

## Precision, Low Noise, Rail-to-Rail Output, CMOS Operational Amplifier

### ■ GENERAL DESCRIPTION

The NJU7076/NJU7077/NJU7078 is a high precision Rail-to-Rail output Single/Dual/Quad CMOS operational amplifier featuring a low noise of 10nV/√Hz typ., low input offset voltage of 150μV max., low temperature drift of 0.5μV/°C typ. and low bias current of 1pA typ..

The output swing can reach 20 mV from the rails, while driving a 10kΩ load (at 5V operation). The NJU7076/NJU7077/NJU7078 also has a high RF noise immunity which can reduce malfunctions caused by RF noises from mobile phones and others. The combination of these specifications makes the NJU7076/ NJU7077/NJU7078 well-suited for sensor applications such as a temperature sensor, weight sensor and others, high precision current sensing amplifiers and current voltage converters.

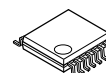
### ■ PACKAGE OUTLINE



**NJU7076F**  
(SOT-23-5)



**NJU7077R**  
(MSOP8(VSP8))



**NJU7078V**  
(SSOP14)

### ■ FEATURES

- High Precision
  - Low Offset Voltage
 

|                 |            |
|-----------------|------------|
| NJU7076/NJU7077 | 150μV max. |
| NJU7078         | 200μV max. |
  - Low Offset Voltage Drift
 

|  |               |
|--|---------------|
|  | 0.5μV/°C typ. |
|--|---------------|
- Low Noise
 

|  |               |
|--|---------------|
|  | 10nV/√Hz typ. |
|--|---------------|
- Low Input Bias Current
 

|  |          |
|--|----------|
|  | 1pA typ. |
|--|----------|
- Rail-to-Rail Output
 

|                 |                                  |
|-----------------|----------------------------------|
| $R_L=10k\Omega$ | 0.02V to 4.98V typ. ( $V^+=5V$ ) |
| $R_L=600\Omega$ | 0.08V to 4.92V typ. ( $V^+=5V$ ) |
- Ground sense
- RF Noise Immunity
- Operating Voltage
 

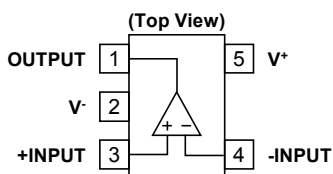
|  |              |
|--|--------------|
|  | 2.2V to 5.5V |
|--|--------------|
- Unity-Gain Stable
- Package
 

|         |                       |
|---------|-----------------------|
| NJU7076 | SOT-23-5              |
| NJU7077 | MSOP8(VSP8)*          |
|         | *MEET JEDEC MO-187-DA |
| NJU7078 | SSOP14                |

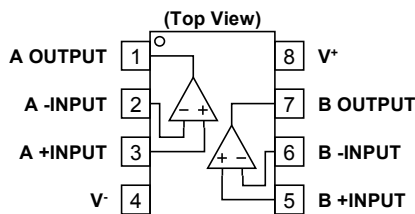
### ■ APPLICATIONS

- Thermocouple / Thermopile Amplifiers
- Strain Gauge / Pressure sensor Amplifiers
- Load Cell and Bridge Transducer Amplifiers
- High Resolution Data Acquisition
- Precision Current Sensing
- Battery monitoring
- Photo-Diode pre amplifier

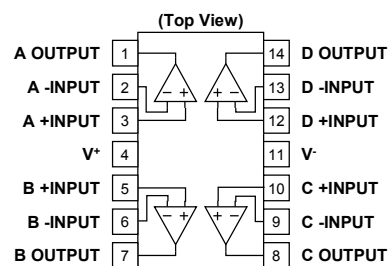
## PIN CONFIGURATION



NJU7076F



NJU7077R



NJU7078V

## ABSOLUTE MAXIMUM RATINGS(Ta=25°C, unless otherwise noted.)

| PARAMETER                                 | SYMBOL      | RATING                     | UNIT |
|-------------------------------------------|-------------|----------------------------|------|
| Supply Voltage                            | $V^+ - V^-$ | 7 <sup>(1)</sup>           | V    |
| Differential Input Voltage <sup>(2)</sup> | $V_{ID}$    | $\pm 7$ <sup>(3)</sup>     | V    |
| Input Voltage                             | $V_{IN}$    | $V^- - 0.3$ to $V^+ + 0.3$ | V    |
| Power Dissipation <sup>(4)</sup>          |             | (2-layer / 4-layer)        | mW   |
| SOT-23-5                                  | $P_D$       | 480 / 650                  | mW   |
| MSOP8(VSP8)                               |             | 500 / 660                  | mW   |
| SSOP14                                    |             | 555 / 690                  | mW   |
| Operating Temperature Range               | $T_{opr}$   | -40 to +125                | °C   |
| Storage Temperature Range                 | $T_{stg}$   | -55 to +150                | °C   |

(1) Supply Voltage is the voltage difference between  $V^+$  and  $V^-$ .

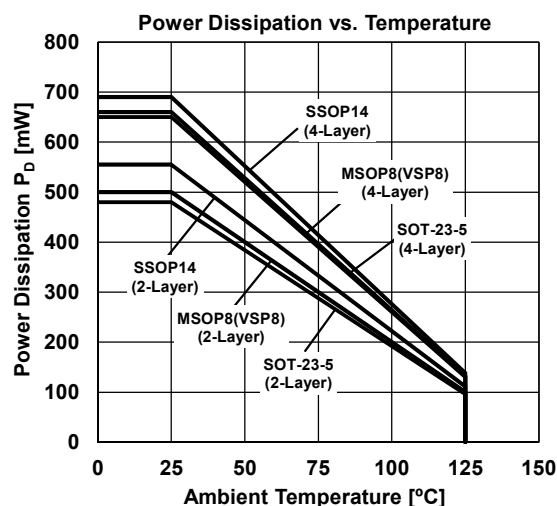
(2) Differential voltage is the voltage difference between +INPUT and -INPUT.

(3) For supply voltage less than 7V, the absolute maximum rating is equal to the supply voltage.

(4) Power dissipation is the power that can be consumed by the IC at Ta=25°C, and is the typical measured value based on JEDEC condition. When using the IC over Ta=25°C subtract the value [mW/°C]=PD/(Tstg(MAX)-25) per temperature.

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

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



## RECOMMENDED OPERATING CONDITIONS(Ta=25°C)

| PARAMETER      | Value                                    | UNIT |
|----------------|------------------------------------------|------|
| Supply Voltage | +2.2 to +5.5 ( $\pm 1.1$ to $\pm 2.75$ ) | V    |

**■ ELECTRICAL CHARACTERISTICS**( $V^+=5V$ ,  $V^-=0V$ ,  $V_{COM}=V^+/2$ ,  $T_a=25^\circ C$ , unless otherwise noted.)

| PARAMETER                                 | SYMBOL               | TEST CONDITION                                                                                             | MIN. | TYP. | MAX. | UNIT   |
|-------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------------|------|------|------|--------|
| DC CHARACTERISTICS                        |                      |                                                                                                            |      |      |      |        |
| Input Offset Voltage<br>NJU7076/NJU7077   | V <sub>IO</sub>      |                                                                                                            | -    | 20   | 150  | μV     |
|                                           |                      | Ta=-40°C to 125°C                                                                                          | -    | -    | 400  | μV     |
| NJU7078                                   |                      |                                                                                                            | -    | 20   | 200  | μV     |
|                                           |                      | Ta=-40°C to 125°C                                                                                          | -    | -    | 400  | μV     |
| Input Offset Voltage Drift                | ΔV <sub>IO</sub> /ΔT | Ta=-40°C to 125°C <sup>(5)</sup>                                                                           | -    | 0.5  | 5    | μV/°C  |
| Input Bias Current                        | I <sub>B</sub>       |                                                                                                            | -    | 1    | -    | pA     |
| Input Offset Current                      | I <sub>IO</sub>      |                                                                                                            | -    | 1    | -    | pA     |
| Open-Loop Voltage Gain                    | A <sub>V</sub>       | Vo=0.5V to 4.5V, R <sub>L</sub> =10kΩ to 2.5V                                                              | 100  | 130  | -    | dB     |
|                                           |                      | Vo=0.5V to 4.5V, R <sub>L</sub> =10kΩ to 2.5V, Ta= -40°C to 125°C                                          | 100  | -    | -    | dB     |
| Common-Mode Rejection Ratio               | CMR                  | V <sub>ICM</sub> =0V to 4V                                                                                 | 70   | 90   | -    | dB     |
|                                           |                      | V <sub>ICM</sub> =0V to 4V, Ta= -40°C to 125°C                                                             | 70   | -    | -    | dB     |
| Supply Voltage Rejection Ratio            | SVR                  | V <sup>+</sup> =2.2V to 5.5V                                                                               | 70   | 90   | -    | dB     |
|                                           |                      | V <sup>+</sup> =2.2V to 5.5V, Ta= -40°C to 125°C                                                           | 70   | -    | -    | dB     |
| High-level Output Voltage                 | V <sub>OH</sub>      | R <sub>L</sub> =10kΩ to 2.5V                                                                               | 4.95 | 4.98 | -    | V      |
|                                           |                      | R <sub>L</sub> =10kΩ to 2.5V, Ta= -40°C to 125°C                                                           | 4.95 | -    | -    | V      |
|                                           |                      | R <sub>L</sub> =600Ω to 2.5V                                                                               | 4.85 | 4.92 | -    | V      |
|                                           |                      | R <sub>L</sub> =600Ω to 2.5V, Ta= -40°C to 125°C                                                           | 4.85 | -    | -    | V      |
|                                           |                      | I <sub>SOURCE</sub> =2mA                                                                                   | 4.9  | 4.96 | -    | V      |
|                                           |                      | I <sub>SOURCE</sub> =2mA, Ta= -40°C to 125°C                                                               | 4.85 | -    | -    | V      |
| Low-level Output Voltage                  | V <sub>OL</sub>      | R <sub>L</sub> =10kΩ to 2.5V                                                                               | -    | 0.02 | 0.05 | V      |
|                                           |                      | R <sub>L</sub> =10kΩ to 2.5V, Ta= -40°C to 125°C                                                           | -    | -    | 0.05 | V      |
|                                           |                      | R <sub>L</sub> =600Ω to 2.5V                                                                               | -    | 0.08 | 0.15 | V      |
|                                           |                      | R <sub>L</sub> =600Ω to 2.5V, Ta= -40°C to 125°C                                                           | -    | -    | 0.2  | V      |
|                                           |                      | I <sub>SINK</sub> =2mA                                                                                     | -    | 0.04 | 0.1  | V      |
|                                           |                      | I <sub>SINK</sub> =2mA, Ta= -40°C to 125°C                                                                 | -    | -    | 0.15 | V      |
| Common-Mode Input Voltage Range           | V <sub>ICM</sub>     | CMR≥70dB                                                                                                   | 0    | -    | 4    | V      |
|                                           |                      | CMR≥70dB, Ta= -40°C to 125°C                                                                               | 0    | -    | 4    | V      |
| Supply Current(All Amplifiers)<br>NJU7076 | I <sub>SUPPLY</sub>  | No Signal, R <sub>L</sub> =OPEN                                                                            | -    | 0.6  | 0.9  | mA     |
|                                           |                      | No Signal, R <sub>L</sub> =OPEN, Ta = -40°C to 125°C                                                       | -    | -    | 0.9  | mA     |
| NJU7077                                   |                      | No Signal, R <sub>L</sub> =OPEN                                                                            | -    | 1.2  | 1.8  | mA     |
|                                           |                      | No Signal, R <sub>L</sub> =OPEN, Ta = -40°C to 125°C                                                       | -    | -    | 1.8  | mA     |
| NJU7078                                   |                      | No Signal, R <sub>L</sub> =OPEN                                                                            | -    | 2.3  | 3.5  | mA     |
|                                           |                      | No Signal, R <sub>L</sub> =OPEN, Ta = -40°C to 125°C                                                       | -    | -    | 3.5  | mA     |
| AC CHARACTERISTICS                        |                      |                                                                                                            |      |      |      |        |
| Gain Bandwidth Product                    | GBW                  | G <sub>V</sub> =40dB, R <sub>F</sub> =100kΩ, R <sub>L</sub> =10kΩ to 2.5V, C <sub>L</sub> =20pF, f=100kHz  | -    | 1.3  | -    | MHz    |
| Phase Margin                              | Φ <sub>m</sub>       | G <sub>V</sub> =40dB, R <sub>F</sub> =100kΩ, R <sub>L</sub> =10kΩ to 2.5V, C <sub>L</sub> =20pF            | -    | 60   | -    | deg    |
| Gain Margin                               | G <sub>m</sub>       | G <sub>V</sub> =40dB, R <sub>F</sub> =100kΩ, R <sub>L</sub> =10kΩ to 2.5V, C <sub>L</sub> =20pF            | -    | 12   | -    | dB     |
| Equivalent Input Noise Voltage            | e <sub>n</sub>       | f=1kHz                                                                                                     | -    | 10   | -    | nV/√Hz |
| Slew Rate                                 | SR                   | G <sub>V</sub> =0dB, R <sub>L</sub> =10kΩ to 2.5V, C <sub>L</sub> =20pF, V <sub>IN</sub> =3V <sub>PP</sub> | -    | 0.5  | -    | V/μs   |
| Total Harmonic Distortion + Noise         | THD+N                | G <sub>V</sub> =20dB, R <sub>L</sub> =10kΩ to 2.5V, f=1kHz, V <sub>O</sub> =3V <sub>PP</sub>               | -    | 0.01 | -    | %      |
| Channel Separation                        | CS                   | f=1kHz, NJU7077/NJU7078                                                                                    | -    | 140  | -    | dB     |

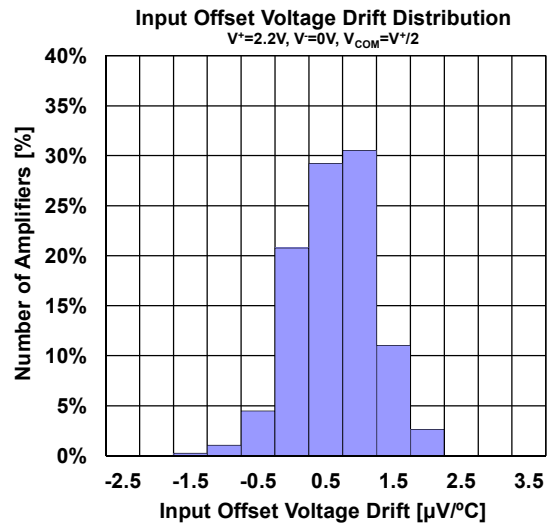
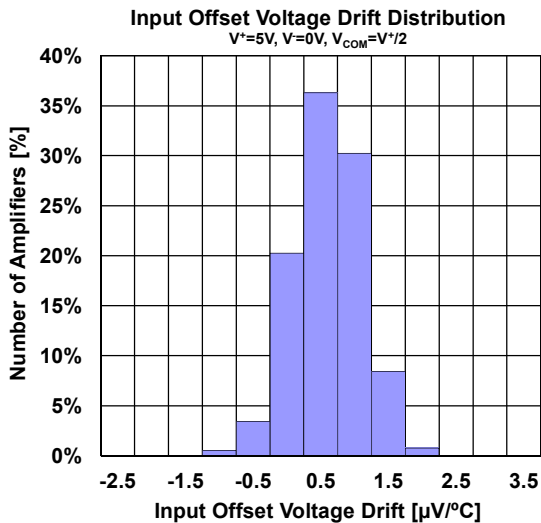
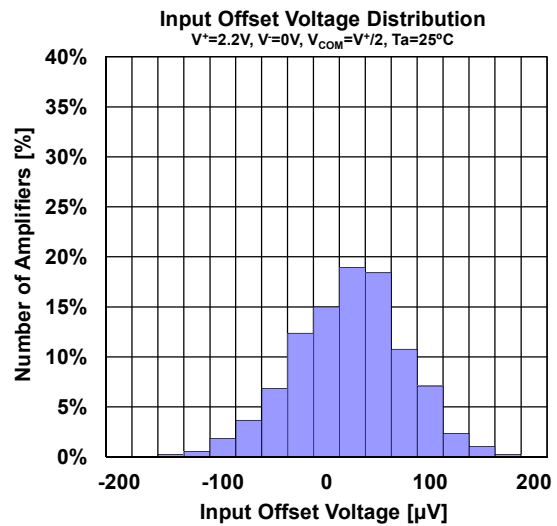
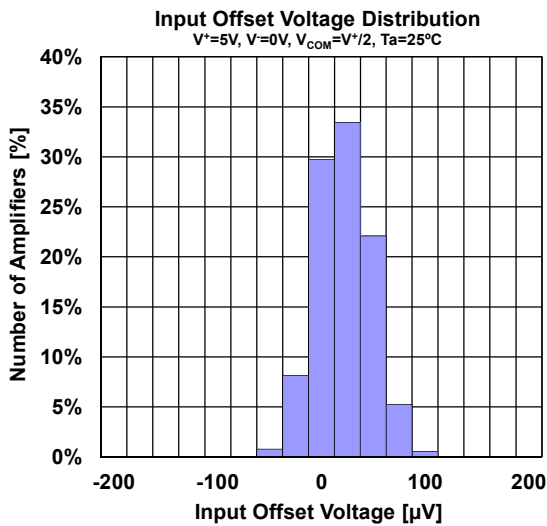
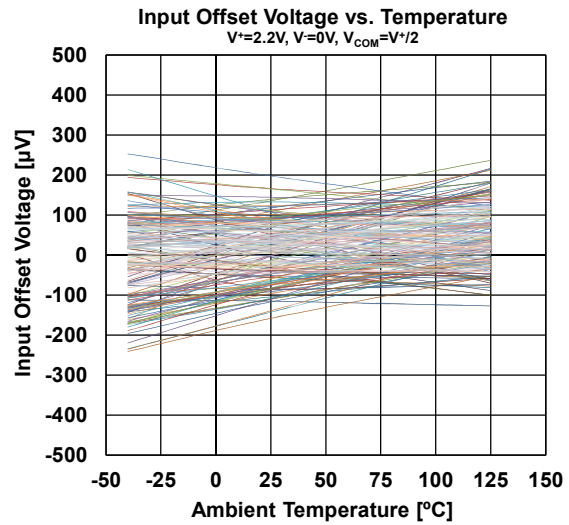
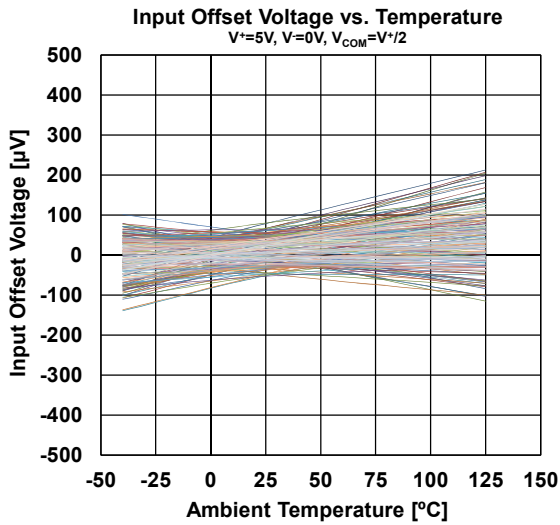
(5) Guaranteed by two points of Temperature  $-40^\circ C$  and  $+125^\circ C$

**■ ELECTRICAL CHARACTERISTICS**( $V^+=2.2\text{V}$ ,  $V^-=0\text{V}$ ,  $V_{\text{COM}}=V^+/2$ ,  $T_a=25^\circ\text{C}$ , unless otherwise noted.)

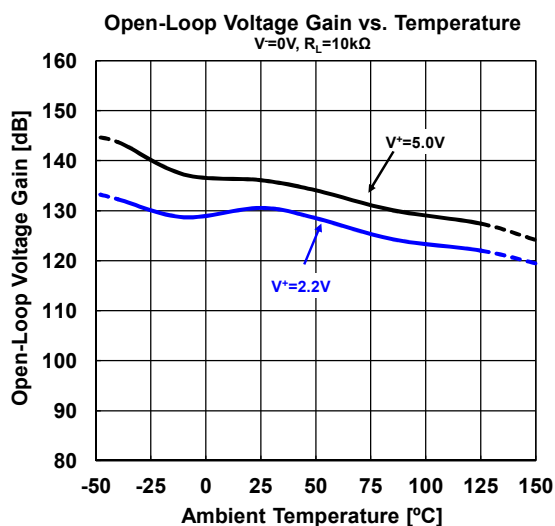
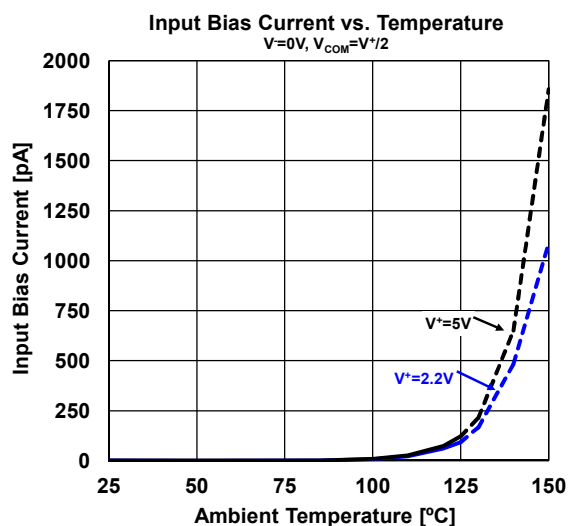
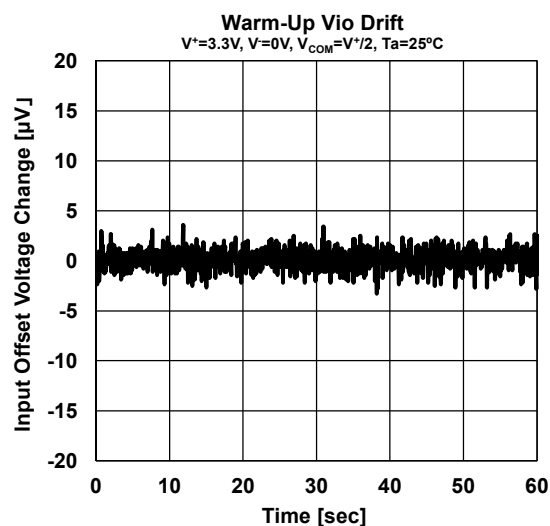
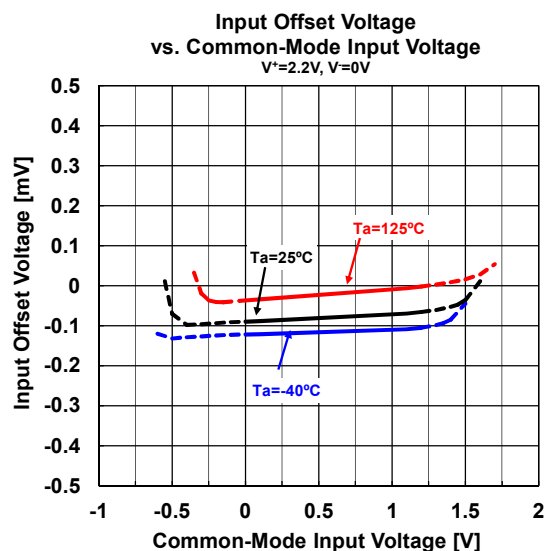
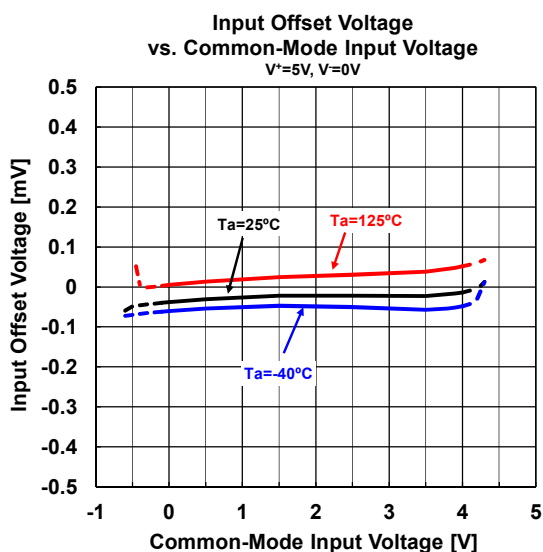
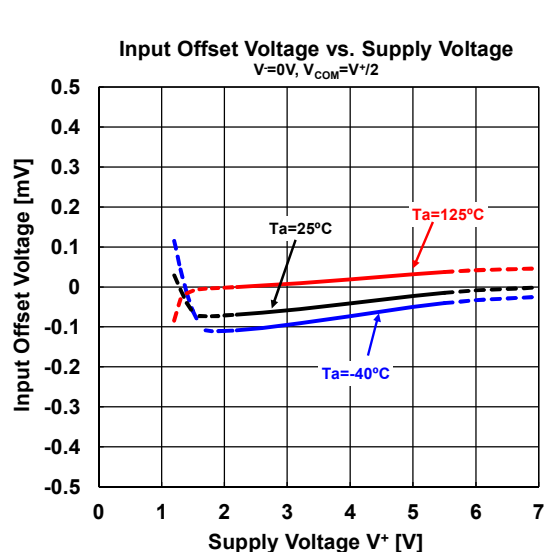
| PARAMETER                                 | SYMBOL               | TEST CONDITION                                                                                             | MIN. | TYP. | MAX. | UNIT   |
|-------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------------|------|------|------|--------|
| DC CHARACTERISTICS                        |                      |                                                                                                            |      |      |      |        |
| Input Offset Voltage<br>NJU7076/NJU7077   | V <sub>IO</sub>      | Ta= -40°C to 125°C                                                                                         | -    | 60   | 250  | μV     |
|                                           |                      |                                                                                                            | -    | -    | 400  | μV     |
| NJU7078                                   |                      | Ta= -40°C to 125°C                                                                                         | -    | 60   | 300  | μV     |
|                                           |                      |                                                                                                            | -    | -    | 400  | μV     |
| Input Offset Voltage Drift                | ΔV <sub>IO</sub> /ΔT | Ta= -40°C to 125°C <sup>(5)</sup>                                                                          | -    | 0.6  | 5    | μV/°C  |
| Input Bias Current                        | I <sub>B</sub>       |                                                                                                            | -    | 1    | -    | pA     |
| Input Offset Current                      | I <sub>IO</sub>      |                                                                                                            | -    | 1    | -    | pA     |
| Open-Loop Voltage Gain                    | A <sub>V</sub>       | Vo=0.6V to 1.6V, R <sub>L</sub> =10kΩ to 1.1V                                                              | 100  | 130  | -    | dB     |
|                                           |                      | Vo=0.6V to 1.6V, R <sub>L</sub> =10kΩ to 1.1V, Ta= -40°C to 125°C                                          | 100  | -    | -    | dB     |
| Common-Mode Rejection Ratio               | CMR                  | V <sub>ICM</sub> =0V to 1.2V                                                                               | 70   | 90   | -    | dB     |
|                                           |                      | V <sub>ICM</sub> =0V to 1.2V, Ta= -40°C to 125°C                                                           | 70   | -    | -    | dB     |
| High-level Output Voltage                 | V <sub>OH</sub>      | R <sub>L</sub> =10kΩ to 1.1V                                                                               | 2.15 | 2.18 | -    | V      |
|                                           |                      | R <sub>L</sub> =10kΩ to 1.1V, Ta= -40°C to 125°C                                                           | 2.15 | -    | -    | V      |
|                                           |                      | R <sub>L</sub> =600Ω to 1.1V                                                                               | 2.1  | 2.14 | -    | V      |
|                                           |                      | R <sub>L</sub> =600Ω to 1.1V, Ta= -40°C to 125°C                                                           | 2.05 | -    | -    | V      |
|                                           |                      | I <sub>SOURCE</sub> =2mA                                                                                   | 2.05 | 2.13 | -    | V      |
|                                           |                      | I <sub>SOURCE</sub> =2mA, Ta= -40°C to 125°C                                                               | 2    | -    | -    | V      |
| Low-level Output Voltage                  | V <sub>OL</sub>      | R <sub>L</sub> =10kΩ to 1.1V                                                                               | -    | 0.02 | 0.05 | V      |
|                                           |                      | R <sub>L</sub> =10kΩ to 1.1V, Ta= -40°C to 125°C                                                           | -    | -    | 0.05 | V      |
|                                           |                      | R <sub>L</sub> =600Ω to 1.1V                                                                               | -    | 0.06 | 0.1  | V      |
|                                           |                      | R <sub>L</sub> =600Ω to 1.1V, Ta= -40°C to 125°C                                                           | -    | -    | 0.15 | V      |
|                                           |                      | I <sub>SINK</sub> =2mA                                                                                     | -    | 0.07 | 0.15 | V      |
|                                           |                      | I <sub>SINK</sub> =2mA, Ta= -40°C to 125°C                                                                 | -    | -    | 0.2  | V      |
| Common-Mode Input Voltage Range           | V <sub>ICM</sub>     | CMR≥70dB                                                                                                   | 0    | -    | 1.2  | V      |
|                                           |                      | CMR≥70dB, Ta= -40°C to 125°C                                                                               | 0    | -    | 1.2  | V      |
| Supply Current(All Amplifiers)<br>NJU7076 | I <sub>SUPPLY</sub>  | No Signal, R <sub>L</sub> =OPEN                                                                            | -    | 0.55 | 0.82 | mA     |
|                                           |                      | No Signal, R <sub>L</sub> =OPEN, Ta = -40°C to 125°C                                                       | -    | -    | 0.82 | mA     |
| NJU7077                                   |                      | No Signal, R <sub>L</sub> =OPEN                                                                            | -    | 1.0  | 1.5  | mA     |
|                                           |                      | No Signal, R <sub>L</sub> =OPEN, Ta = -40°C to 125°C                                                       | -    | -    | 1.5  | mA     |
| NJU7078                                   |                      | No Signal, R <sub>L</sub> =OPEN                                                                            | -    | 2.0  | 3.0  | mA     |
|                                           |                      | No Signal, R <sub>L</sub> =OPEN, Ta = -40°C to 125°C                                                       | -    | -    | 3.0  | mA     |
| AC CHARACTERISTICS                        |                      |                                                                                                            |      |      |      |        |
| Gain Bandwidth Product                    | GBW                  | G <sub>V</sub> =40dB, R <sub>F</sub> =100kΩ, R <sub>L</sub> =10kΩ to 1.1V, C <sub>L</sub> =20pF, f=100kHz  | -    | 1.2  | -    | MHz    |
| Phase Margin                              | Φ <sub>m</sub>       | G <sub>V</sub> =40dB, R <sub>F</sub> =100kΩ, R <sub>L</sub> =10kΩ to 1.1V, C <sub>L</sub> =20pF            | -    | 60   | -    | deg    |
| Gain Margin                               | G <sub>m</sub>       | G <sub>V</sub> =40dB, R <sub>F</sub> =100kΩ, R <sub>L</sub> =10kΩ to 1.1V, C <sub>L</sub> =20pF            | -    | 12   | -    | dB     |
| Equivalent Input Noise Voltage            | e <sub>n</sub>       | f=1kHz                                                                                                     | -    | 10   | -    | nV/√Hz |
| Slew Rate                                 | SR                   | G <sub>V</sub> =0dB, R <sub>L</sub> =10kΩ to 1.1V, C <sub>L</sub> =20pF, V <sub>IN</sub> =1V <sub>PP</sub> | -    | 0.5  | -    | V/μs   |
| Total Harmonic Distortion + Noise         | THD+N                | G <sub>V</sub> =20dB, R <sub>L</sub> =10kΩ to 1.1V, f=1kHz, V <sub>O</sub> =1V <sub>PP</sub>               | -    | 0.01 | -    | %      |
| Channel Separation                        | CS                   | f=1kHz, NJU7077/NJU7078                                                                                    | -    | 140  | -    | dB     |

(5) Guaranteed by two points of Temperature  $-40^\circ\text{C}$  and  $+125^\circ\text{C}$

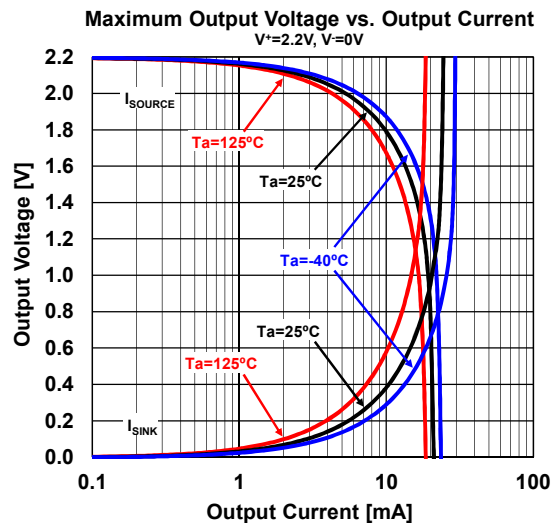
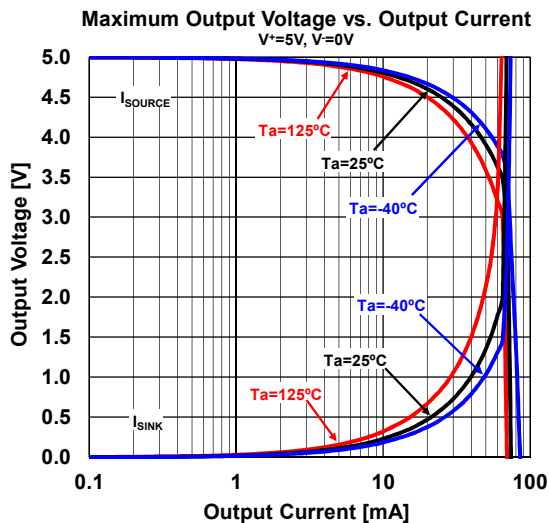
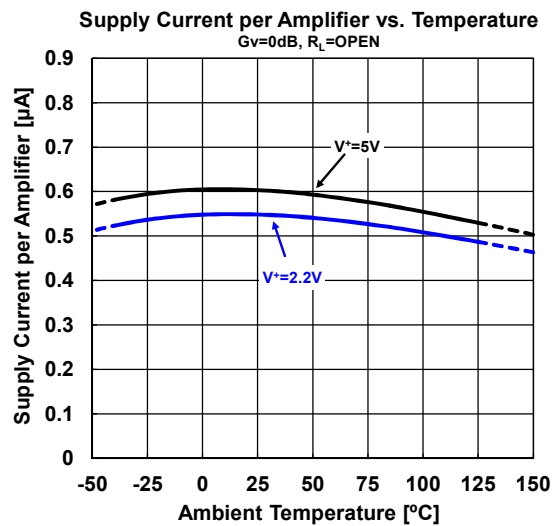
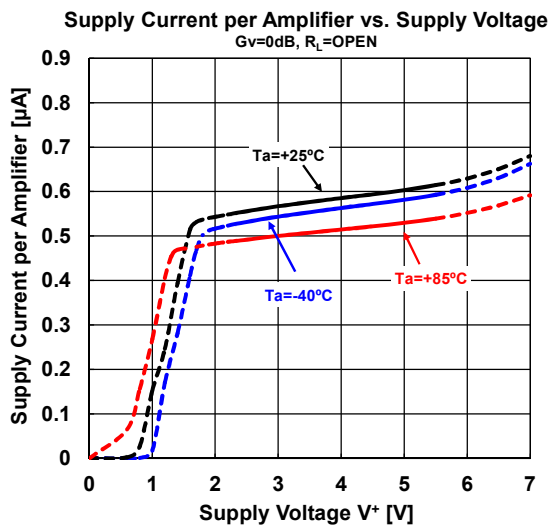
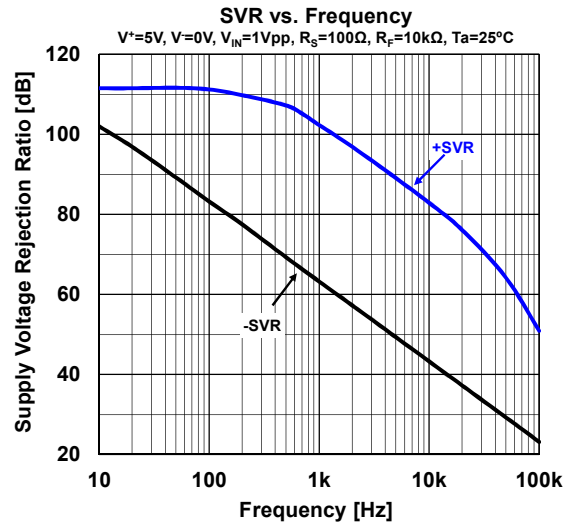
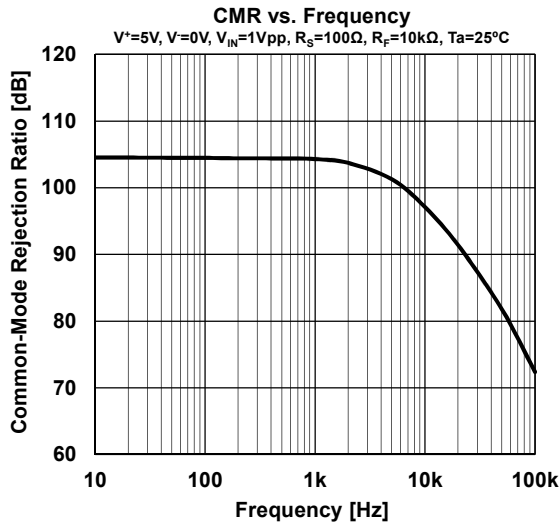
■ TYPICAL CHARACTERISTICS



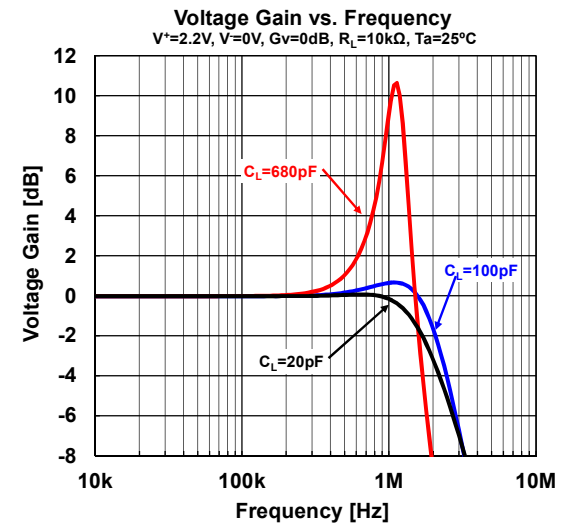
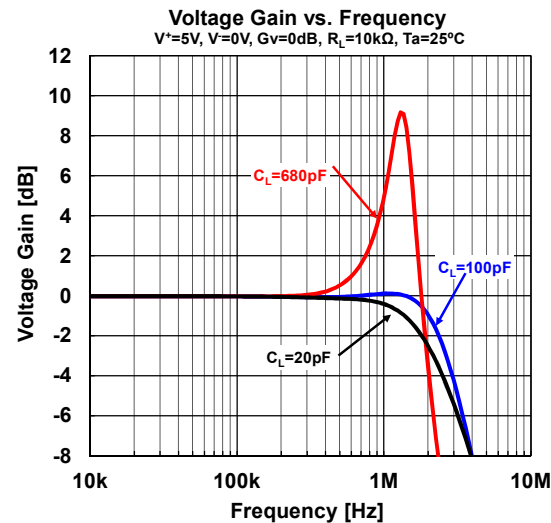
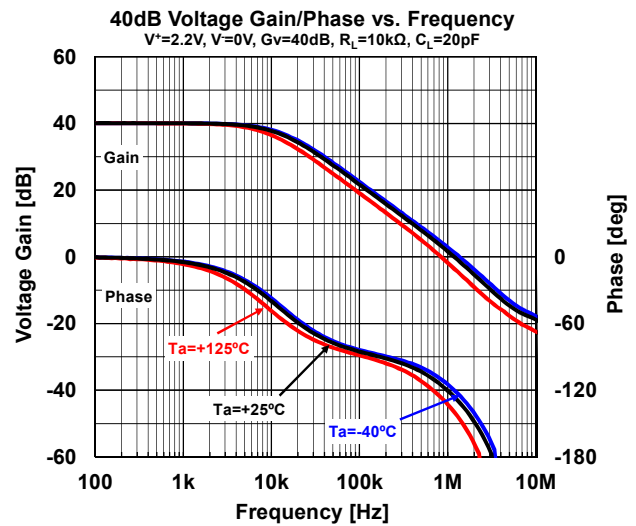
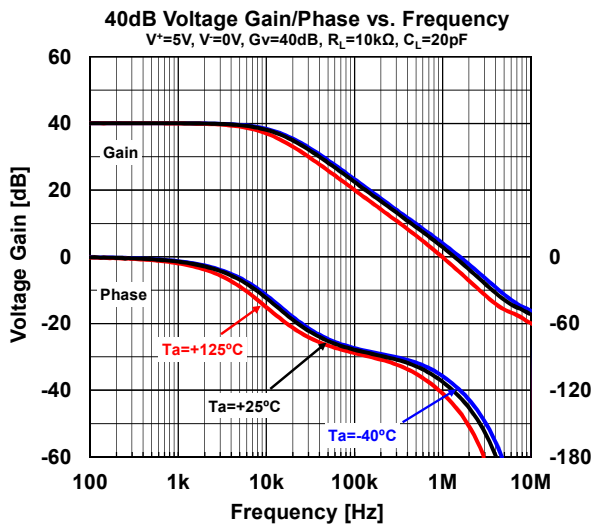
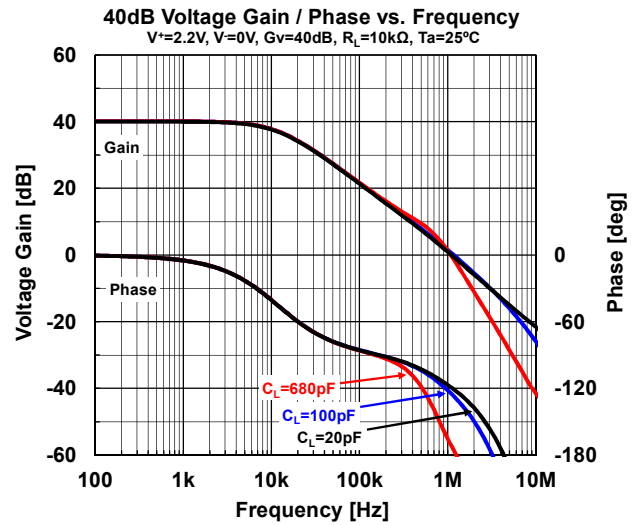
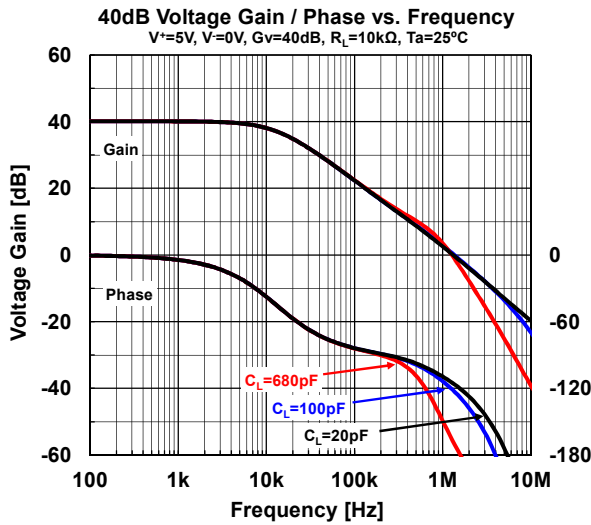
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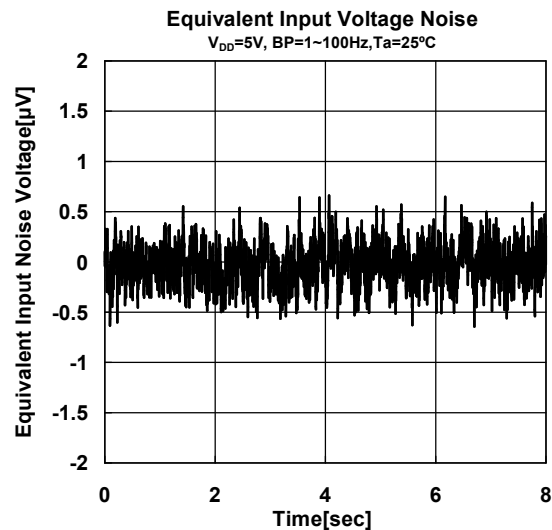
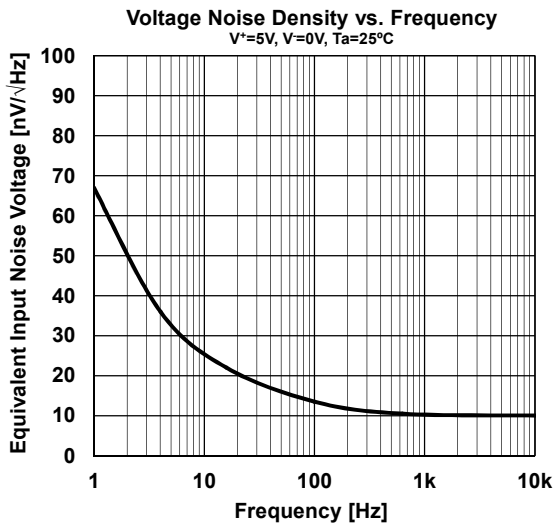
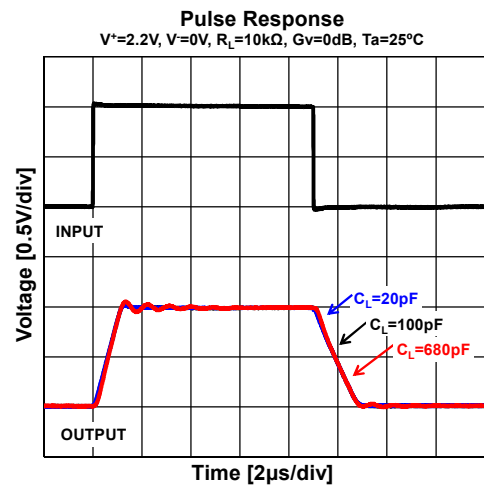
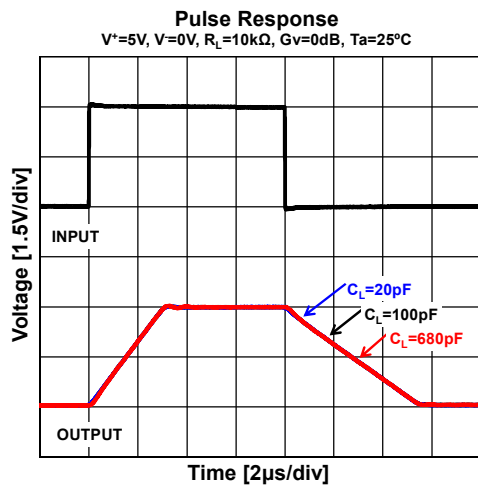
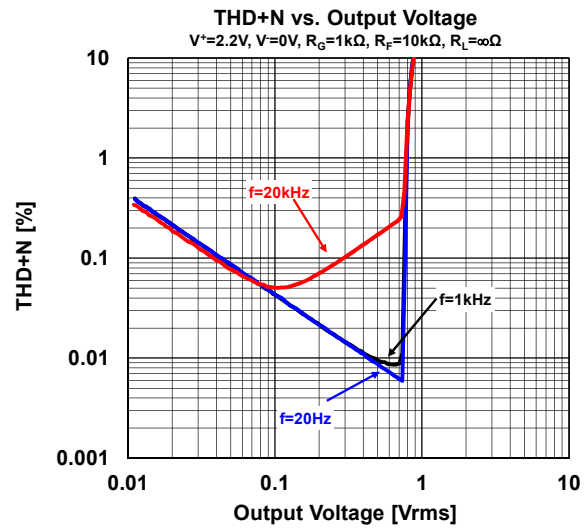
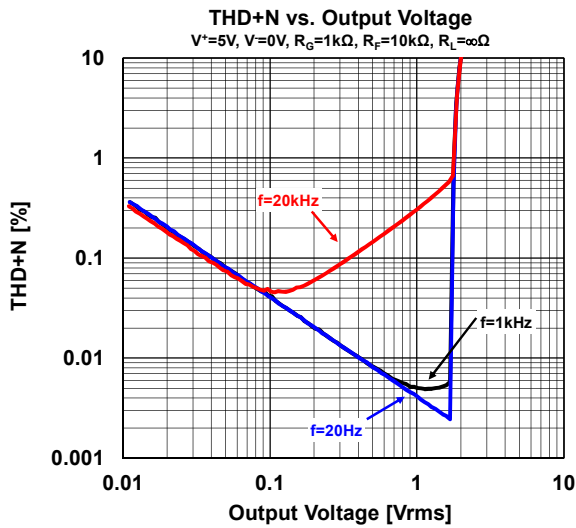
## ■ TYPICAL CHARACTERISTICS



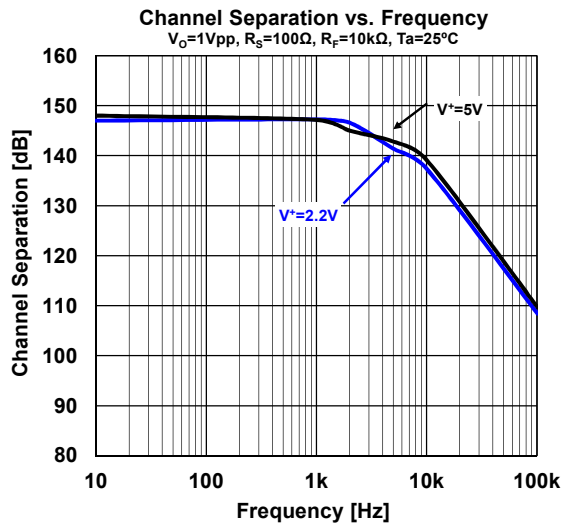
■ TYPICAL CHARACTERISTICS



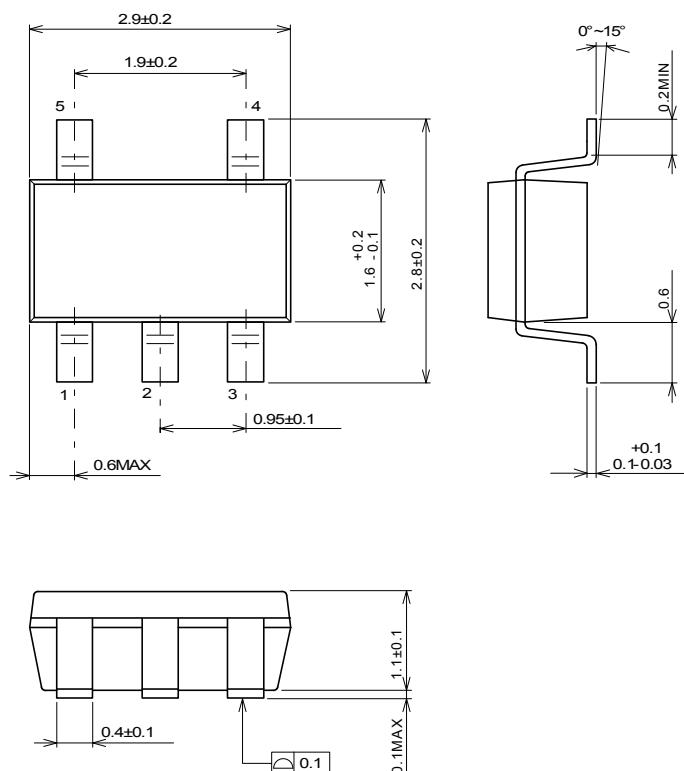
■ TYPICAL CHARACTERISTICS



## ■ TYPICAL CHARACTERISTICS

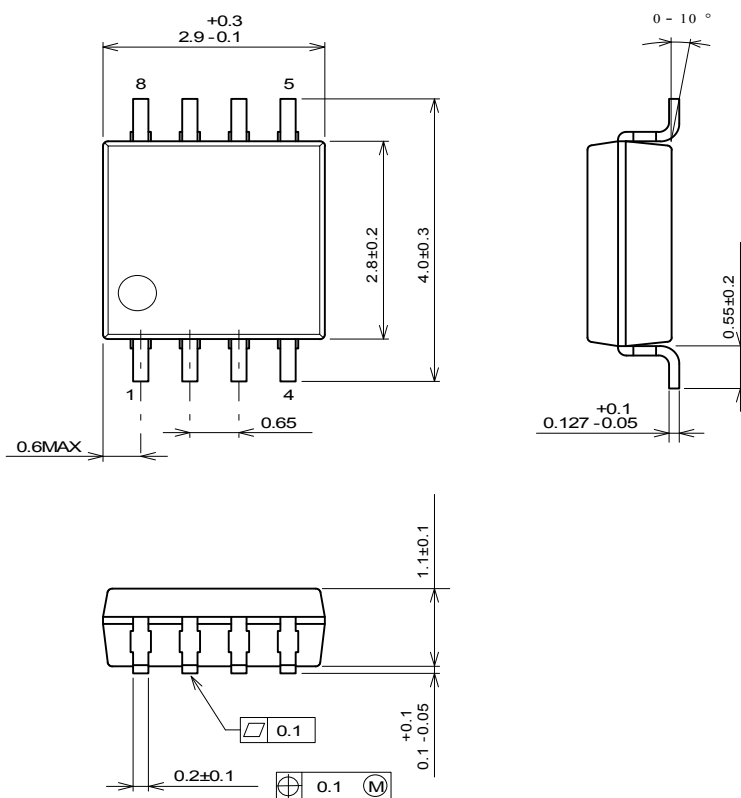


## ■ PACKAGE DIMENSIONS



Unit: mm

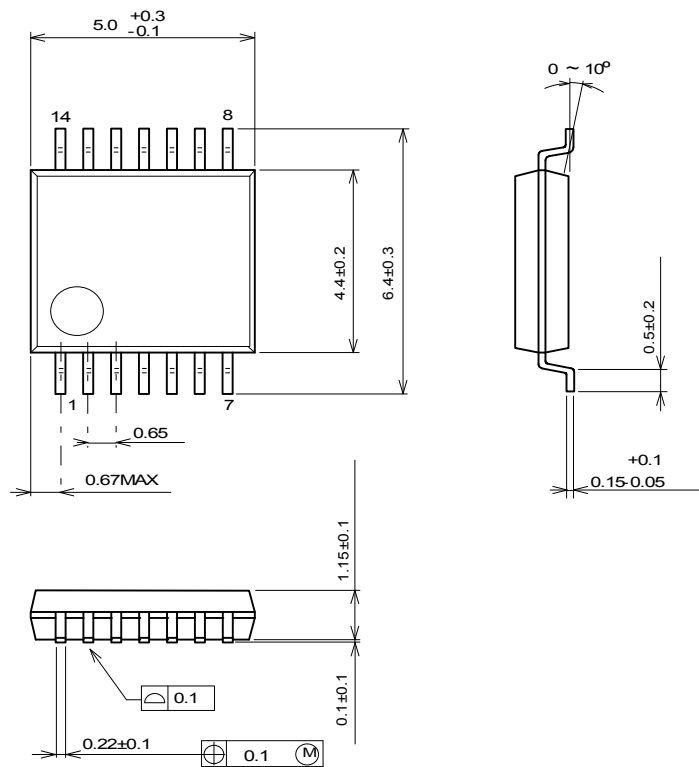
### SOT-23-5 Package



Unit: mm

**MSOP8(VSP8)\* Package**  
**\*MEET JEDEC MO-187-DA**

## ■ PACKAGE DIMENSIONS



Unit: mm

### SSOP14 Package

**[CAUTION]**  
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- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели,  
кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



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