# Phase Shifter-less Wide Band FM IF Demodulator IC for Voice

## ■ FEATURES

- Unnecessary External phase shifter (CD or IFT)
- Auto IF detection
  IF = 1.5MHz to 15MHz
  * S-curve characteristic cannot be obtained
- Demodulated Output Frequency Range
  fmod = 20Hz to 100kHz
  * External parts modification : up to 300kHz
- Excellent electrical characteristics

| | | |
|---|---|---|
| SNR | 80dB | @fdev = 75kHz |
| THD | 0.015% | @fdev = 75kHz |

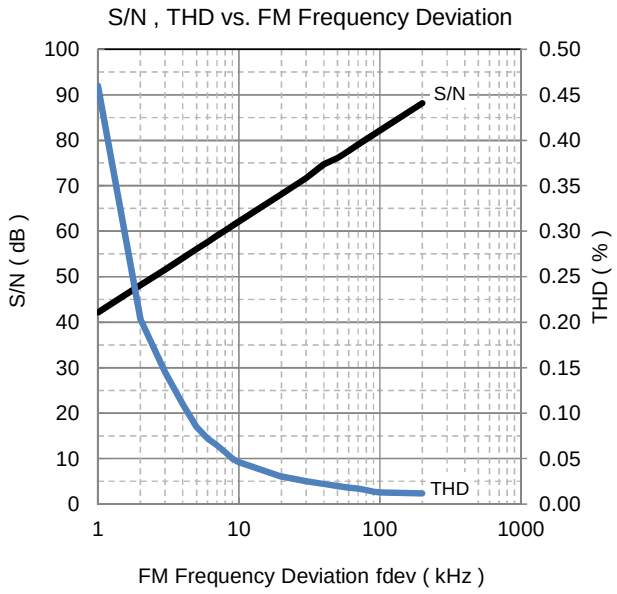
## ■ APPLICATION

- Wireless microphone (RF/IR)
- Wireless headphone (RF/IR)
- Intercom , Door phone

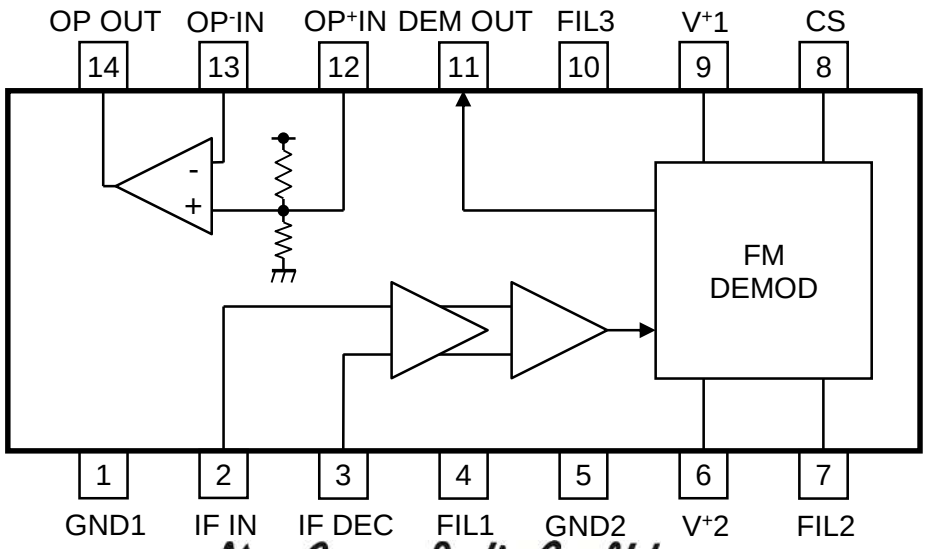
## ■ GENERAL DESCRIPTION

NJW2311 is the IC which has the automatic IF detection of FM modulating signal of the 1.5MHz to 15MHz, that operates from 4.5V, and makes unnecessary such as the phase-shifter which was conventionally required as external parts.
An IF amplifier, a FM demodulator and a low noise Op-amplifier are built in.
Since high S/N ratio and low distortion characteristics are realized, it is the best for the various FM Receivers of wireless or wired Voice communications.

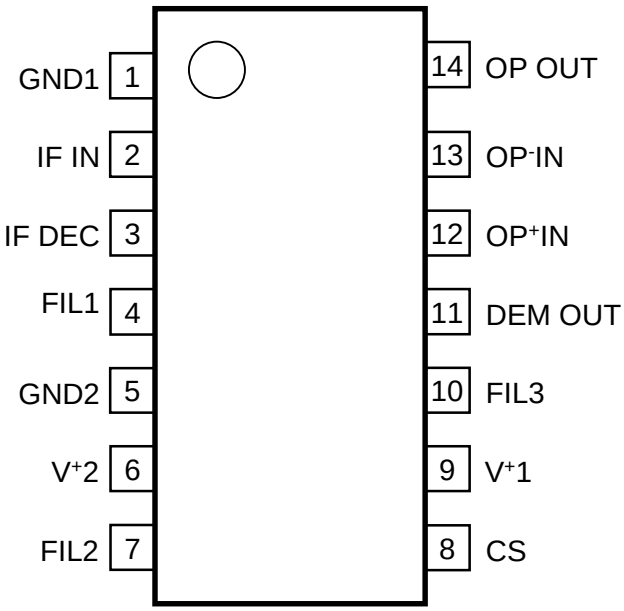
## ■ FM Demodulation characteristic




## ■ BLOCK DIAGRAM

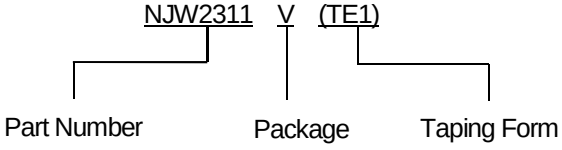


## ■ PIN CONFIGURATION




| PIN NO. | SYMBOL | DESCRIPTION |
|---|---|---|
| 1 | GND1 | GND |
| 2 | IF IN | IF input |
| 3 | IF DEC | IF decoupling |
| 4 | FIL1 | Vref decoupling |
| 5 | GND2 | GND |
| 6 | $V^+2$ | Power supply |
| 7 | FIL2 | Demodulation noise removal |
| 8 | CS | Current output |
| 9 | $V^+1$ | Power supply |
| 10 | FIL3 | Demodulation filter |
| 11 | DEM OUT | Demodulated signal output |
| 12 | $OP^+$ IN | Op-amp non-inverting ( + ) input |
| 13 | $OP^-$ IN | Op-amp inverting ( - ) input |
| 14 | OP OUT | Op-amp output |

## ■ MARK INFORMATION




## ■ ORDERING INFORMATION

| PART NUMBER | PACKAGE OUTLINE | RoHS | HALOGEN-FREE | TERMINAL FINISH | MARKING | WEIGHT (mg) | MOQ(pcs) |
|---|---|---|---|---|---|---|---|
| NJW2311V | SSOP14 | ✔ | ✔ | Sn2Bi | 2311 | 65 | 2,000 |

## ■ ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | RATINGS | UNIT |
|---|---|---|---|
| Supply Voltage | $V^+1$,$V^+2$ | 5.5 | V |
| Power Dissipation (Ta=25°C) | $P_D$ | 440 | mW |
| Operating Temperature Range | $T_{opr}$ | -40 to +85 | °C |
| Storage Temperature Range | $T_{stg}$ | -50 to +125 | °C |

## ■ RECOMMENDED OPERATING CONDITIONS

| PARAMETER | SYMBOL | RATINGS | UNIT |
|---|---|---|---|
| Supply Voltage | $V^+1$,$V^+2$ | +4.5 to +5.5 | V |
| IF operating frequency | $f_{IF}$ | 1.5 to 15 | MHz |

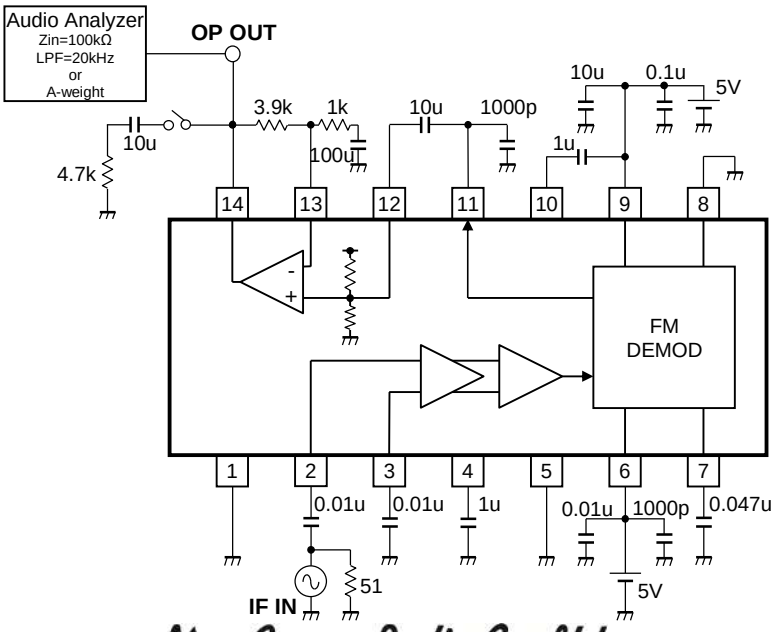
## ■ ELECTRICAL CHARACTERISTICS

( Ta = 25 °C , $V^+1 = V^+2$ = 5V , IF IN = 10.7MHz / 100dBuV , fdev = ±75kHz , fmod = 1kHz , unless otherwise noted )

| PARAMETER* | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Current Consumption | $I_{CC}$ | | - | 23 | 28 | mA |
| IF Input Resistance | $R_{IIF}$ | between Pin2 and 3 | 15 | 20 | 25 | kΩ |
| Output DC Level | $V_{DC}$ | | 2.0 | 2.5 | 3.0 | V |
| Output AF Level | $V_{AF}$ | | 190 | 250 | 310 | mVrms |
| Signal to Noise Ratio | S/N | A-weight | 74 | 80 | - | dB |
| Total Harmonics Distortion | THD1 | LPF = 20kHz , fdev = ±75kHz | - | 0.015 | - | % |
| | THD2 | LPF = 20kHz , fdev = ±200kHz | - | 0.03 | - | |
| Receiver Sensitivity | Sen | A-weight | - | 55 | - | dBuV |
| AM Rejection Ratio | AMR | LPF = 20kHz , AM = 30% | - | 55 | - | dB |
| Output AF frequency characteristics | $f_{DET}1$ | fmod = 100kHz , relative attenuation from fmod=1kHz condition | - | -2 | - | |
| | $f_{DET}2$ | fmod = 20Hz , relative attenuation from fmod=1kHz condition | - | -3.5 | - | |
| OP OUT Load Capability | $R_{OD}$ | Ro = 4.7kΩ , relative attenuation from no-load condition | - | 0 | 3 | |

* Refer to GLOSSARY (page 6) about the contents of PARAMETER.

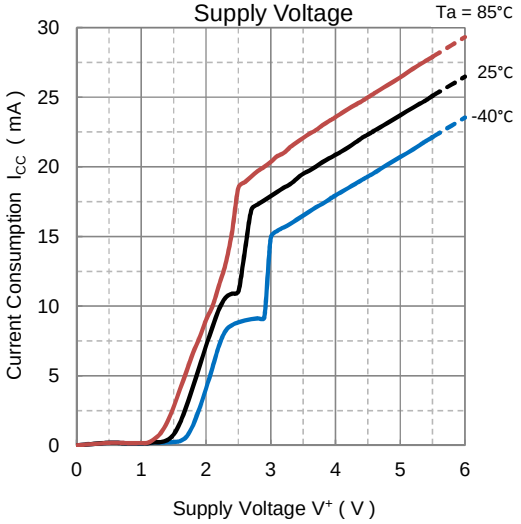
## ■ MEASURING CIRCUIT



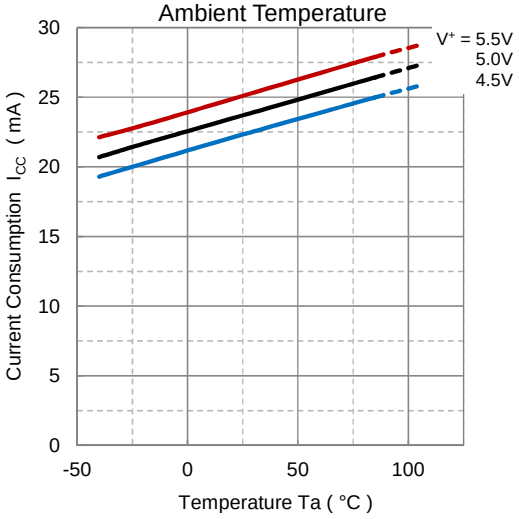
## ■ TYPICAL CHARACTERISTICS

(Ta = 25 °C, $V^+1 = V^+2$ = 5V, IF IN = 10.7MHz / 100dBuV, fdev = ±75kHz, fmod = 1kHz, unless otherwise noted)

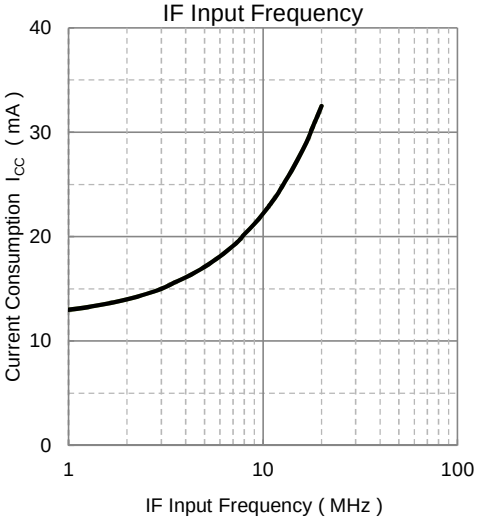
Current Consumption vs. Supply Voltage



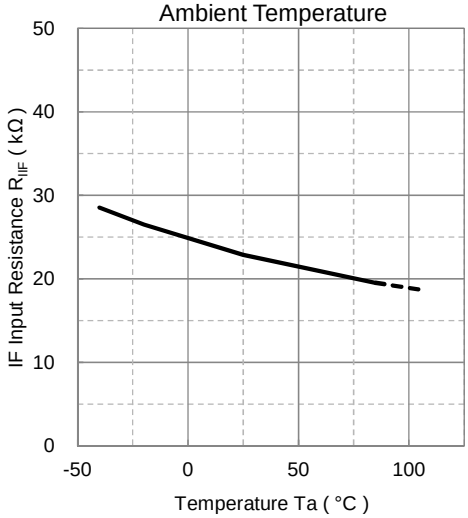

Current Consumption vs. Ambient Temperature



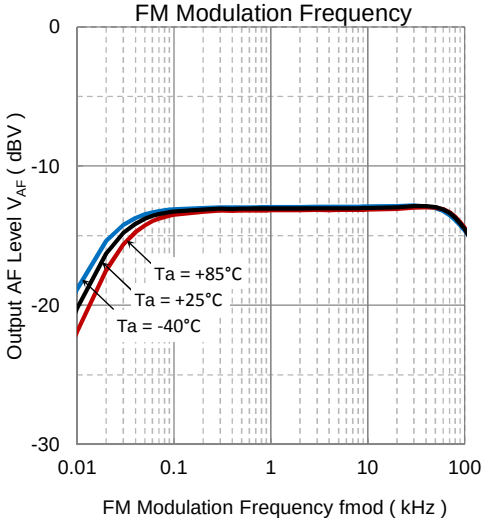

Current Consumption vs. IF Input Frequency




IF Input Resistance vs. Ambient Temperature

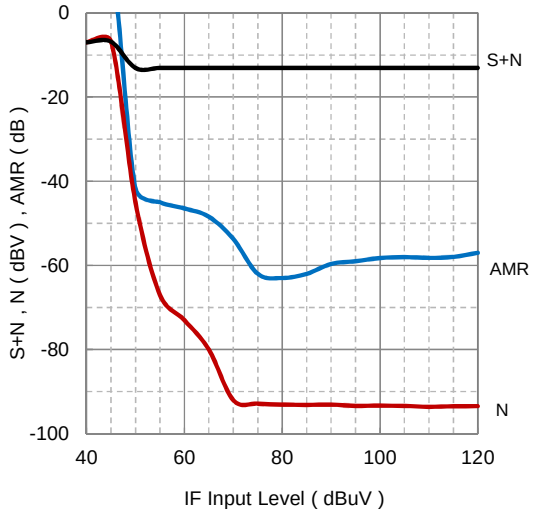



Demodulated Signal Level vs. FM Modulation Frequency

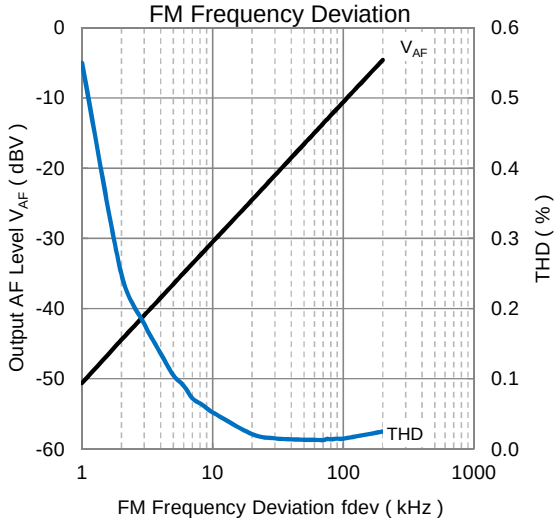


( Ta = 25 °C , $V^+1 = V^+2$ = 5V , IF IN = 10.7MHz / 100dBuV , fdev = ±75kHz , fmod = 1kHz , unless otherwise noted )

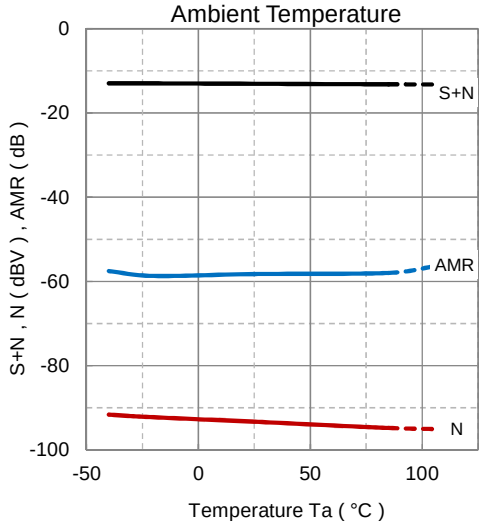
S+N , N , AMR vs. IF Input Level



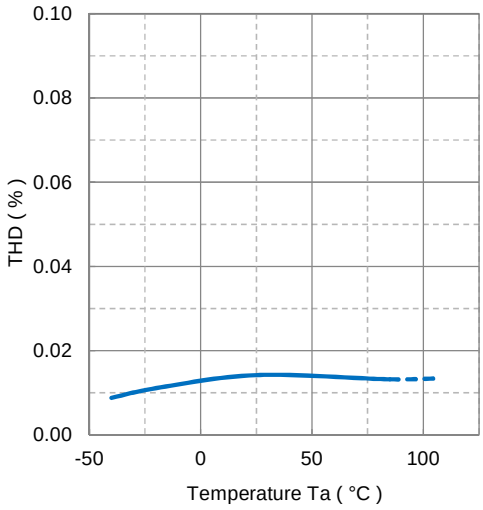

Demodulated Signal Level vs. FM Frequency Deviation



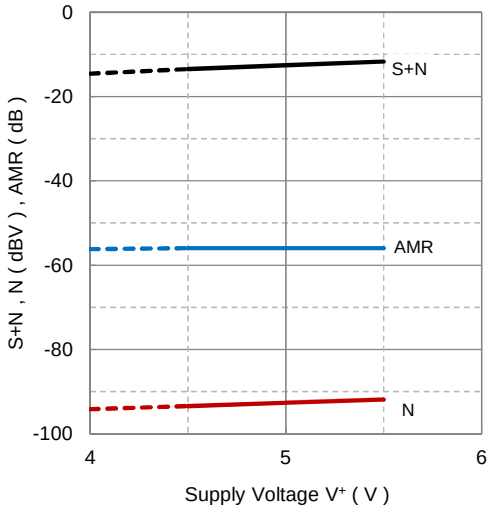

S+N , N , AMR vs. Ambient Temperature



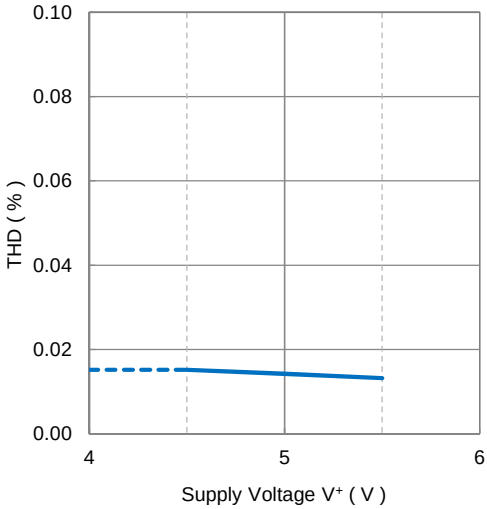

THD vs. Ambient Temperature




S+N , N , AMR vs. Supply Voltage




THD vs. Supply Voltage



■ **GLOSSARY**

| SYMBOL | PARAMETER | TERMINAL | DESCRIPTION |
|---|---|---|---|
| $I_{CC}$ | Current Consumption | $V^+1$,$V^+2$ | Total current through $V^+1$(Pin9) and $V^+2$(Pin6) at no signal condition. |
| $R_{I\,IF}$ | IF Amplifier Input Impedance | IF IN, IF DET | Impedance between IF IN (Pin2) and IF DEC (Pin3). |
| $V_{DC}$ | Output DC Level | OP OUT | DC output voltage at OP OUT terminal (Pin14) under IF IN=10.7MHz carrier signal input condition. |
| $V_{AF}$ | Output AF Level | OP OUT | AC output voltage at OP OUT terminal (Pin14) under a demodulated signal input condition. |
| S/N | Signal to Noise Ratio | OP OUT | Signal-to-Noise ratio of demodulated signal.<br>$S/N = 20\log\frac{\text{Signal}}{\text{Noise}}$<br>Signal: AC output voltage ($V_{AF}$) of the OP OUT terminal (Pin14) at standard condition<br>Noise: AC output voltage ($V_{AF}$) of the OP OUT terminal (Pin14) at non-modulated condition |
| THD | Total Harmonic Distortion | OP OUT | THD is the factor which shows the degree of the distortion of the FM demodulated output signal and is the ratio of the total harmonics versus the fundamental wave.<br>$THD = \frac{\sqrt{V2^2 + V3^2 + \cdots + V10^2}}{V1}$<br>V1: effective voltage of fundamental frequency.<br>V2, V3 ··· V10: effective voltage of harmonic frequency.<br>THD1: fdev = ±75kHz condition<br>THD2: fdev = ±200kHz condition |
| Sen | Demodulation Sensitivity | OP OUT | The minimum input signal point which a demodulated output signal is more than 50dB of S/N which isn't buried in noise. |
| AMR | AM Rejection Ratio | OP OUT | Ratio of AM demodulated signal level and FM demodulated signal level.<br>$AMR = 20\log\frac{V_{AF}}{\text{AM demodulated level}}$<br>$V_{AF}$: Output AF Level<br>AM demodulated level: 100dBμ, AM = 30% mod, fmod = 1kHz |
| $f_{DET}$ | Output AF Frequency Characteristics | OP OUT | Flatness of FM demodulated output signal level over wide modulation frequency range.<br>$f_{DET}1$: fmod = 100kHz , relative attenuation from fmod = 1kHz condition<br>$f_{DET}2$: fmod = 20Hz , relative attenuation from fmod = 1kHz condition |
| $R_{OD}$ | OP OUT Load Capability | OP OUT | Attenuation of the FM demodulated signal level by connection of the load resistance.<br>Ro = 4.7kΩ , relative attenuation from no-load condition |
| | | | |
| IF | Intermediate Frequency | | Down-converted frequency in the intermediate receiver section. |
| fmod | IF Signal Modulation | | Frequency of base-band signal to generate FM IF signal. |
| fdev | IF signal deviation | | FM deviation of an IF signal. |

## ■ APPLICATION NOTE

➢ **Influence of power supply noise on S/N characteristics**

The noise level of the FM demodulated output signal of the NJW2311 may increase when operating without a low noise DC power supply. Actually, when noises are on the power supply terminal ($V^+1$, $V^+2$), S/N ratio of NJW2311 deteriorates. It's effective to reduce the noise level which appears in the power supply terminal ($V^+1$, $V^+2$) to get excellent S/N characteristics.

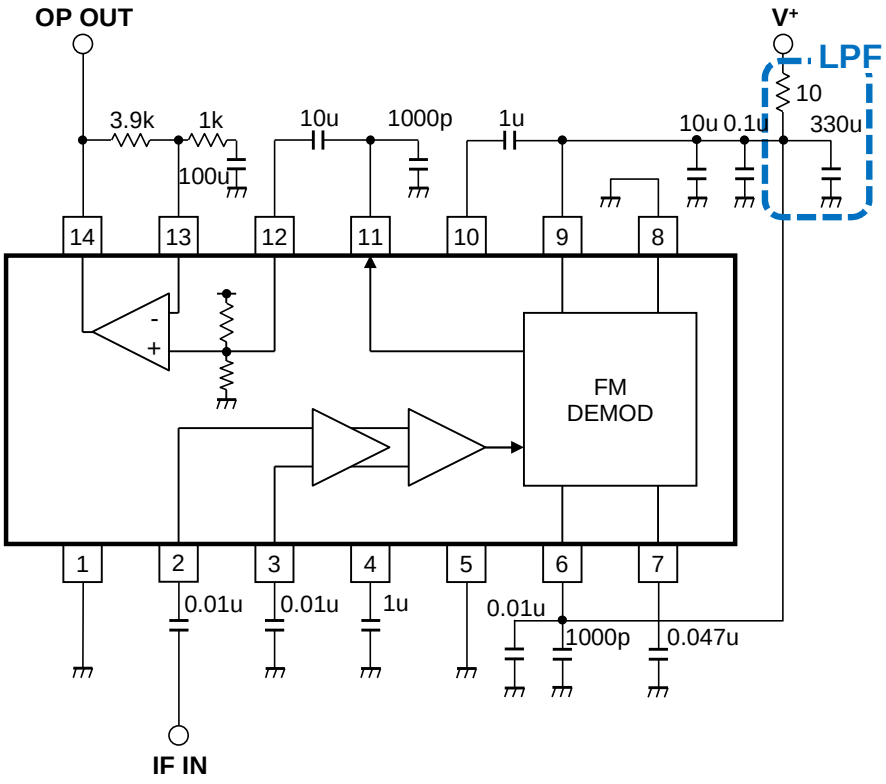
The following is an example to connect a capacitor and a resistor into between an external power supply and the power supply terminal ($V^+1$, $V^+2$) and make it a low pass filter. In this case, the cutoff frequency of the LPF should be set to much lower frequency than the demodulation (AF) frequency.

$$fc = \frac{1}{2\pi\tau}$$

* fc: Cut off frequency
  t : Time constant (RC)

On the other hand, a big value of capacitor of the LPF has slow response when the DC power becomes turned on. And, a big value of resistor of the LPF has the drop voltage of the DC power. Therefore please pay attention so that the voltage of the power supply terminal of NJW2311 ($V^+1$,$V^+2$) may fit into a range of the recommended operating condition.

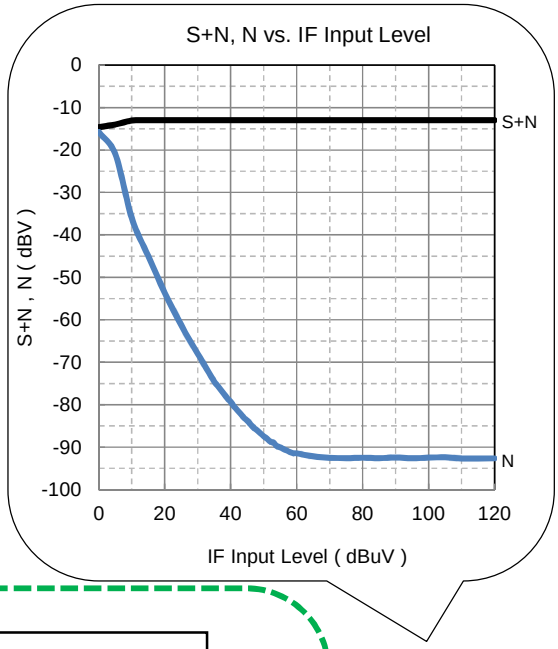
➢ **Reference circuit diagram to prevent degradation of S/N**

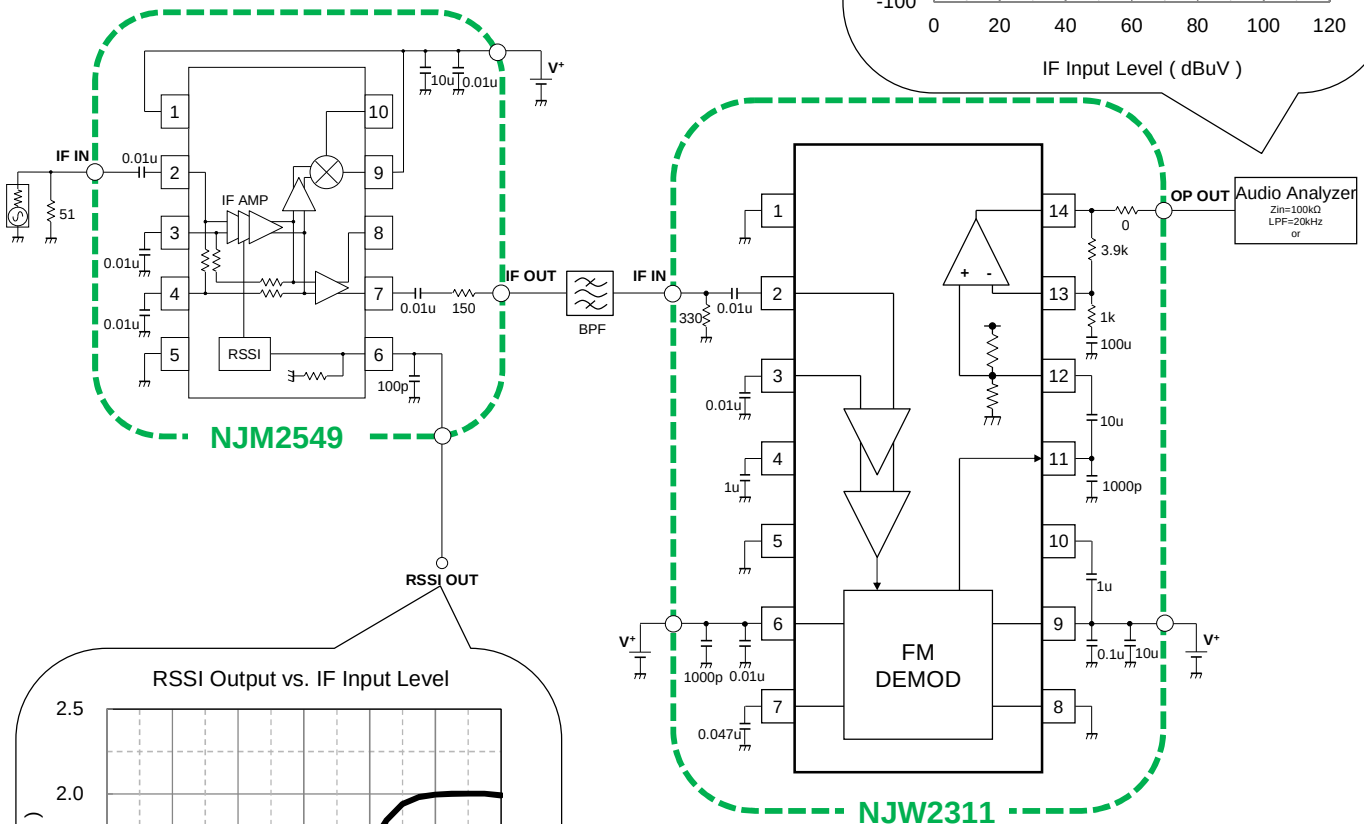


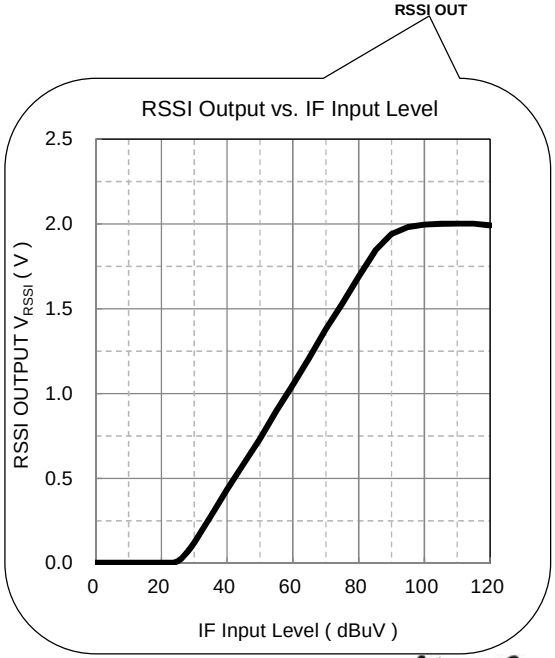
➢ **Recommended combination of ICs to boost the receiver sensitivity up**

A pre-amplifier before NJW2311 is useful to boost the demodulation sensitivity up.
The following of circuit diagram and its characteristics are the recommended combination with NJM2549 to boost the receiver sensitivity up. NJM2549 has a built-in RSSI function, it can use for a carrier squelch.

➢ **Circuit configuration and characteristics for boosting of the demodulation sensitivity**

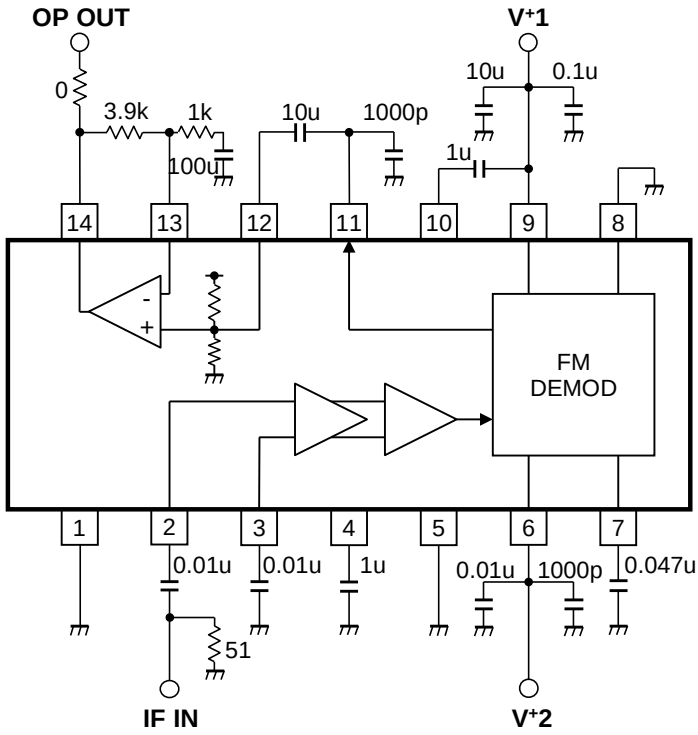


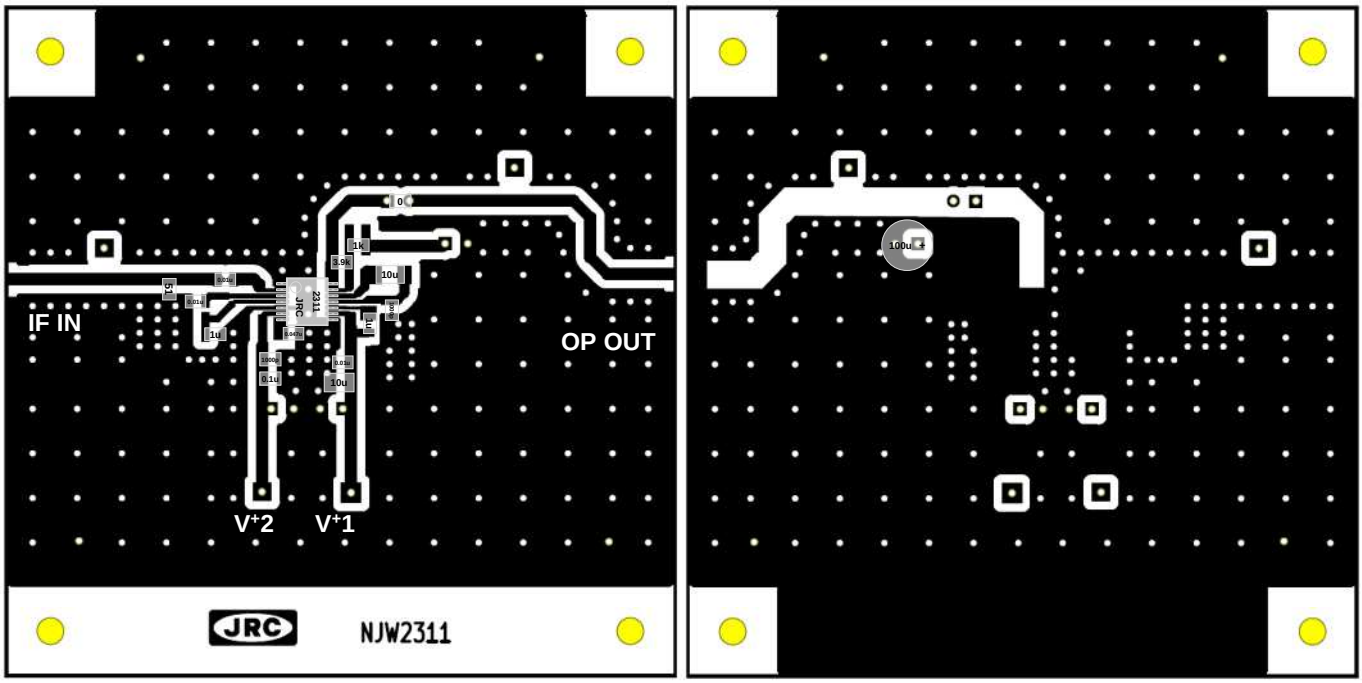

BPF:SFECF10M7EA00-R0
(Murata Manufacturing Co., Ltd., Japan)

➢ **EVALUATION BOARD**




➢ **Evaluation board**

**Top view** **Bottom view**



## ➢ PCB layout information

The demodulation sensitivity and electromagnetic interference (EMI) of the NJW 2311 are affected by the pattern layout. Particular attention is required to the pattern layout of the power supply line, GND line, and signal line.

- **Demodulation sensitivity**

If the GND terminal is unstable, or if the grounding points of external components are not preferred location, the reception sensitivity will be reduced. For this reason, please make pattern layout so that parasitic impedance of power supply and GND line is as low as possible.

When it becomes difficult to lower the parasitic impedance, please consider the pattern layout with reference to the following contents.

・ Improvement of GND stability

Through hole: Reduce the impedance of board GND by increasing the number of through holes with GND of another PCB layer.

Solid pattern: Place the signal line so that it does not cross the GND pattern on the NJW 2311 mounted side.

Pin 7 and 8: Connect to the GND of the surface layer without going through a through hole.

Pin 4: Connect to the GND of the surface layer without going through a through hole.

・ GND separation

Pin 2 and 3: Common GND of the front stage circuit of the IF input

Pin 2 and 3: Isolated GND from GND of Pin 7 ※ Increase parasitic impedance via through hole or pattern line.

Pin 4: Isolated GND from GND of Pin 7 ※ Increase parasitic impedance via through hole or pattern line.

・ Enhanced power supply stability

Place the GND of the bypass capacitor of power supply terminal $V^+1$ (Pin 9) near the GND1 (Pin 1).

Place the GND of the bypass capacitor of power supply terminal $V^+2$ (Pin 6) near the GND2 (Pin 5).

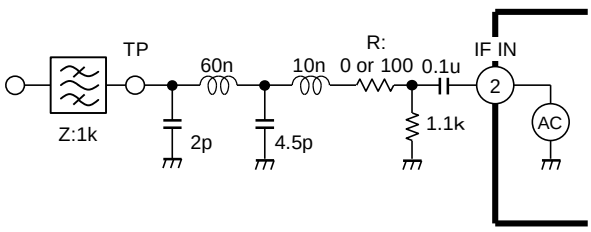
- **Electro Magnetic Interference (EMI)**

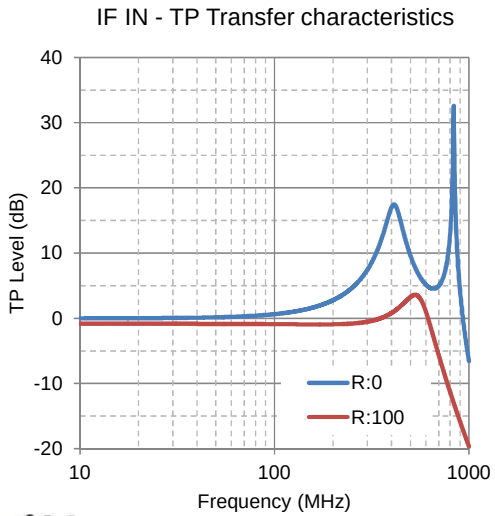
The NJW 2311 amplifies the IF input signal to generate a saturation waveform (rectangular wave), and then performs signal processing in the FM demodulator circuit.

When an IF signal is input to these circuits, the circuit current including the input signal frequency and harmonic components flows and noise is generated in a wide frequency range. If this noise component current to the power supply, GND and signal line, electromagnetic interference is radiated using the pattern layout as an antenna. Therefore, please shorten the pattern layout of power supply, GND, and signal line as much as possible.

The equivalent circuit is shown below for the pattern layout when the signal path connected from the filter (input / output impedance: 1 kΩ) to the IF IN terminal (pin 2) is lengthened. When the wire is made longer, the transfer characteristic from the IF IN terminal (pin 2) to TP becomes the blue line on the graph and a peak occurs at a specific frequency. As a countermeasure, by setting a resistor in the immediate vicinity of the IF IN terminal (pin 2), the transfer characteristic from the IF IN terminal (pin 2) to TP becomes the red line on the graph and the frequency peak can be suppressed.

However, depending on the impedance of the signal path and the resistance value, reception sensitivity may decrease, so be careful.



## ➢ Function Description

The NJW2311 is composed of the IF amplifier, the FM demodulator and the low noise Op-amplifier.
The following is the description of the function and terminals of each circuit.

- **2 systems of power supply terminal ($V^+1$, $V^+2$) and GND terminal (GND1,GND2)**

Power supply terminal $V^+1$ and GND1 are being used for the comparator circuit which is placed after the IF amplifier circuit. Power supply terminal $V^+2$ and GND2 are being used for all circuits except for the above-mentioned comparator part. A reason of separation of power supply is to avoid the harmonic frequencies in IF which occurs at the above-mentioned comparator part.

- **IF amplifier circuit（IF AMP）**

An IF amplifier circuit is a saturation amplifier to make a clipped signal (square wave) to remove an amplitude noise in an IF signal. The output of the IF amplifier which is the fixed level is sent to the FM demodulator circuit. (Since a FM modulating signal has information in frequency shifting, even if a clipped FM modulating signal doesn't influence information.)
A weak FM signal can be demodulated even in a noisy environment by this way.
NJW2311 doesn't have an output terminal of an IF amplifier circuit.

▪ **Circuit composition**

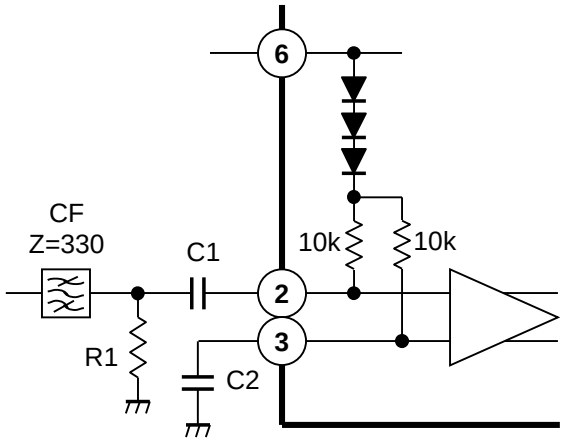
The IF amplifier circuit consists of a differential amplifier and a comparator, and has a high gain.

・ **IF IN terminal (Pin2) input impedance is 10kΩ, Resistance between Pin2 and 3 is 20kΩ (typical)**

An internal resistance of 20kΩ is connected between the IF IN terminal and the IF decoupling terminal. The midpoint of this 20kΩ is connected to the power source for DC biassing through 3 stage of diodes.
Therefore input detector of IF IN terminal will be 10kΩ.

・ **IF IN terminal (Pin2): A CF (ceramic filter) connection example**

When connecting CF to the IF IN terminal, it's necessary to consider the impedance-matching between the characteristic impedance (Z) of CF and the IF IN terminal for good filter characteristics.
The right figure will be the example of the impedance-matching between the CF and Pin2 using an external resistor R1. In this case, the external capacitor C1 is placed.
Without C1 case, the external resistor R1 will be connected to Pin2 directly, so the inner bias voltage fluctuates and the demodulated sensitivity will be degrading.
The external resistor R1 can be calculated by the following equation.




$$\frac{1}{R1} = \frac{1}{Z} - \frac{1}{10k\Omega}$$

※Since the standard evaluation board doesn't have CF, so R1 is 51 Ω to match the impedance of Signal Generator.

・ **IF IN terminal (Pin2), IF decoupling terminal (Pin3): external capacitor and frequency characteristics**

A minimum cutoff frequency of an IF amplifier frequency response will be related with the capacitor connected to IF IN terminal and IF DEC terminal (The upper limit cutoff frequency doesn't change).
Big capacitor value even can amplify a low frequency, and small capacitor value amplifies only the 10.7MHz neighborhood.

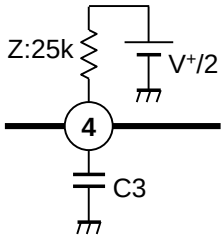
- **FM demodulator circuit**

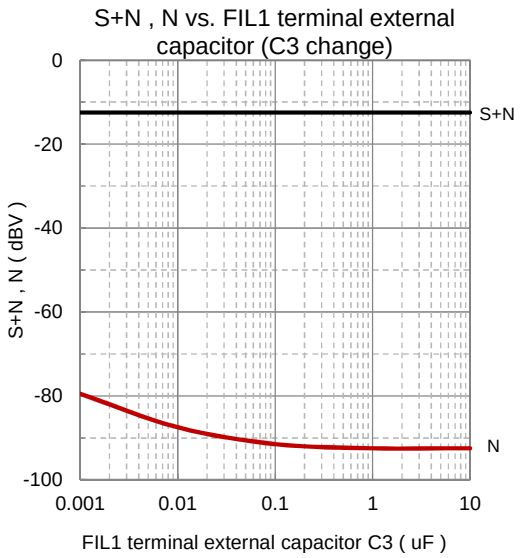
  This FM demodulator circuit works at low voltage, and could achieve low noise by original circuit technology.
  A 90 degree phase-shifter and a local signal were necessary as the external parts in the past FM IF demodulator IC, but NJW2311 contributes to equipped area reduction to a set because NJW2311 doesn't require such external parts and other special parts.

▪ **FIL1 terminal (Pin4): A noise is removed by external capacitor connected to GND**

FIL1 terminal is the connection terminal to an external decoupling capacitor of the reference voltage.
A reference voltage of 1/2 * $V^+$ is supplied inside the IC, and terminal impedance is 25kΩ.
FIL1 terminal connects an external capacitor passed through to GND for the purpose of a noise removal of the internal reference voltage of the IC.
Lower cut-off frequency for removal noise can calculate from the following equation, which is determined from both of 25kΩ of terminal impedance and the external capacitor C3.

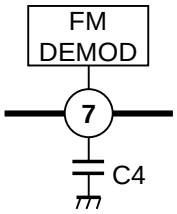
$$fc = \frac{1}{2 * \pi * 25k\Omega * C3}$$



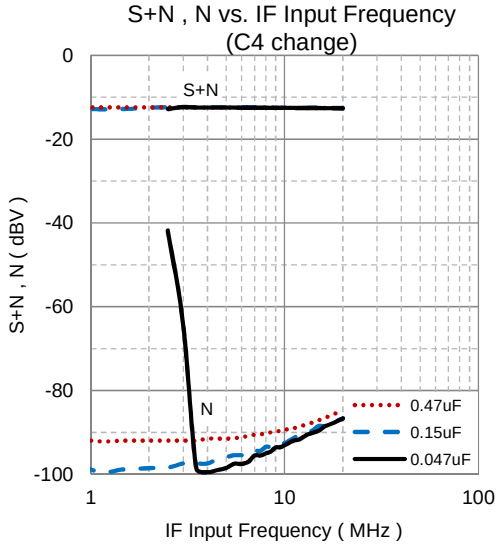



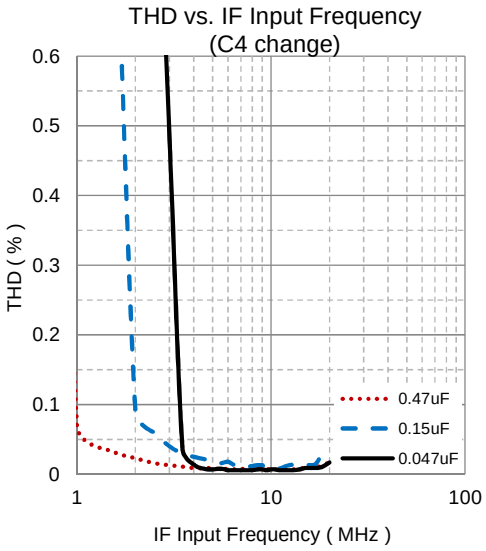

▪ **FIL2 terminal (Pin7): Carrier frequency is removed by external capacitor connected to GND**

FIL2 terminal is the noise removal terminal of the demodulated signal.
FIL2 terminal connects an external capacitor connected to GND for the purpose of carrier frequency removal from an FM demodulated output signal. If the carrier frequency is so different from the standard carrier frequency (10.7MHz), there is a possibility that an FM demodulated output has much a carrier frequency leak. When there are a lot of leaks of a carrier frequency in a FM demodulated output signal, it's effective to reduce the leaks by changing external capacitor C4.

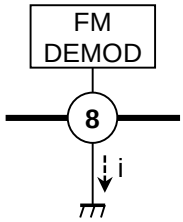



And on the other hand, the external capacitor C4 influences to the response speed (raising-time) when the power becomes supplied, so a big value of the capacitor will make slow response and a small one will be in reverse.



- **CS terminal (Pin8): Usually grounded**

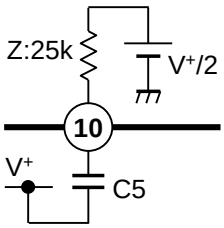


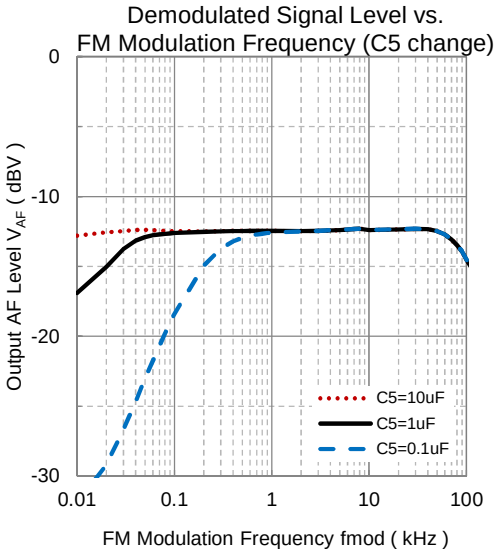

CS terminal is an electric current output terminal from an IC inner circuit.
It's usually connected to a GND terminal.
In the increasing of ground impedance case, it increases a noise of the output of the FM demodulator, and S/N will be degraded. Also, the operating electric current decreases.

- **FIL3 terminal (Pin10): Lower cut-off frequency of the FM demodulated output is determined by the external capacitor connected to $V^+$**

FIL3 terminal is related to decision about a lower cut-off frequency of the FM demodulated output frequency band as a demodulator filter terminal.
A DC bias of 1/2 * $V^+$ is supplied inside the IC, and terminal impedance is 25kΩ.
The lower cut-off frequency of the FM demodulated output frequency band is determined by 25kΩ of terminal impedance and external capacitor C5, as calculated from the following formula.

$$fc = \frac{1}{2 * \pi * 25k\Omega * C5}$$

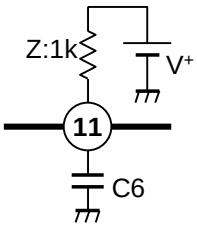


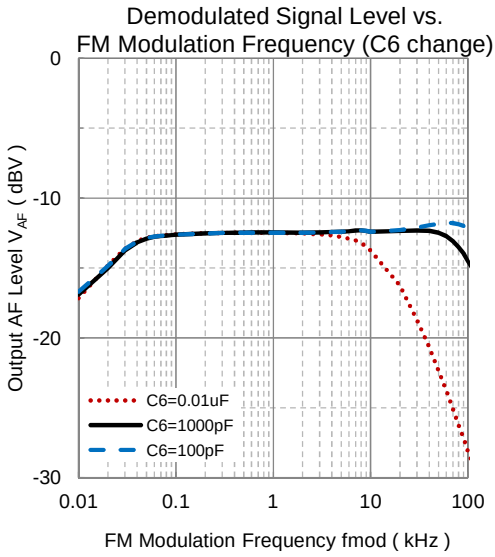




- **DEM OUT terminal (Pin11): Higher cut-off frequency of the FM demodulated output is determined by the external capacitor connected to GND**

DEM OUT terminal is the FM demodulated output.
The terminal impedance is 1kΩ.
The higher cut-off frequency of the FM demodulated output frequency band is determined by 1kΩ of terminal impedance and external capacitor C6, as calculated from the following formula.

$$fc = \frac{1}{2 * \pi * 1k\Omega * C6}$$



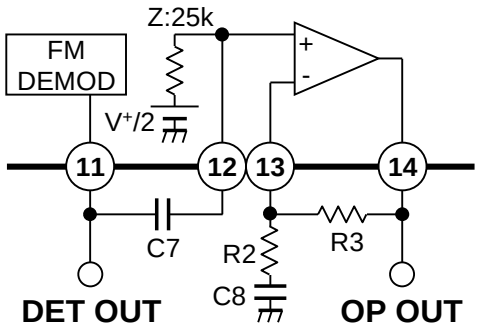
- **Op-amplifier circuit**

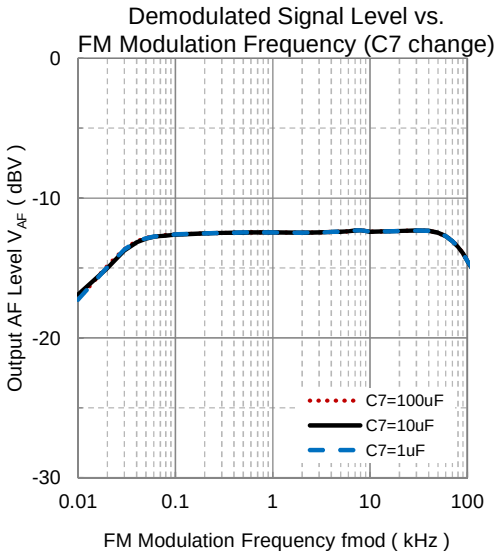
The Op-amplifier circuit amplifies the signal of the FM demodulated output on DEM OUT terminal (about 51 mVrms under standard condition), and outputs.
The gain of the amplifier can be established by the external resistors.

▪ **$OP^+$ IN terminal (Pin12): Lower cut-off frequency of the carrier frequency is determined by the external capacitor connected to DEM OUT terminal**

$OP^+$ IN terminal is a non-reversed input terminal of the OP-amplifier.
DEMOD OUT terminal is connected to $OP^+$ IN terminal through the coupling capacitor C7.
A DC bias of 1/2 * $V^+$ is supplied inside the IC, and terminal impedance is 25kΩ.
The lower cut-off frequency of the Op-amplifier is determined by 25kΩ of terminal impedance and the external capacitor C7, as calculated from the following formula.

$$fc = \frac{1}{2 * \pi * 25k\Omega * C7}$$

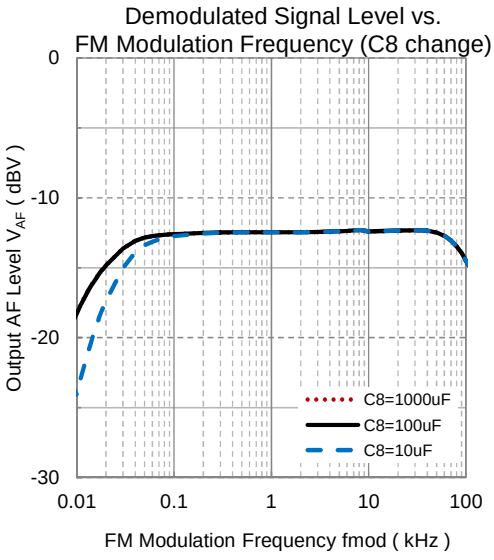



▪ **$OP^-$ IN terminal (Pin13): lower cut-off frequency of the Op-amplifier is determined from C and R**

$OP^-$ IN terminal is a reversed input terminal of the Op-amplifier.
The lower cut-off frequency of a FM demodulated output frequency band is determined from a time constant of the external resistor R2 and the external capacitor C8.
The upper limited frequency of a FM demodulated output is decided from the following formula.

$$fc = \frac{1}{2 * \pi * R2 * C8}$$



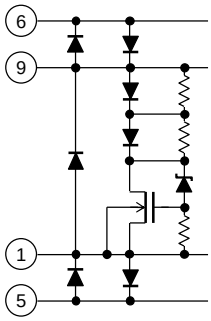
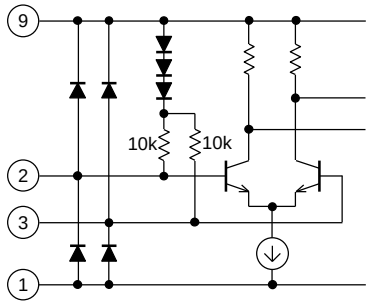
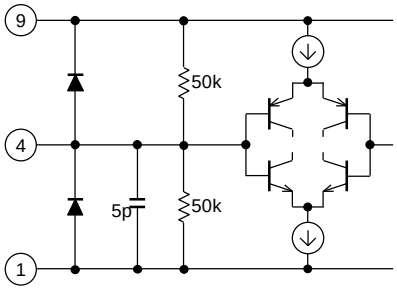
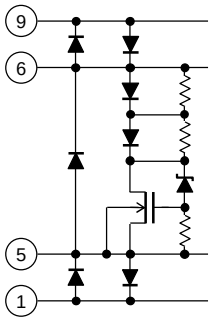
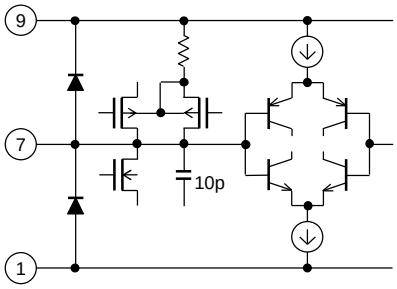

▪ **OP OUT terminal (Pin14): The gain is determined by the external resistor connected to $OP^-$ IN terminal**

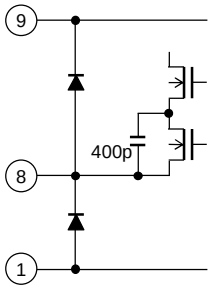
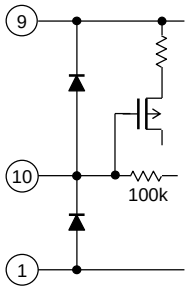
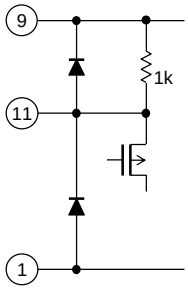
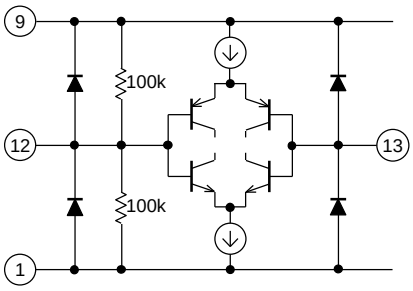
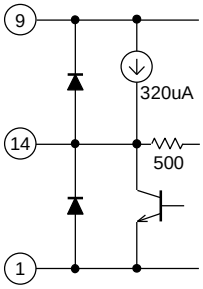
OP OUT terminal is the output terminal of the Op-amplifier.
Gain (Av) can be set by applying negative feedback.
The gain is determined from the following formula.

$$Av = 1 + \frac{R3}{R2}$$

➢ **TERMINAL FUNCTION**

( Ta = 25 °C , $V^+1 = V^+2$ = 5V , IF IN = 10.7MHz / 100dBuV , fdev = ±75kHz , fmod = 1kHz , unless otherwise noted )

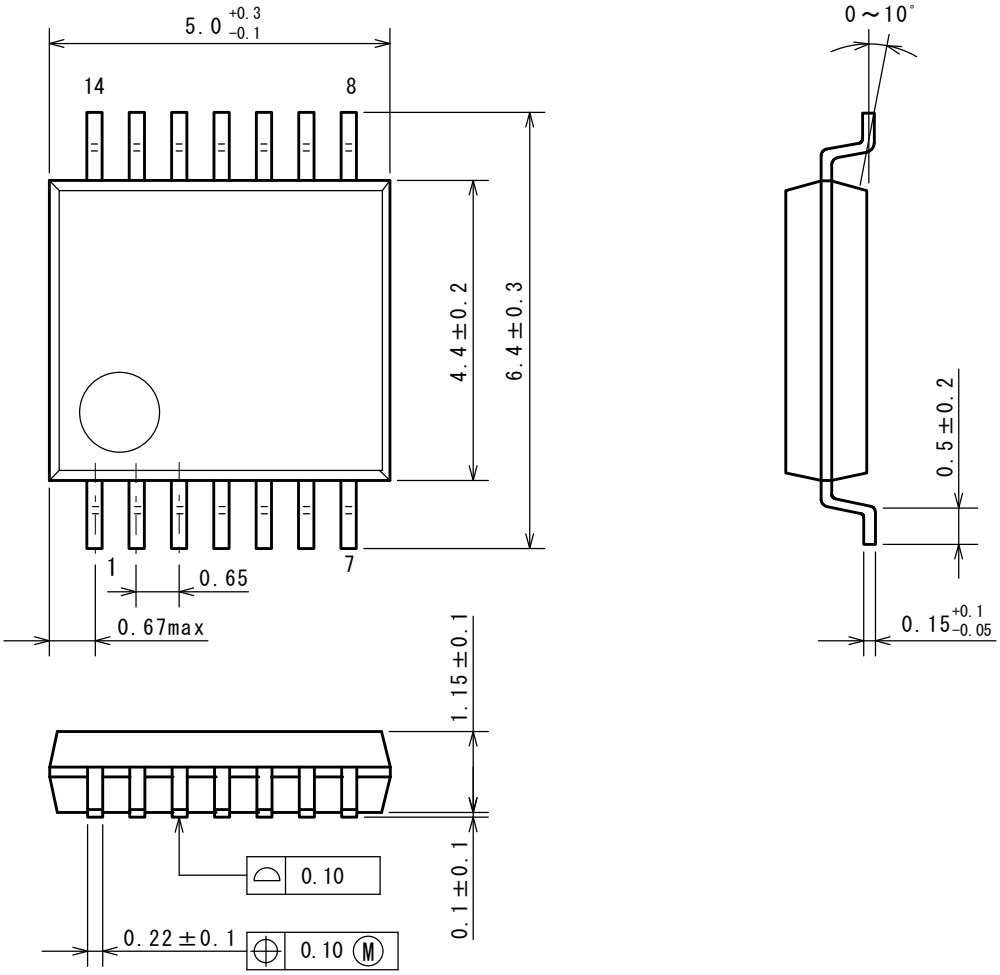
| Pin No. | SYMBOL | EQUIVALENT CIRCUIT | VOLTAGE | FUNCTION |
|---|---|---|---|---|
| 1<br>9 | GND1<br>$V^+1$ |  | 0 V<br>5 V | 1pin: Main ground terminal<br>9pin: Main power supply terminal |
| 2<br>3 | IF IN<br>IF DEC |  | 2.6 V | 2pin: IF Amplifier Input terminal<br>3pin: IF Amplifier Decoupling terminal |
| 4 | FIL1 |  | 2.5 V | Reference voltage decoupling terminal. |
| 5<br>6 | GND2<br>$V^+2$ |  | 0 V<br>5 V | 5pin: IF Amplifier final stage (comparator) ground terminal<br>6pin: IF Amplifier final stage (comparator) power supply terminal |
| 7 | FIL2 |  | 2.5 V | Noise removal terminal of the demodulated signal. |

| Pin No. | SYMBOL | EQUIVALENT CIRCUIT | VOLTAGE | FUNCTION |
|---|---|---|---|---|
| 8 | CS |  | 0 V | Electric current output terminal. Usually connected to GND. |
| 10 | FIL3 |  | 2.3 V | Demodulator filter terminal. |
| 11 | DEM OUT |  | 4 V | Demodulated output terminal. |
| 12<br>13 | $OP^+IN$<br>$OP^-IN$ |  | 2.5 V<br>2.5 V | Pin 12 : non-inverting input terminal of internal Op-amplifier.<br>Pin 13 :inverting input terminal of internal Op-amplifier. |
| 14 | OP OUT |  | 2.5 V | Output terminal of the Op-amplifier. |

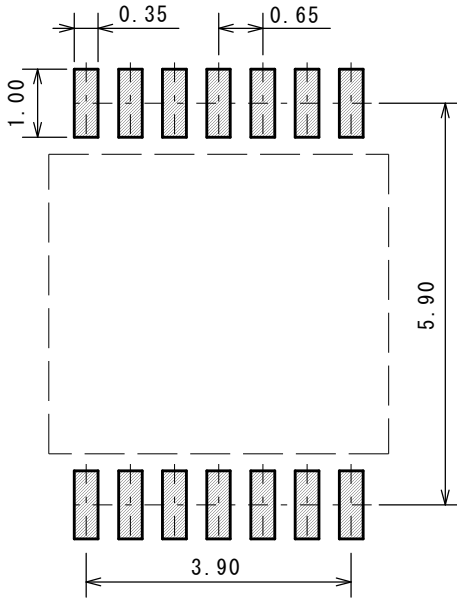
## SSOP14

Unit: mm

### ■PACKAGE DIMENSIONS




### ■EXAMPLE OF SOLDER PADS DIMENSIONS

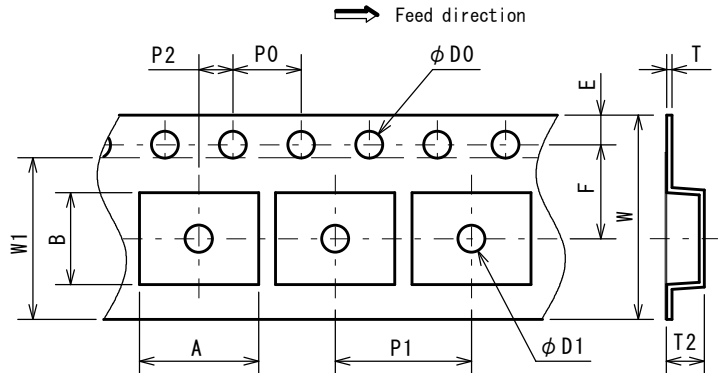


## SSOP14

Unit: mm

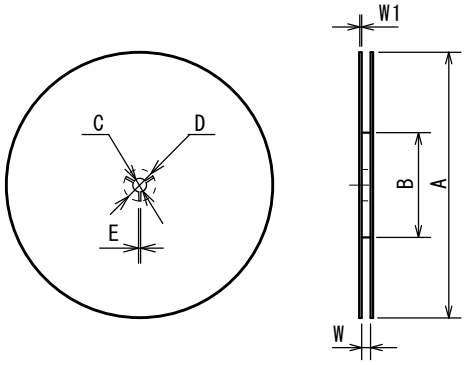
### ■PACKING SPEC

#### TAPING DIMENSIONS



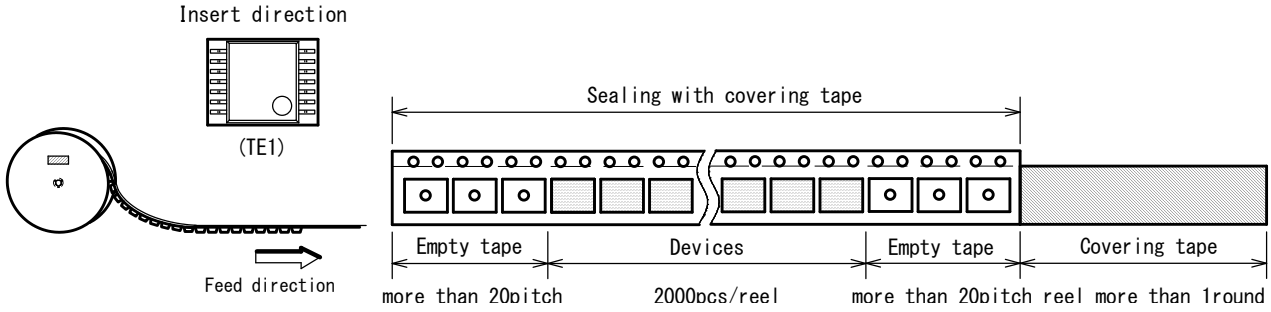

| SYMBOL | DIMENSION | REMARKS |
|---|---|---|
| A | 6.95 | BOTTOM DIMENSION |
| B | 5.4 | BOTTOM DIMENSION |
| D0 | 1.55±0.05 | |
| D1 | 1.55±0.1 | |
| E | 1.75±0.1 | |
| F | 5.5±0.05 | |
| P0 | 4.0±0.1 | |
| P1 | 8.0±0.1 | |
| P2 | 2.0±0.05 | |
| T | 0.3±0.05 | |
| T2 | 2.2 | |
| W | 12.0±0.3 | |
| W1 | 9.5 | THICKNESS 0.1max |

#### REEL DIMENSIONS

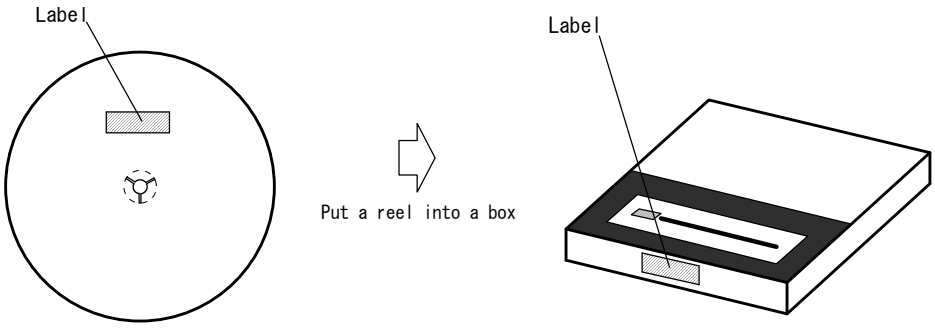



| SYMBOL | DIMENSION |
|---|---|
| A | φ254±2 |
| B | φ100±1 |
| C | φ 13±0.2 |
| D | φ 21±0.8 |
| E | 2±0.5 |
| W | 13.5±0.5 |
| W1 | 2±0.2 |

#### TAPING STATE




#### PACKING STATE

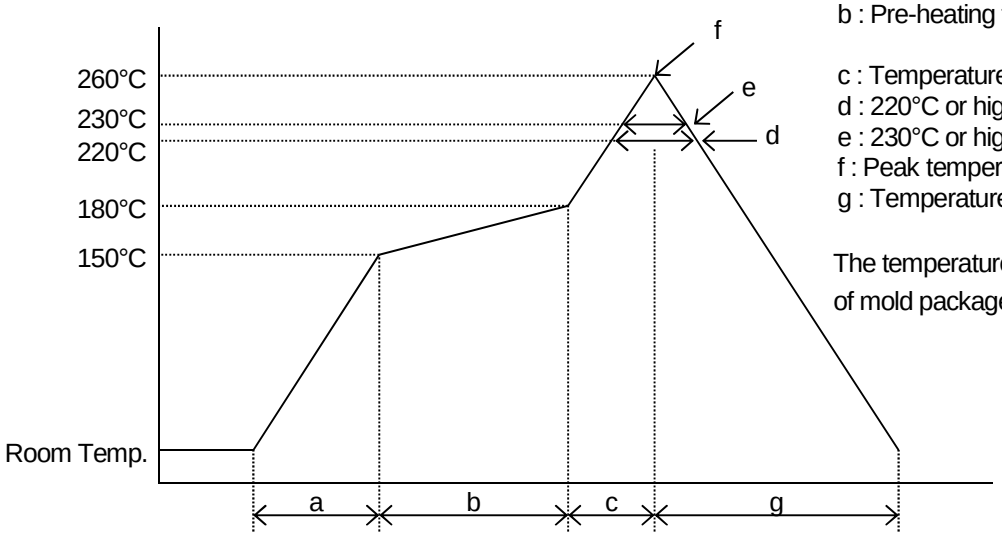


## ■RECOMMENDED MOUNTING METHOD

INFRARED REFLOW SOLDERING METHOD

EAE-D1006-000-02

*Recommended reflow soldering procedure



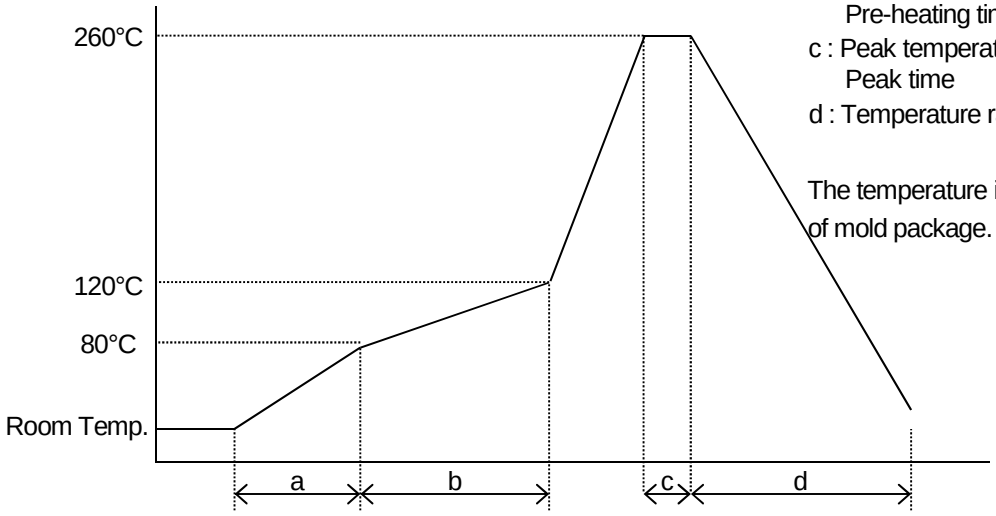

a : Temperature ramping rate : 1 to 4°C /s
b : Pre-heating temperature : 150 to 180°C
time : 60 to 120s
c : Temperature ramp rate : 1 to 4°C /s
d : 220°C or higher time : Shorter than 60s
e : 230°C or higher time : Shorter than 40s
f : Peak temperature : Lower than 260°C
g : Temperature ramping rate : 1 to 6°C /s

The temperature indicates at the surface of mold package.

FLOW SOLDERING METHOD

EAE-D2003-000-00

*flow soldering procedure




a : Temperature ramping rate : 1 to 7°C /s
b : Pre-heating temperature : 80 to 120°C
Pre-heating time : 60 to 120s
c : Peak temperature : not exceeding 260°C
Peak time : within 10s
d : Temperature ramping rate : 1 to 7°C /s

The temperature indicates at the surface of mold package.

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   Various Safety devices

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