

## 2Vrms Ground Referenced Stereo Line Amplifier

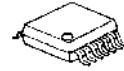
### ■ GENERAL DESCRIPTION

The **NJU72015** is an audio line Amplifier . It can swing 2Vrms (5.6V peak-to-peak) signal at 3.3V operating voltage.

Ground-referenced outputs eliminate output coupling capacitor. It contains differential input.

The pop noise suppression circuit removes a pop noise at the power-on and power-off.

### ■ PACKAGE OUTLINE



**NJU72015V**

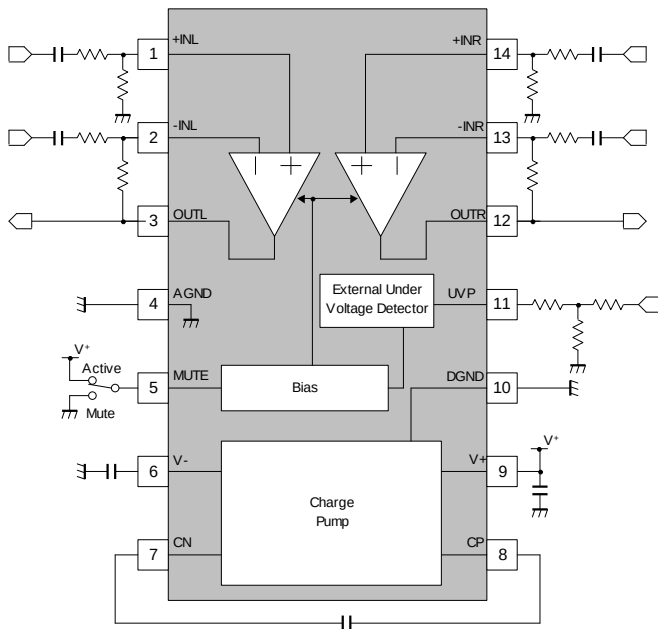
### ■ APPLICATIONS

- Audio applications requiring 2Vrms outputs

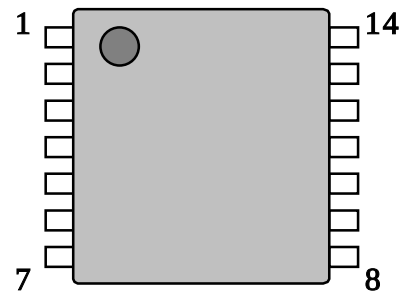
### ■ FEATURES

- Operating Voltage +3.0 to +3.6V
- Operating Current  $I_{DD}=5mA$  typ.at  $V^+=3.3V$ , No Signal, No Load
- Output Coupling Capacitor-less
- Differential Input
- Pop Noise Suppression Circuit
- C-MOS Technology
- Package Outline SSOP14

### ■ BLOCK DIAGRAM



### ■ PIN CONFIGURATION



| No. | Symbol | Function                           |
|-----|--------|------------------------------------|
| 1   | +INL   | Lch Noninverted Input              |
| 2   | -INL   | Lch Inverted Input                 |
| 3   | OUTL   | Lch Output                         |
| 4   | GND    | Ground                             |
| 5   | MUTE   | Mute Control                       |
| 6   | V-     | V- Power Supply                    |
| 7   | CN     | Flying Capacitor Negative Terminal |
| 8   | CP     | Flying Capacitor Positive Terminal |
| 9   | V+     | V+ Power Supply                    |
| 10  | DGND   | Ground                             |
| 11  | UVP    | Undervoltage Protection Input      |
| 12  | OUTR   | Rch Output                         |
| 13  | -INR   | Rch Inverted Input                 |
| 14  | +INR   | Rch Noninverted Input              |

## ■ ABSOLUTE MAXIMUM RATING (Ta=25°C)

| PARAMETER                   | SYMBOL     | RATING                      | UNIT |
|-----------------------------|------------|-----------------------------|------|
| Supply Voltage              | $V^+$      | +4                          | V    |
| Power Dissipation           | $P_D$      | 530 <sup>(Note1)</sup>      | mW   |
| Maximum Input Voltage       | $V_{IMAX}$ | $-V^+ - 0.3 \sim V^+ + 0.3$ | V    |
| Operating Temperature Range | Topr       | -40 ~ +85                   | °C   |
| Storage Temperature Range   | Tstg       | -40 ~ +125                  | °C   |

(Note1) EIA/JEDEC STANDARD Test board (76.2x114.3x1.6mm, 2layer, FR-4) mounting

## ■ RECOMMENDED OPERATING CONDITIONS

( $V^+=3.3V$ , Ta=25°C unless otherwise specified)

| PARAMETER         | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|-------------------|--------|----------------|------|------|------|------|
| Operating Voltage | $V^+$  |                | 3.0  | 3.3  | 3.6  | V    |

## ■ ELECTRICAL CHARACTERISTICS

### ◆ DC CHARACTERISTICS

( $V^+=3.3V$ , Mute=OFF,  $R_L=10k\Omega$ , Ta=25°C unless otherwise specified)

| PARAMETER                                          | SYMBOL    | TEST CONDITION     | MIN. | TYP. | MAX. | UNIT |
|----------------------------------------------------|-----------|--------------------|------|------|------|------|
| Operating Current                                  | $I_{DD}$  | No signal, No load | -    | 5    | 10   | mA   |
| Power Supply Rejection Ratio                       | PSRR      | $V^+=3V$ to 3.6V   | -    | 80   | -    | dB   |
| External undervoltage detection                    | $V_{uvp}$ |                    | -    | 1.25 | -    | V    |
| External undervoltage detection hysteresis current | $I_{Hys}$ |                    | -    | 5    | -    | uA   |
| Output Offset Voltage                              | $V_{OS}$  | $R_g=0\Omega$      | -    | -    | 1    | mV   |

### ◆ AC CHARACTERISTICS

( $V^+=3.3V$ , f=1kHz,  $V_{in}=1V_{rms}$  [differential input], Mute=OFF,  $R_{IN}=10k\Omega$ ,  $R_{fb}=20k\Omega$ ,  $R_L=10k\Omega$ , Ta=25°C unless otherwise specified)

| PARAMETER                      | SYMBOL     | TEST CONDITION             | MIN. | TYP.  | MAX. | UNIT |
|--------------------------------|------------|----------------------------|------|-------|------|------|
| Maximum Output Voltage Level   | $V_{OMAX}$ | THD=1%                     | -    | 2.3   | -    | Vrms |
| Mute Level                     | $V_{MUTE}$ | $R_g=0\Omega$ , Mute=ON    | -    | -80   | -    | dB   |
| Equivalent Input Noise Voltage | $V_{NI}$   | $R_g=0\Omega$ , A-weighted | -    | -106  | -    | dB   |
| Total Harmonic Distortion      | THD        | BW:400Hz-22kHz             | -    | 0.003 | -    | %    |
| Channel Separation             | CS         | $R_g=600\Omega$ , Bandpass | -    | 110   | -    | dB   |

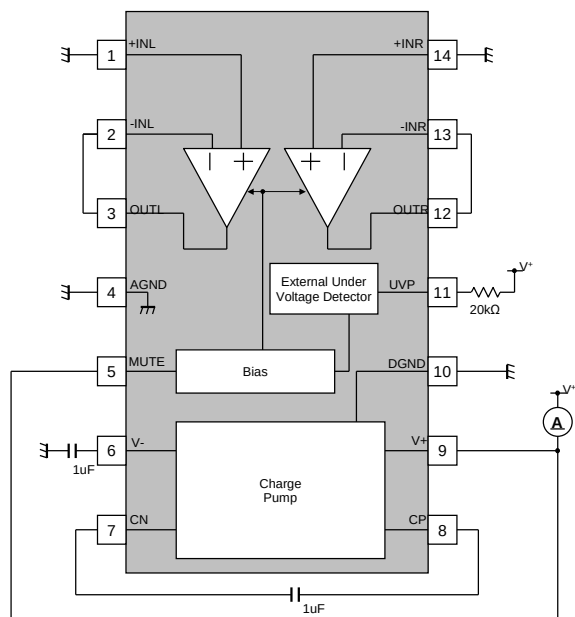
## ■ CONTROL CHARACTERISTICS

( $V^+=3.3V$ , Ta=25°C unless otherwise specified)

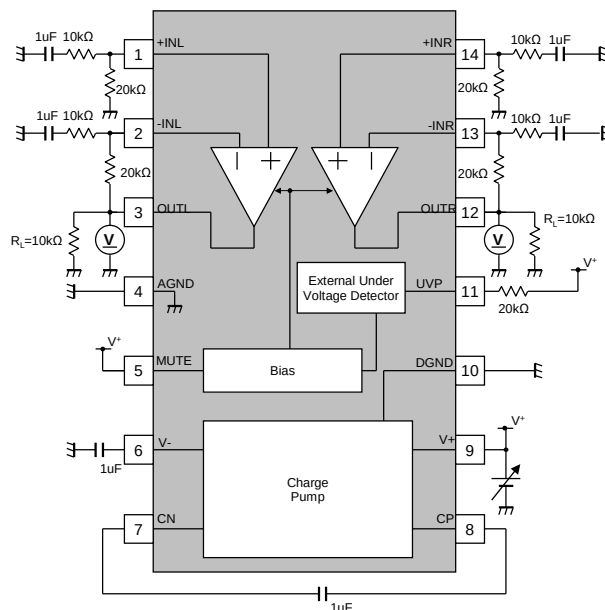
| PARAMETER          | SYMBOL | TEST CONDITION | MIN.              | TYP. | MAX.              | UNIT |
|--------------------|--------|----------------|-------------------|------|-------------------|------|
| Mute terminal High | MuteH  | Mute=OFF       | 0.7V <sup>+</sup> | -    | V <sup>+</sup>    | V    |
| Mute terminal Low  | MuteL  | Mute=ON        | 0                 | -    | 0.3V <sup>+</sup> | V    |

## TEST CIRCUIT

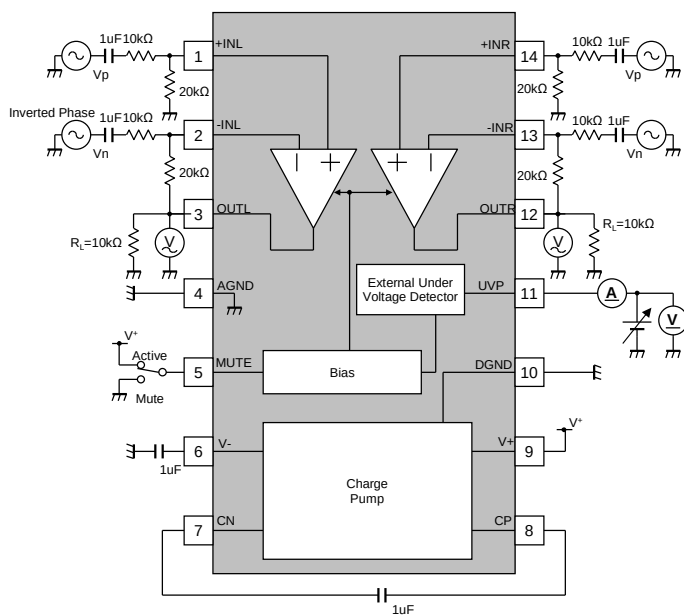
◆  $I_{DD}$



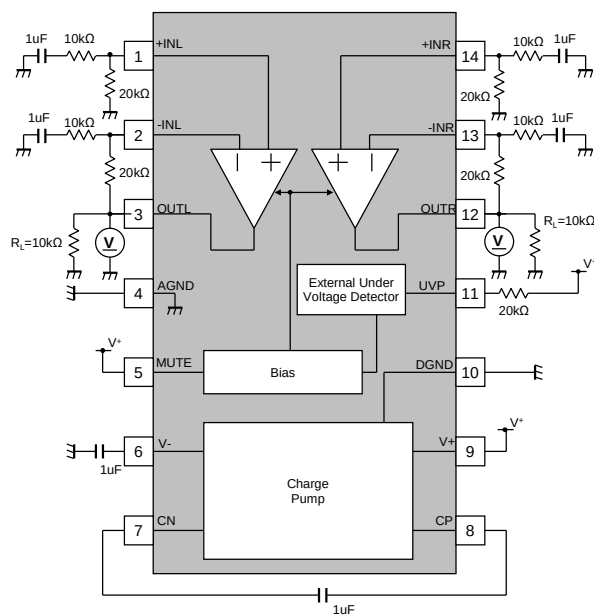
◆ PSRR



◆  $V_{UVP}$ ,  $I_{Hys}$ ,  $V_{OMAX}$ ,  $V_{MUTE}$

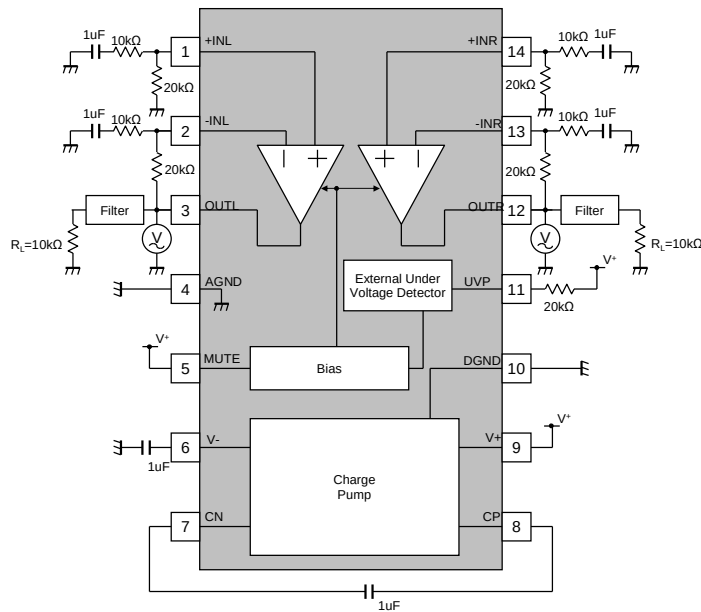


◆  $V_{OS}$

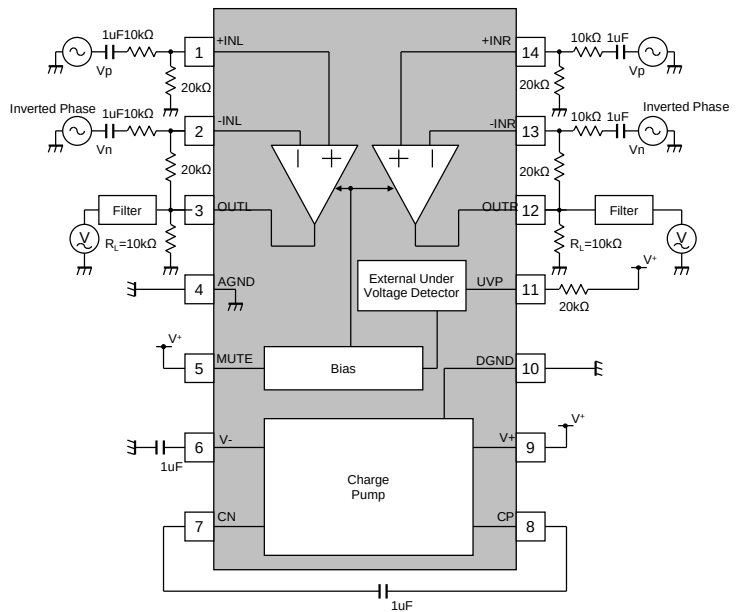


◆ $V_{NI}$

$V_{NI}$  = Measurement - 12dB

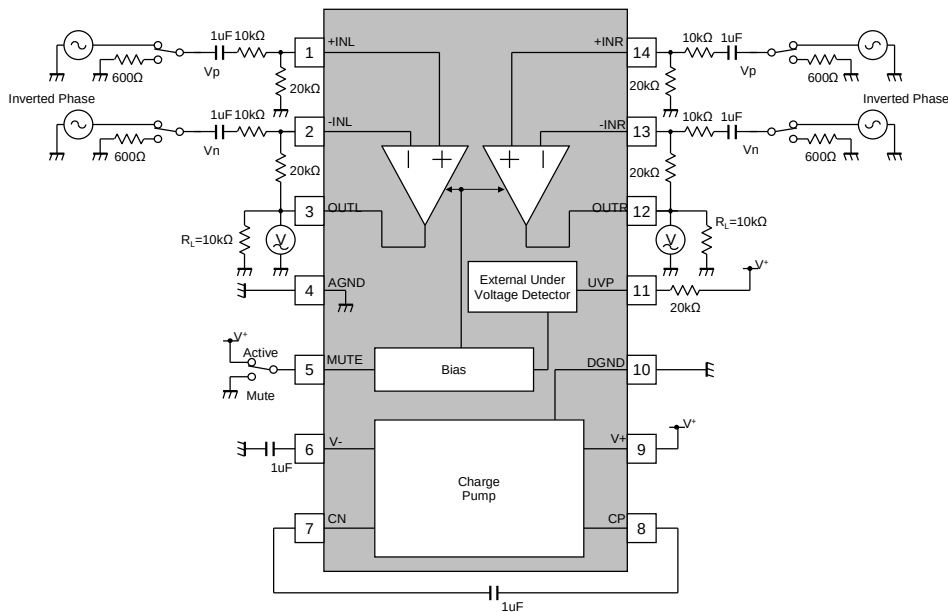


◆THD

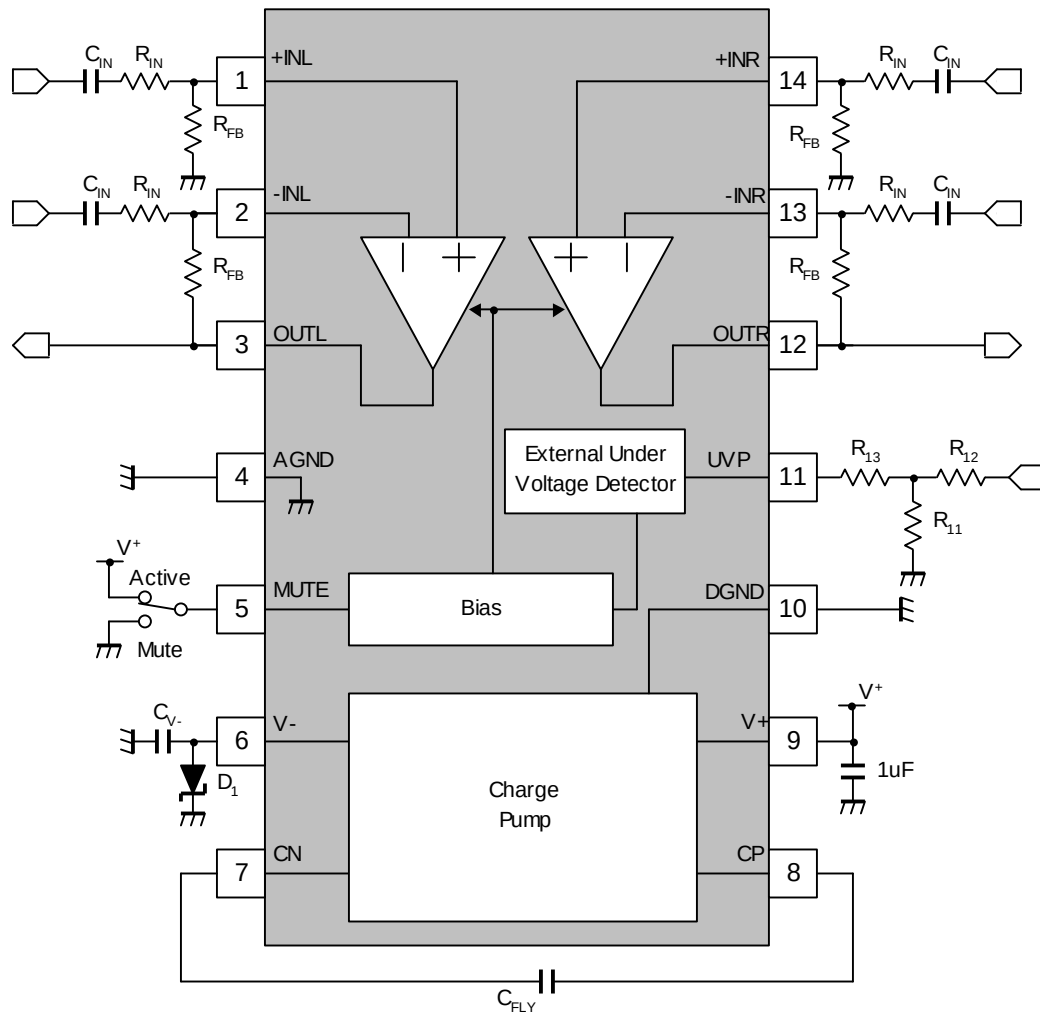


◆CS

OUTL:  $CS = 20 \cdot \log(OUTR/OUTL)$   
OUTR:  $CS = 20 \cdot \log(OUTL/OUTR)$



■ APPLICATION CIRCUIT



\*1) Connect a zener diode between V- terminal[6pin] and GND terminal[8pin] to prevent connecting V- terminal[6pin] and V+ terminal[3pin].

### ■ APPLICATION CIRCUIT

#### ◆Operating Overview

The drawing in Fig 1 illustrates the internal circuit in NJU72015. The NJU72015 has a charge-pump for negative power supply, pop noise suppression circuit, external under voltage detector, and a line amplifier.

The NJU72015 operates from a single supply voltage from 3.0V to 3.6V and the NJU72015's line drivers use a charge pump to invert the positive power supply (V+) to negative power supply (V-), see Fig 2. The output voltages are centered at zero volts with the capability to swing to the positive rail or negative rail. This feature eliminates the output capacitor that is using in conventional line driver operating by a single-supply voltage.

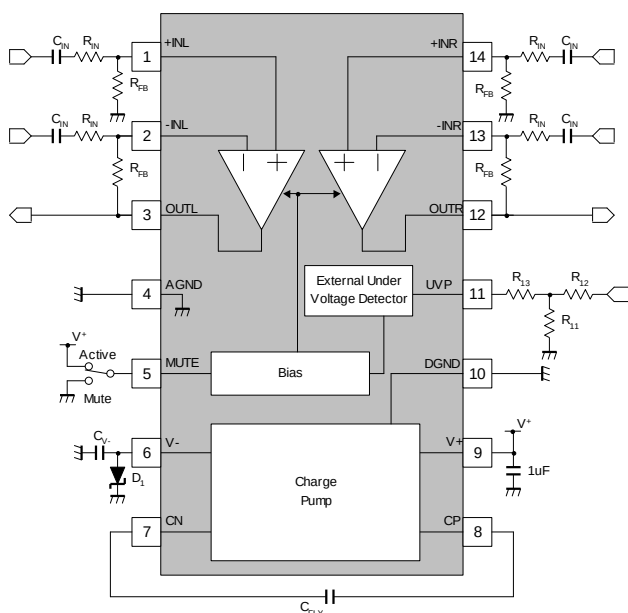


Fig.1 NJU72015 Block diagram

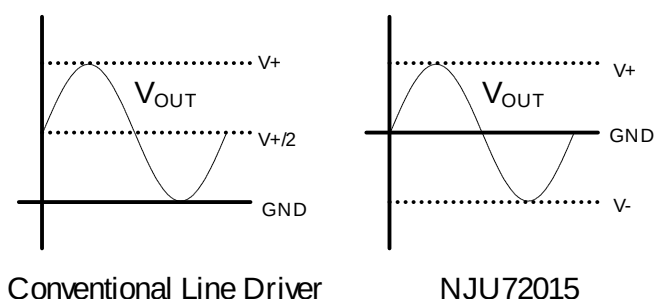


Fig.2 Capacitor-free Operation

#### ◆Gain Setting Resistor

The drawing in Fig.1 illustrates the gain setting circuit configuration of NJU72015. The differential input gain of the NJU72015 is set by:

$$A_V = \frac{R_{FB}}{R_{IN}}$$

The value of Gain setting resistors,  $R_{IN}$  and  $R_{FB}$ , affect noise, stability and input capacitor size. Selecting values that are too low demands a large input ac-coupling capacitor,  $C_{IN}$ . Selecting values that are too high increases the noise of the amplifier.

#### ◆Input Coupling Capacitor

An input capacitor,  $C_{IN}$ , is required to be added in series with the audio signal into the input pins of the NJU72015. The capacitor allows the amplifier to bias the input signal to the proper DC level for optimum operation. These capacitors form a high-pass filter with the input resistor,  $R_{IN}$ . The cutoff frequency is set by:

$$f_{C(HPF)} = \frac{1}{2\pi R_{IN} C_{IN}}$$

The value of  $C_{IN}$  must be considered carefully because it directly affects the low frequency response and can distort the audio signal.

## Technical Information

### ◆Flying Capacitor

The flying capacitor is required to generate a negative power supply. To achieve a high efficiency, low-ESR capacitors (ceramic capacitor) are to be selected, and to be placed near the CP terminal (pin7) and CN terminal (pin8) so as to reduce the resistance caused by the PCB trace. The recommended value of this capacitor is 1uF. Selecting values that are too low might reduce the maximum output voltage and might not be operated to specifications.

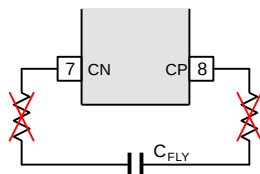


Fig.3 Flying capacitor @ 7pin/8pin

### ◆Negative supply decoupling Capacitor

To achieve a high efficiency on the negative voltage regulator (negative supply for the amplifier circuit), low ESR capacitor (ceramic capacitor) is to be used for this decoupling capacitor. This capacitor is to be placed near the V<sup>-</sup> terminal (pin6) so as to reduce the resistance caused by the PCB trace. The recommended value of this capacitor is 1uF.

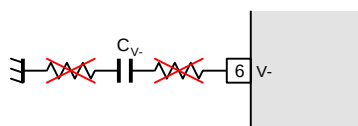


Fig.4 Decoupling capacitor @ 6pin

### ◆Protection Diode

For protection purpose, it is advisable to place a low V<sub>f</sub> diode (Schottky diode) to Ground at V<sup>-</sup> terminal (pin 6). The external diodes will protect the IC negative supply terminal when a positive voltage is accidentally applied to the pin.

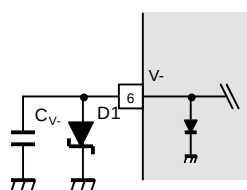


Fig.5 Negative supply terminal @ 6pin

### ◆External Under Voltage Protection

External under voltage detection can be used to mute the NJU72015's output before an input device can generate a pop noise.

The active-mute threshold at the UVP pin is 1.25V. The user selects a resistor divider to obtain the active-mute threshold and hysteresis for the specific application. The threshold is set by:

$$V_{HYS} = 5\mu \times R_{13} \times \frac{R_{11} + R_{12}}{R_{12}}$$

$$V_{UVP} = 1.25 \times \frac{R_{11} + R_{12}}{R_{12}} - V_{HYS}$$

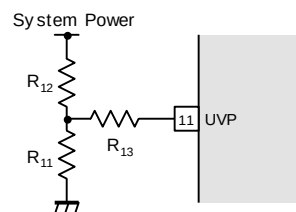
$$= (1.25 - 5\mu \times R_{13}) \times \frac{R_{11} + R_{12}}{R_{12}}$$

with the condition  $R_{13} \gg R_{11}/R_{12}$

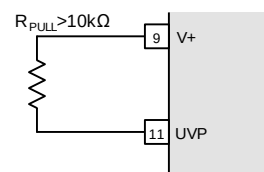
For example, to obtain  $V_{UVP}=4V$  and 1V hysteresis,  $R_{11}=3k\Omega$ ,  $R_{12}=1k\Omega$  and  $R_{13}=50k\Omega$ .

If the UVP function is not used, A pull-up resistance  $R_{PULL}$  is to be connected between UVP terminal and V<sup>+</sup> terminal.

#### ●Application Circuit for Using UVP



#### ●Application Circuit for Not Using UVP



#### ● Sequence of UVP Function

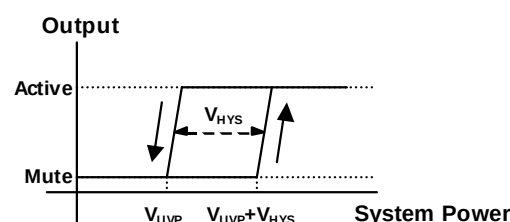


Fig.6 UVP function

### ◆Power up & down sequence to minimize pop noise

To further reduce pop noise, Recommend to Fig.7 how Power up and down sequence.

#### ➤ When power supply is turned ON

To further reduce pop noise during power ON, the MUTE terminal should switch L->H after the power supply terminal has turned ON. It is recommended to have a time interval of 10msec ( $T_{ON}$ ) or more between these two transitions.

#### ➤ When power supply is turned OFF

To further reduce pop noise during power OFF, the MUTE terminal should switch H->L after the power supply terminal has turned OFF. It is recommended to have a time interval of 10msec ( $T_{OFF}$ ) or more between these two transitions.

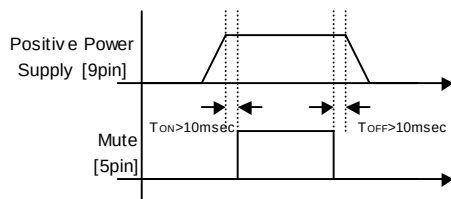


Fig.7 Timing diagram when turning on power supply and intercepting it



**■ TERMINAL DESCRIPTION**

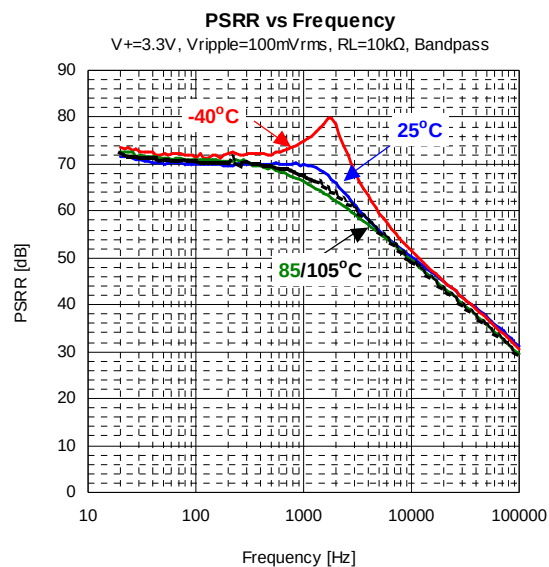
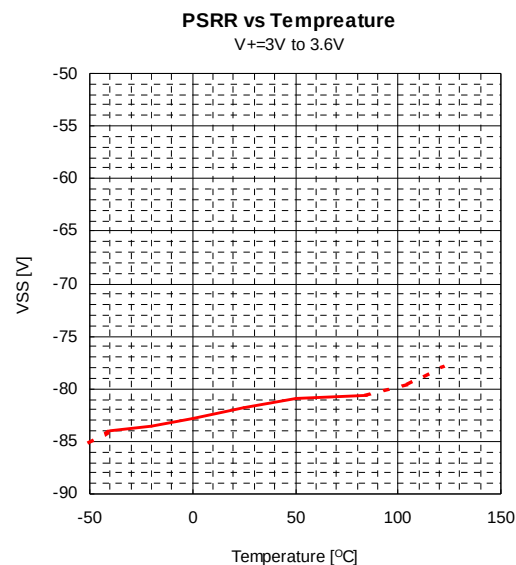
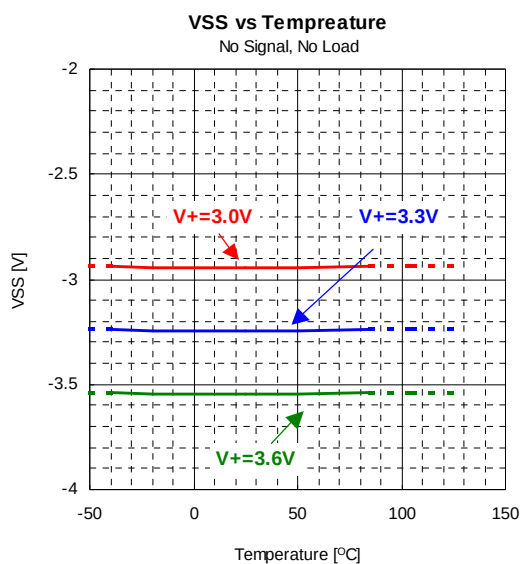
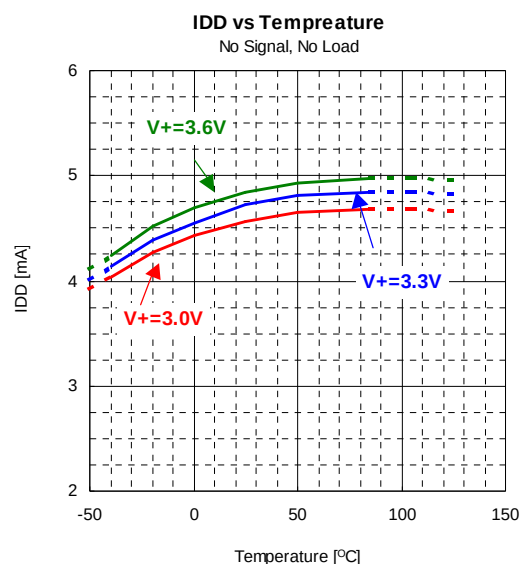
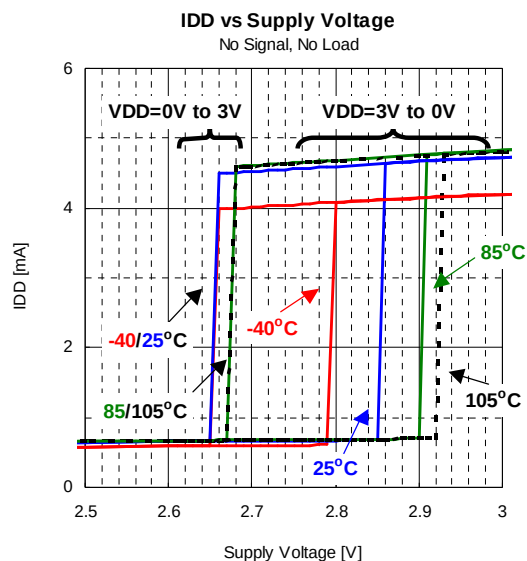
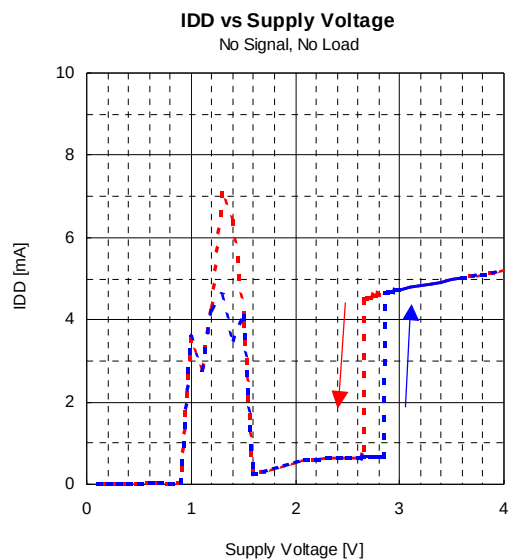
| Terminal           | SYMBOL                       | FUNCTION                                                                                 | EQUIVALENT CIRCUIT | VOLTAGE      |
|--------------------|------------------------------|------------------------------------------------------------------------------------------|--------------------|--------------|
| 1<br>2<br>13<br>14 | +INL<br>-INL<br>-INR<br>+INR | AC Input                                                                                 |                    | 0V           |
| 2<br>9             | OUTL<br>OUTR                 | AC Output                                                                                |                    | 0V           |
| 5                  | MUTE                         | MUTE Control                                                                             |                    | 0V           |
| 7<br>8<br>9        | CN<br>CP<br>DGND             | Flying Capacitor<br>Negative Terminal<br>Flying Capacitor<br>Positive Terminal<br>Ground |                    | -<br>-<br>0V |



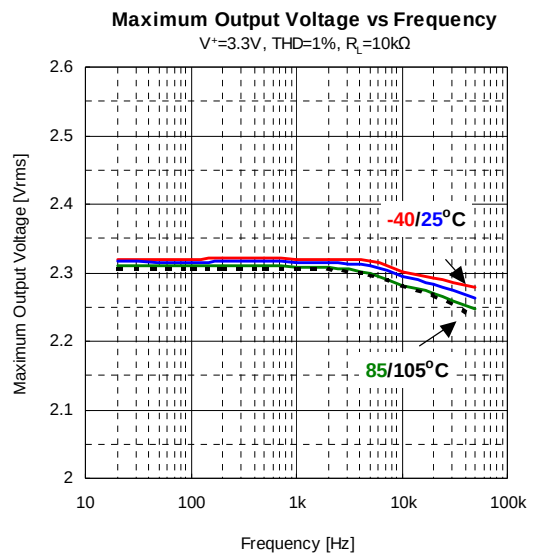
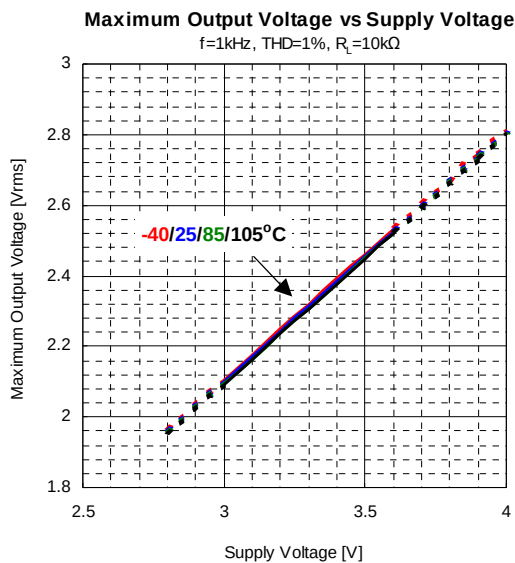
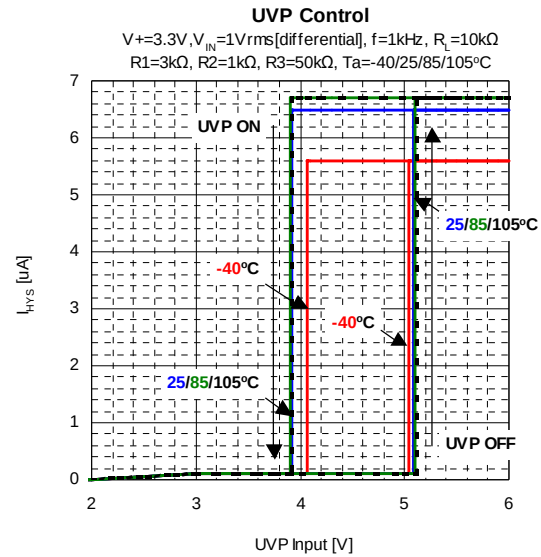
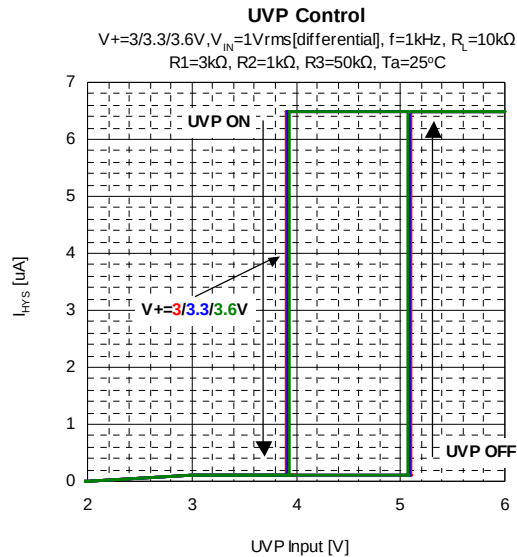
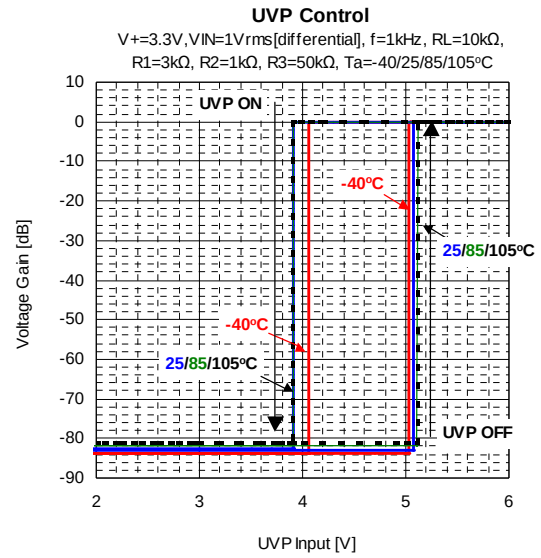
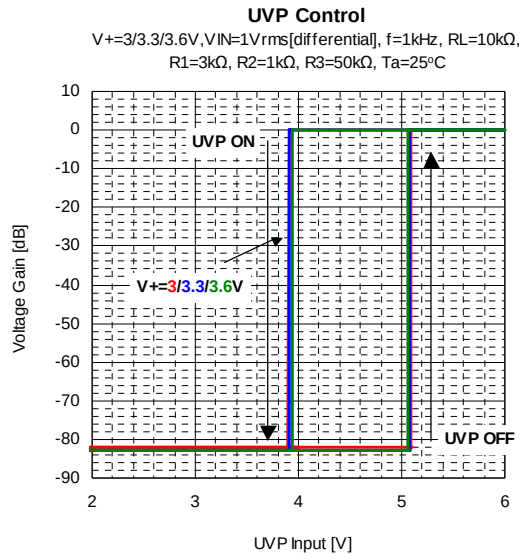
■TERMINAL DESCRIPTION

| Terminal | SYMBOL | FUNCTION                      | EQUIVALENT CIRCUIT | VOLTAGE |
|----------|--------|-------------------------------|--------------------|---------|
| 11       | UVP    | Undervoltage Protection Input |                    | -       |

# ■ TYPICAL CHARACTERISTICS

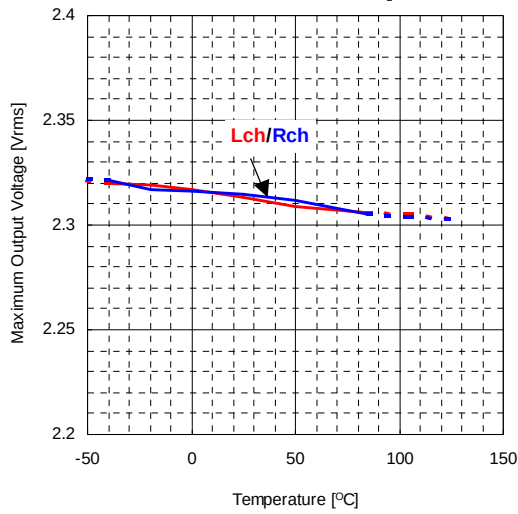


## TYPICAL CHARACTERISTICS

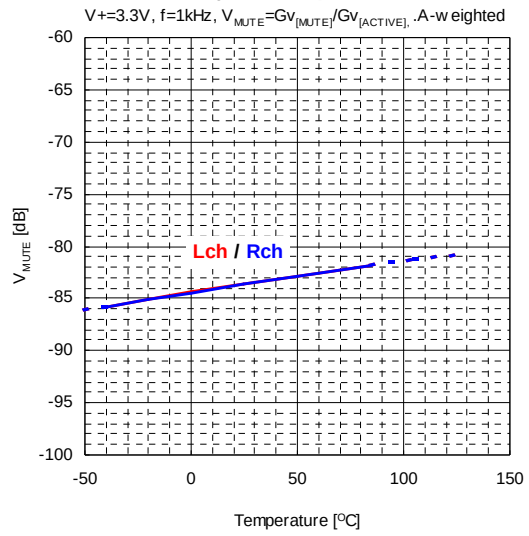


# ■ TYPICAL CHARACTERISTICS

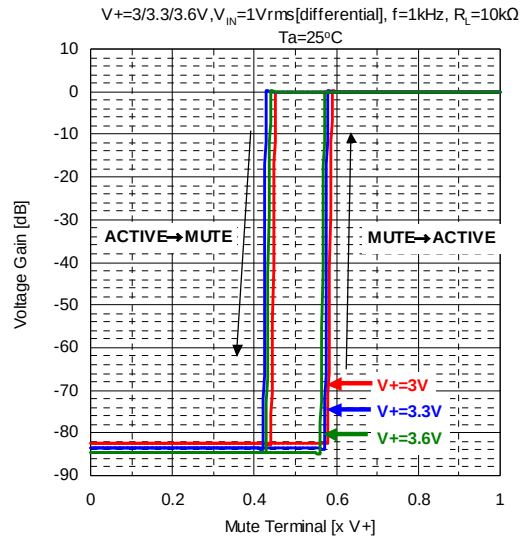
**Maximum Output Voltage vs Temperature**  
 $V_{+}=3.3V$ ,  $f=1kHz$ ,  $THD=1\%$ ,  $R_L=10k\Omega$



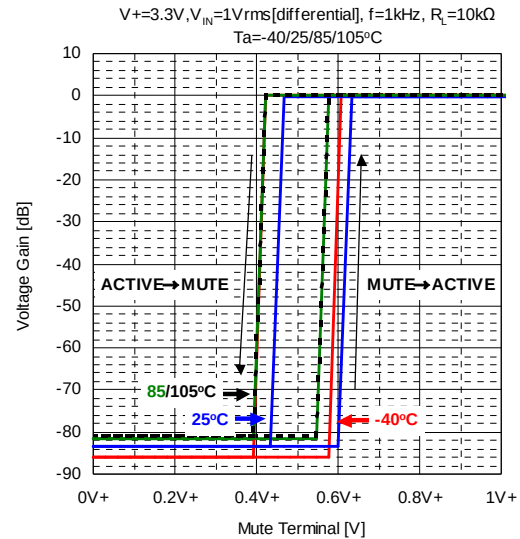
**$V_{MUTE}$  vs Temperature**



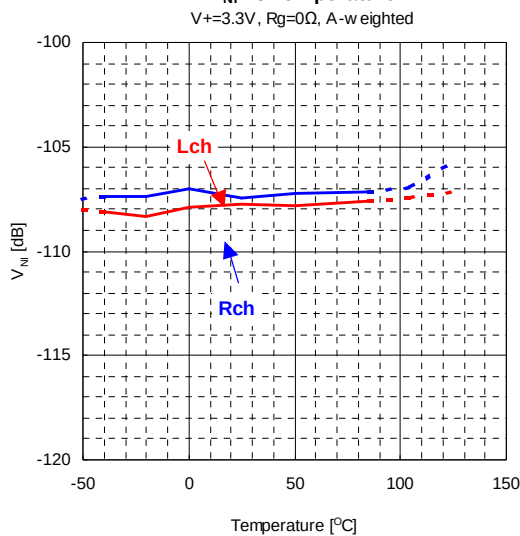
**Mute Control**



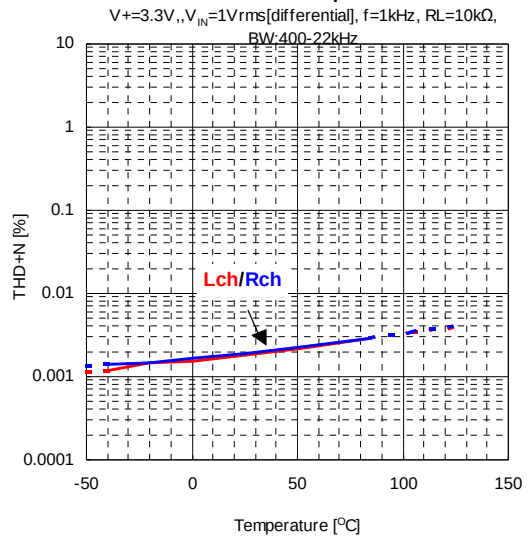
**Mute Control**



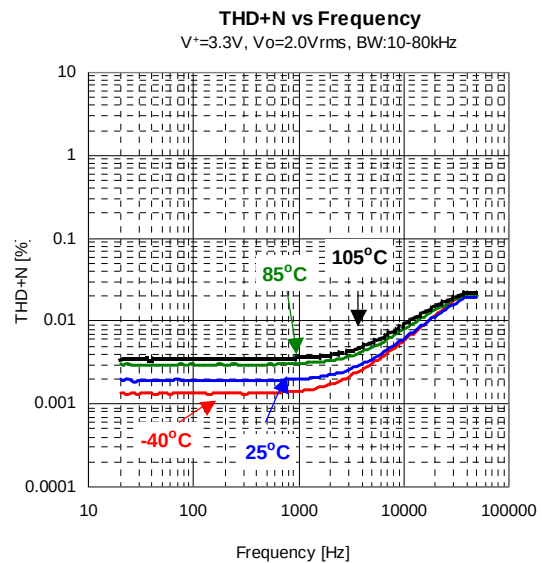
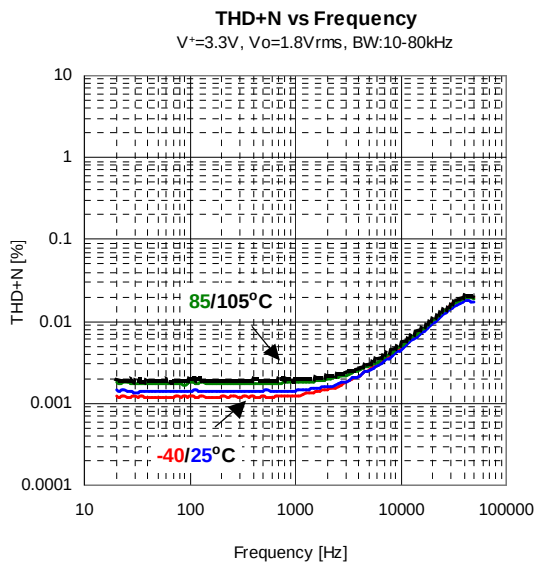
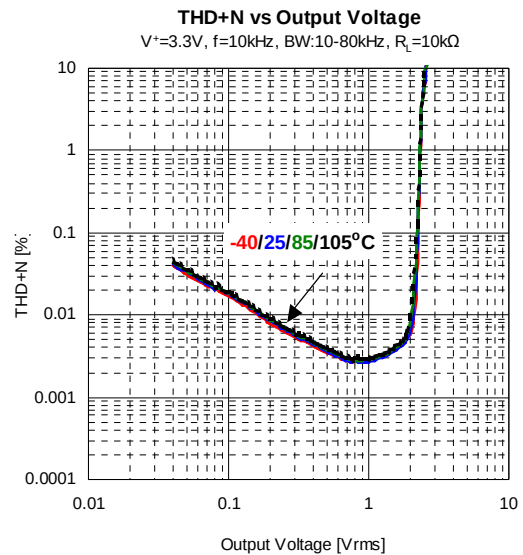
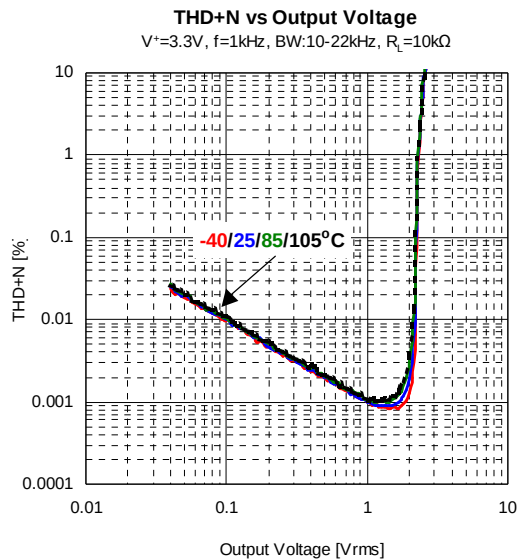
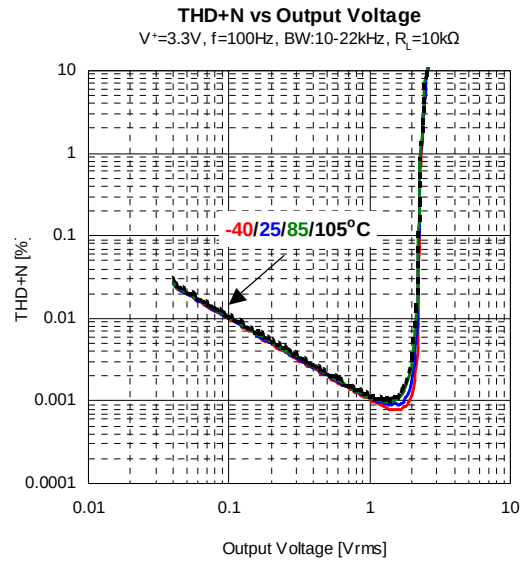
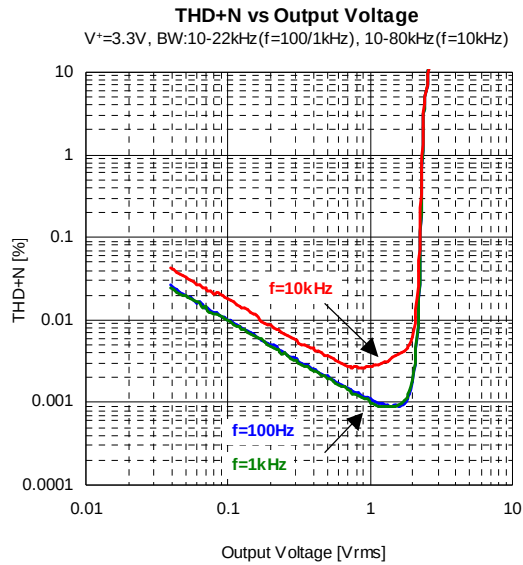
**$V_{NI}$  vs Temperature**



**THD+N vs Temperature**



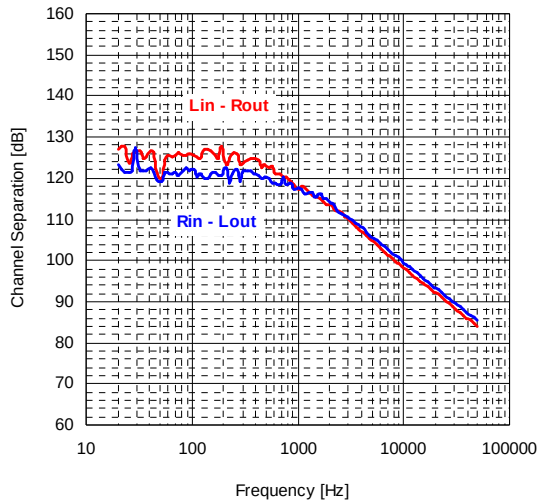
## ■ TYPICAL CHARACTERISTICS



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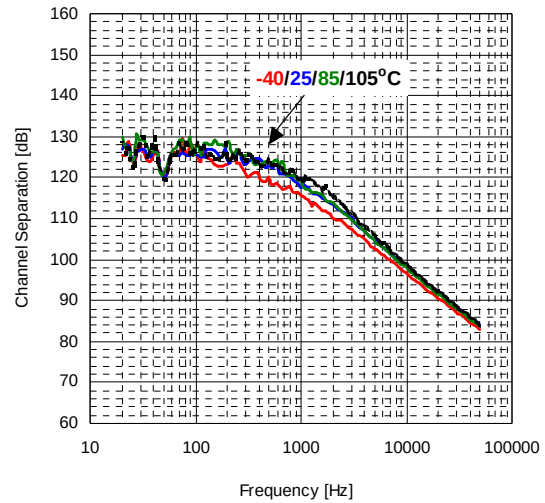
**Channel Separation vs Frequency**

$V^+=3.3V$ ,  $V_o=2V_{rms}$ ,  $R_g=600\Omega$ , BW:BandPass,  $R_L=10k\Omega$



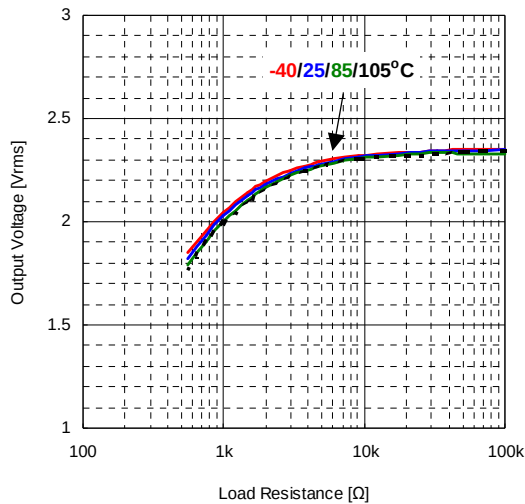
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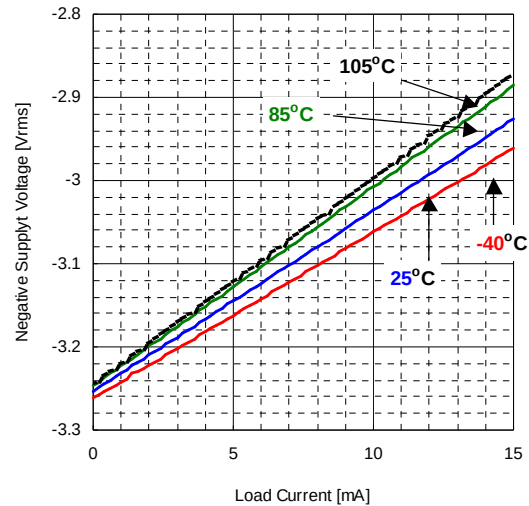
**Output Voltage vs Load Resistance**

$V^+=3.3V$ ,  $f=1kHz$ , THD=1%



**Negative Supply Voltage vs Load Current**

$V^+=3.3V$ , No Signal, No Load



**[CAUTION]**

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Мы предлагаем:

- Конкурентоспособные цены и скидки постоянным клиентам.
- Специальные условия для постоянных клиентов.
- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.
- Приемлемые сроки поставки, возможна ускоренная поставка.
- Доставку товара в любую точку России и стран СНГ.
- Комплексную поставку.
- Работу по проектам и поставку образцов.
- Формирование склада под заказчика.
- Сертификаты соответствия на поставляемую продукцию (по желанию клиента).
- Тестирование поставляемой продукции.
- Поставку компонентов, требующих военную и космическую приемку.
- Входной контроль качества.
- Наличие сертификата ISO.

В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.

Конструкторский отдел помогает осуществить:

- Регистрацию проекта у производителя компонентов.
- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



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