

# Wireless Audio Link IC

## BH1415F

The BH1415F is a FM stereo transmitter IC that transmits simple configuration. The IC consists of a stereo modulator for generating stereo composite signals and a FM transmitter for broadcasting a FM signal on the air. The stereo modulator generates a composite signal which consists of the MAIN, SUB, and pilot signal from a 38kHz oscillator. The FM transmitter radiates FM wave on the air by modulating the carrier signal with a composite signal.

### ●Applications

CD changer, Car TV, Car navigation, Wireless speakers, Personal computer (sound board), Game machine

### ●Features

- 1) It is possible to improve the timbre because it has the pre-emphasis circuit, limiter circuit, and the low-pass filter circuit.
- 2) Built-in pilot-tone system FM stereo modulator circuit.
- 3) The transmission frequency is stable because it has a PLL system FM transmitter circuit.
- 4) PLL data input (CE, CK, DA) by serial input.

### ●Absolute maximum ratings (Ta = 25°C, In measurement circuit.)

| Parameter                       | Symbol             | Limits                    | Unit | Conditions     |
|---------------------------------|--------------------|---------------------------|------|----------------|
| Supply voltage                  | V <sub>CC</sub>    | +7.0                      | V    | Pin8,12        |
| Data input voltage              | V <sub>IN-D</sub>  | -0.3~V <sub>CC</sub> +0.3 | V    | Pin15,16,17,18 |
| Phase comparator output voltage | V <sub>OUT-P</sub> | -0.3~V <sub>CC</sub> +0.3 | V    | Pin7           |
| Power dissipation               | P <sub>d</sub>     | 450*                      | mW   |                |
| Storage temperature             | T <sub>stg</sub>   | -55~+125                  | °C   |                |

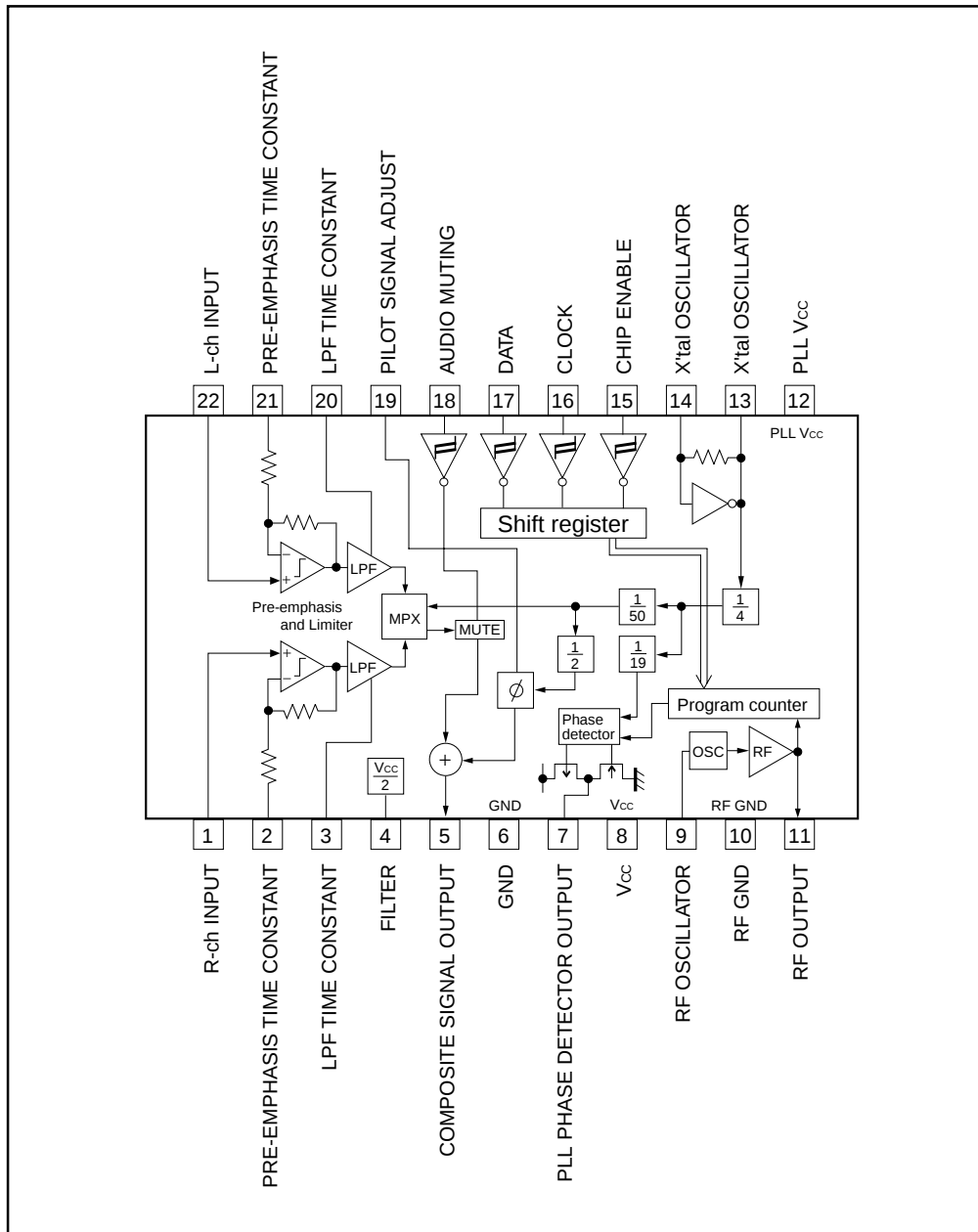
\* Derating : 4.5mW/°C for operation above Ta=25°C.

### ●Recommended operating conditions (Ta = 25°C)

| Parameter                                | Symbol            | Min.               | Typ. | Max.               | Unit | Conditions     |
|------------------------------------------|-------------------|--------------------|------|--------------------|------|----------------|
| Operating supply voltage                 | V <sub>CC</sub>   | 4.0                | —    | 6.0                | V    | Pin8,12        |
| Operating temperature                    | T <sub>opr</sub>  | -40                | —    | +85                | °C   |                |
| Audio input level                        | V <sub>IN-A</sub> | —                  | —    | -10                | dBV  | Pin1,22        |
| Audio input frequency band               | f <sub>IN-A</sub> | 20                 | —    | 15k                | Hz   | Pin1,22        |
| Pre-emphasis time constant set up range  | t <sub>PRE</sub>  | —                  | —    | 155                | μsec | Pin2,21        |
| Transmission frequency                   | f <sub>TX</sub>   | 70                 | —    | 120                | MHz  | Pin9,11        |
| Control terminal "H" level input voltage | V <sub>IH</sub>   | 0.8V <sub>CC</sub> | —    | V <sub>CC</sub>    | V    | Pin15,16,17,18 |
| Control terminal "L" level input voltage | V <sub>IL</sub>   | GND                | —    | 0.2V <sub>CC</sub> | V    | Pin15,16,17,18 |

## Audio ICs

## ●Block diagram



## Audio ICs

## ●Pin descriptions

| Pin No. | Pin descriptions                                                                                                                       | Equivalent circuit | DC (V)              |
|---------|----------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------|
| 1       | R-ch audio source input terminal<br>It cuts DC with the capacitor and it inputs R-ch audio signal.                                     |                    | $\frac{1}{2}V_{CC}$ |
| 22      | L-ch audio source input terminal<br>It cuts DC with the capacitor and it inputs L-ch audio signal.                                     |                    |                     |
| 2,21    | Pre-emphasis time constant terminal<br>It connects a capacitor for the time constant of pre-emphasis.<br>$\tau = 22.7k\Omega \times C$ |                    | $\frac{1}{2}V_{CC}$ |
| 3,20    | LPF time constant terminal<br>This is 15kHz LPF.<br>It connects a 150pF capacitor.                                                     |                    | $\frac{1}{2}V_{CC}$ |
| 4       | Filter terminal<br>It is a ripple filter for the reference voltage of the audio part.                                                  |                    | $\frac{1}{2}V_{CC}$ |
| 5       | Composite signal output terminal<br>It connects to the FM modulator.                                                                   |                    | $\frac{1}{2}V_{CC}$ |
| 6       | GND                                                                                                                                    | _____              | GND                 |
| 7       | PLL phase detector output terminal<br>It connects to the PLL LPF circuit.                                                              |                    | —                   |
| 8       | Power supply terminal                                                                                                                  | _____              | $V_{CC}$            |

## Audio ICs

| Pin No. | Pin descriptions                                                                                                                  | Equivalent circuit | DC (V)              |
|---------|-----------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------|
| 9       | RF oscillator terminal<br><br>This is the base terminal of the colpitts oscillator. It connects time constant of the oscillation. |                    | $\frac{4}{7}V_{CC}$ |
| 10      | RF GND                                                                                                                            | —                  | GND                 |
| 11      | RF transmission output terminal<br><br>It connects to the antenna through BPF.                                                    |                    | $V_{CC} - 1.9$      |
| 12      | PLL power supply terminal                                                                                                         | —                  | $V_{CC}$            |
| 13,14   | X'tal oscillator terminal<br><br>It connects a 7.6MHz crystal oscillator.                                                         |                    | —                   |
| 15      | Chip enable terminal<br><br>The terminal to make high level in serial data input.                                                 |                    | —                   |
| 16      | Clock input terminal<br><br>The clock which takes data and synchronization in serial data input.                                  |                    |                     |
| 17      | Data input terminal<br><br>The input terminal of the serial data which is forwarded from the controller                           |                    |                     |
| 18      | Audio mute terminal<br><br>$0.8V_{CC} \leq \text{Pin18}$ : Mute ON<br>$0.2V_{CC} \geq \text{Pin18}$ : Mute OFF                    |                    |                     |
| 19      | Pilot signal adjust terminal                                                                                                      |                    | $\frac{1}{2}V_{CC}$ |

## Audio ICs

**●Electrical characteristics** (Unless otherwise noted Ta = 25°C, V<sub>CC</sub> = 5.0V, Signal source : f<sub>IN</sub> = 400Hz)

| Parameter                   | Symbol               | Min.                     | Typ.                      | Max. | Unit | Conditions                           | Measurement circuit |
|-----------------------------|----------------------|--------------------------|---------------------------|------|------|--------------------------------------|---------------------|
| Quiescent current           | I <sub>Q</sub>       | 14                       | 20                        | 28   | mA   |                                      | Fig.1               |
| Channel separation          | Sep                  | 25                       | 40                        | –    | dB   | V <sub>IN</sub> =–20dBV<br>L→R,R→L   | Fig.2               |
| Total harmonic distortion   | THD                  | –                        | 0.1                       | 0.3  | %    | V <sub>IN</sub> =–20dBV<br>L+R       | Fig.3               |
| Channel balance             | C.B                  | –2                       | 0                         | +2   | dB   | V <sub>IN</sub> =–20dBV<br>L+R       | Fig.2               |
| Input output gain           | G <sub>V</sub>       | –2                       | 0                         | +2   | dB   | V <sub>IN</sub> =–20dBV<br>L+R       | Fig.3               |
| Pilot modulation rate       | M <sub>P</sub>       | 12                       | 15                        | 18   | %    | V <sub>IN</sub> =–20dBV,L+R<br>Pin5  | Fig.3               |
| Sub carrier rejection ratio | SCR                  | –                        | –30                       | –20  | dB   | V <sub>IN</sub> =–20dBV<br>L+R       | Fig.3               |
| Pre-emphasis time constant  | τ <sub>PRE</sub>     | 40                       | 50                        | 60   | μsec | V <sub>IN</sub> =–20dBV<br>L+R       | Fig.3               |
| Limiter input level         | V <sub>IN(LIM)</sub> | –16                      | –13                       | –10  | dBV  | Output level at 1dB gain compression | Fig.4               |
| LPF cut off frequency       | f <sub>C(LPF)</sub>  | 12                       | 15                        | 18   | kHz  | V <sub>O</sub> =–3dB<br>Pin2,21Open  | Fig.5               |
| Mute attenuation volume     | V <sub>O(MUTE)</sub> | –                        | –48                       | –42  | dB   | V <sub>IN</sub> =–20dBV<br>L+R       | Fig.3               |
| Transmission output level   | V <sub>TX</sub>      | 97                       | 100                       | 103  | dBμV | f <sub>TX</sub> =100MHz              | Fig.6               |
| "H" level input current     | I <sub>IH</sub>      | –                        | –                         | 1.0  | μA   | Pin15,16,17,18 V <sub>IN</sub> =5V   | Fig.7               |
| "L" level input current     | I <sub>IL</sub>      | –1.0                     | –                         | –    | μA   | Pin15,16,17,18 V <sub>IN</sub> =0V   | Fig.7               |
| "H" level output voltage    | V <sub>OH</sub>      | V <sub>CC</sub> –<br>1.0 | V <sub>CC</sub> –<br>0.15 | –    | V    | Pin7 I <sub>OUT</sub> =–1.0mA        | Fig.7               |
| "L" level output voltage    | V <sub>OL</sub>      | –                        | 0.15                      | 1.0  | V    | Pin7 I <sub>OUT</sub> =1.0mA         | Fig.7               |
| "off" level leak current1   | I <sub>OFF1</sub>    | –                        | –                         | 100  | nA   | Pin7 V <sub>OUT</sub> =5V            | Fig.8               |
| "off" level leak current2   | I <sub>OFF2</sub>    | –100                     | –                         | –    | nA   | Pin7 V <sub>OUT</sub> =GND           | Fig.8               |

## ● Measurement circuits

Quiescent current

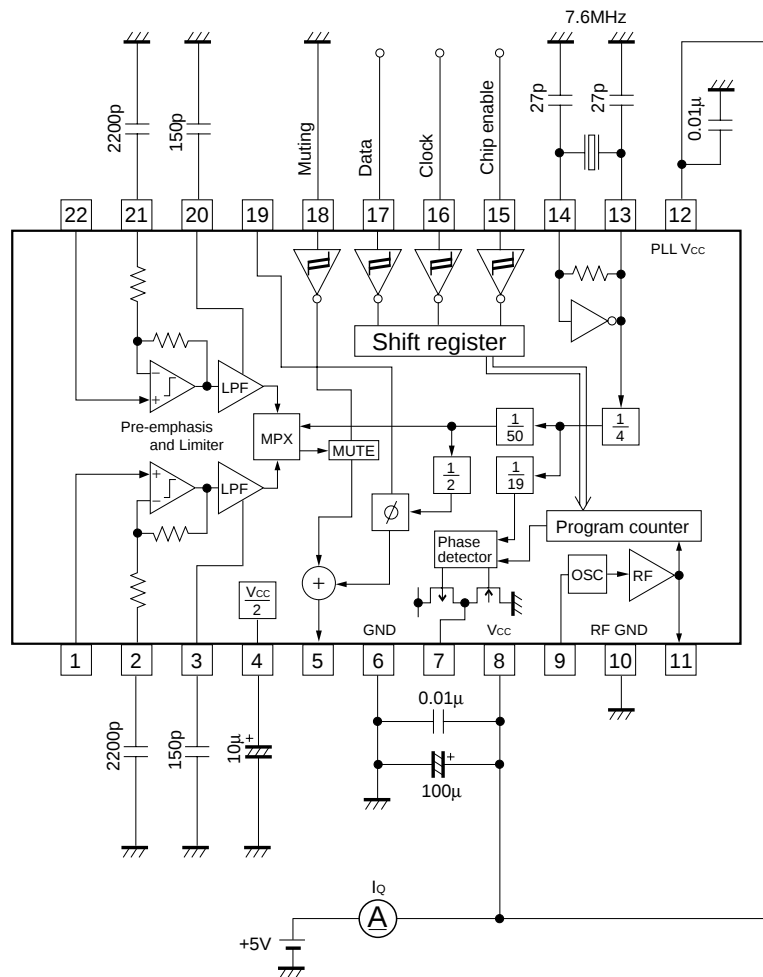


Fig.1

## Audio ICs

Channel separation  
Channel balance

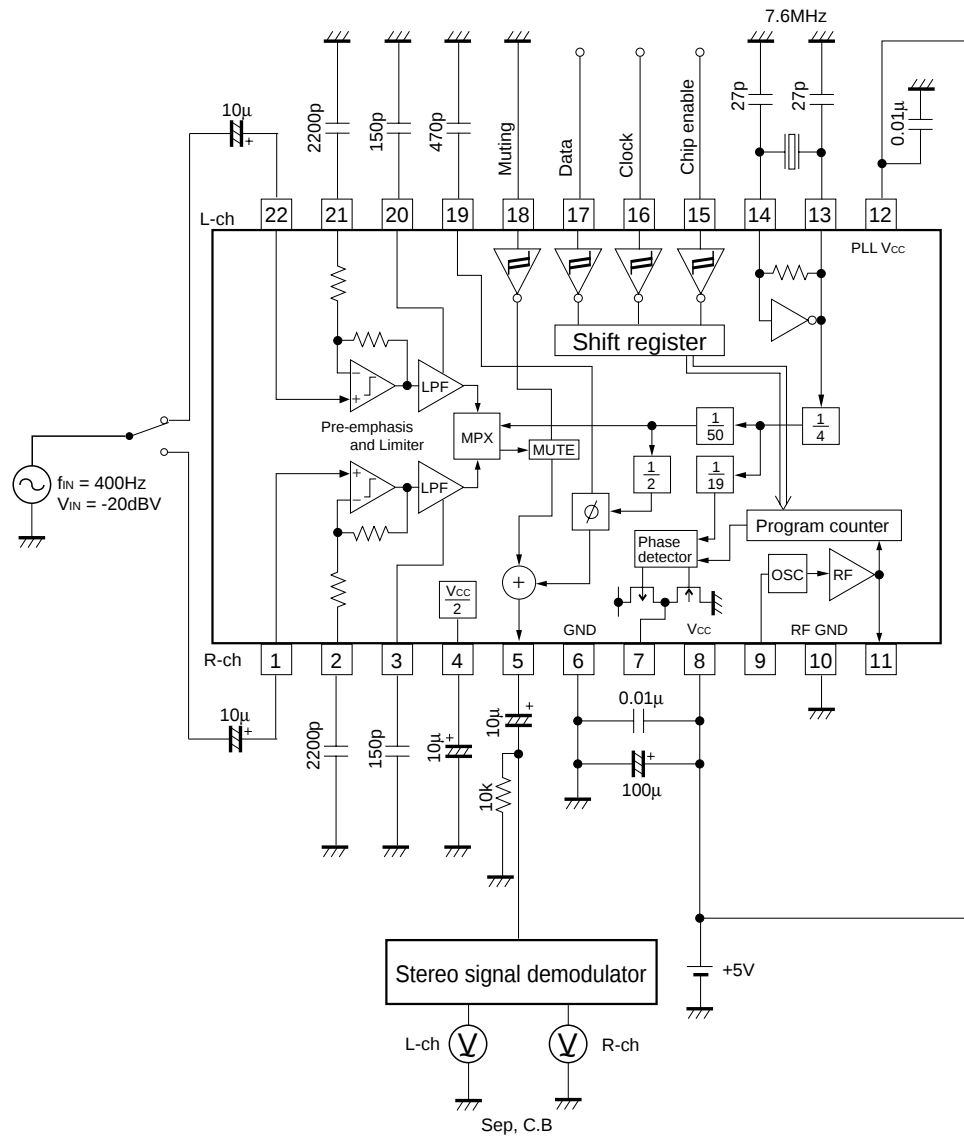
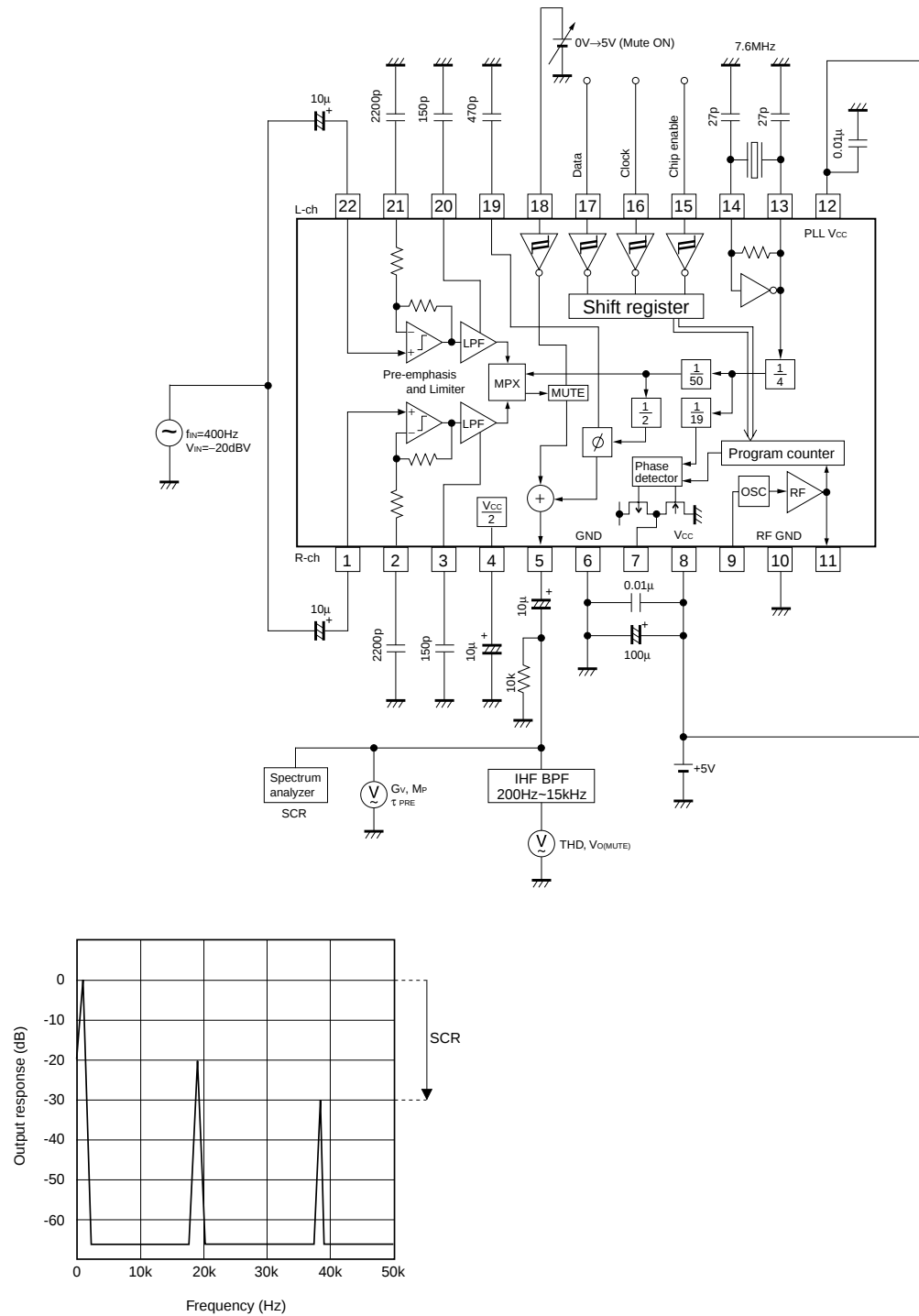


Fig.2

## Audio ICs

Total harmonic distortion  
 Input output gain  
 Pilot index of modulation  
 Sub carrier rejection ratio  
 Pre-emphasis time constant  
 Mute attenuation volume



Limiter input level

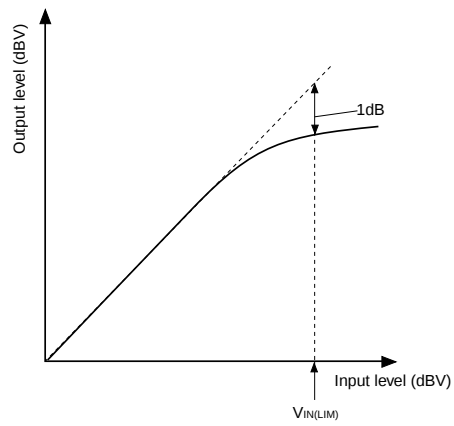
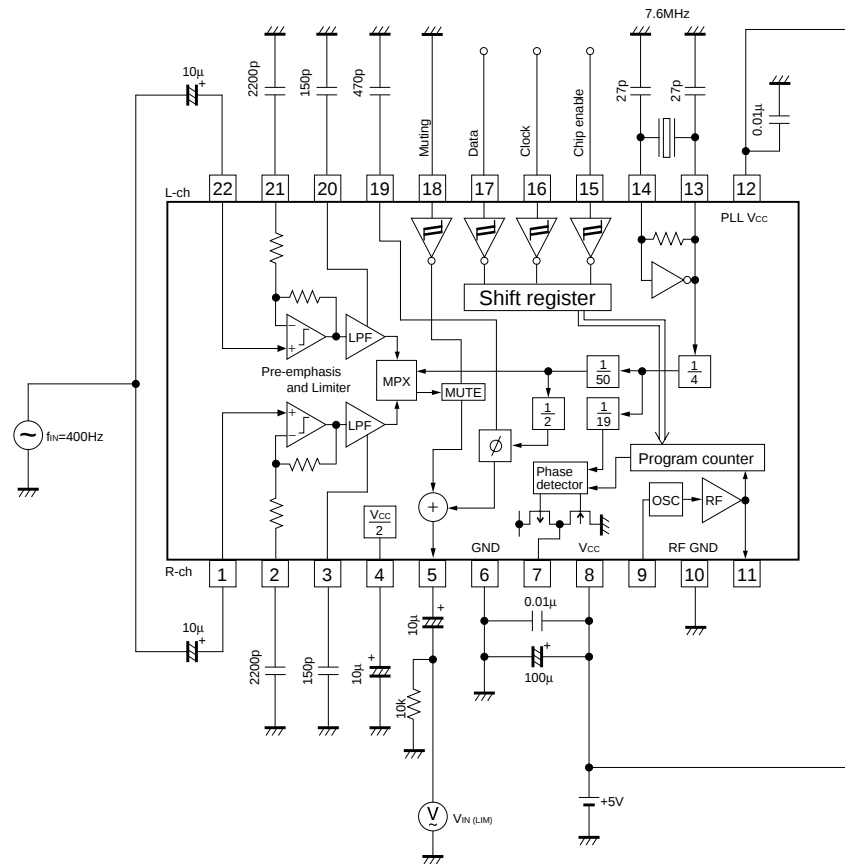


Fig.4

## Audio ICs

LPF cut off frequency

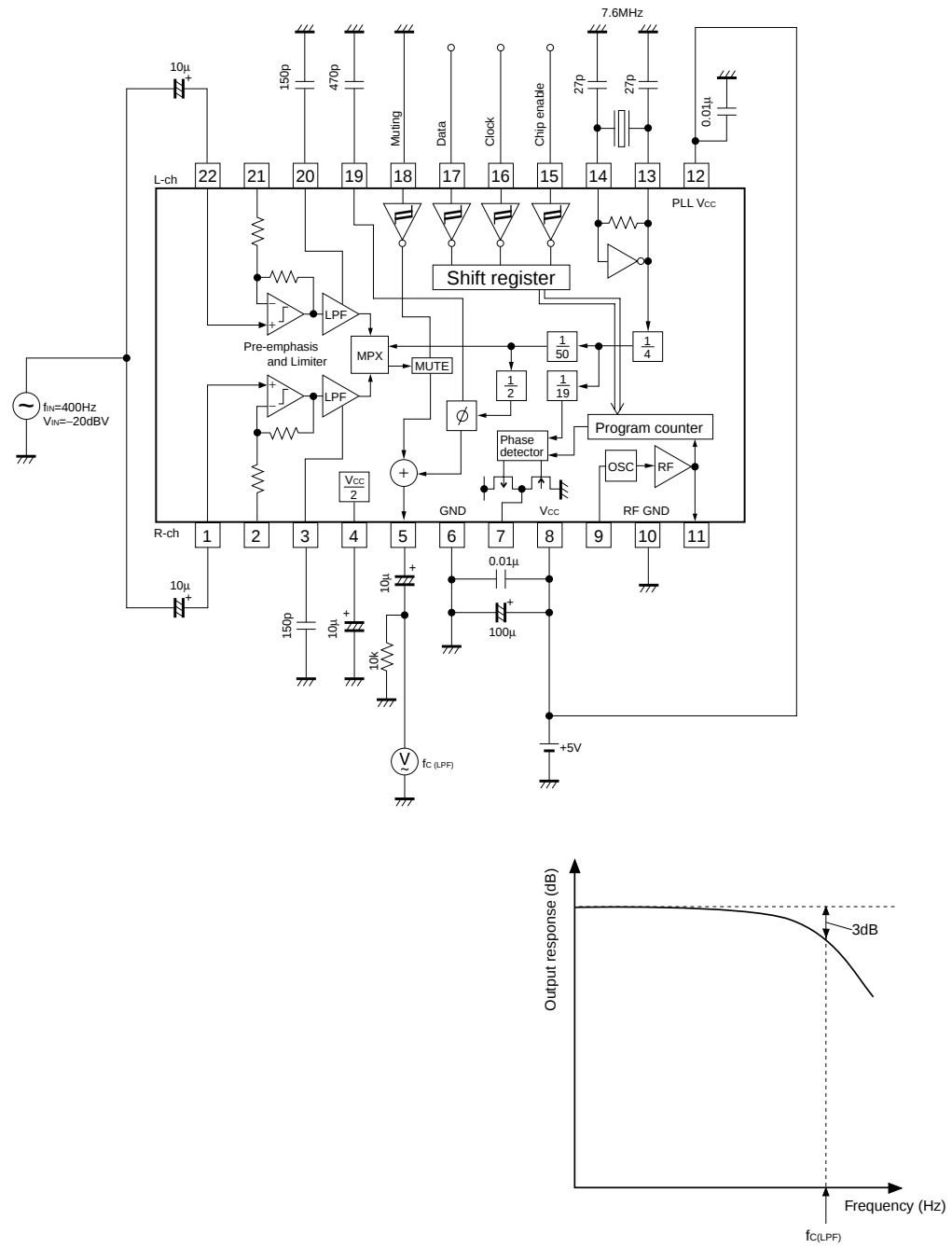


Fig.5

Transmission output level

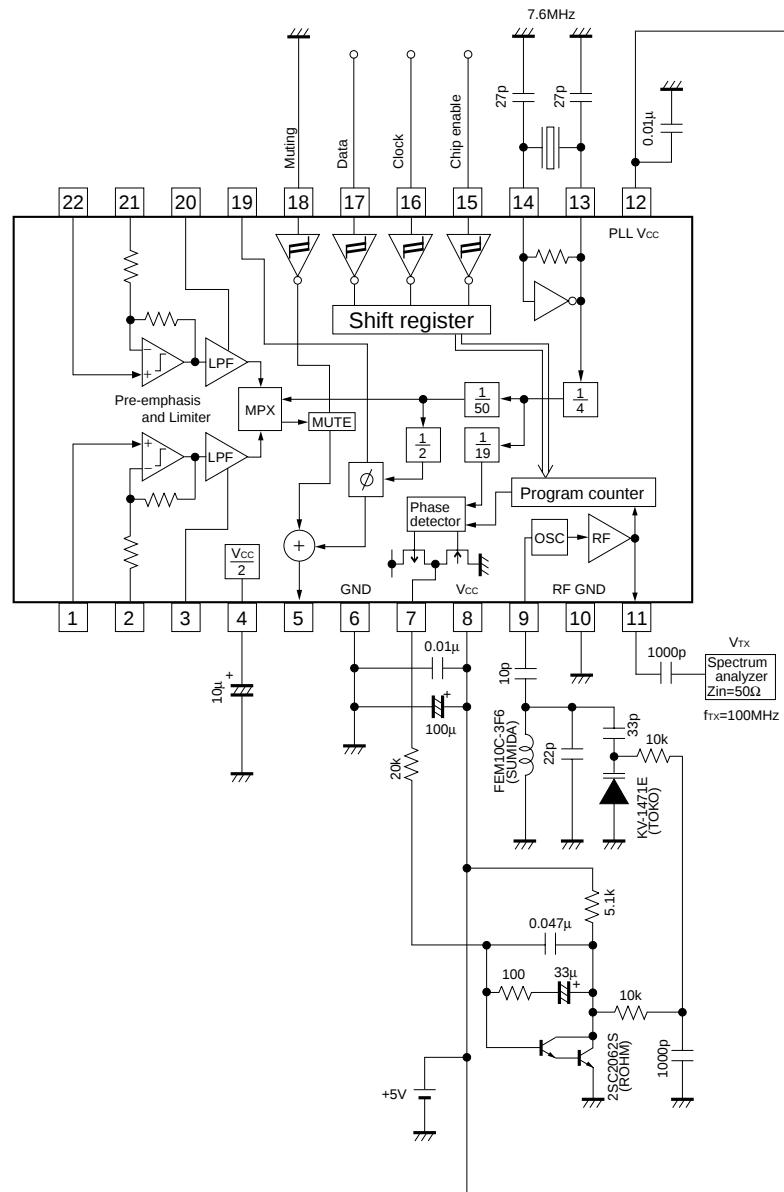


Fig.6

## Audio ICs

"H" level input current  
 "L" level input current  
 "H" level output voltage  
 "L" level output voltage

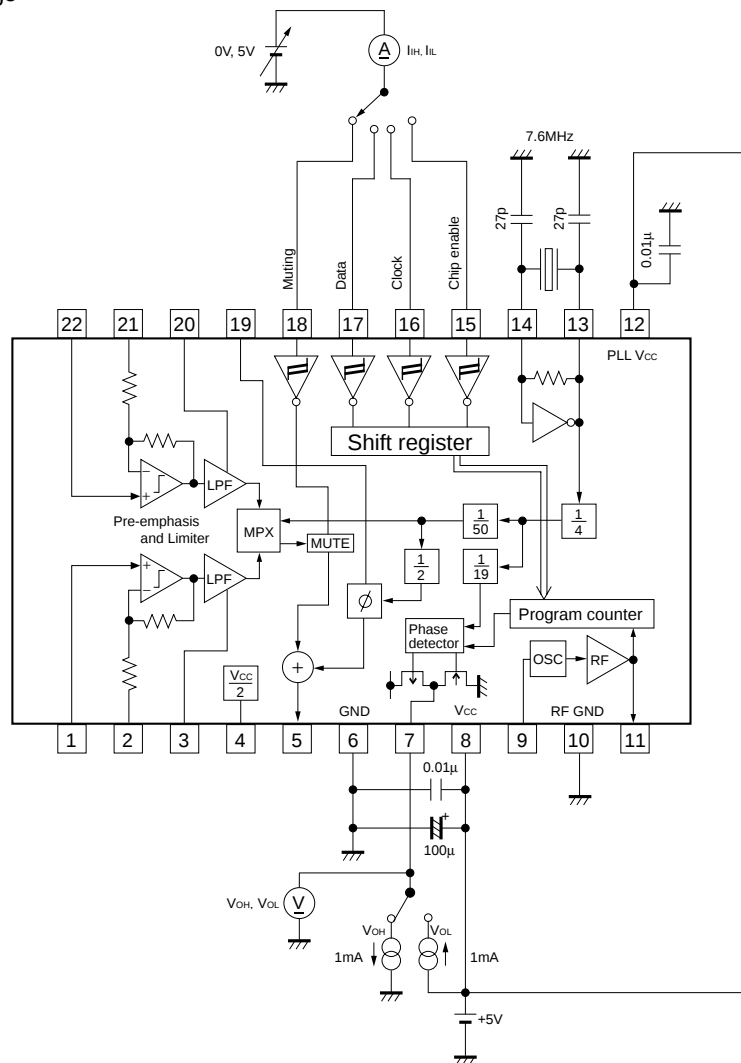


Fig.7

“off” level leak input current

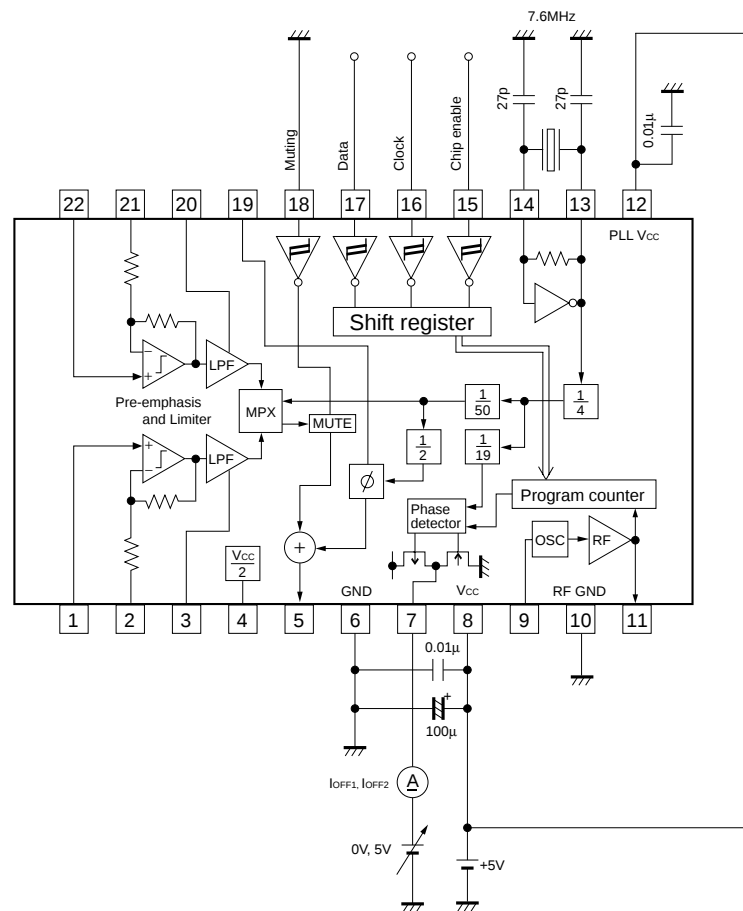


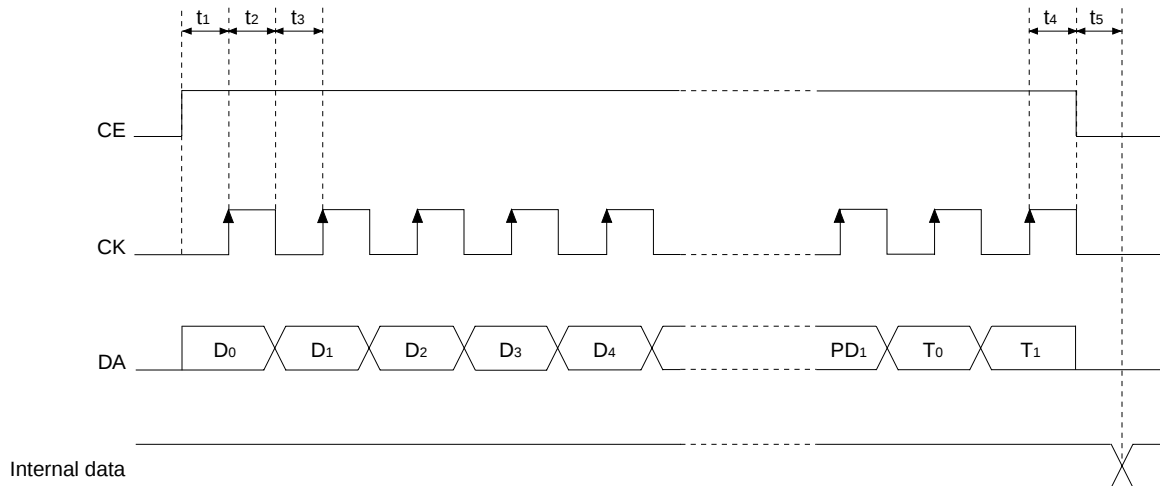
Fig.8

## Audio ICs

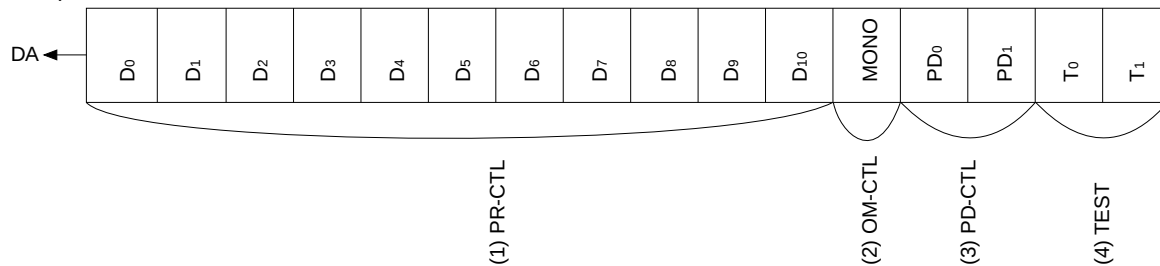
## ●Circuit operations

Input of the serial data

$t_1, t_2, t_3, t_4 \geq 1.5\mu\text{sec}$   
 $t_5 < 1.5\mu\text{sec}$  (X'tal : 7.6MHz)



Composition of the serial data



Explanation of the serial data

| No.            | Control unit / Data                                          | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                |                |                |                |                |                |                 |   |   |   |                |                |                |                |                |                |                |                |                |                |                 |
|----------------|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|---|---|---|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|
| (1)            | <p>PROGRAM COUNTER</p> <p>D<sub>0</sub> ~ D<sub>10</sub></p> | <p>· It is the data which sets the program counter number of the dividing. This data can set a transmission frequency.</p> <p>· It is a binary value. It sets D<sub>10</sub> with MSB and it sets D<sub>0</sub> with LSB.</p> <p>Example In case of 99.7MHz oscillation<br/>99.7MHz ÷ 100kHz(fref) = 997 → 3E5(HEX)</p> <div><div>5</div><div>E</div><div>3</div><table><tr><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td></tr><tr><td>D<sub>0</sub></td><td>D<sub>1</sub></td><td>D<sub>2</sub></td><td>D<sub>3</sub></td><td>D<sub>4</sub></td><td>D<sub>5</sub></td><td>D<sub>6</sub></td><td>D<sub>7</sub></td><td>D<sub>8</sub></td><td>D<sub>9</sub></td><td>D<sub>10</sub></td></tr></table><div>LSB</div><div>MSB</div></div> | 1              | 0              | 1              | 0              | 0              | 1              | 1              | 1               | 1 | 1 | 0 | D <sub>0</sub> | D <sub>1</sub> | D <sub>2</sub> | D <sub>3</sub> | D <sub>4</sub> | D <sub>5</sub> | D <sub>6</sub> | D <sub>7</sub> | D <sub>8</sub> | D <sub>9</sub> | D <sub>10</sub> |
| 1              | 0                                                            | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0              | 0              | 1              | 1              | 1              | 1              | 1              | 0               |   |   |   |                |                |                |                |                |                |                |                |                |                |                 |
| D <sub>0</sub> | D <sub>1</sub>                                               | D <sub>2</sub>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | D <sub>3</sub> | D <sub>4</sub> | D <sub>5</sub> | D <sub>6</sub> | D <sub>7</sub> | D <sub>8</sub> | D <sub>9</sub> | D <sub>10</sub> |   |   |   |                |                |                |                |                |                |                |                |                |                |                 |

## Audio ICs

| No.             | Control unit / Data                                           | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                       |                 |                                   |                    |                                    |   |                                                               |   |   |                   |   |   |                    |   |   |                |
|-----------------|---------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------------------------|--------------------|------------------------------------|---|---------------------------------------------------------------|---|---|-------------------|---|---|--------------------|---|---|----------------|
| (2)             | MULTIPLEXER<br><br>MONO                                       | <ul style="list-style-type: none"><li>It changes a stereo and monaural operation.</li></ul> <table><tr><th>MONO</th><th>Condition of the composite signal</th></tr><tr><td>0</td><td>Monaural operation L+R , Pilot OFF</td></tr><tr><td>1</td><td>Stereo operation L+R+(L-R),sinωst+Psin<math>\frac{\omega_s}{2}</math> t</td></tr></table>                                                                                                   | MONO            | Condition of the composite signal | 0                  | Monaural operation L+R , Pilot OFF | 1 | Stereo operation L+R+(L-R),sinωst+Psin $\frac{\omega_s}{2}$ t |   |   |                   |   |   |                    |   |   |                |
| MONO            | Condition of the composite signal                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                |                 |                                   |                    |                                    |   |                                                               |   |   |                   |   |   |                    |   |   |                |
| 0               | Monaural operation L+R , Pilot OFF                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                |                 |                                   |                    |                                    |   |                                                               |   |   |                   |   |   |                    |   |   |                |
| 1               | Stereo operation L+R+(L-R),sinωst+Psin $\frac{\omega_s}{2}$ t |                                                                                                                                                                                                                                                                                                                                                                                                                                                |                 |                                   |                    |                                    |   |                                                               |   |   |                   |   |   |                    |   |   |                |
| (2)             | PHASE DETECTOR<br><br>PD <sub>0</sub> , PD <sub>1</sub>       | <ul style="list-style-type: none"><li>It controls charge pump output by the phase comparator compulsorily.</li></ul> <table><tr><th>PD<sub>0</sub></th><th>PD<sub>1</sub></th><th>Charge pump output</th></tr><tr><td>0</td><td>0</td><td>Usual operation</td></tr><tr><td>0</td><td>1</td><td>Compulsion by Low</td></tr><tr><td>1</td><td>0</td><td>Compulsion by High</td></tr><tr><td>1</td><td>1</td><td>High impedance</td></tr></table> | PD <sub>0</sub> | PD <sub>1</sub>                   | Charge pump output | 0                                  | 0 | Usual operation                                               | 0 | 1 | Compulsion by Low | 1 | 0 | Compulsion by High | 1 | 1 | High impedance |
| PD <sub>0</sub> | PD <sub>1</sub>                                               | Charge pump output                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                   |                    |                                    |   |                                                               |   |   |                   |   |   |                    |   |   |                |
| 0               | 0                                                             | Usual operation                                                                                                                                                                                                                                                                                                                                                                                                                                |                 |                                   |                    |                                    |   |                                                               |   |   |                   |   |   |                    |   |   |                |
| 0               | 1                                                             | Compulsion by Low                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |                                   |                    |                                    |   |                                                               |   |   |                   |   |   |                    |   |   |                |
| 1               | 0                                                             | Compulsion by High                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                   |                    |                                    |   |                                                               |   |   |                   |   |   |                    |   |   |                |
| 1               | 1                                                             | High impedance                                                                                                                                                                                                                                                                                                                                                                                                                                 |                 |                                   |                    |                                    |   |                                                               |   |   |                   |   |   |                    |   |   |                |
| (3)             | TEST MODE<br><br>T <sub>0</sub> , T <sub>1</sub>              | <ul style="list-style-type: none"><li>It is data for the LSI test.</li><li>Always in T<sub>0</sub> Input "1".</li><li>Always in T<sub>1</sub> Input "0".</li></ul>                                                                                                                                                                                                                                                                             |                 |                                   |                    |                                    |   |                                                               |   |   |                   |   |   |                    |   |   |                |

## ●External dimensions (Units : mm)

