

## Block diagram introduction

Audio signal is input the limiter of IC through Pre-emphasis net, after being dealt with by the built-in limiter, it is sent to the mpx Compound Unit, simultaneity, the signal produced by CRYSTAL (7.6M) gets stereo transmitting signal after being divided channel, then is sent to the mpx Compound Unit and gets compound signal which is dealt with mpx, the compound signal is sent into “osc modulator” to modulate the carrier wave signal produced by osc, after magnified by RF, then is sent to the in-built antenna to transmit signal.

The PLL circuit is made up of “mcu”、“shift register”、“program counter”、phase detector”, through locking the user`s selected channel, the “key button” produce touched-pulse data to turn on or off power and adapt channel, “LCD” is used to indicate the channel, FM, MHz, power ect., the button “power” refers to supplying stable power to MCU and transmitter.

# 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   |                |

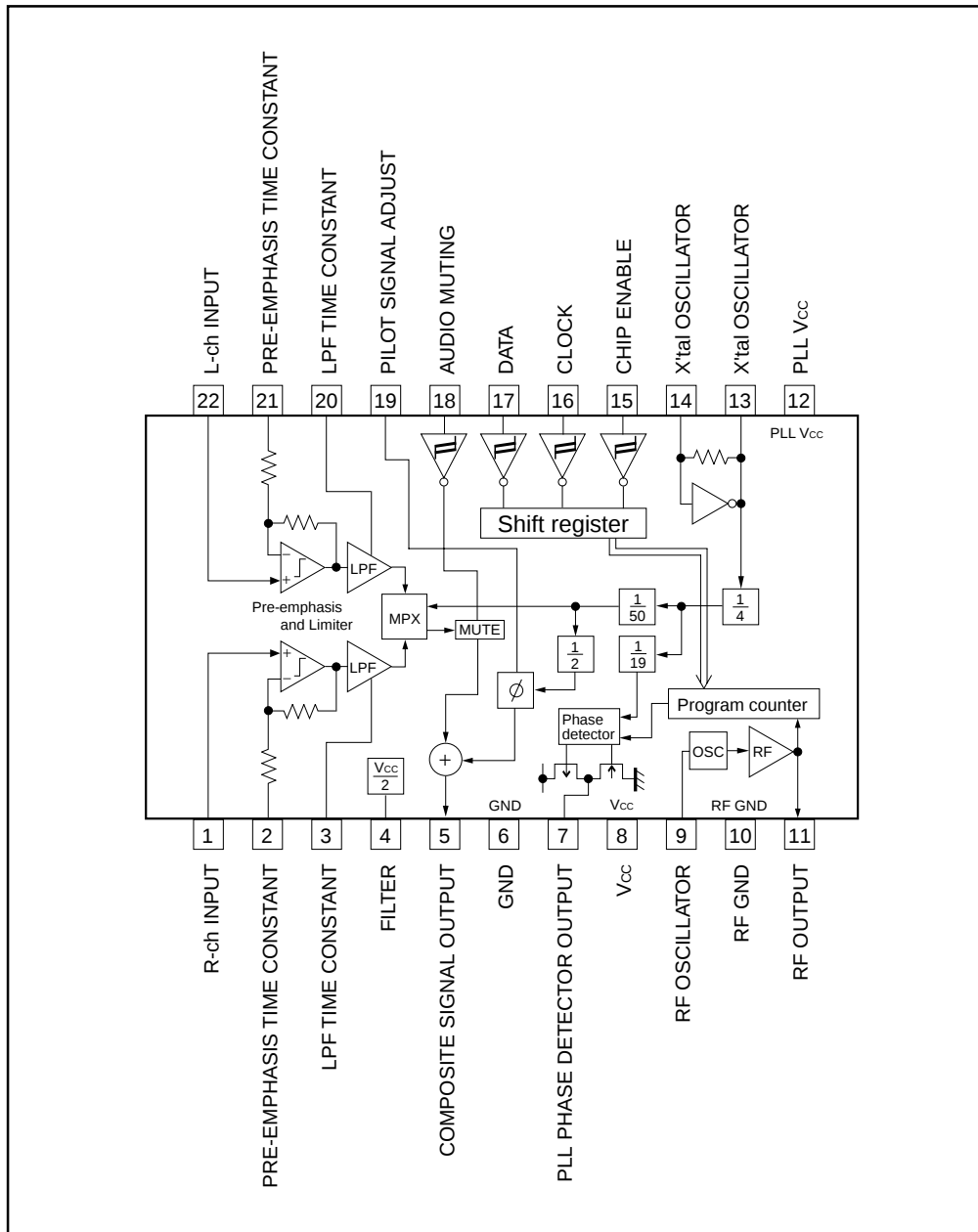
\* Derating : 4.5mW/°C for operation above Ta=25°C.

### ●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

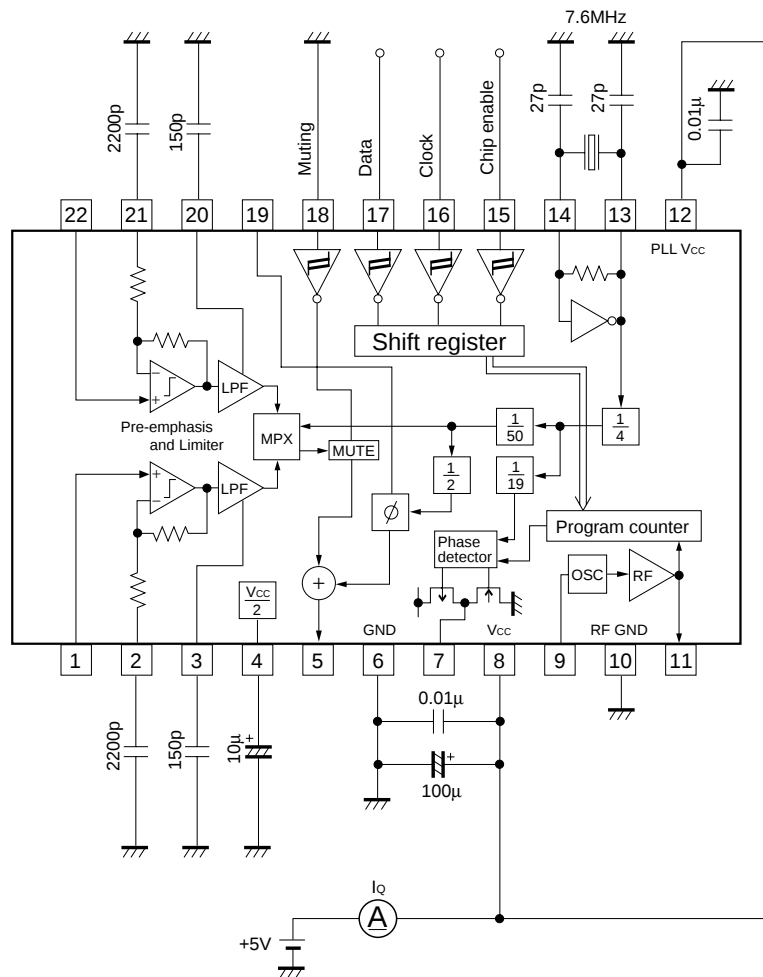


Fig.1

## Audio ICs

Channel separation  
Channel balance

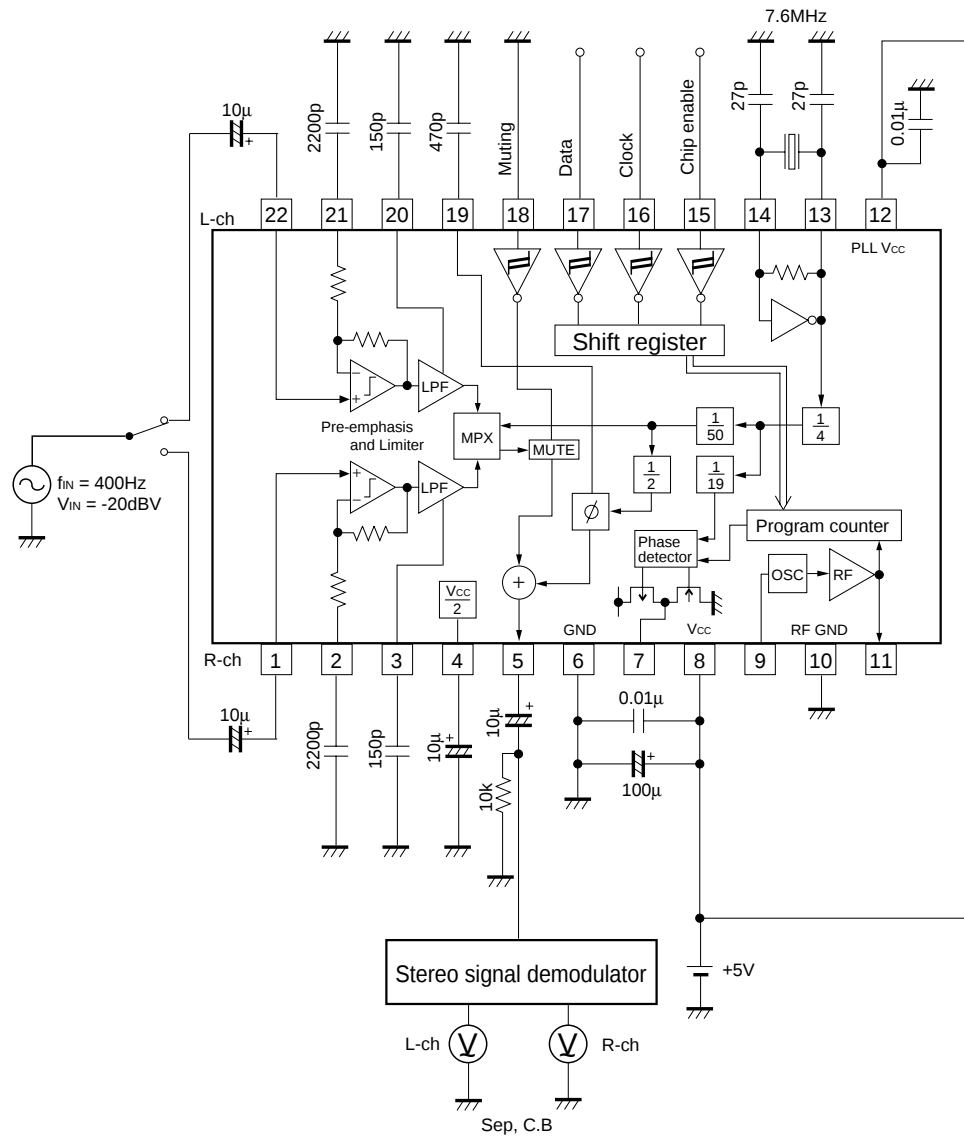


Fig.2

## Audio ICs

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

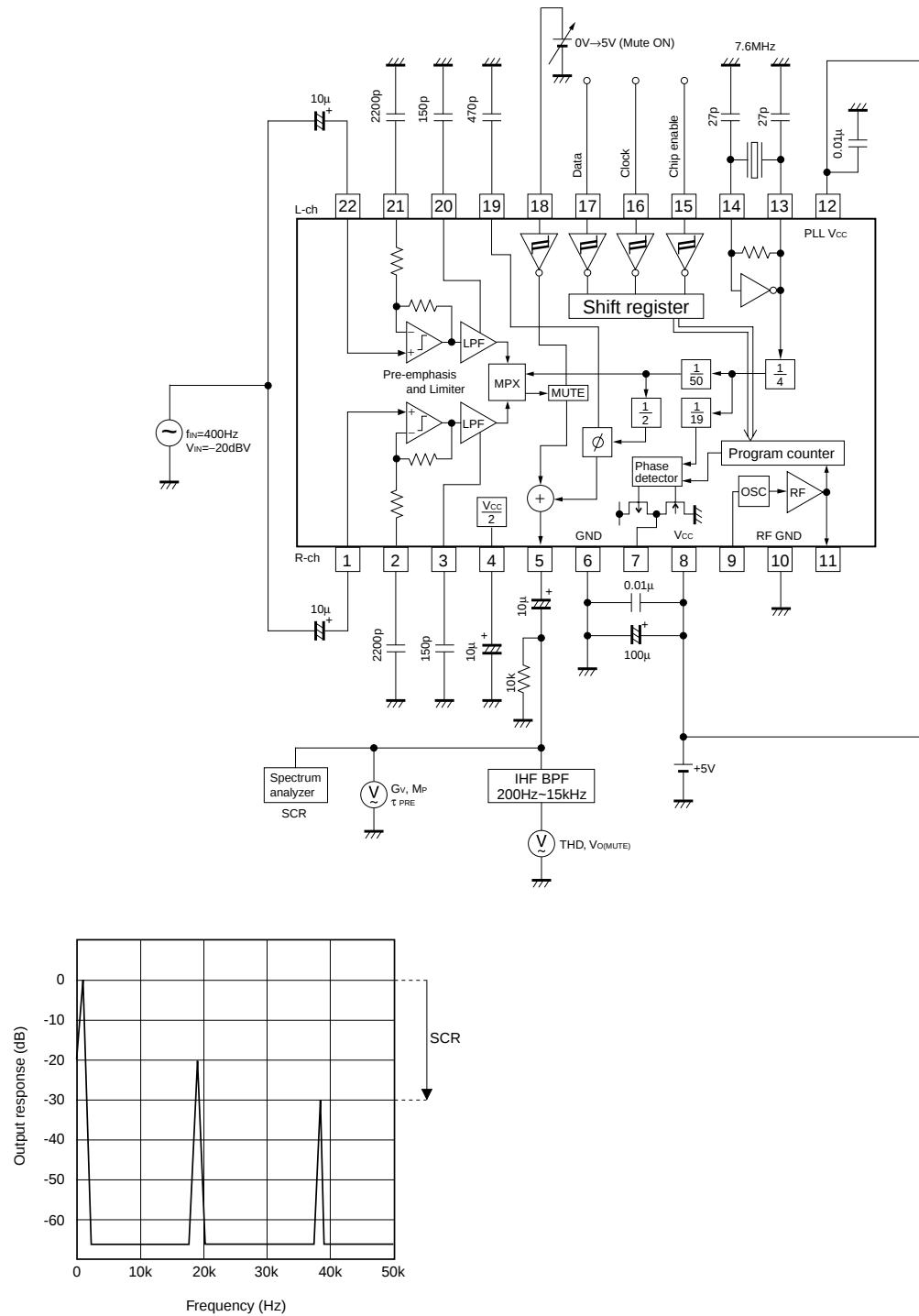


Fig.3

Limiter input level

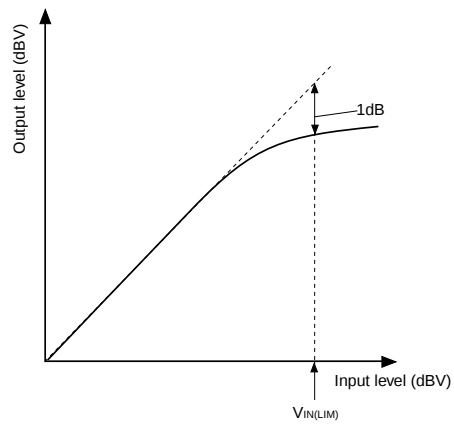
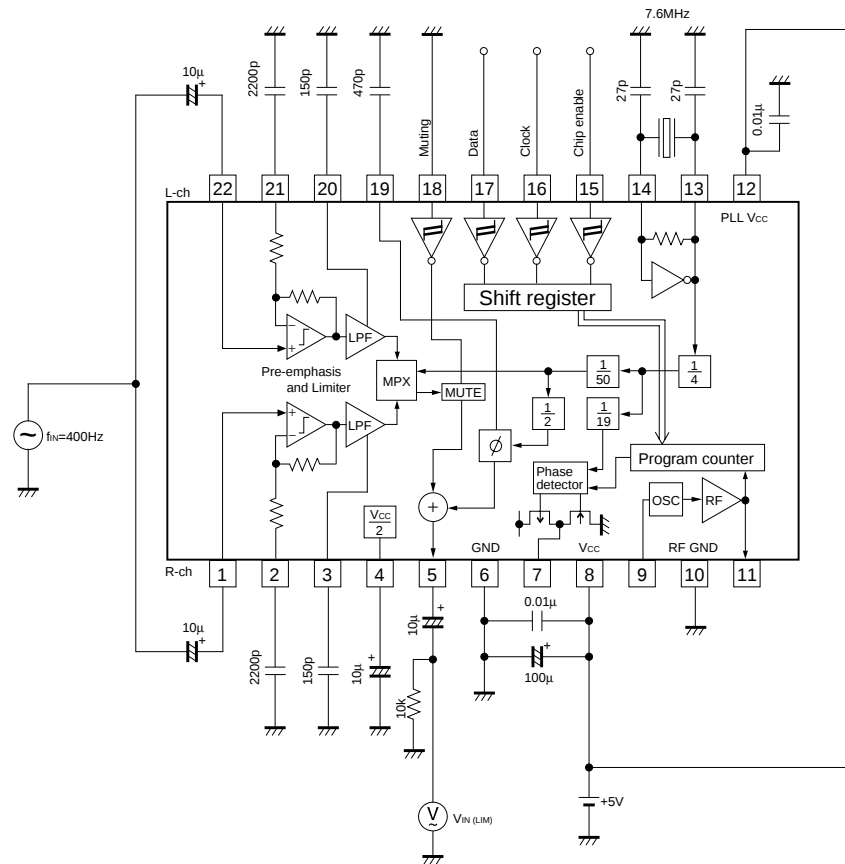


Fig.4

## Audio ICs

LPF cut off frequency

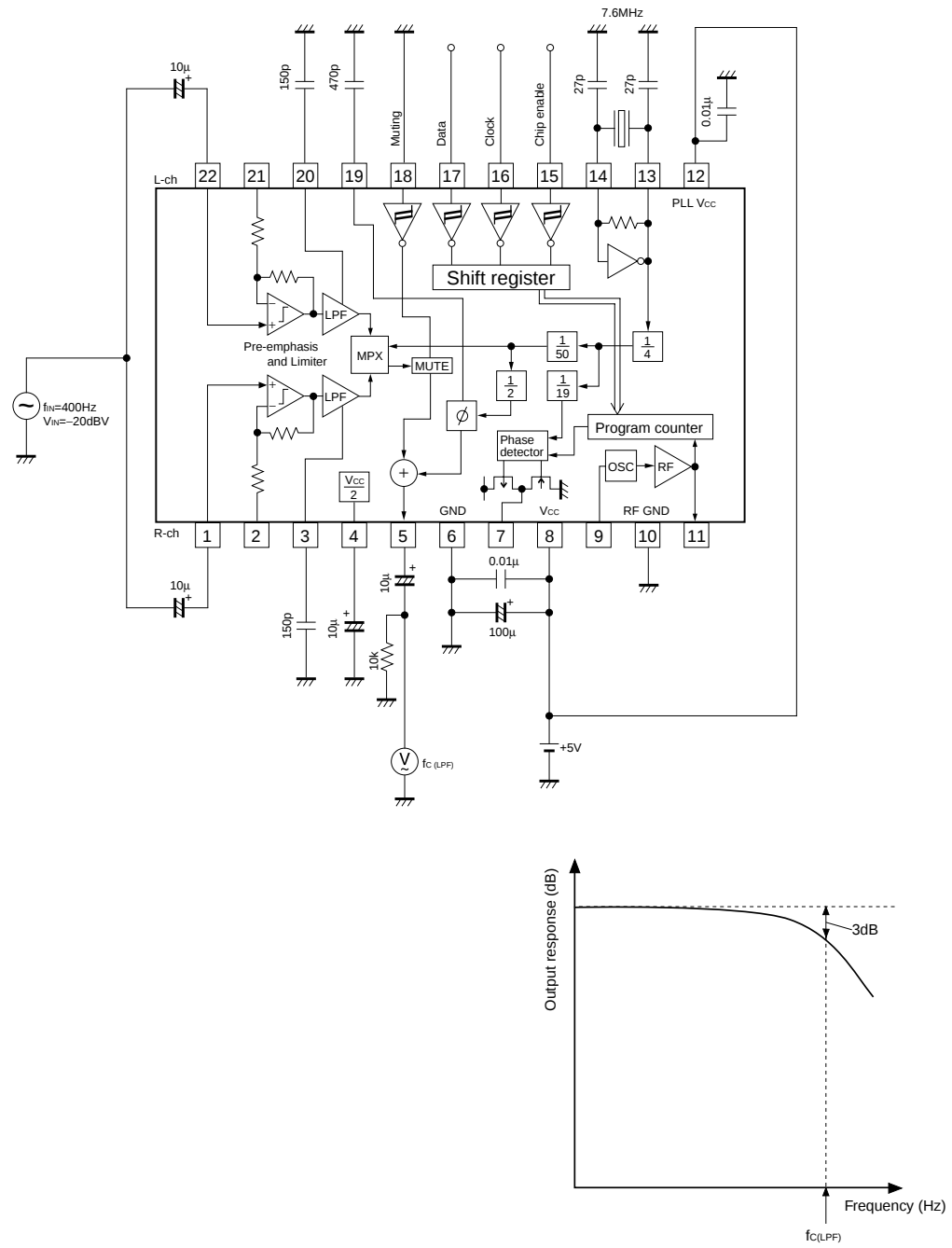


Fig.5

Transmission output level

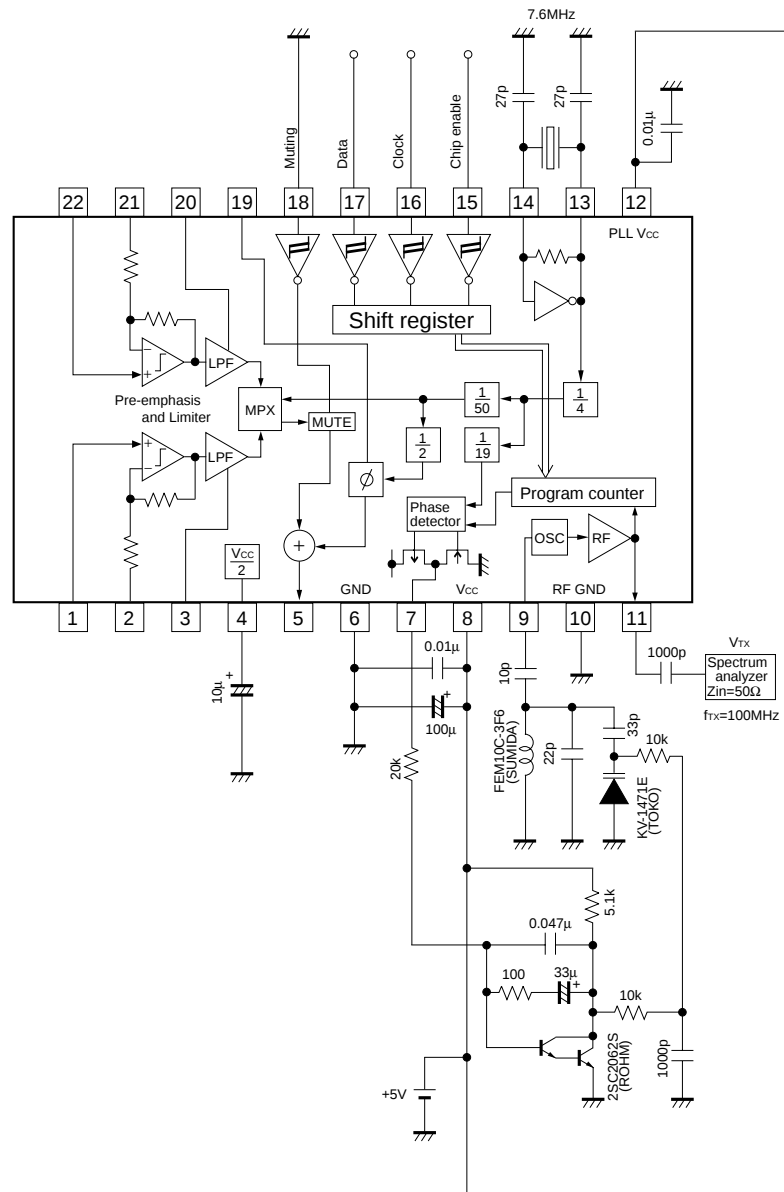


Fig.6

## Audio ICs

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

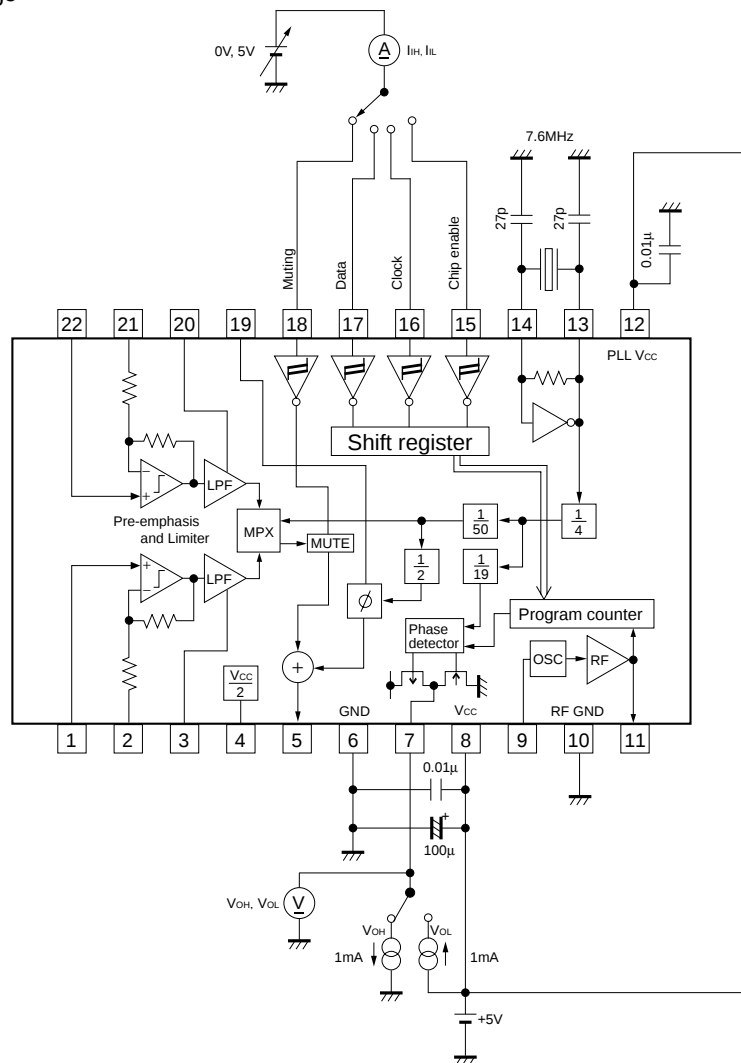


Fig.7

The diagram illustrates the internal architecture of the 74C90 PLL FM receiver IC. Key components include a shift register, a program counter, a phase detector, and a PLL section. The IC is powered by a 5V supply and has a 0V supply for the PLL section. The diagram also shows the connection of a 7.6MHz crystal and a 0.01μF capacitor to the PLL section. The IC is shown with its 22 pins, with pins 1-4 connected to power and ground, and pins 5-11 connected to control and data lines. Pins 12-15 are connected to clock and enable lines, and pins 16-22 are connected to data and control lines. The diagram also shows the connection of a 100μF capacitor to the 5V supply and a 0.01μF capacitor to the 0V supply.

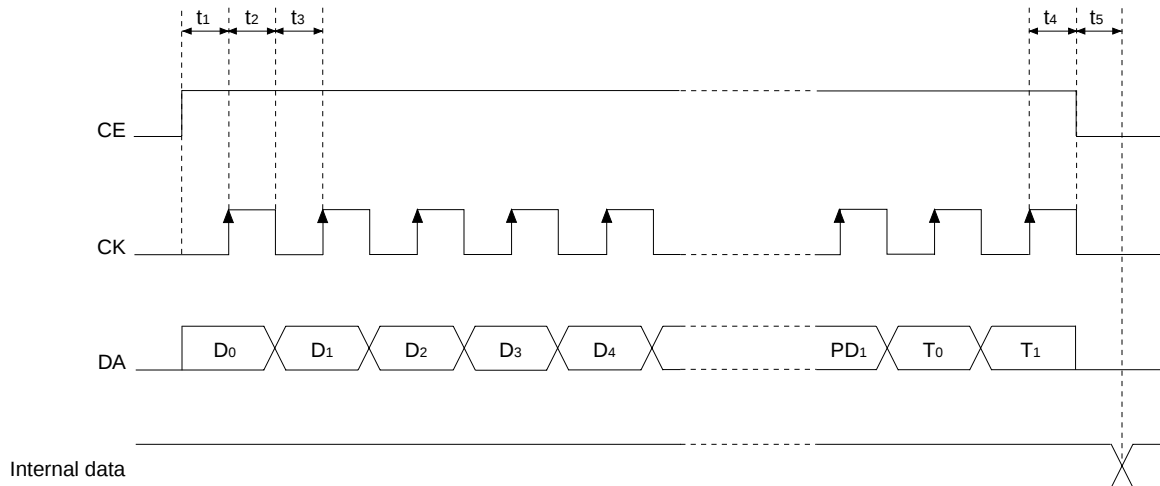
Fig.8

## Audio ICs

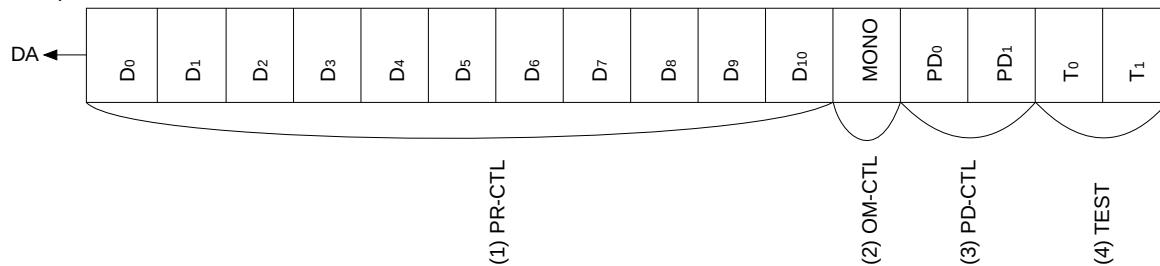
## ●Circuit operations

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) | <div>PROGRAM COUNTER</div> <div>D<sub>0</sub> ~ D<sub>10</sub></div> | <div><div>· It is the data which sets the program counter number of the dividing.This data can set a transmission frequency.</div><div>· It is a binary value. It sets D<sub>10</sub> with MSB and it sets D<sub>0</sub> with LSB.</div><div>Example In case of 99.7MHz oscillation<br/>99.7MHz ÷ 100kHz(fref) = 997 → 3E5(HEX)</div><div><div><div><div>5</div><div>1010</div><div>D<sub>0</sub>D<sub>1</sub>D<sub>2</sub>D<sub>3</sub></div></div><div><div>E</div><div>0111</div><div>D<sub>4</sub>D<sub>5</sub>D<sub>6</sub>D<sub>7</sub></div></div><div><div>3</div><div>110</div><div>D<sub>8</sub>D<sub>9</sub>D<sub>10</sub></div></div></div><div><div>LSB</div><div>MSB</div></div></div></div> |

## 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)

