

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.)

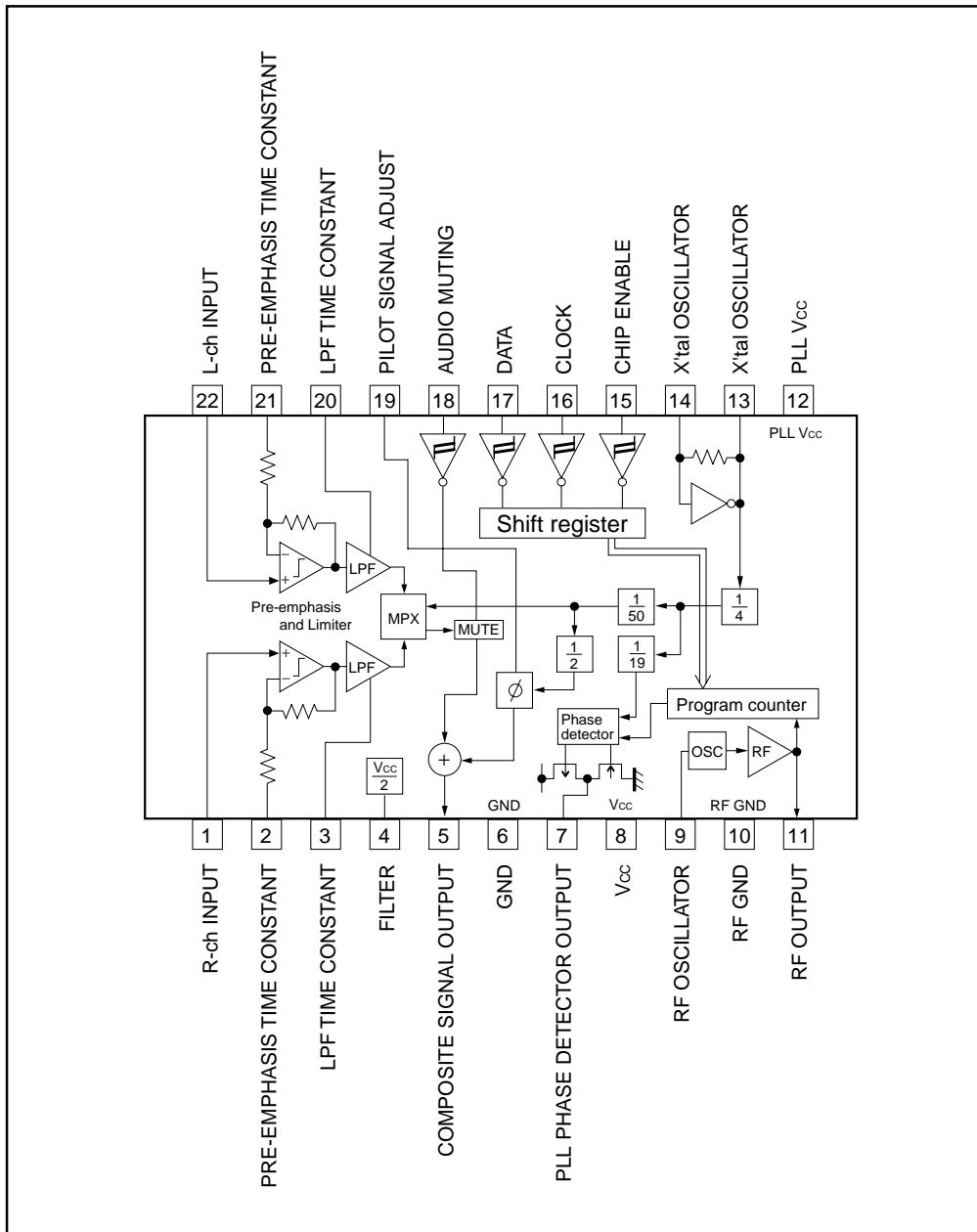
| Parameter | Symbol | Limits | Unit | Conditions |
|---------------------------------|--------------------|---------------------------|------|----------------|
| Supply voltage | V _{CC} | +7.0 | V | Pin8,12 |
| Data input voltage | V _{IN-D} | -0.3~V _{CC} +0.3 | V | Pin15,16,17,18 |
| Phase comparator output voltage | V _{OUT-P} | -0.3~V _{CC} +0.3 | V | Pin7 |
| Power dissipation | P _d | 450* | mW | |
| Storage temperature | T _{stg} | -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 _{CC} | 4.0 | – | 6.0 | V | Pin8,12 |
| Operating temperature | T _{opr} | -40 | – | +85 | °C | |
| Audio input level | V _{IN-A} | – | – | -10 | dBV | Pin1,22 |
| Audio input frequency band | f _{IN-A} | 20 | – | 15k | Hz | Pin1,22 |
| Pre-emphasis time constant set up range | t _{PRE} | – | – | 155 | μsec | Pin2,21 |
| Transmission frequency | f _{TX} | 70 | – | 120 | MHz | Pin9,11 |
| Control terminal "H" level input voltage | V _{IH} | 0.8V _{CC} | – | V _{CC} | V | Pin15,16,17,18 |
| Control terminal "L" level input voltage | V _{IL} | GND | – | 0.2V _{CC} | V | Pin15,16,17,18 |

●Block diagram



Audio ICs

● Pin descriptions

| Pin No. | Pin descriptions | Equivalent circuit | DC (V) |
|---------|--|--------------------|---------------------|
| 1 | R-ch audio source input terminal 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 It cuts DC with the capacitor and it inputs L-ch audio signal. | | $\frac{1}{2}V_{CC}$ |
| 2,21 | Pre-emphasis time constant terminal It connects a capacitor for the time constant of pre-emphasis. $\tau = 22.7k\Omega \times C$ | | |
| 3,20 | LPF time constant terminal This is 15kHz LPF. It connects a 150pF capacitor. | | $\frac{1}{2}V_{CC}$ |
| 4 | Filter terminal It is a ripple filter for the reference voltage of the audio part. | | $\frac{1}{2}V_{CC}$ |
| 5 | Composite signal output terminal It connects to the FM modulator. | | $\frac{1}{2}V_{CC}$ |
| 6 | GND | — | GND |
| 7 | PLL phase detector output terminal 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 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 It connects to the antenna through BPF. | | $V_{CC} - 1.9$ |
| 12 | PLL power supply terminal | ————— | V_{CC} |
| 13,14 | X'tal oscillator terminal It connects a 7.6MHz crystal oscillator. | | — |
| 15 | Chip enable terminal The terminal to make high level in serial data input. | | — |
| 16 | Clock input terminal The clock which takes data and synchronization in serial data input. | | |
| 17 | Data input terminal The input terminal of the serial data which is forwarded from the controller | | |
| 18 | Audio mute terminal $0.8V_{CC} \leq \text{Pin18}$: Mute ON $0.2V_{CC} \geq \text{Pin18}$: Mute OFF | | |
| 19 | Pilot signal adjust terminal | | $\frac{1}{2}V_{CC}$ |

Audio ICs

●Electrical characteristics (Unless otherwise noted $T_a = 25^\circ\text{C}$, $V_{CC} = 5.0\text{V}$, Signal source : $f_{IN} = 400\text{Hz}$)

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

Audio ICs

● Measurement circuits

Quiescent current

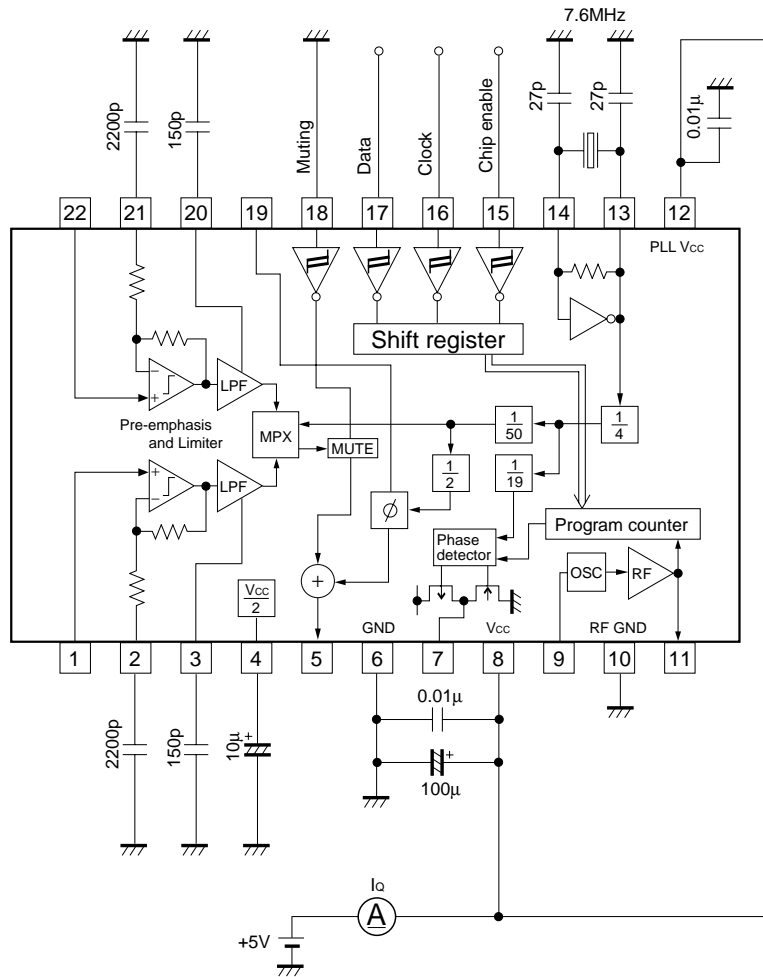


Fig.1

Audio ICs

Channel separation
Channel balance

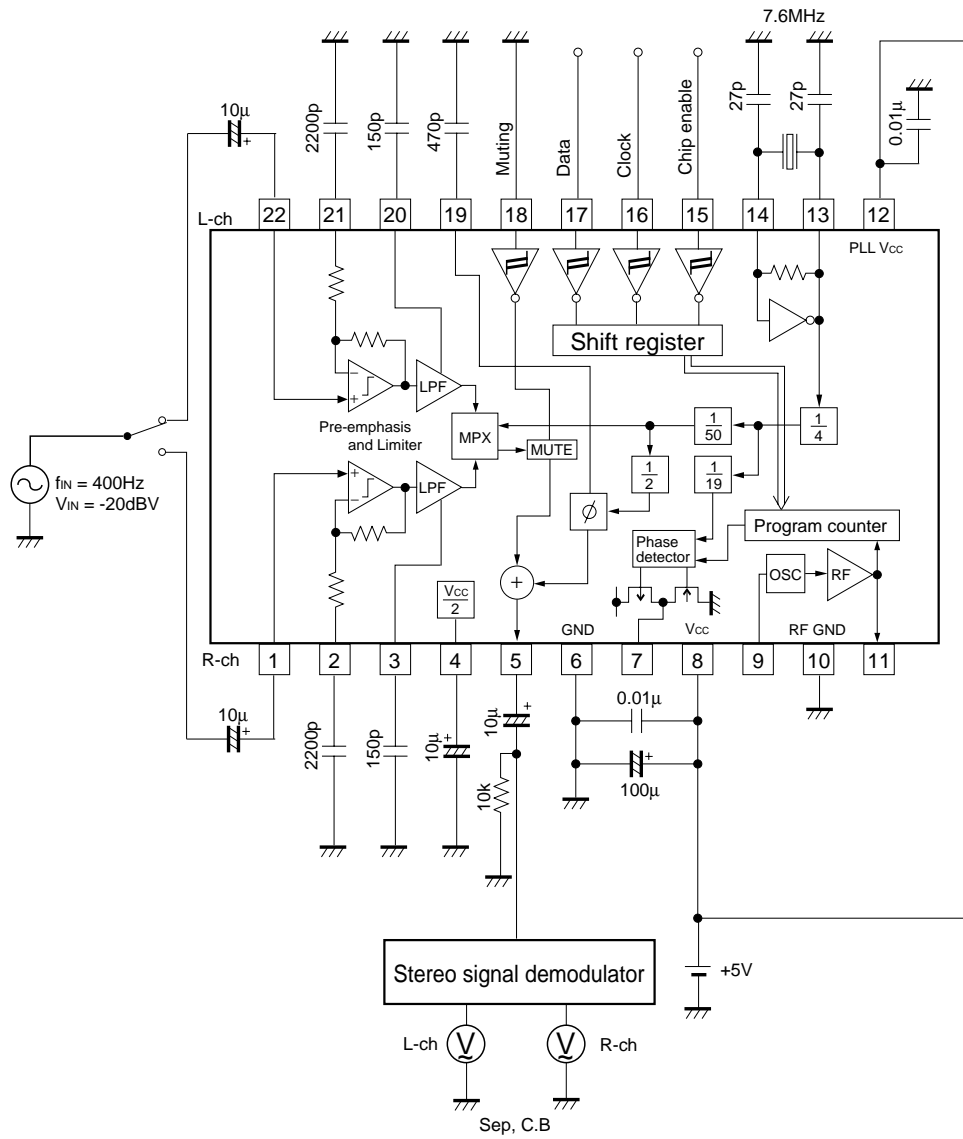


Fig.2

Audio ICs

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

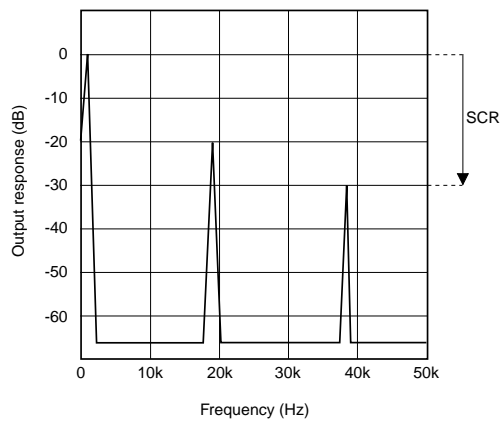
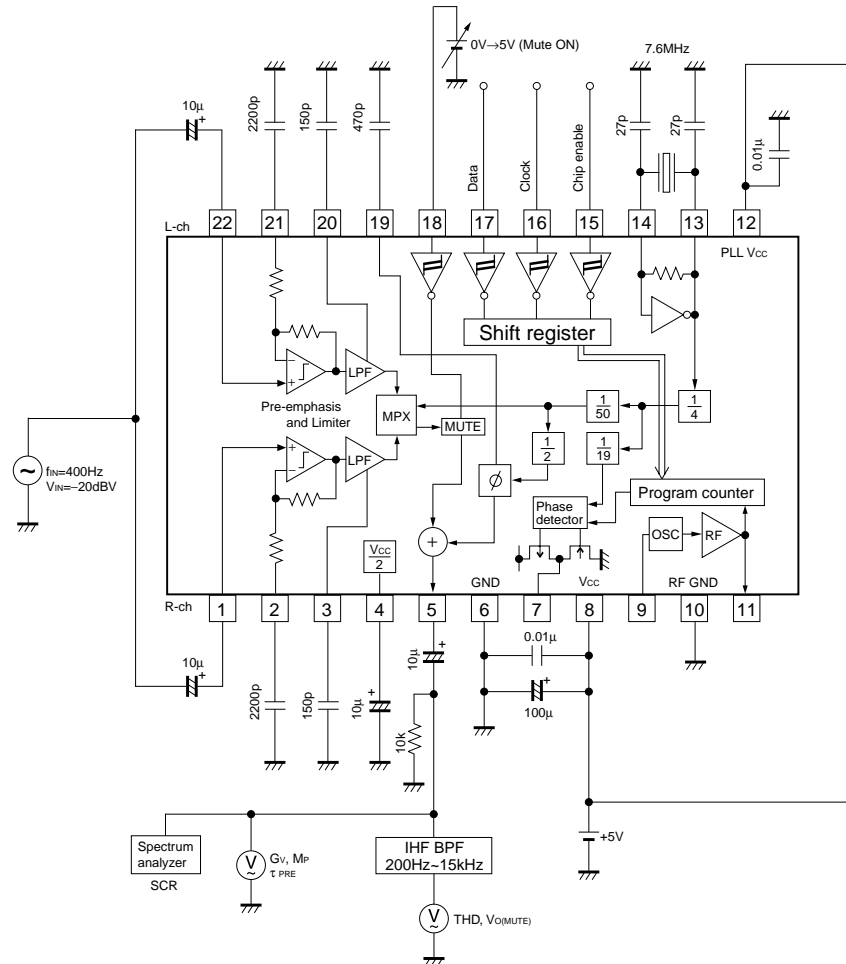


Fig.3

Audio ICs

Limiter input level

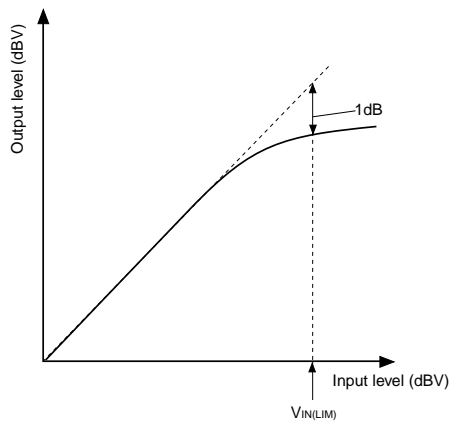
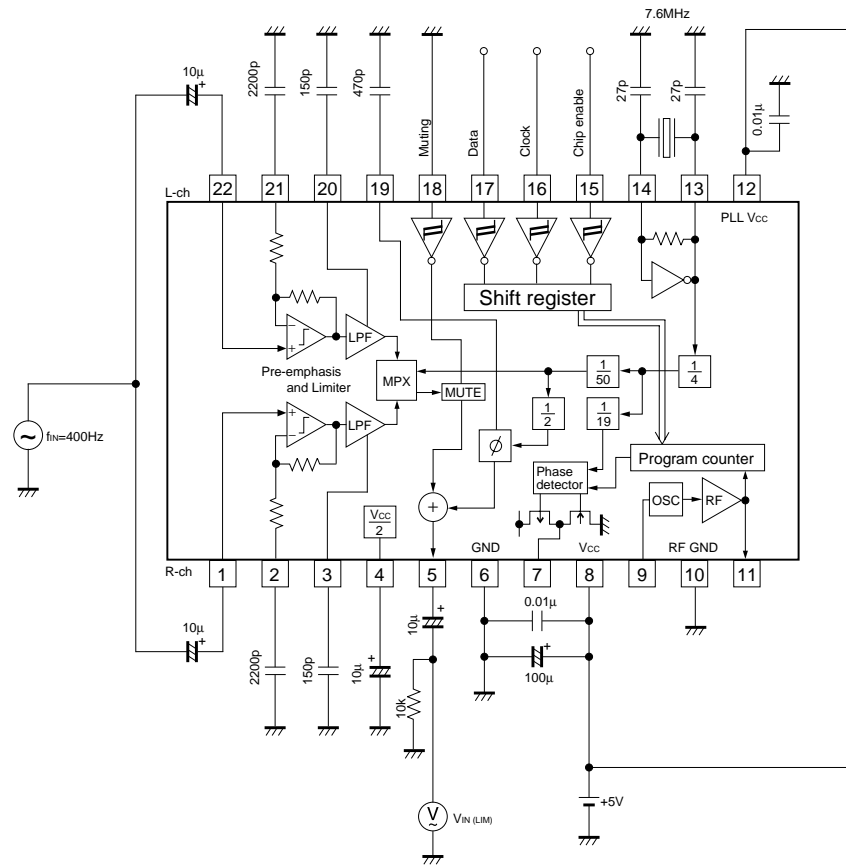


Fig.4

Audio ICs

LPF cut off frequency

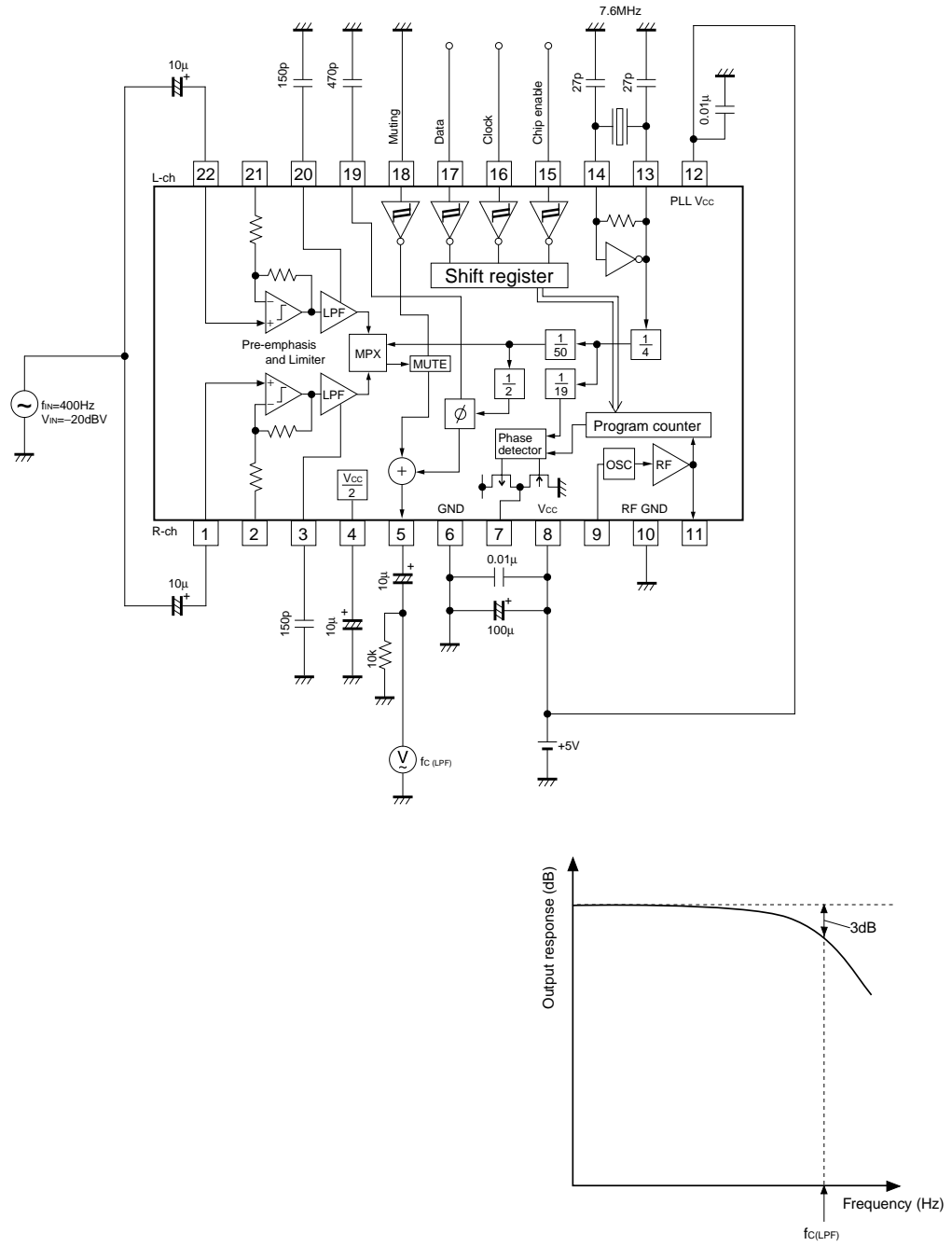


Fig.5

Transmission output level

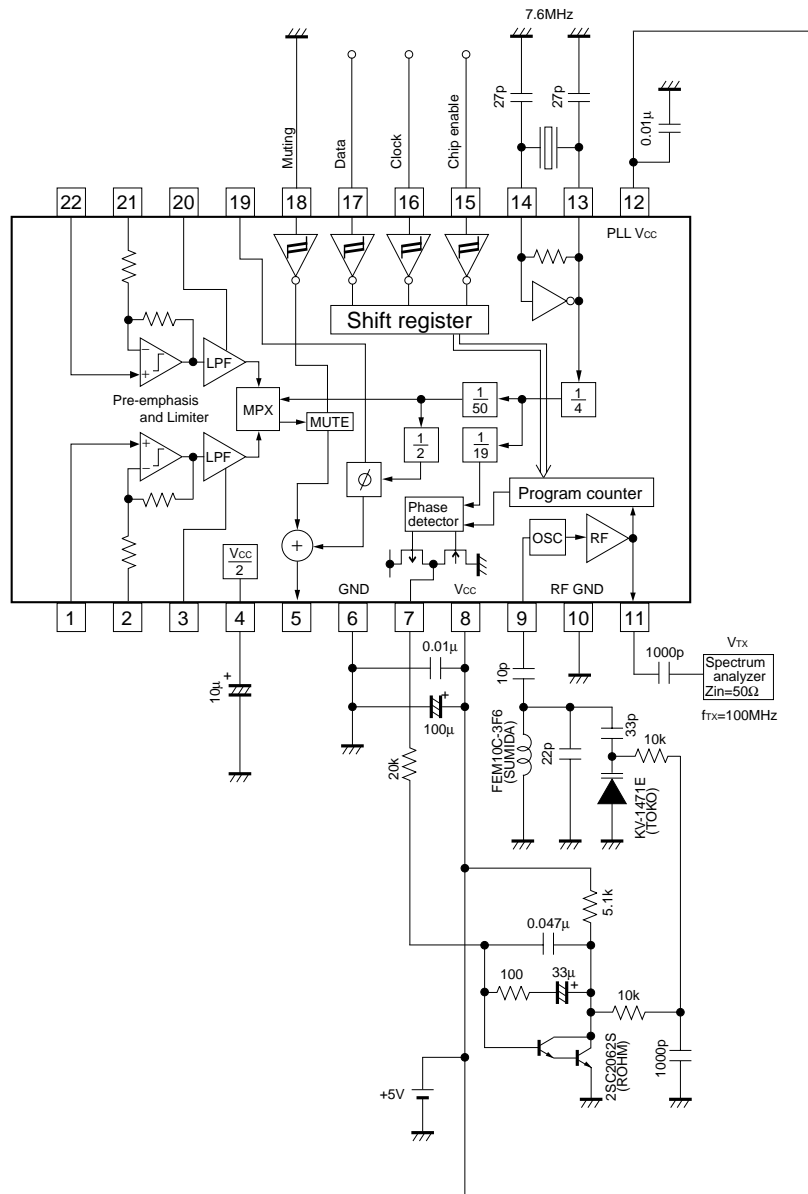


Fig.6

Audio ICs

- “H” level input current
- “L” level input current
- “H” level output voltage
- “L” level output voltage

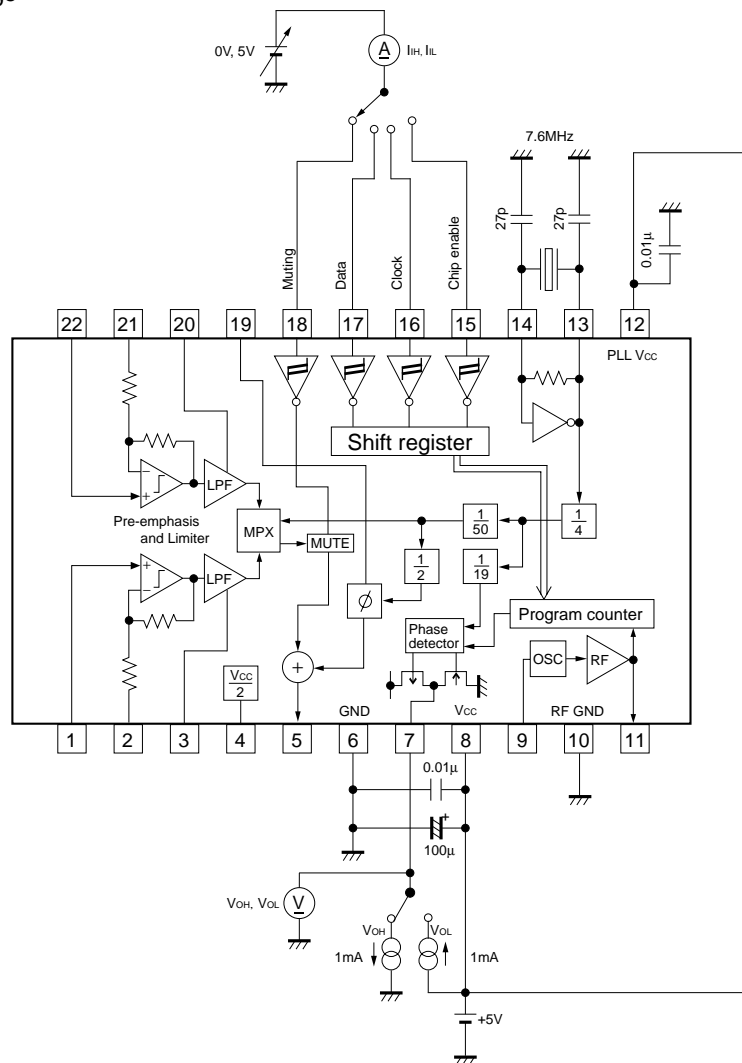


Fig.7

“off” level leak input current

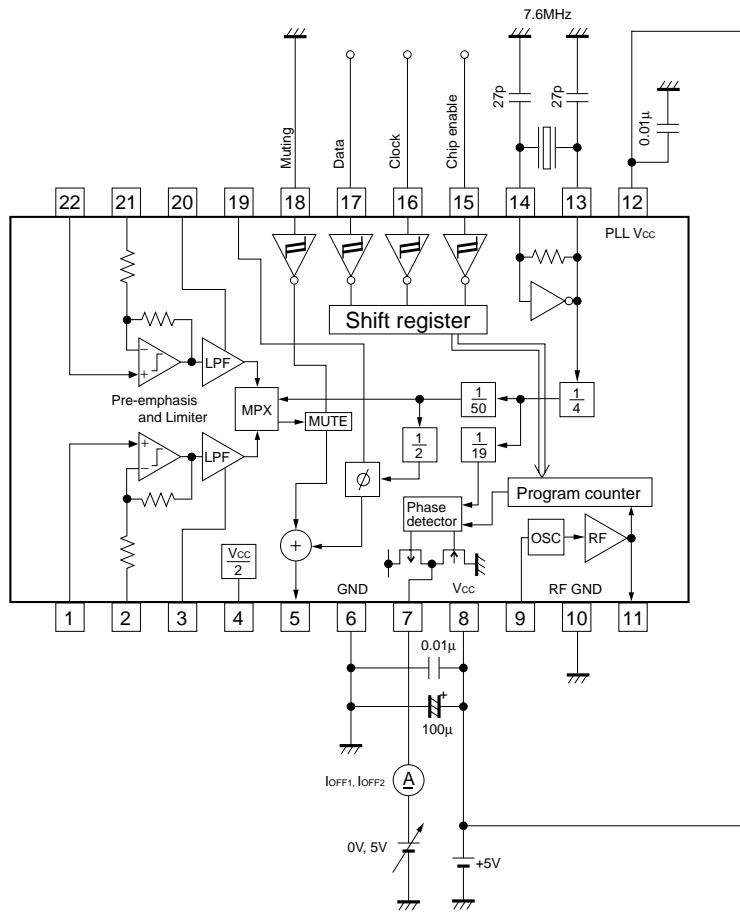


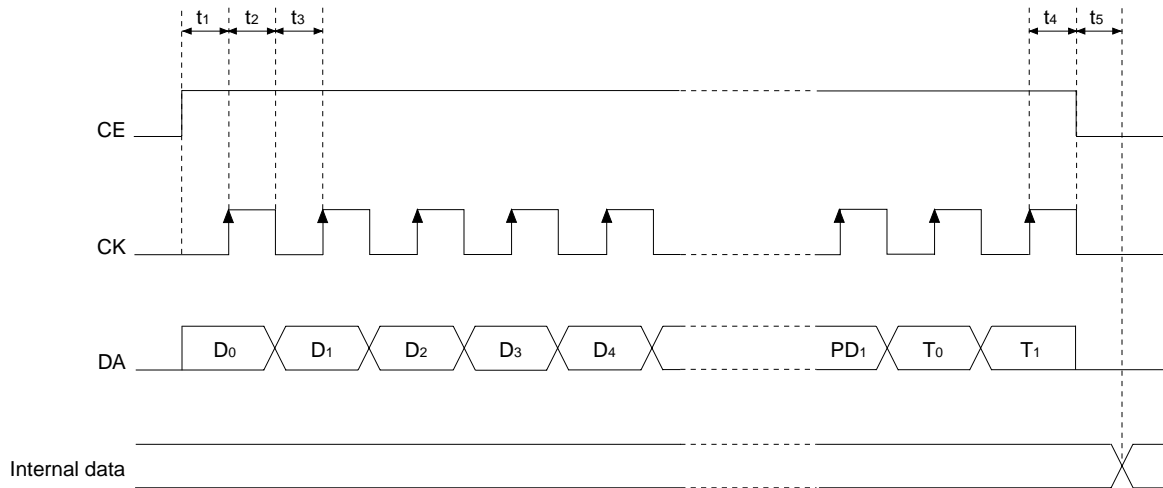
Fig.8

Audio ICs

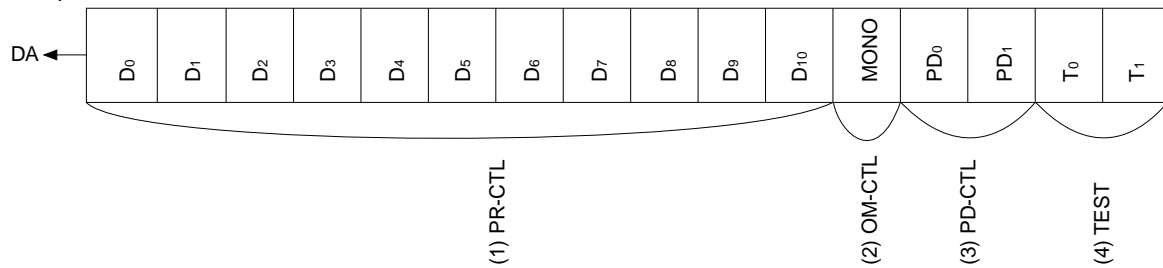
●Circuit operations

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



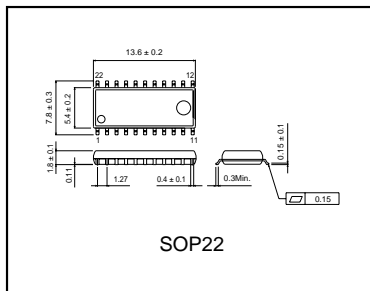
Explanation of the serial data

| No. | Control unit / Data | Contents | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------|---|---|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|-----|--|--|---|---|---|---|---|---|---|---|---|---|---|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|-----|--|--|--|--|--|--|--|--|--|--|-----|
| (1) | PROGRAM COUNTER D ₀ ~ D ₁₀ | <ul style="list-style-type: none"> It is the data which sets the program counter number of the dividing. This data can set a transmission frequency. It is a binary value. It sets D₁₀ with MSB and it sets D₀ with LSB. <p>Example In case of 99.7MHz oscillation $99.7\text{MHz} \div 100\text{kHz}(\text{fref}) = 997 \rightarrow 3\text{E5}(\text{HEX})$</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td colspan="5" style="text-align: center;">5</td> <td colspan="3" style="text-align: center;">E</td> <td colspan="3" style="text-align: center;">3</td> </tr> <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>D₀</td><td>D₁</td><td>D₂</td><td>D₃</td><td>D₄</td><td>D₅</td><td>D₆</td><td>D₇</td><td>D₈</td><td>D₉</td><td>D₁₀</td> </tr> <tr> <td colspan="5" style="text-align: center;">LSB</td> <td colspan="6"></td> <td style="text-align: center;">MSB</td> </tr> </table> | 5 | | | | | E | | | 3 | | | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | D ₀ | D ₁ | D ₂ | D ₃ | D ₄ | D ₅ | D ₆ | D ₇ | D ₈ | D ₉ | D ₁₀ | LSB | | | | | | | | | | | MSB |
| 5 | | | | | E | | | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D ₀ | D ₁ | D ₂ | D ₃ | D ₄ | D ₅ | D ₆ | D ₇ | D ₈ | D ₉ | D ₁₀ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LSB | | | | | | | | | | | MSB | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Audio ICs

| No. | Control unit / Data | Contents | | | | | | | | | | | | | | | |
|-----------------|--|---|-----------------|-----------------------------------|--------------------|------------------------------------|---|--|---|---|-------------------|---|---|--------------------|---|---|----------------|
| (2) | MULTIPLEXER MONO | <ul style="list-style-type: none"> It changes a stereo and monaural operation. <table border="1"> <thead> <tr> <th>MONO</th> <th>Condition of the composite signal</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Monaural operation L+R , Pilot OFF</td> </tr> <tr> <td>1</td> <td>Stereo operation $L+R+(L-R)\sin\omega_s t+P\sin\frac{\omega_s}{2} t$</td> </tr> </tbody> </table> | MONO | Condition of the composite signal | 0 | Monaural operation L+R , Pilot OFF | 1 | Stereo operation $L+R+(L-R)\sin\omega_s t+P\sin\frac{\omega_s}{2} t$ | | | | | | | | | |
| MONO | Condition of the composite signal | | | | | | | | | | | | | | | | |
| 0 | Monaural operation L+R , Pilot OFF | | | | | | | | | | | | | | | | |
| 1 | Stereo operation $L+R+(L-R)\sin\omega_s t+P\sin\frac{\omega_s}{2} t$ | | | | | | | | | | | | | | | | |
| (2) | PHASE DETECTOR PD ₀ , PD ₁ | <ul style="list-style-type: none"> It controls charge pump output by the phase comparator compulsorily. <table border="1"> <thead> <tr> <th>PD₀</th> <th>PD₁</th> <th>Charge pump output</th> </tr> </thead> <tbody> <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> </tbody> </table> | PD ₀ | PD ₁ | Charge pump output | 0 | 0 | Usual operation | 0 | 1 | Compulsion by Low | 1 | 0 | Compulsion by High | 1 | 1 | High impedance |
| PD ₀ | PD ₁ | Charge pump output | | | | | | | | | | | | | | | |
| 0 | 0 | Usual operation | | | | | | | | | | | | | | | |
| 0 | 1 | Compulsion by Low | | | | | | | | | | | | | | | |
| 1 | 0 | Compulsion by High | | | | | | | | | | | | | | | |
| 1 | 1 | High impedance | | | | | | | | | | | | | | | |
| (3) | TEST MODE T ₀ , T ₁ | <ul style="list-style-type: none"> It is data for the LSI test. Always in T₀ Input "1". Always in T₁ Input "0". | | | | | | | | | | | | | | | |

●External dimensions (Units : mm)



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Datasheets for electronics components.