

# AN2904FHQ

## Sound input/output interface IC for digital still camera

### ■ Overview

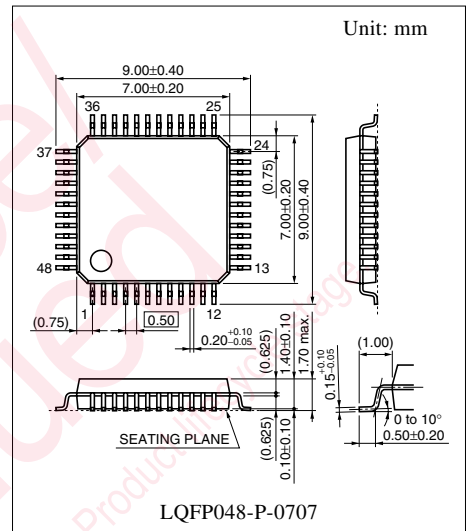
The AN2904FHQ is a sound input/output interface IC which is optimum for incorporation of sound functions in a digital still camera. The sound front-side processing prior to the digital processing and sound rear-side processing after DAC are integrated on a single chip. The IC is effective to make the equipment compact.

### ■ Features

- Functions required for a front and rear side sound processing are integrated on a single chip
- Built-in a microphone amp. and a microphone power source
- Built-in a 0.5 W BTL amp.
- Built-in a BTL amp. power save function
- Built-in an internal microphone amp. off function (Usable for an external microphone amp.)

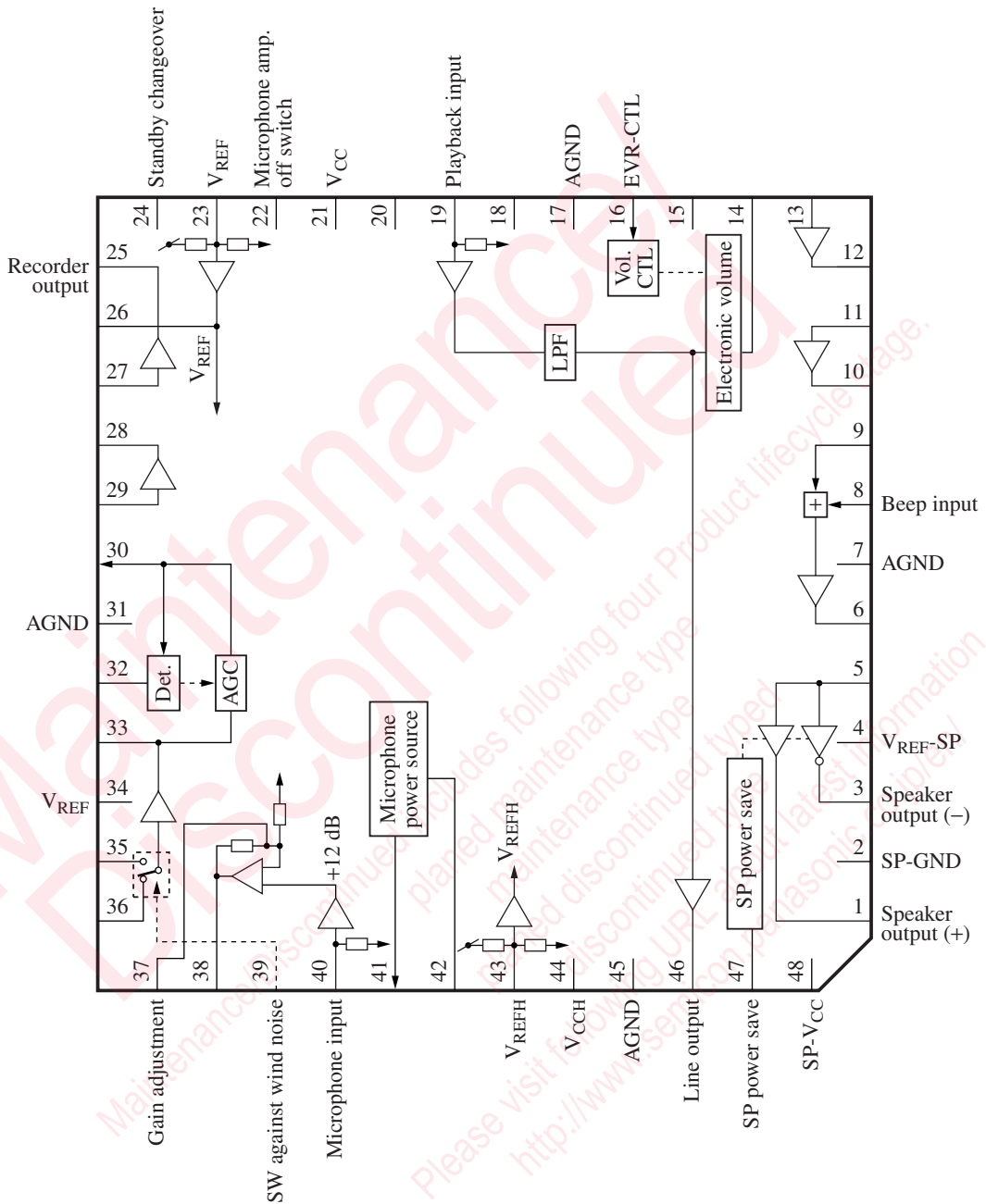
### ■ Applications

- Digital still camera (DSC)



Note) The package of this product will be changed to lead-free type (LQFP048-P-0707A). See the new package dimensions section later of this datasheet.

■ Block Diagram



## ■ Pin Descriptions

| Pin No. | Description                         | Pin No. | Description                           |
|---------|-------------------------------------|---------|---------------------------------------|
| 1       | Speaker output (+)                  | 25      | Rec. output                           |
| 2       | GND (for SP)                        | 26      | HPF operational amp. output           |
| 3       | Speaker output (-)                  | 27      | HPF operational amp. input            |
| 4       | $1/2 V_{CC-SP}$                     | 28      | LPF output                            |
| 5       | Speaker amp. input                  | 29      | LPF operational amp. input            |
| 6       | Mix. amp. output                    | 30      | AGC output                            |
| 7       | GND                                 | 31      | GND                                   |
| 8       | Beep input                          | 32      | AGC detection pin                     |
| 9       | Mix. amp. input                     | 33      | Wind noise HPF output                 |
| 10      | SP block HPF output                 | 34      | Wind noise HPF bias output            |
| 11      | SP block HPF operational amp. input | 35      | Wind noise HPF operational amp. input |
| 12      | Buffer amp. output                  | 36      | Wind noise HPF through input          |
| 13      | Buffer amp. input                   | 37      | Microphone amp. negative feedback pin |
| 14      | Electrotonic volume output          | 38      | Microphone amp. output                |
| 15      | N.C.                                | 39      | SW against wind noise                 |
| 16      | Electrotonic volume control         | 40      | Microphone amp. input                 |
| 17      | GND                                 | 41      | Microphone power source               |
| 18      | N.C.                                | 42      | Microphone power source smoothing pin |
| 19      | Playback input                      | 43      | $1/2 V_{CCH} (V_{REFH})$              |
| 20      | N.C.                                | 44      | $V_{CCH}$                             |
| 21      | $V_{CC}$                            | 45      | GND                                   |
| 22      | Microphone amp. power save SW       | 46      | Line output                           |
| 23      | $1/2 V_{CC} (V_{REF})$              | 47      | Speaker power save SW                 |
| 24      | Standby changeover                  | 48      | $V_{CC-SP}$ (for speaker drive)       |

## ■ Absolute Maximum Ratings

| Parameter                        | Symbol      | Rating      | Unit |
|----------------------------------|-------------|-------------|------|
| Supply voltage *2                | $V_{CCH}$   | 5.2         | V    |
|                                  | $V_{CC}$    | 3.5         |      |
|                                  | $V_{CC-SP}$ | 5.2         |      |
| Supply current                   | $I_{CC}$    | —           | A    |
| Power dissipation *3             | $P_D$       | 361         | mW   |
| Operating ambient temperature *1 | $T_{opr}$   | -20 to +70  | °C   |
| Storage temperature *1           | $T_{stg}$   | -55 to +150 | °C   |

Note) \*1: Except for the operating ambient temperature and storage temperature, all ratings are for  $T_a = 25^\circ\text{C}$ .

\*2: When used within the range not exceeding the absolute maximum ratings and the power dissipation.

\*3: The power dissipation shown is for the independent IC without a heat sink at  $T_a = 70^\circ\text{C}$ .

### ■ Recommended Operating Range

| Parameter      | Symbol        | Range        | Unit |
|----------------|---------------|--------------|------|
| Supply voltage | $V_{CCH}$     | 4.50 to 5.00 | V    |
|                | $V_{CC}$      | 2.70 to 3.30 |      |
|                | $V_{CC-SP}^*$ | 2.70 to 5.00 |      |

Note) \*: When used within the range not exceeding the absolute maximum ratings and the power dissipation.

### ■ Electrical Characteristics at $V_{CCH} = 4.9\text{ V}$ , $V_{CC} = 3.1\text{ V}$ , $V_{CC-SP} = 4.1\text{ V}$ , $T_a = 25^\circ\text{C}$

| Parameter   | Symbol      | Conditions  | Min | Typ  | Max  | Unit |
|---|-------------|---|-----|------|------|------|
| <b>Circuit current</b>  |             |   |     |      |      |      |
| Circuit current without signal (1A)<br>( $V_{CC}$ -system)                            | $I_{VCCA}$  | $V_{CC} = 3.10\text{ V}$ , without signal                                 | 2.2 | 3.2  | 4.2  | mA   |
| Circuit current without signal (2A)<br>( $V_{CCH}$ -system)                           | $I_{VCCA}$  | $V_{CCH} = 4.90\text{ V}$ , without signal                                | 1.1 | 2.1  | 3.1  | mA   |
| Circuit current without signal (3A)<br>( $V_{CC-SP}$ -system)                         | $I_{VCCSA}$ | $V_{CC-SP} = 4.10\text{ V}$ , without signal                              | 1.0 | 4.0  | 8.0  | mA   |
| Circuit current without signal (1B)<br>( $V_{CC}$ -system)                            | $I_{VCCB}$  | $V_{CC} = 3.10\text{ V}$ at I/O power save                                | —   | 0.3  | 1.5  | mA   |
| Circuit current without signal (2B)<br>( $V_{CCH}$ -system)                           | $I_{VCCB}$  | $V_{CCH} = 4.90\text{ V}$ at I/O power save                               | —   | 1.4  | 2.4  | mA   |
| Circuit current without signal (3B)<br>( $V_{CC-SP}$ -system)                         | $I_{VCCSB}$ | $V_{CC-SP} = 4.10\text{ V}$ at SP power save                              | —   | 0.6  | 1.6  | mA   |
| Circuit current without signal (3C)<br>( $V_{CCH}$ -system)                           | $I_{VCCB}$  | $V_{CC-SP} = 4.10\text{ V}$ at SP power save                              | —   | 1.5  | 2.5  | mA   |
| Circuit current without signal (3D)<br>( $V_{CCH}$ -system)                           | $I_{VCCB}$  | $V_{CC-SP} = 4.10\text{ V}$ at SP, I/O power save                         | —   | 0.6  | 1.5  | mA   |
| Circuit current without signal (1C)<br>( $V_{CC}$ -system)                            | $I_{VCC}$   | $V_{CC} = 3.10\text{ V}$ with mic.amp. off                                | —   | 1.8  | 2.8  | mA   |
| <b>Power supply for microphone</b>  |             |   |     |      |      |      |
| Microphone supply voltage   | $V_{MIC}$   | $V_{CC} = 3.10\text{ V}$ with output current<br>-5 mA                     | 1.8 | 2.0  | 2.2  | V    |
| <b>Microphone amp. characteristics</b> Microphone amp. input → Microphone amp. output |             |   |     |      |      |      |
| Microphone amp. output level  | VROM        | $V_{IN} = -37\text{ dBFS}$ , 1 kHz  | -9  | -8   | -7   | dBFS |
| Microphone amp. output distortion factor 1  | THROM1      | $V_{IN} = -37\text{ dBFS}$ , 1 kHz<br>up to 5th THD                       | —   | 0.02 | 0.10 | %    |
| Microphone amp. output noise  | NROM        | Without input, using A-curve filter                                       | —   | -89  | -84  | dBFS |
| Microphone amp. output distortion factor 2  | THROM2      | $V_{IN} = -33\text{ dBFS}$ , 1 kHz<br>up to 5th THD, Load = 22 k $\Omega$ | —   | 0.02 | 1.0  | %    |

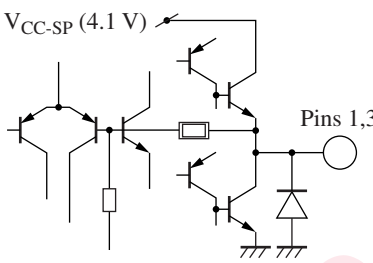
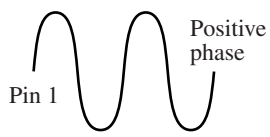
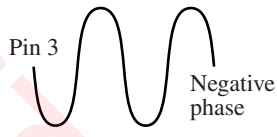
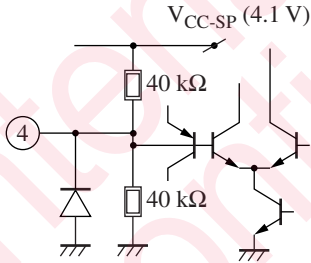
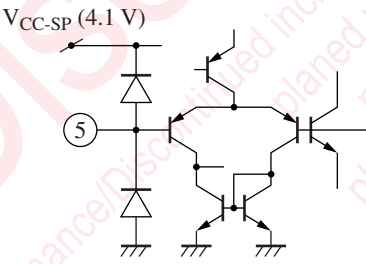
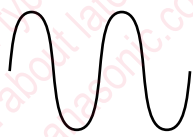
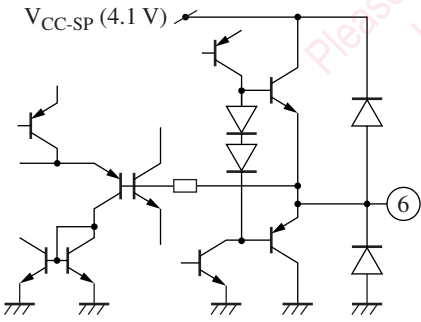
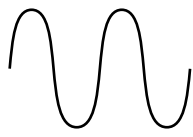
**■ Electrical Characteristics at  $V_{CCH} = 4.9\text{ V}$ ,  $V_{CC} = 3.1\text{ V}$ ,  $V_{CC-SP} = 4.1\text{ V}$ ,  $T_a = 25^\circ\text{C}$  (continued)**

| Parameter   | Symbol     | Conditions  | Min   | Typ   | Max   | Unit |
|---|------------|---|-------|-------|-------|------|
| <b>Rec. AGC characteristics</b>   |            | <b>AGC input → Rec. input</b>   |       |       |       |      |
| Rec. reference output level A<br>(Input: microphone amp.)               | VROA       | $V_{IN} = -38\text{ dBs}$ , 1 kHz   | -13.3 | -12.3 | -11.3 | dBs  |
| Rec. reference output distortion factor 1A (Input: microphone amp.)     | THROA      | $V_{IN} = -38\text{ dBs}$ , 1 kHz<br>up to 5th THD  | —     | 0.02  | 0.10  | %    |
| Rec. output noise voltage A   | VNROA      | Without input signal,<br>using A-curve filter   | —     | -80   | -75   | dBs  |
| Microphone AGC characteristics 1<br>Reference +5 dB                     | VAGCML1    | $V_{IN} = -33\text{ dBs}$ , 1 kHz   | -9.3  | -7.3  | -5.3  | dBs  |
| Microphone AGC characteristics 2<br>Reference +10 dB                    | VAGCML2    | $V_{IN} = -28\text{ dBs}$ , 1 kHz   | -9.0  | -6.0  | -3.0  | dBs  |
| Microphone AGC characteristics 3<br>Reference +16 dB                    | VAGCML6    | $V_{IN} = -22\text{ dBs}$ , 1 kHz   | -8.8  | -5.8  | -2.8  | dBs  |
| Microphone AGC characteristics 3<br>distortion factor. Reference +16 dB | THAGCML3   | $V_{IN} = -22\text{ dBs}$ , 1 kHz<br>up to 5th THD  | —     | 0.15  | 0.40  | %    |
| Microphone AGC characteristics 4<br>Reference +34 dB                    | VAGCM4     | $V_{IN} = -4\text{ dBs}$ , 1 kHz  | -8.0  | -5.0  | -2.0  | dBs  |
| Microphone AGC characteristics 4<br>distortion factor. Reference +34 dB | THAGCML4   | $V_{IN} = -4\text{ dBs}$ , 1 kHz<br>up to 5th THD, Load = 22 k $\Omega$                             | —     | 0.2   | 1.0   | %    |
| AGC-DC offset voltage   | $V_{DROM}$ | Without input signal,<br>difference from $V_{REF}$ voltage  | -30   | 0     | +30   | mV   |
| <b>PB line output characteristics</b>                                   |            | <b>PB input → Line output</b>   |       |       |       |      |
| Line reference output level<br>at playback                              | VLOPS      | $V_{IN} = -12.3\text{ dBs}$ , 1 kHz   | -8.0  | -7.0  | -6.0  | dBs  |
| Line reference output distortion<br>factor at playback                  | THLOPS     | $V_{IN} = -12.3\text{ dBs}$ , 1 kHz<br>up to 5th THD  | —     | 0.02  | 0.10  | %    |
| Line reference output noise<br>at playback                              | VNOPS      | Without input signal,<br>using A-curve filter, up to 5th THD  | —     | -83   | -78   | dBs  |
| Line maximum output level<br>at playback                                | VLMAPS     | f = 1 kHz, Load = 22 k $\Omega$<br>input level THD = 1% (up to 5th)                                 | 2.8   | 5.7   | —     | dBs  |
| Line crosstalk<br>Mic.-in → Line-out                                    | VSOPS1     | $V_{IN} = -61\text{ dBs}$ , 1 kHz<br>using A-curve filter at PB                                     | —     | -83   | -78   | dB   |
| Rec. crosstalk 1<br>PB-in → Rec.-out                                    | VNOM       | $V_{IN} = -7.3\text{ dBs}$ , 1 kHz<br>using A-curve filter  | —     | -77   | -73   | dB   |
| <b>Electronic volume characteristics</b>                                |            | <b>PB input → EVR output</b>  |       |       |       |      |
| Electronic volume<br>maximum (+10 dB) gain                              | $VEV_{MA}$ | $V_{IN} = -12.3\text{ dBs}$ , 1 kHz<br>Vol. = max. (+10 dB) ( $V_{16} = 3.1\text{ V}$ )             | -6.0  | -5.0  | -4.0  | dBs  |
| Electronic volume<br>typical (0 dB) gain                                | $VEV_{TP}$ | $V_{IN} = -12.3\text{ dBs}$ , 1 kHz<br>Vol. = center (0 dB) ( $V_{16} = 1.55\text{ V}$ )            | -18.0 | -15.0 | -12.0 | dBs  |
| Electronic volume minimum<br>(maximum attenuation) gain                 | $VEV_{MI}$ | $V_{IN} = -12.3\text{ dBs}$ , 1 kHz, Vol. = min.<br>( $V_{16} = 0\text{ V}$ ), using A-curve filter | —     | -90.0 | -80.0 | dBs  |

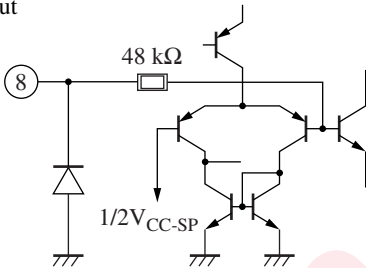
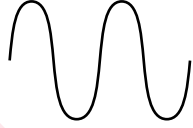
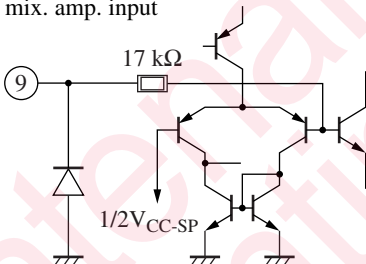
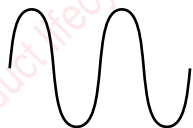
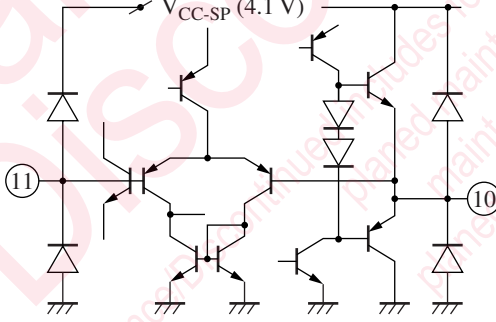

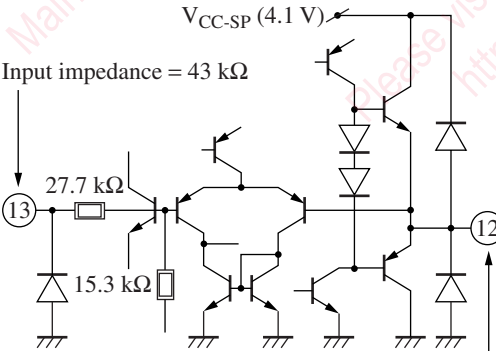
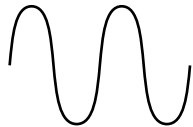
**■ Electrical Characteristics at  $V_{CCH} = 4.9\text{ V}$ ,  $V_{CC} = 3.1\text{ V}$ ,  $V_{CC-SP} = 4.1\text{ V}$ ,  $T_a = 25^\circ\text{C}$  (continued)**

| Parameter   | Symbol    | Conditions   | Min | Typ | Max | Unit |
|---|-----------|--|-----|-----|-----|------|
| <b>Speaker output-system characteristics</b>      |           |  |     |     |     |      |
| SP reference output level at playback             | VSPPS     | $V_{IN} = -14.3\text{ dBs}$ , 1 kHz<br>Vol. = max. (+10 dB), $R_{OUT} = 8\ \Omega$                           | 0.0 | 1.5 | 3.0 | dBs  |
| SP reference output distortion factor at playback | THSPPS    | $V_{IN} = -14.3\text{ dBs}$ , 1 kHz<br>Vol. = max. (+10 dB), $R_{OUT} = 8\ \Omega$                           | —   | 0.2 | 0.9 | %    |
| SP reference output noise voltage at playback     | VNSPPS    | Vol. = center (0 dB), using A-curve filter, $R_{OUT} = 8\ \Omega$ , without signal                           | —   | -78 | -74 | dBs  |
| SP maximum rating output at playback              | VMSPPS    | Vol. = max. (+10 dB), $f = 1\text{ kHz}$<br>Power consumption at $R_{OUT} = 8\ \Omega$<br>TDH = 10%          | 300 | 500 | —   | mW   |
| SP output at power save and playback              | VPSPPS    | $V_{IN} = -14.3\text{ dBs}$ , 1 kHz,<br>Vol. = max. (+10 dB),<br>using A-curve filter, $R_{OUT} = 8\ \Omega$ | —   | -93 | -90 | dBs  |
| SP reference output level 2<br>Beep input-system  | VSPPSB    | $V_{IN} = -7\text{ dBs}$ , 1 kHz<br>Vol. = max. (+10 dB), $R_{OUT} = 8\ \Omega$                              | 0.0 | 1.5 | 3.0 | dBs  |
| <b>Mode selection hold voltage</b>                |           |  |     |     |     |      |
| HPF on/off. Off hold voltage range                | $V_{39L}$ |  | 0.0 | —   | 0.5 | V    |
| HPF on/off. On hold voltage range                 | $V_{39H}$ |  | 2.6 | —   | 3.1 | V    |
| SP output on/off<br>On hold voltage range         | $V_{47L}$ |  | 0.0 | —   | 0.5 | V    |
| SP output on/off<br>Off hold voltage range        | $V_{47H}$ |  | 2.6 | —   | 4.1 | V    |
| Standby on/off<br>On hold voltage range           | $V_{24L}$ |  | 0.0 | —   | 0.5 | V    |
| Standby on/off<br>Off hold voltage range          | $V_{24H}$ |  | 2.6 | —   | 3.1 | V    |
| Microphone amp. on/off<br>On hold voltage range   | $V_{22L}$ |  | 0.0 | —   | 0.5 | V    |
| Microphone amp. on/off<br>Off hold voltage range  | $V_{22H}$ |  | 2.6 | —   | 3.1 | V    |

Terminal Equivalent Circuits

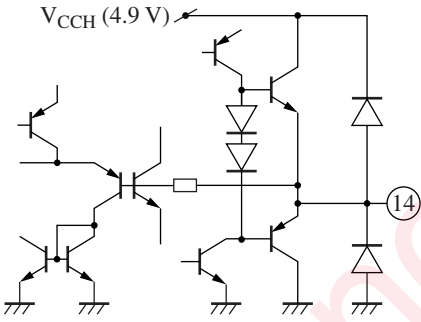
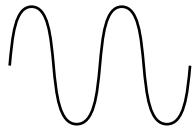
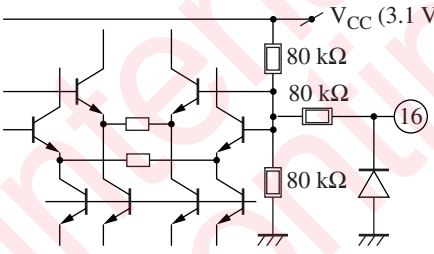
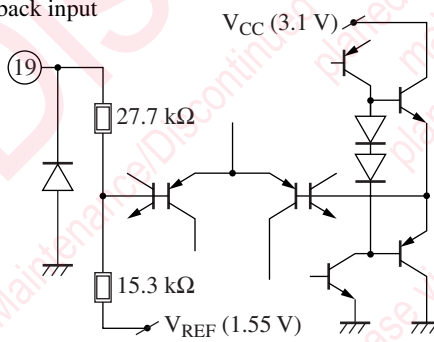

| Pin No. | Equivalent circuit  | Voltage/waveform  |
|---------|---|---|
| 1       | <p>Speaker output</p>  <p>Output impedance = 10 Ω or less</p>              |  <p>Pin 1 Positive phase</p>  <p>Pin 3 Negative phase</p> <p>DC 2.05 V<br/>AC 1.5 dBS</p> |
| 2       | GND   | —   |
| 3       | Speaker output Refer to pin 1   | Refer to pin 1  |
| 4       | <p>1/2 V<sub>CC-SP</sub></p>  <p>Input impedance = 20 kΩ</p>               | DC 2.05 V   |
| 5       | <p>SP amp. input</p>  <p>Input impedance = high impedance</p>            |  <p>High impedance</p>  |
| 6       | <p>SP block mix. amp. output</p>  <p>Output impedance = 10 Ω or less</p> |  <p>DC 2.05 V<br/>AC -24 dBS</p>  |

■ Terminal Equivalent Circuits (continued)

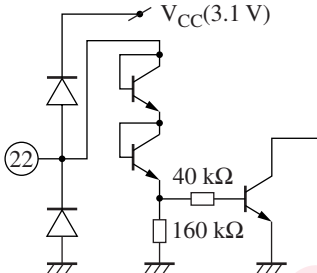
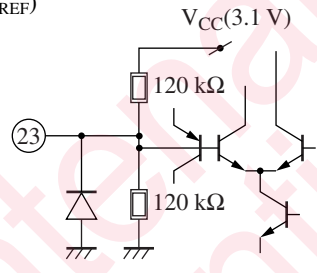
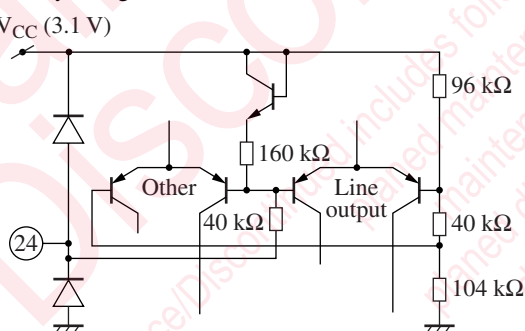
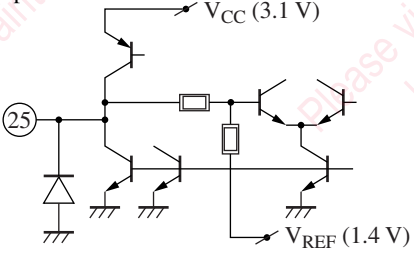

| Pin No.  | Equivalent circuit  | Voltage/waveform  |
|----------|---|---|
| 7        | GND   | —   |
| 8        | <p>Beep input</p>  <p>Input impedance = 48 kΩ</p>  |  <p>DC 2.05 V<br/>AC -15 dB</p>   |
| 9        | <p>SP block mix. amp. input</p>  <p>Input impedance = 17 kΩ</p>                                |  <p>DC 2.05 V<br/>AC -24 dB</p>   |
| 10<br>11 | <p>SP block HPF buffer circuit</p>  <p>Output impedance = 10 Ω or less</p>                    |  <p>DC 2.05 V<br/>AC -24 dB</p> |
| 12<br>13 | <p>Buffer circuit</p>  <p>Input impedance = 43 kΩ</p> <p>Output impedance = 10 Ω or less</p> |  <p>DC 2.05 V<br/>AC -15 dB</p> |



■ Terminal Equivalent Circuits (continued)

| Pin No. | Equivalent circuit   | Voltage/waveform   |
|---------|--|--|
| 14      | <p>Electronic volume output</p>  <p>Output impedance = 10 Ω or less</p> |  <p>DC 2.45 V<br/>AC -15 dBS</p>     |
| 15      | N.C.   | —  |
| 16      | <p>Electronic volume control</p>  <p>Input impedance = 120 kΩ</p>       | DC 1.55 V  |
| 17      | GND  | —  |
| 18      | N.C.   | —  |
| 19      | <p>Playback input</p>  <p>Input impedance = 43 kΩ</p>                 |  <p>DC 1.55 V<br/>AC -12.3 dBS</p> |
| 20      | GND  | —  |
| 21      | V <sub>CC</sub>  | DC 3.1 V   |

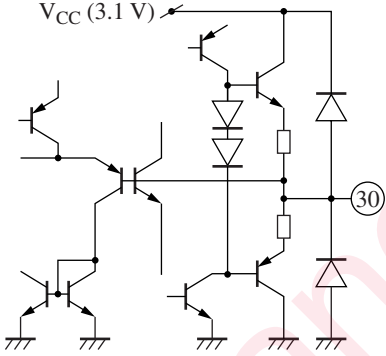
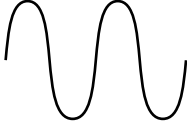
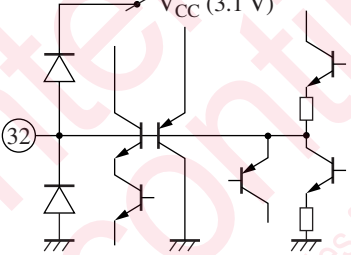
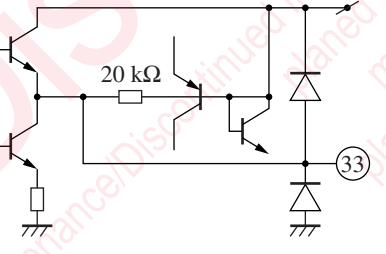

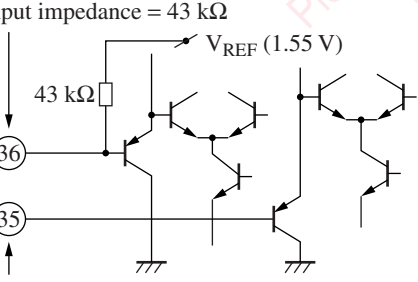
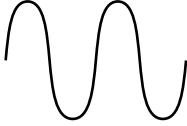
■ Terminal Equivalent Circuits (continued)

| Pin No. | Equivalent circuit   | Voltage/waveform   |
|---------|--|--|
| 22      | <p>Microphone amp. off switch</p>  <p>Input impedance = 32 kΩ</p>                         | —  |
| 23      | <p>1/2 V<sub>CC</sub> (V<sub>REF</sub>)</p>  <p>Input impedance = 60 kΩ</p>               | DC 1.55 V  |
| 24      | <p>Standby changeover</p> <p>V<sub>CC</sub> (3.1 V)</p>  <p>Input impedance = 200 kΩ</p> | DC 1.55 V  |
| 25      | <p>Rec. output</p>  <p>Output impedance = 10 Ω or less</p>                              |  <p>DC 1.55 V<br/>AC -12.3 dBs</p> |

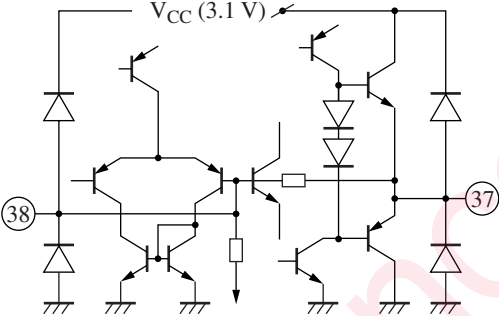
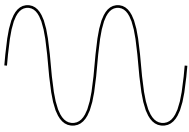
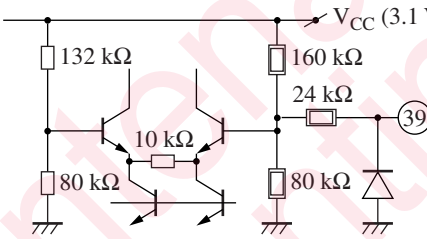
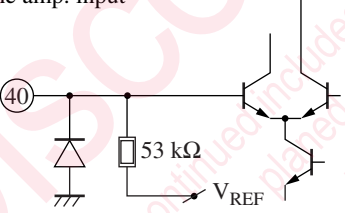

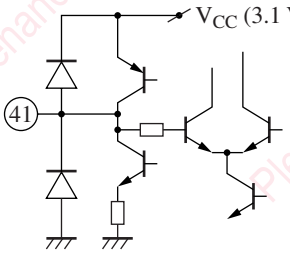
■ Terminal Equivalent Circuits (continued)

| Pin No.  | Equivalent circuit   | Voltage/waveform                |
|----------|--|---------------------------------|
| 26       | <p><math>V_{REF}</math> output</p> <p>Output impedance = 100 <math>\Omega</math></p>             | <p>DC 1.55 V</p>                |
| 27       | <p>Input impedance = high impedance</p>  | <p>DC 1.55 V<br/>AC -26 dBS</p> |
| 28<br>29 | <p>Input impedance = high impedance</p> <p>Output impedance = 10 <math>\Omega</math> or less</p> | <p>DC 1.55 V<br/>AC -26 dBS</p> |

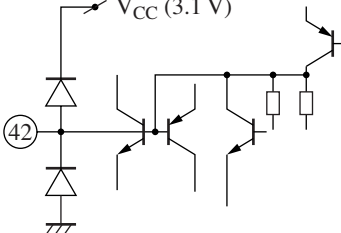
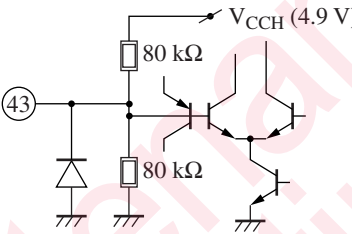
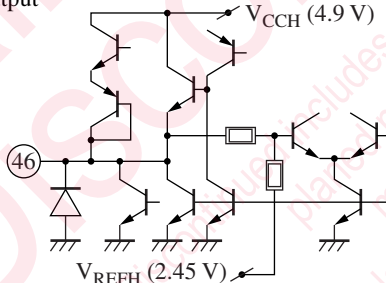

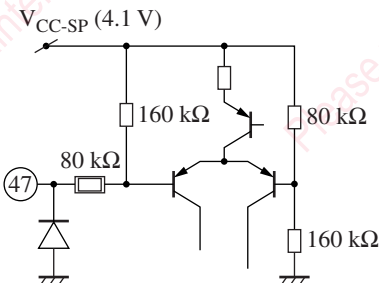
■ Terminal Equivalent Circuits (continued)

| Pin No.  | Equivalent circuit  | Voltage/waveform   |
|----------|---|--|
| 30       | <p>Microphone AGC output</p>  <p>Output impedance = 10 Ω or less</p>   |  <p>DC 1.55 V<br/>AC -26 dBs</p>   |
| 31       | GND   | —  |
| 32       | <p>Microphone AGC detection pin</p>  <p>Output impedance = 10 Ω or less</p>   | DC 0 ~ 1 V   |
| 33       | <p>Microphone AGC input</p>  <p>Output impedance = 10 Ω or less</p>  |  <p>DC 1.55 V<br/>AC -38 dBs</p> |
| 34       | Refer to pin 26   | Refer to pin 26  |
| 35<br>36 | <p>Input changeover circuit for microphone HPF</p> <p>Input impedance = 43 kΩ</p>  <p>Input impedance = high impedance</p> |  <p>DC 1.55 V<br/>AC -38 dBs</p> |

■ Terminal Equivalent Circuits (continued)

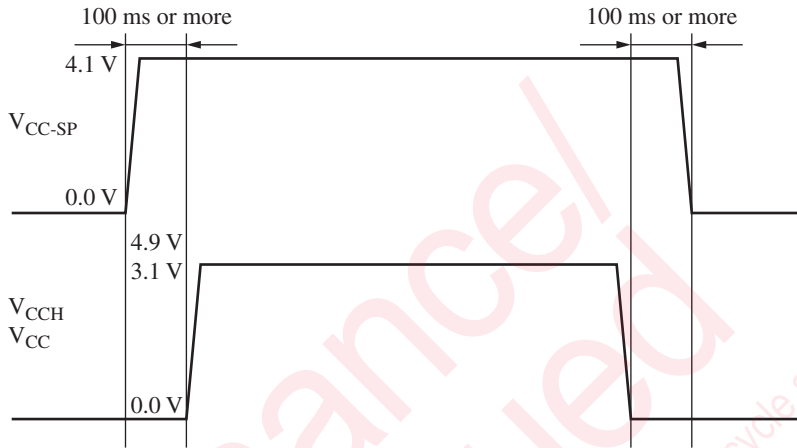
| Pin No.  | Equivalent circuit  | Voltage/waveform  |
|----------|---|---|
| 37<br>38 | <p data-bbox="230 237 569 266">Microphone amp. gain changeover</p>  <p data-bbox="343 598 665 627">Output impedance = 10 Ω or less</p> |  <p data-bbox="967 492 1081 556">DC 1.55 V<br/>AC -38 dBS</p>     |
| 39       | <p data-bbox="230 643 500 672">Measure against wind noise</p>  <p data-bbox="377 937 624 966">Input impedance = 53 kΩ</p>              | <p data-bbox="967 643 1077 672">DC 1.03 V</p>   |
| 40       | <p data-bbox="230 977 459 1006">Microphone amp. input</p>  <p data-bbox="377 1226 624 1255">Input impedance = 53 kΩ</p>               |  <p data-bbox="967 1163 1081 1226">DC 1.55 V<br/>AC -71 dBS</p> |
| 41       | <p data-bbox="230 1273 500 1302">Microphone supply voltage</p>  <p data-bbox="343 1564 665 1593">Output impedance = 10 Ω or less</p> | <p data-bbox="967 1273 1077 1302">DC 2.0 V</p>  |

■ Terminal Equivalent Circuits (continued)

| Pin No. | Equivalent circuit   | Voltage/waveform   |
|---------|--|--|
| 42      | Smoothing C pin for reg.<br>                                | DC 1.25 V  |
| 43      | $1/2 V_{CCH}$ ( $V_{REFH}$ )<br><br>Input impedance = 40 kΩ | DC 2.45 V  |
| 44      | $V_{CCH}$  | DC 4.9 V   |
| 45      | GND  | —  |
| 46      | Line output<br><br>Output impedance = 10 Ω or less         | <br>DC 2.45 V<br>AC -7 dBs |
| 47      | SP-block power save SW<br><br>Input impedance = 240 kΩ    | —  |
| 48      | $V_{CC-SP}$  | DC 4.1 V   |

■ Usage Notes

- About the power-on order, and the pop noise at SP power source on/off

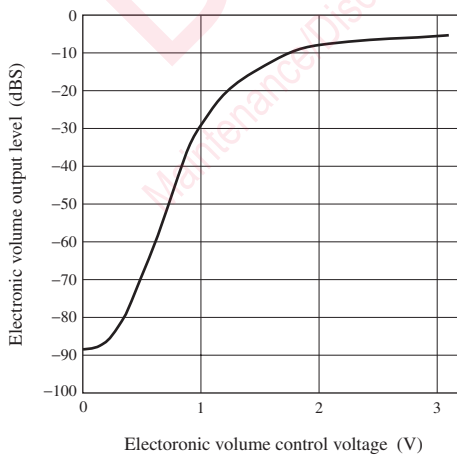


At this time, make power save work, interlocking the SP power save of pin 47 with  $V_{CC-SP}$ , or by applying high level to that pin earlier than  $V_{CC-SP}$ .

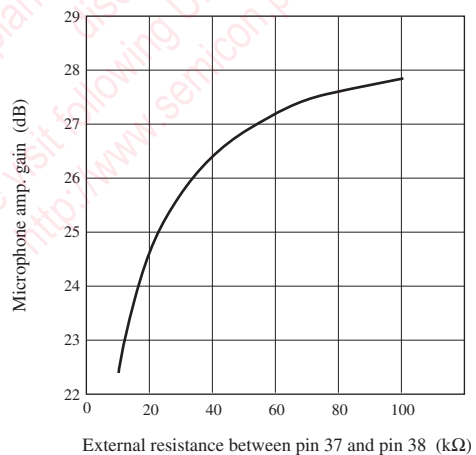
As mentioned above, apply  $V_{CC-SP}$  at the time of power on, and remove  $V_{CC-SP}$  lastly at the power off. This is because an SP power save circuit uses  $V_{CC-SP}$ -system power source. This operation prevents the speaker from generating a pop noise at turning the power on/off.

■ Application Notes

- Electronic volume control curve

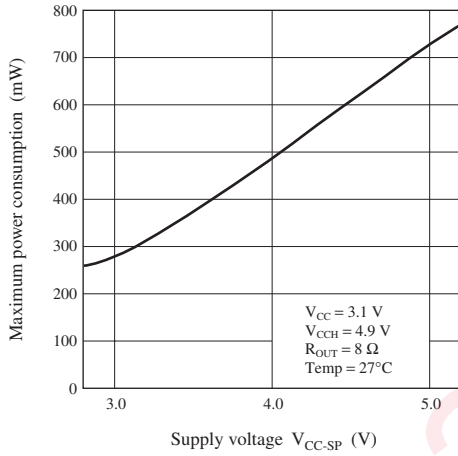


- External resistor vs. microphone gain



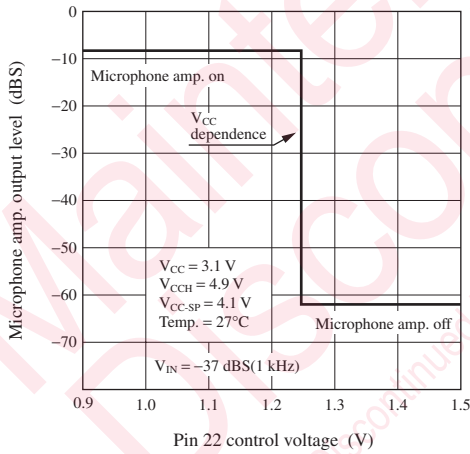
■ Application Notes (continued)

•  $V_{CC-SP}$  vs. maximum power consumption

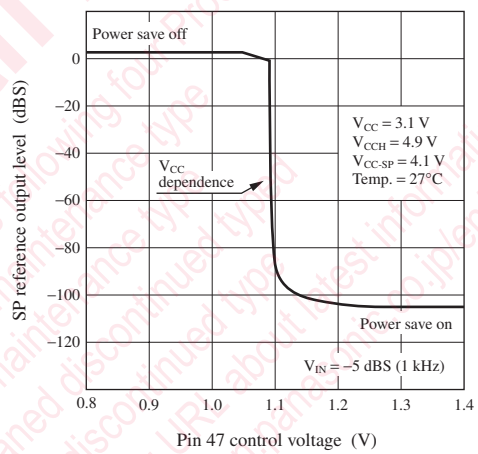


• Changeover voltage of each control pin

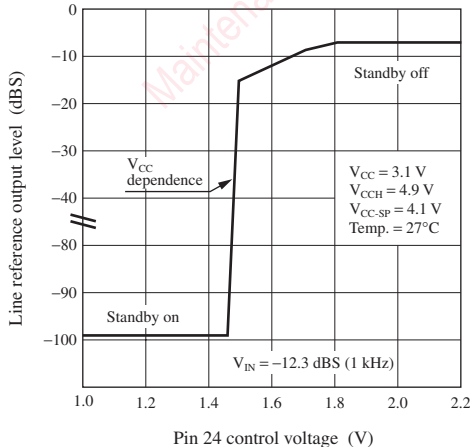
Microphone amp. on/off changeover voltage



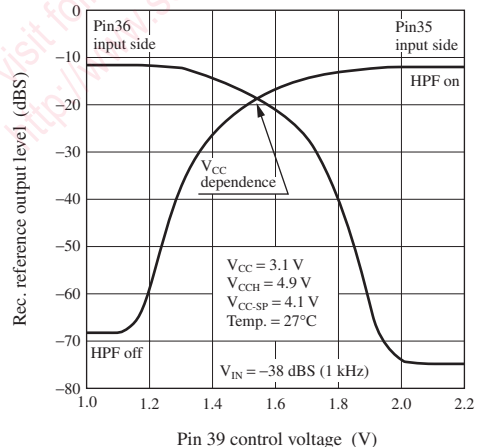
SP power save on/off changeover voltage



Standby on/off changeover voltage

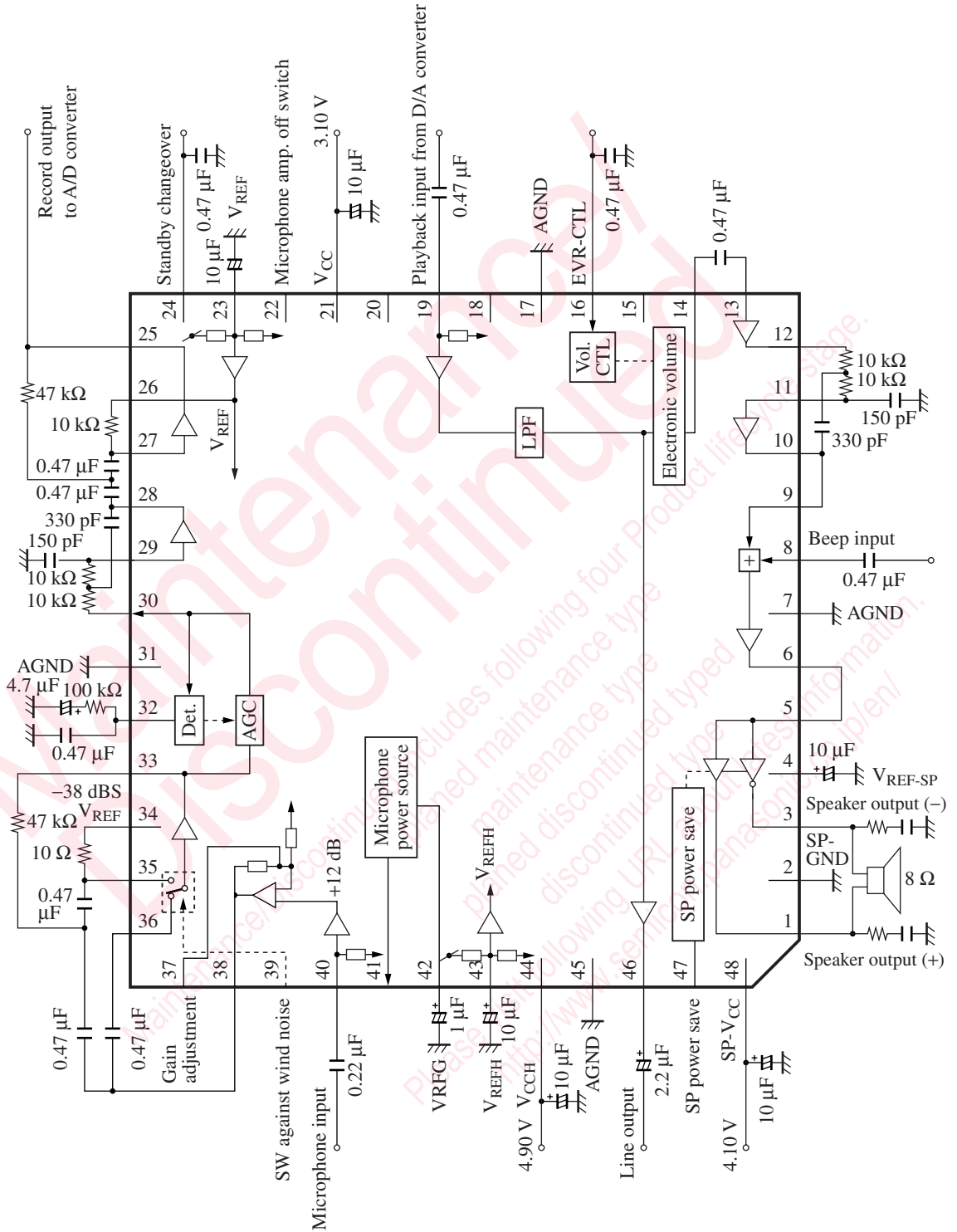


Wind noise HPF on/off changeover voltage





■ Application Circuit Example





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