, NR B                 | 1.4   | 2.9   | 4.4   | dB   |
| B type decode boost characteristics 2         | BP2    | TAPEIN 2kHz, LINEOUT -25dB, NR B                  | 5.5   | 7.0   | 8.5   | dB   |
| B type decode boost characteristics 3         | BP3    | TAPEIN 5kHz, LINEOUT -25dB, NR B                  | 3.9   | 5.4   | 6.9   | dB   |
| B type decode boost characteristics 4         | BP4    | TAPEIN 10kHz, LINEOUT -40dB, NR B                 | 9.7   | 10.4  | 11.9  | dB   |
| B type decode boost characteristics 5         | BP5    | TAPEIN 10kHz, LINEOUT 0dB, NR B                   | -1.1  | 0.4   | 1.9   | dB   |
| C type decode boost characteristics 1         | CP1    | TAPEIN 500Hz, LINEOUT -60dB, NR C                 | 14.2  | 16.2  | 18.2  | dB   |
| C type decode boost characteristics 2         | CP2    | TAPEIN 500Hz, LINEOUT -25dB, NR C                 | 7.2   | 9.2   | 11.2  | dB   |
| C type decode boost characteristics 3         | CP3    | TAPEIN 2kHz, LINEOUT -60dB, NR C                  | 18.7  | 20.7  | 22.7  | dB   |
| C type decode boost characteristics 4         | CP4    | TAPEIN 2kHz, LINEOUT -25dB, NR C                  | 5.4   | 7.4   | 9.4   | dB   |
| C type decode boost characteristics 5         | CP5    | TAPEIN 5kHz, LINEOUT -25dB, NR C                  | 3.5   | 5.5   | 7.5   | dB   |
| C type decode boost characteristics 6         | CP6    | TAPEIN 10kHz, LINEOUT 0dB, NR C                   | -5.5  | -3.5  | -1.5  | dB   |
| Total harmonic distortion 1                   | THD1   | TAPEIN 1kHz -20dBm, NR OFF, RL = 2.7kΩ            | —     | 0.01  | 0.2   | %    |
| Total harmonic distortion 2                   | THD2   | TAPEIN 1kHz -20dBm, NR B, RL = 2.7kΩ              | —     | 0.04  | 0.2   | %    |
| Total harmonic distortion 3                   | THD3   | TAPEIN 1kHz -20dBm, NR C, RL = 2.7kΩ              | —     | 0.05  | 0.3   | %    |
| Decode S/N ratio 1                            | SN1    | No signal, NR B, Rg = 5.1kΩ, CCIR/ARM filter used | 77.0  | 87.0  | —     | dB   |
| Decode S/N ratio 2                            | SN2    | No signal, NR C, Rg = 5.1kΩ, CCIR/ARM filter used | 80.0  | 82.0  | —     | dB   |
| Signal handling                               | SH1    | TAPEIN 1kHz, NR OFF, RL = 2.7kΩ, THD = 1%         | 13.0  | 14.4  | —     | dB   |
| Crosstalk between channels 1                  | CT1    | TAPEIN 1kHz -24dBm, NR OFF, 1kHz BPF used         | —     | -96.0 | -70.0 | dB   |



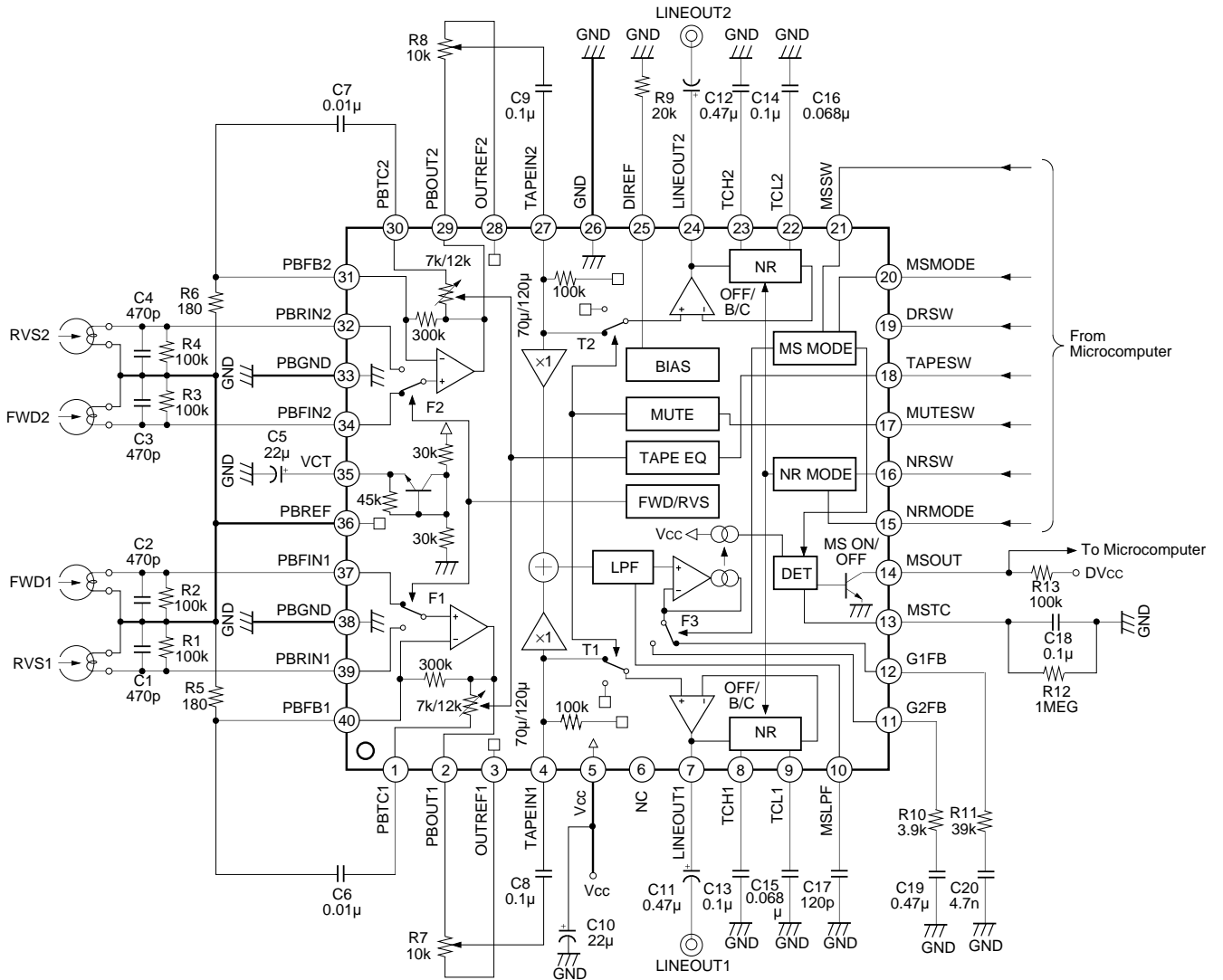
| Item  | Symbol | Measurement conditions  | Min.  | Typ.   | Max.  | Unit |
|---|--------|---|-------|--------|-------|------|
| Mute characteristic                                 | MUTE   | TAPE IN 1kHz -24dBm,<br>MUTE ON 1kHz BPF used, NR OFF                   | —     | -110.0 | -70.0 | dB   |
| Output DC offset voltage                            | Vos1   | No signal, NR OFF, difference from VCT                                  | -0.1  | 0.0    | 0.1   | V    |
| Playback Equalizer Amplifier                        |        |   |       |        |       |      |
| Playback equalizer amplifier reference output level | PBREF  | PBIN 315Hz -70dBm, 120μs mode   | -27.0 | -25.0  | -23.0 | dBm  |
| Playback equalizer amplifier frequency response 1   | F120   | PBIN 2.7kHz -58.5dBm,<br>120μs mode at 315Hz                            | -1.5  | 0.0    | 1.5   | dB   |
| Playback equalizer amplifier frequency response 2   | F70    | PBIN 4.5kHz -53.8dBm,<br>70μs mode at 315Hz                             | -1.5  | 0.0    | 1.5   | dB   |
| Signal handling                                     | SH2    | PBIN 1kHz, 120μs mode, RL = 2.7kΩ,<br>THD = 1%                          | -10.0 | -3.0   | —     | dBm  |
| Total harmonic distortion                           | THD4   | PBIN 1kHz -52dBm, 120μs mode,<br>RL = 2.7kΩ                             | —     | 0.07   | 0.5   | %    |
| S/N ratio   | SN3    | No signal, 70μs mode, Rg = 680Ω,<br>CCIR/ARM filter used                | 57.0  | 63.5   | —     | dB   |
| Output DC offset voltage                            | Vos2   | No signal, 120μs mode, Rg = 680Ω,<br>difference from VCT                | -1.0  | 0.0    | 1.0   | V    |
| Crosstalk between channels                          | CT4    | PBIN 1kHz -52dBm, 120μs mode,<br>1kHz BPF used                          | —     | -75.0  | -70.0 | dB   |
| Crosstalk between FORWARD and REVERSE               | CT5    | PBIN 1kHz -52dBm, 120μs mode,<br>1kHz BPF used                          | —     | -80.0  | -70.0 | dB   |
| Music Sensor  |        |   |       |        |       |      |
| Signal detection level 1                            | VMS1   | TAPEIN 5kHz, MS ON, G1 mode,<br>external constant of 39kΩ and 0.0047μF  | -43.0 | -40.0  | -37.0 | dBm  |
| Signal detection level 2                            | VMS2   | TAPEIN 5kHz, MS ON, G2 mode,<br>external constant of 3.9kΩ and 0.47μF   | -63.0 | -60.0  | -57.0 | dBm  |
| MS output leak current                              | IOH    | No signal, MS OFF, G1 mode  | —     | 0.0    | 1.0   | μA   |
| MS output saturation voltage                        | VOL    | TAPEIN 5kHz -30dBm, MS ON,<br>G1 mode, 1mA applied to MSOUT pin         | —     | 0.3    | 1.0   | V    |
| Logic Voltage                                       |        |   |       |        |       |      |
| Low level   | VIL    | Input voltage of NRMODE, NRSW,<br>MUTESW, TAPESW, DRSW, MSMODE,<br>MSSW | 0.0   | —      | 0.8   | V    |
| High level  | VIH    | Input voltage of NRMODE, NRSW,<br>MUTESW, TAPESW, DRSW, MSMODE,<br>MSSW | 2.5   | —      | Vcc   | V    |

Electrical Characteristics Measurement Circuit



- Notes 1. Resistor tolerance ±5%  
 \*: ±1%  
 2. Capacitor tolerance ±5%  
 \*: ±2%  
 Coupling Capacitor ±10%

Application Circuit

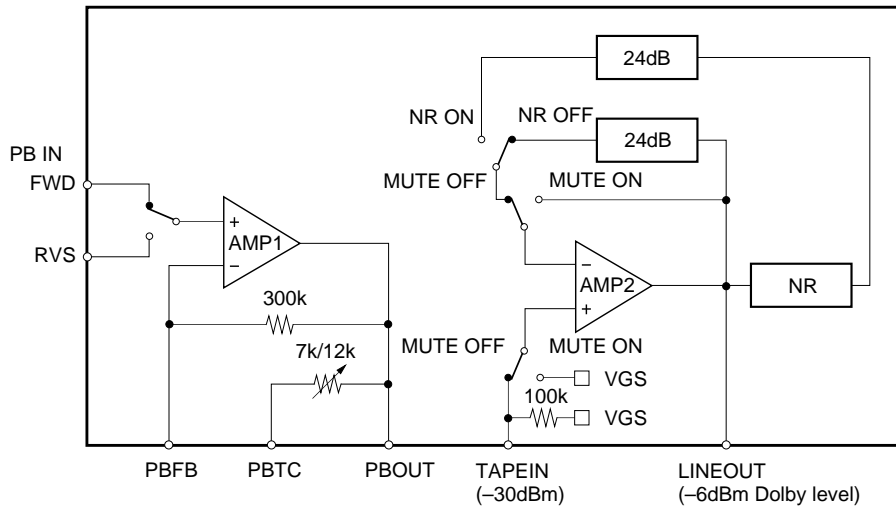


Application circuits shown are typical examples illustrating the operation of the devices. Sony cannot assume responsibility for any problems arising out of the use of these circuits or for any infringement of third party patent and other right due to same.

**Description of Operation**

**1. Signal route**

The CXA2561Q signal circuit is shown in Fig. 1.



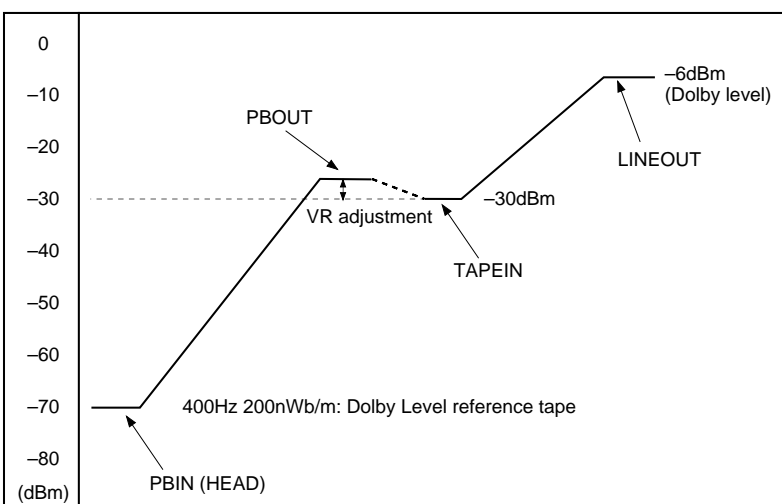
**Fig. 1. Signal route block diagram**

**2. Gain adjustment method**

Adjust the playback equalizer amplifier gain so that -6dBm (Dolby level) is output on LINEOUT (Pins 7 and 24) by playing back the reference tape for Dolby level adjustment.

Adjustment should be performed according to the rules of Dolby Laboratories Corporation because this IC has the built-in Dolby NR system.

Dolby level is defined as 200nWb/m measured according to the ANSI high efficiency head method.



**Fig. 2. Level diagram**

Use the following reference tapes specified by Dolby Laboratories Corporation.

1. A-bex Laboratories, Inc.  
(part no. TCC-130)
2. BASF (product code 09797 XE)
3. Kaneon Corp.  
(LC Engineering part no. LCT-7001)
4. Standard Tape Laboratory  
(catalogue no. 28)
5. TEAC Corporation, Japan  
(part no. MTT150)
6. TEAC Corporation of America  
(part no. MTT150)
7. Victor Company of Japan, Ltd.  
(part no. TMT-6130, VTT-727)
8. Sony Corporation (part no. TY-256)

3. Playback equalizer amplifier

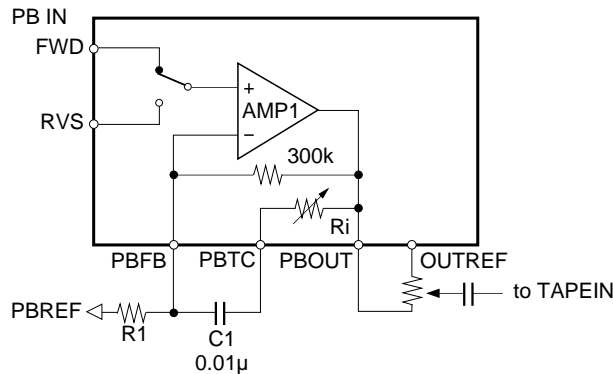


Fig. 3. Playback equalizer amplifier block diagram

The CXA2561Q configures the playback equalizer amplifier by connecting the external capacitor C1 and resistor R1 shown in Fig. 3.

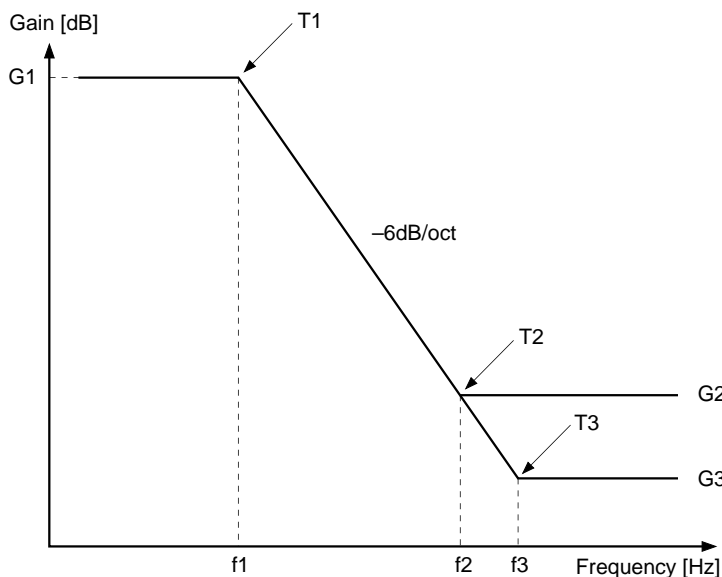
Two systems (FORWARD and REVERSE) of playback head input are provided for each channel.

The FORWARD input pin is selected when DRSW (Pin 19) is Low; REVERSE is selected when DRSW is High.

The playback equalizer amplifier frequency response can be set in two levels (70µs/ 120µs).

When TAPESW (Pin 18) is Low, Ri is 7kΩ; when TAPESW is High, Ri is 12kΩ.

The gain can be adjusted by connecting VR between PBOUT (Pins 2 and 29) and OUTREF (Pins 3 and 28); or by using VR for the external R1.



$$G1 = 20 \log \frac{R1 + 300k}{R1}$$

$$G2 = G3 = 20 \log \frac{R1 + Ri//300k}{R1}$$

$$T1 = C1 \cdot (300k + Ri)$$

$$T2, T3 = \frac{C1 \cdot (R1 \cdot 300k + 300k \cdot Ri + Ri \cdot R1)}{R1 + R2}$$

Fig. 4. Playback equalizer amplifier frequency response

4. Music sensor

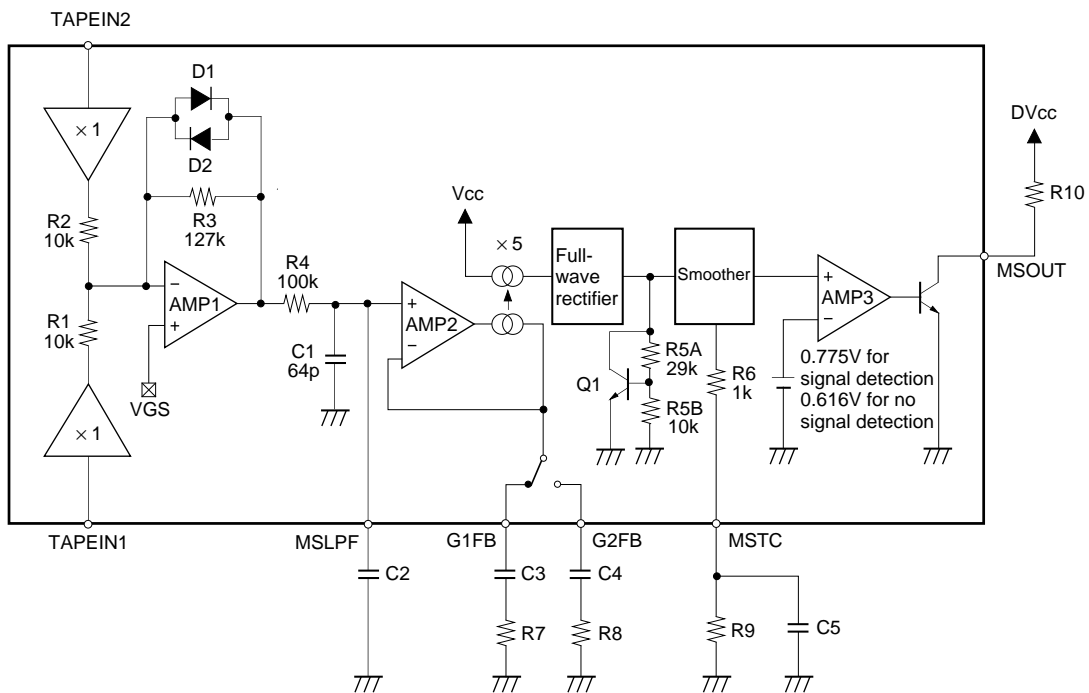


Fig. 5. Music sensor block diagram

(1) Adjustment of music signal detection level

Adjustment the external resistors R7 and R8 to adjust the music signal interval detection level. The signal detection level  $v_1$  and no signal detection level  $v_2$  are expressed by the following equations.

$$v_1 = -39 + 20\log(39k/R_{ext}) \text{ [dBm]} \quad R_{ext}: R7 \text{ or } R8$$

$$v_2 = v_1 - 2 \text{ [dBm]}$$

(2) Low-frequency cut-off adjustment of music sensor

Adjust the external resistors R7, R8 and the external capacitors C3, C4 to adjust the low-frequency cut-off. The low-frequency cut-off is expressed by the following equation.

$$f_{c1} = 1 / (2\pi \cdot C_{ext} \cdot R_{ext}) \quad C_{ex}, R_{ext}: C3, R7 \text{ or } C4, R8$$

(3) High-frequency cut-off adjustment of music sensor

Adjust the capacitor C2 to MSLPF (Pin 10) to adjust the high-frequency cut-off. The high-frequency cut-off is expressed by the following equation.

$$f_{c2} = 1 / (2\pi \cdot (64p + C2) \cdot 100k)$$

The high-frequency cut-off is approximately 25kHz when MSLPF is left open.

(4) Response time adjustment

Adjust the external resistor R9 and the external capacitor C5 to adjust the response time. The response time for signal detection depends on the internal resistor R6 and the external capacitor C5. The response time for no signal detection depends on the external resistor R9 and the external capacitor C5.

## 5. Operating mode control method

The CXA2561Q has a Dolby NR mode select switch (NRMODE), Dolby NR switch (NRSW), mute switch (MUTE SW), playback equalizer amplifier select switch (TAPESW), head input select switch (DRSW), music sensor mode select switch (MSMODE) and music sensor switch (MSSW).

The operating modes for each switch are shown in the following table.

| Pin No. | Pin name | Pin voltage     |                 |
|---------|----------|-----------------|-----------------|
|         |          | Low (OPEN)      | High            |
| 15      | NRMODE   | Dolby B type NR | Dolby C type NR |
| 16      | NRSW     | Dolby NR OFF    | Dolby NR ON     |
| 17      | MUTESW   | MUTE OFF        | MUTE ON         |
| 18      | TAPESW   | 70 $\mu$ s      | 120 $\mu$ s     |
| 19      | DRSW     | PBIN FORWARD    | PBIN REVERSE    |
| 20      | MSMODE   | G1              | G2              |
| 21      | MSSW     | MS ON           | MS OFF          |

### Notes on Operation

#### 1. DIREF pin resistance

The current on DIREF (Pin 25) is the reference for the Dolby NR static characteristic, playback equalizer amplifier resistor 7k $\Omega$ /12k $\Omega$  and the comparator threshold value of the music sensor.

Use the resistor with high accuracy for connecting to the DIREF pin.

(The resistance accuracy of 2% <metal-oxide> is recommended.)

#### 2. Dolby NR

The Dolby NR attack/recovery time is determined by the capacitance connected to TCH (Pins 8 and 23), and TCL (Pin 9 and 22).

Use the parts, connected to these pins, with high accuracy and small temperature characteristics.

(The capacitance accuracy of 10% <film> is recommended.)

#### 3. Playback equalizer amplifier

The playback equalizer amplifier characteristics are determined by the resistor connected between the IC internal resistor and PBFB (Pins 31 and 40) and the capacitor connected between PBFB and PBTC (Pins 1 and 30). Use the parts which satisfies the accuracy required for the playback equalizer amplifier.

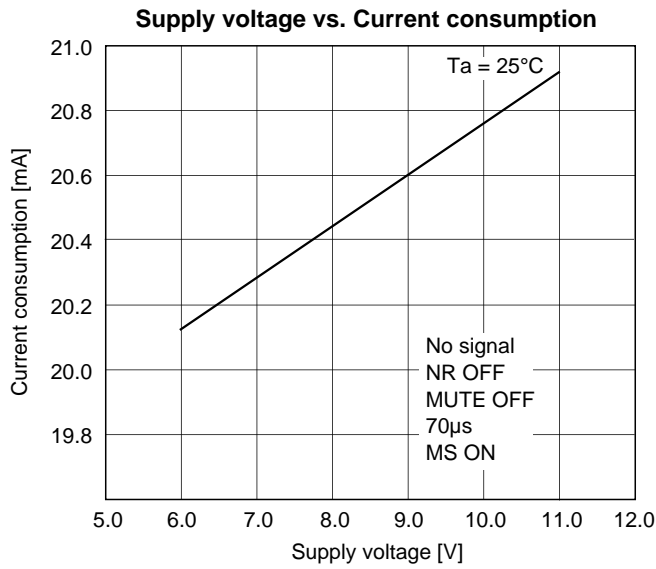
#### 4. Music sensor

The resistance and capacitance connected to G2FB (Pin 11) and G1FB (Pin 12) determine the detection level and high-frequency cut-off.

The response time is determined by the resistance and capacitance connected to MSTC (Pin 13).

Use the parts which satisfies the accuracy required for the music sensor.

Example of Representative Characteristics



**Playback equalizer amplifier frequency response**

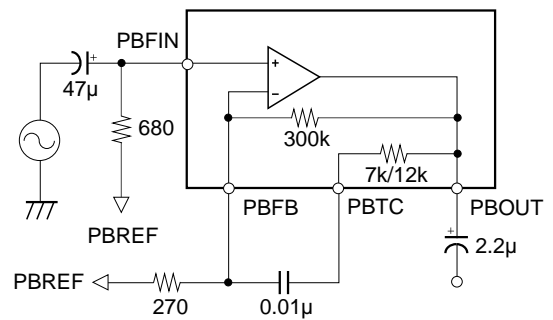
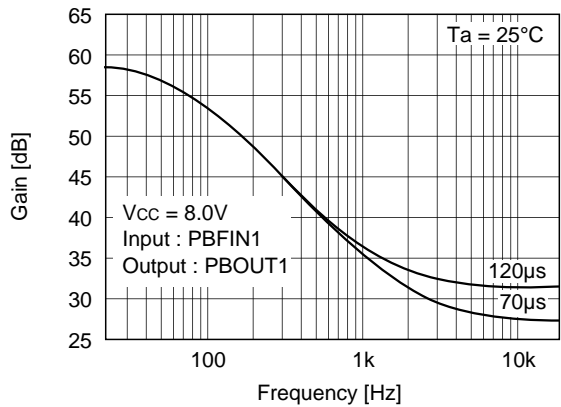
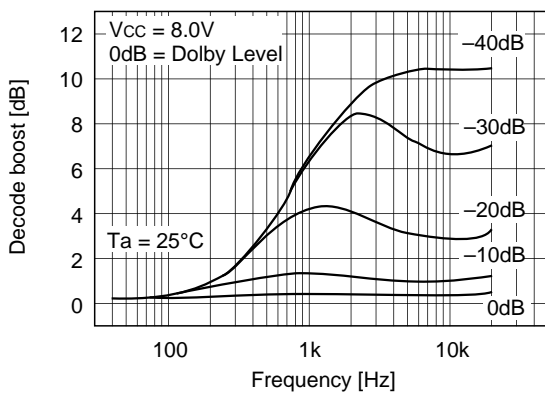
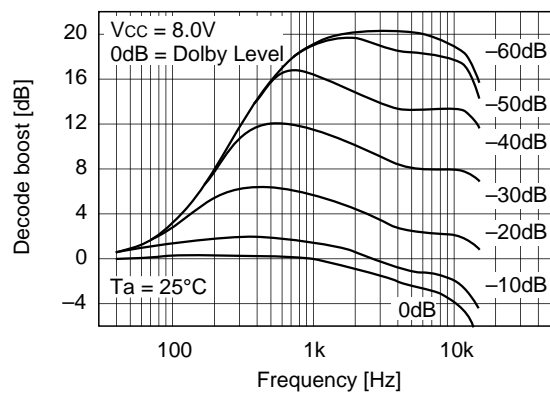


Fig. 6 Measurement circuit for playback equalizer amplifier frequency response

**B type decode boost characteristics**

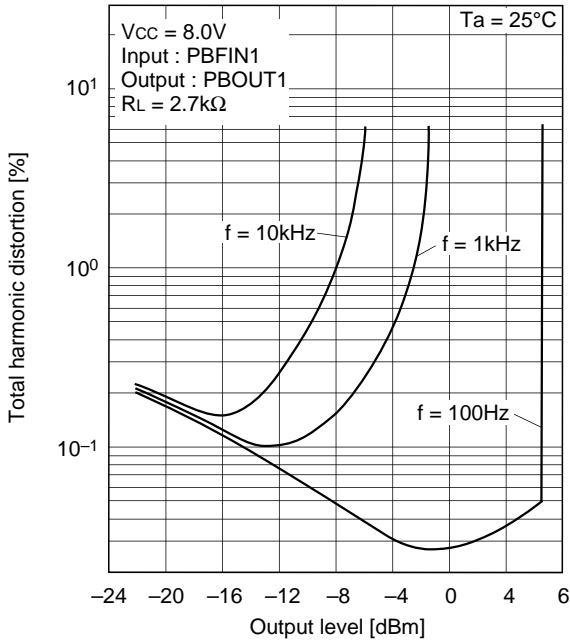


**C type decode boost characteristics**

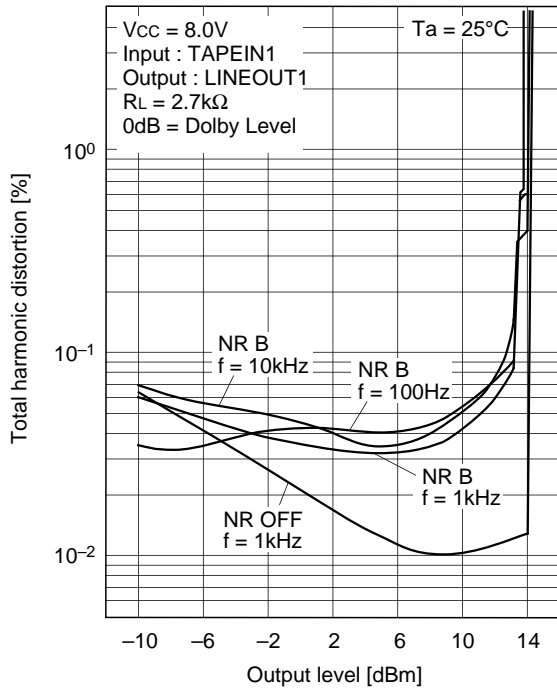




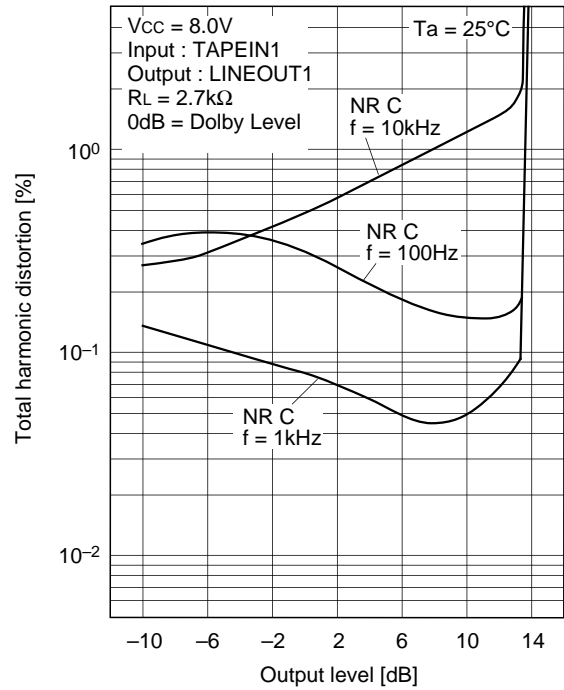
**Total harmonic distortion (playback equalizer amplifier)**



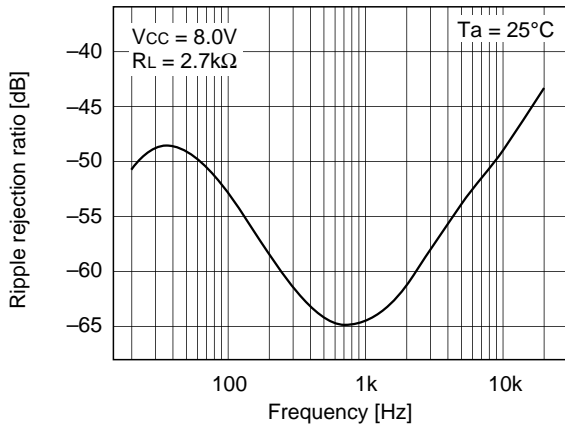
**B type total harmonic distortion (NR OFF included)**



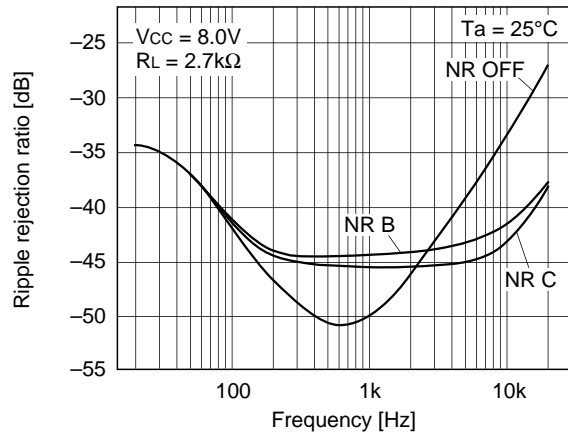
**C type total harmonic distortion**



Ripple rejection ratio (PBOUT)



Ripple rejection ratio (LINEOUT)



Crosstalk between channels (1ch → 2ch)

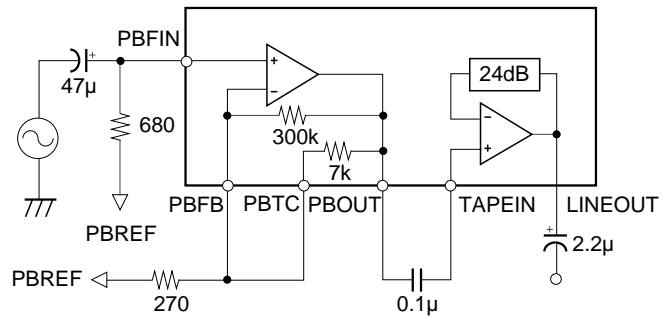
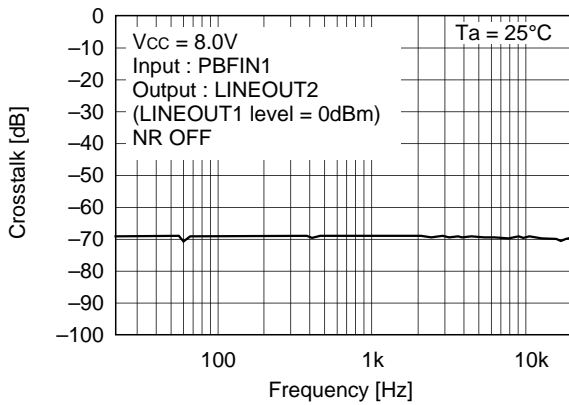
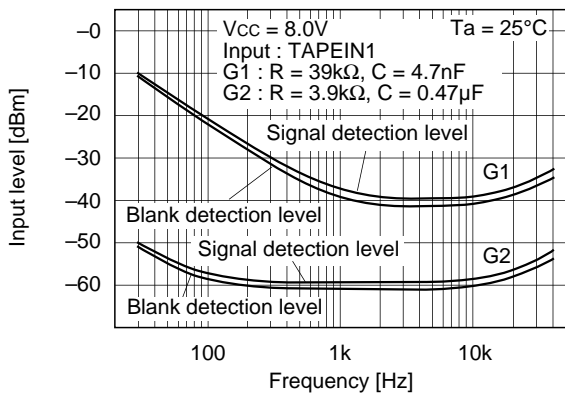
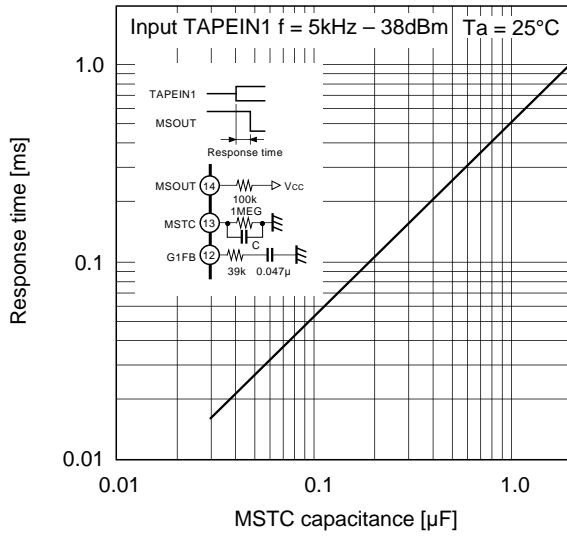


Fig. 7 Measurement circuit for crosstalk between channels

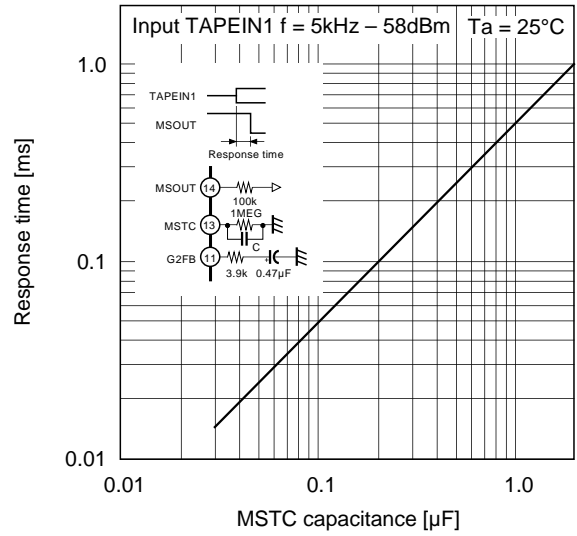
Frequency response for signal and blank detection level



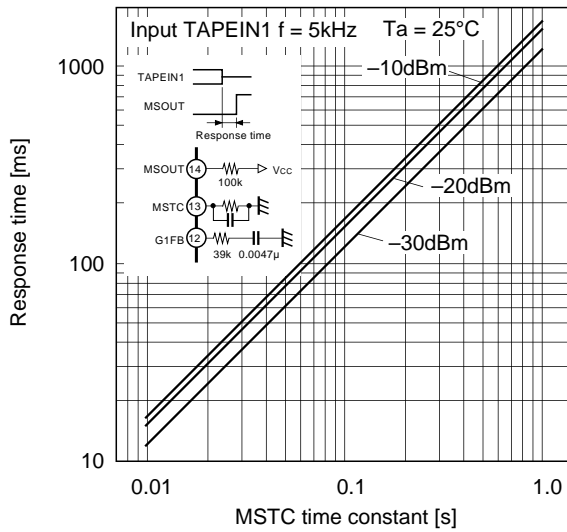
**Signal detection response time (G1)**



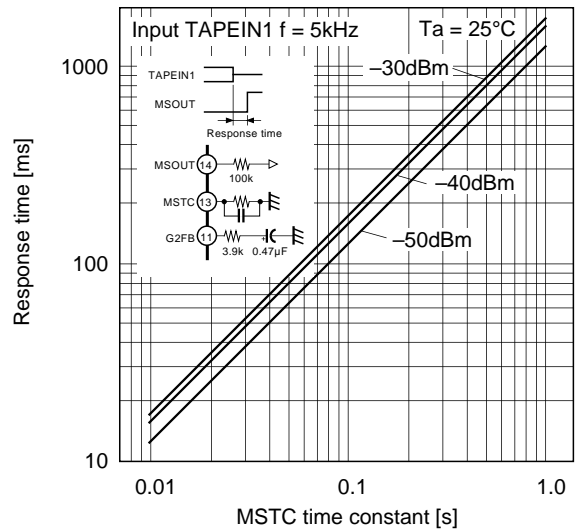
**Signal detection response time (G2)**



**Blank detection response time (G1)**

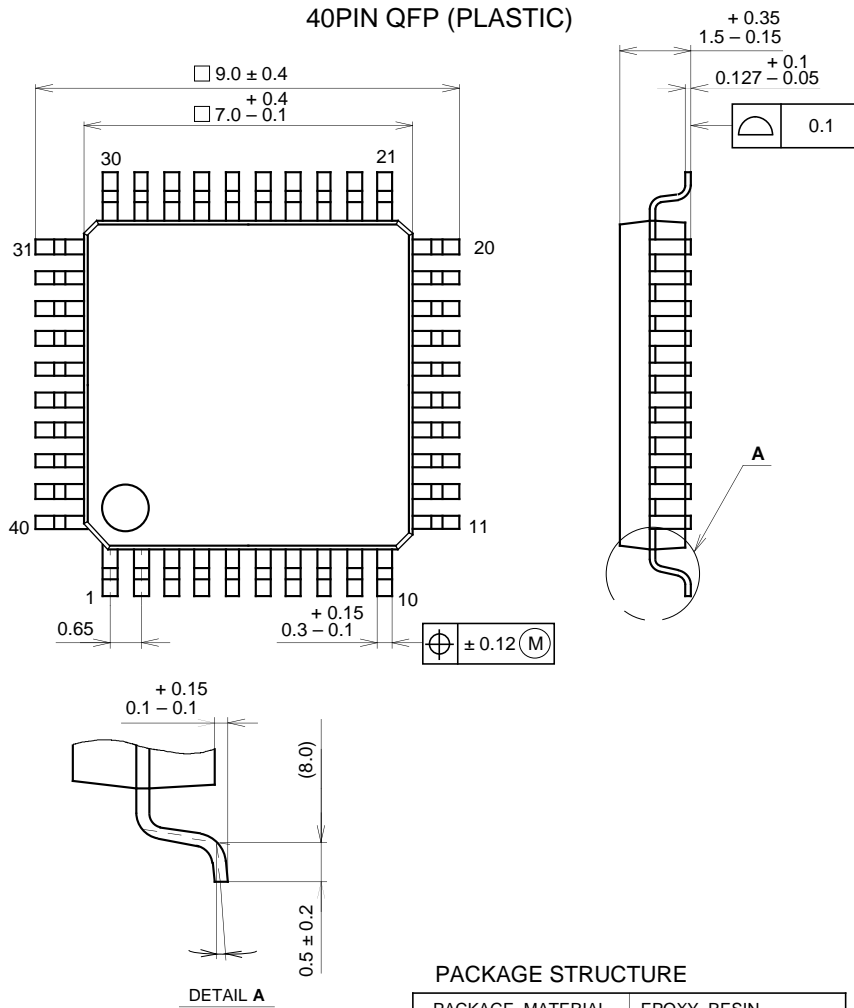


**Signal detection response time (G2)**



Package Outline

Unit: mm



|            |                |
|------------|----------------|
| SONY CODE  | QFP-40P-L01    |
| EIAJ CODE  | *QFP040-P-0707 |
| JEDEC CODE | _____          |

**PACKAGE STRUCTURE**

|                  |                            |
|------------------|----------------------------|
| PACKAGE MATERIAL | EPOXY RESIN                |
| LEAD TREATMENT   | SOLDER / PALLADIUM PLATING |
| LEAD MATERIAL    | COPPER / 42 ALLOY          |
| PACKAGE WEIGHT   | 0.2g                       |

**NOTE : PALLADIUM PLATING**

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