

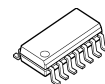
## QUAD SINGLE-SUPPLY OPERATIONAL AMPLIFIER

### ■ GENERAL DESCRIPTION

The NJM2902C / NJM2902CA consists of four independent, high gain, internally frequency compensated operation amplifiers, which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

Application areas include transducer amplifiers, DC gain blocks, and all the conventional op amp circuits, which now can be more easily implemented in single power supply systems. For example, the NJM2902C / NJM2902CA can be directly operated off of the standard +5V power supply voltage, which is used in digital systems and will easily provide the required interface electronics without requiring the additional  $\pm 15V$  power supplies.

### ■ PACKAGE OUTLINE



NJM2902CG  
NJM2902CAG  
(SOP14)



NJM2902CV  
NJM2902CAV  
(SSOP14)

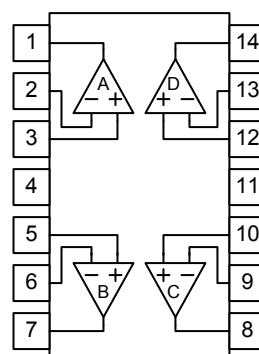
### ■ FEATURES

- Single Supply
- Operating Voltage +3V to +32V
- Low Operating Current 1.2mA typ.
- Slew Rate 0.6V/ $\mu$ s typ.
- Bipolar Technology
- Package Outline SOP14,SSOP14
- Internal ESD protection Human body model (HBM)  $\pm 2000V$  typ.
- Wide temperature range  $-40^{\circ}C$  to  $+125^{\circ}C$
- Input Offset Voltage Grade

| NJM2902C(Normal-Grade) | NJM2902CA(A-Grade) |
|------------------------|--------------------|
| 7mV max.               | 2.5mV max.         |

### ■ PIN CONFIGURATION

(Top View)



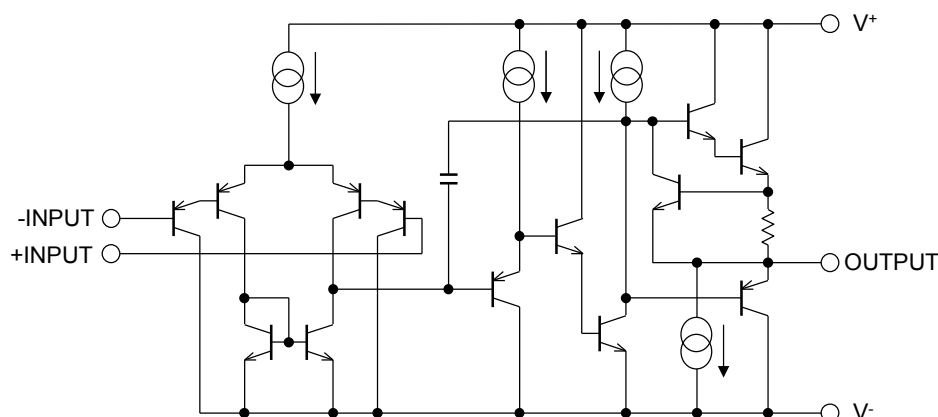
#### PIN FUNCTION

1. A OUTPUT
2. A -INPUT
3. A +INPUT
4. V<sup>+</sup>
5. B +INPUT
6. B -INPUT
7. B OUTPUT
8. C OUTPUT
9. C -INPUT
10. C +INPUT
11. V<sup>-</sup>
12. D +INPUT
13. D -INPUT
14. D OUTPUT

NJM2902CG/NJM2902CAG

NJM2902CV/NJM2902CAV

### ■ EQUIVALENT CIRCUIT ( 1/4 Shown )



# NJM2902C / NJM2902CA

## ■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

| PARAMETER                          | SYMBOL      | RATINGS                                                          | UNIT |
|------------------------------------|-------------|------------------------------------------------------------------|------|
| Supply Voltage                     | $V^+ - V^-$ | +32                                                              | V    |
| Differential Input Voltage (Note1) | $V_{ID}$    | ±32                                                              | V    |
| Input Voltage (Note2)              | $V_{IN}$    | $V^- - 0.3$ to $V^+ + 32$                                        | V    |
| Output Terminal Input Voltage      | $V_O$       | $V^- - 0.3$ to $V^+ + 0.3$                                       | V    |
| Power Dissipation                  | $P_D$       | SOP : 880 (Note3) 1200 (Note4)<br>SSOP : 510 (Note3) 640 (Note4) | mW   |
| Operating Temperature Range        | $T_{opr}$   | -40 to +125                                                      | °C   |
| Storage Temperature Range          | $T_{stg}$   | -65 to +150                                                      | °C   |

(Note1) Differential voltage is the voltage difference between +INPUT and -INPUT

(Note2) Input voltage is the voltage should be allowed to apply to the input terminal independent of the magnitude of  $V^+$ .

The normal operation will establish when any input is within the Common Mode Input Voltage Range of electrical characteristics.

(Note3) EIA/JEDEC STANDARD Test board (76.2 x 114.3 x 1.6mm, 2layers, FR-4) mounting

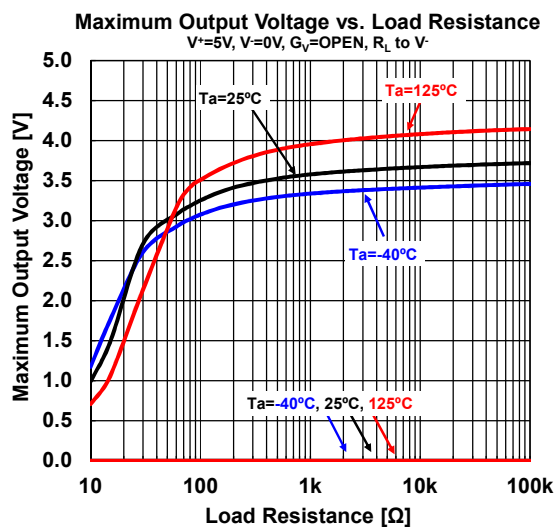
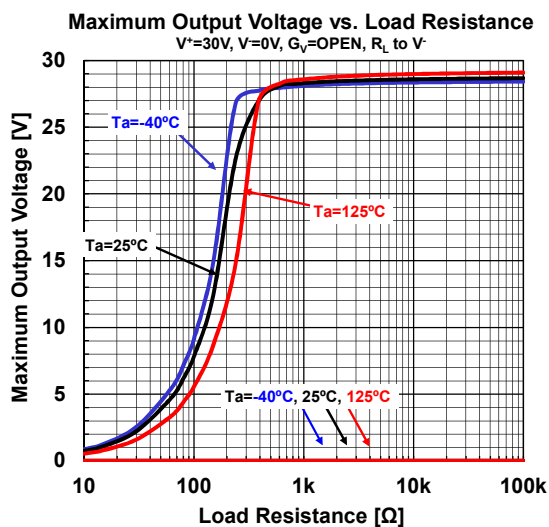
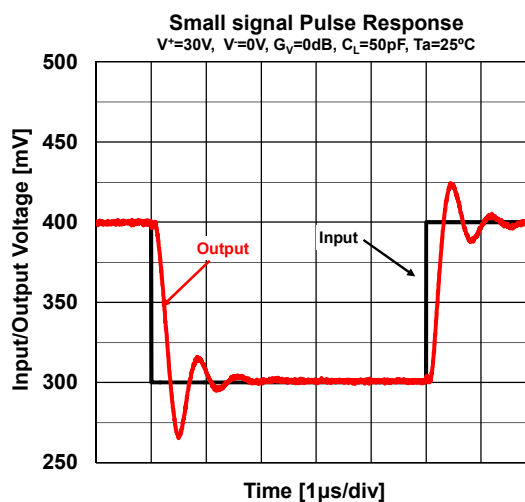
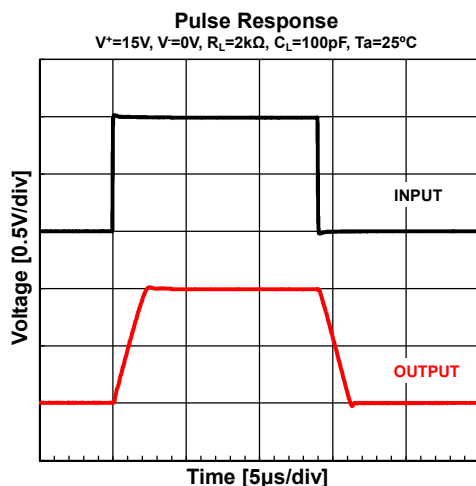
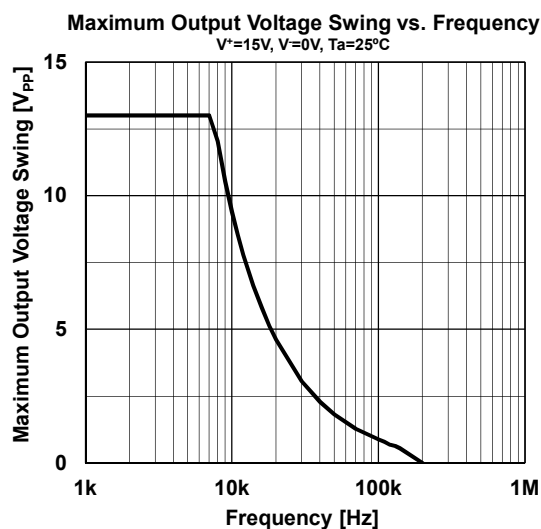
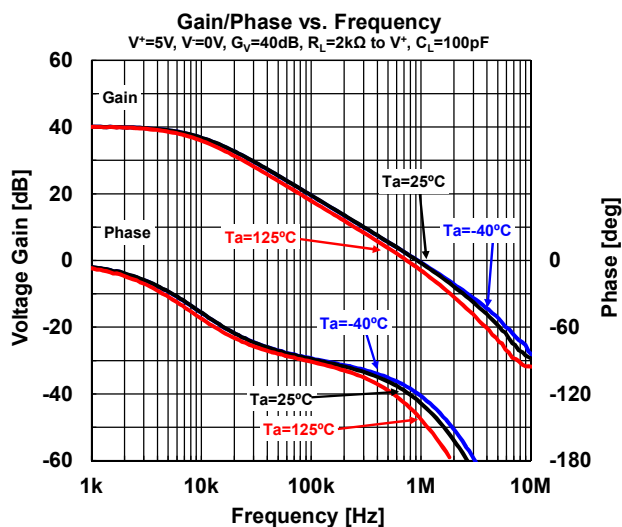
(Note4) EIA/JEDEC STANDARD Test board (76.2 x 114.3 x 1.6mm, 4layers, FR-4) mounting

## ■ ELECTRICAL CHARACTERISTICS

(( $V^+=5V$ ,  $V^-=0V$ ,  $T_a=25^\circ C$ , unless otherwise noted.))

| PARAMETER                         | SYMBOL       | TEST CONDITION                                                                                               | MIN.     | TYP.       | MAX.      | UNIT            |
|-----------------------------------|--------------|--------------------------------------------------------------------------------------------------------------|----------|------------|-----------|-----------------|
| Supply Current (All amplifiers)   | $I_{SUPPLY}$ | $V^+=5V$ , no signal<br>$V^+=30V$ , no signal                                                                | -<br>-   | 1.2<br>-   | 2<br>3    | mA              |
| Input Offset Voltage              | $V_{IO}$     | $R_S=0\Omega$<br>$R_S=0\Omega$ , NJM2902CA                                                                   | -<br>-   | 0.5<br>0.5 | 7<br>2.5  | mV              |
| Input Bias Current                | $I_B$        |                                                                                                              | -        | 20         | 150       | nA              |
| Input Offset Current              | $I_{IO}$     |                                                                                                              | -        | 2          | 30        | nA              |
| Open-Loop Voltage Gain            | $A_v$        | $R_L \geq 2k\Omega$                                                                                          | 94       | 100        | -         | dB              |
| Supply Voltage Rejection Ratio    | SVR          | $V^+=5$ to 30V, $R_S < 10k\Omega$                                                                            | 65       | 110        | -         | dB              |
| Common Mode Input Voltage Range   | $V_{ICM}$    | $V^+=30V$ , CMR>70dB                                                                                         | 0        | -          | $V^+-1.5$ | V               |
| Common Mode Rejection Ratio       | CMR          | $R_S < 10k\Omega$                                                                                            | 70       | 100        | -         | dB              |
| Output Source Current             | $I_{SOURCE}$ | $V^+=15V$ , $V_O=+2V$ , $V_{IN+}=1V$ , $V_{IN-}=0V$                                                          | 20       | 40         | -         | mA              |
| Output Sink Current               | $I_{SINK}$   | $V^+=15V$ , $V_O=+2V$ , $V_{IN+}=0V$ , $V_{IN-}=1V$<br>$V^+=15V$ , $V_O=+0.2V$ , $V_{IN+}=0V$ , $V_{IN-}=1V$ | 10<br>12 | 20<br>50   | -<br>-    | mA<br>$\mu A$   |
| High-level output voltage         | $V_{OH}$     | $R_L=2k\Omega$ , $V^+=30V$<br>$R_L=10k\Omega$ , $V^+=30V$                                                    | 26<br>27 | 27<br>28   | -<br>-    | V               |
| Low-level output voltage          | $V_{OL}$     | $R_L=10k\Omega$                                                                                              | -        | 5          | 20        | mV              |
| Slew Rate                         | SR           | $V^+=15V$ , $V_{IN}=0.5$ to 3V, $C_L=100pF$                                                                  | -        | 0.6        | -         | V/ $\mu s$      |
| Gain Band Width Product           | GBW          | $V^+=30V$ , $f=100kHz$ , $V_{IN}=10mV_{rms}$ , $R_L=2k\Omega$ , $C_L=100pF$                                  | -        | 1.3        | -         | MHz             |
| Total Harmonic Distortion + Noise | THD+N        | $f=1kHz$ , $G_v=20dB$ , $R_L=2k\Omega$ , $V_O=2V_{pp}$ , $C_L=100pF$                                         | -        | 0.015      | -         | %               |
| Equivalent input noise voltage    | $e_n$        | $f=1kHz$ , $R_S=100\Omega$ , $V^+=30V$                                                                       | -        | 30         | -         | nV/ $\sqrt{Hz}$ |
| Channel Separation                | CS           | $1kHz < f < 10kHz$                                                                                           | -        | 120        | -         | dB              |

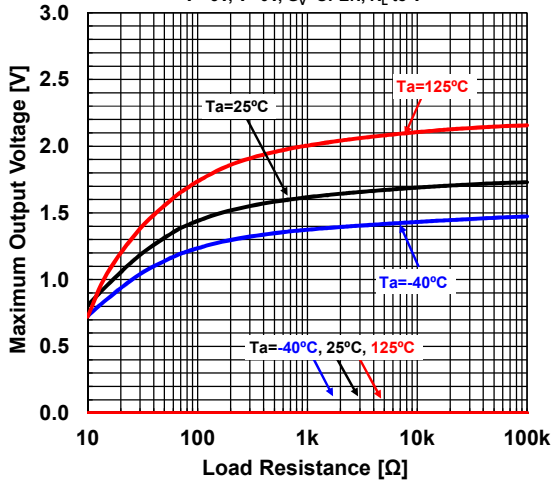
## ■ TYPICAL CHARACTERISTICS



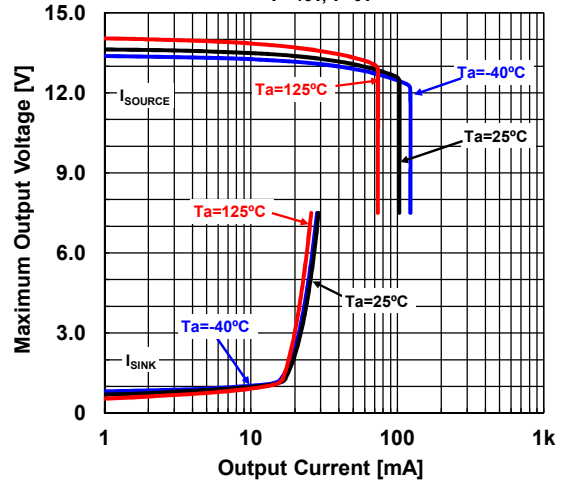
# NJM2902C / NJM2902CA

## ■ TYPICAL CHARACTERISTICS

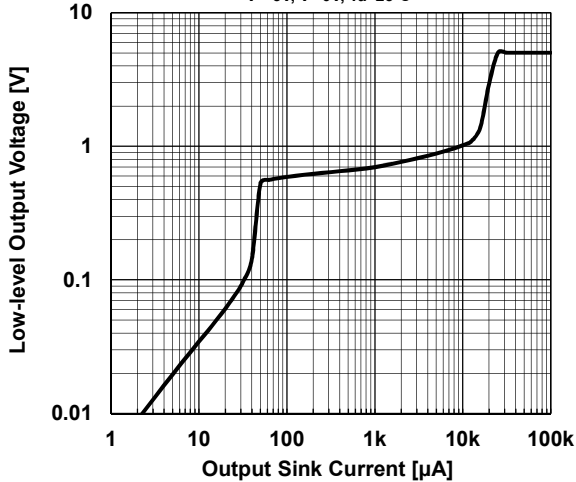
Maximum Output Voltage vs. Load Resistance  
 $V^+ = 3V$ ,  $V^- = 0V$ ,  $G_V = \text{OPEN}$ ,  $R_L$  to  $V^-$



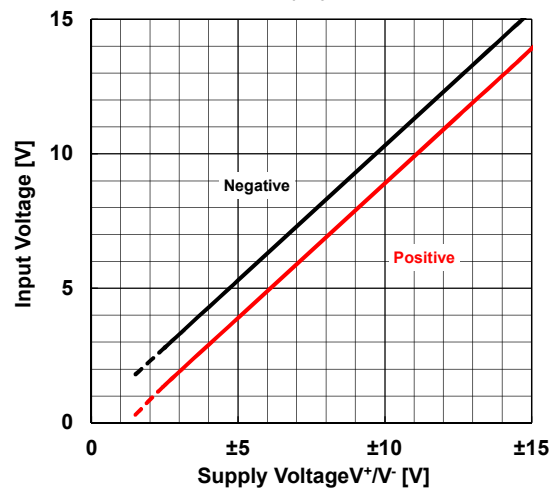
Maximum Output Voltage vs. Output Current  
 $V^+ = 15V$ ,  $V^- = 0V$



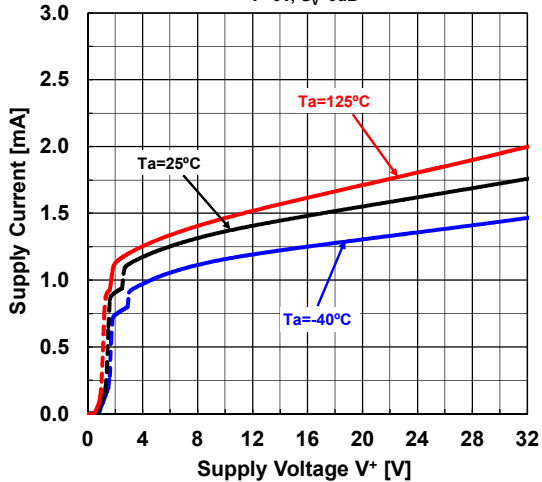
Low-level Output Voltage vs. Output Sink Current  
 $V^+ = 5V$ ,  $V^- = 0V$ ,  $T_a = 25^\circ\text{C}$



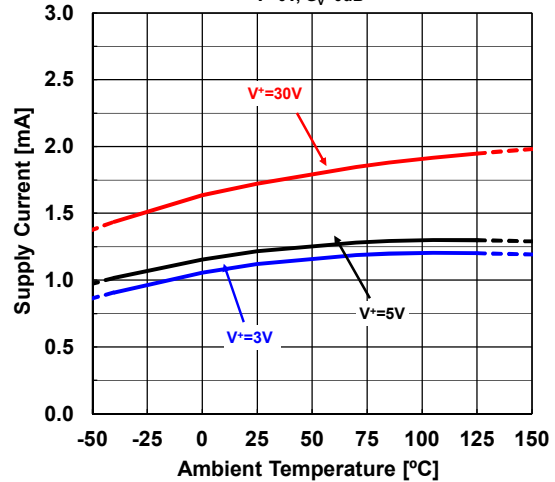
Input Voltage Range vs. Supply Voltage  
 $T_a = 25^\circ\text{C}$



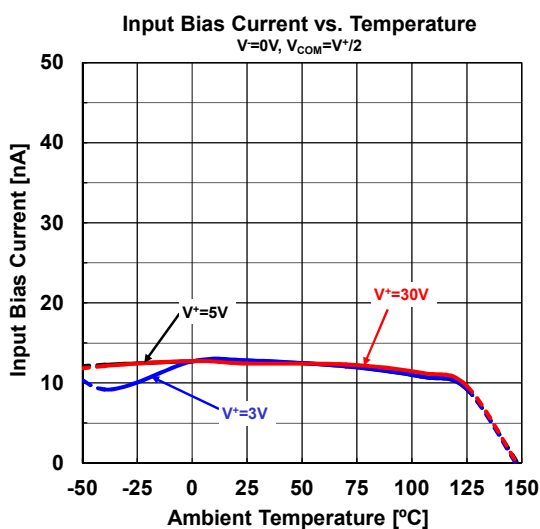
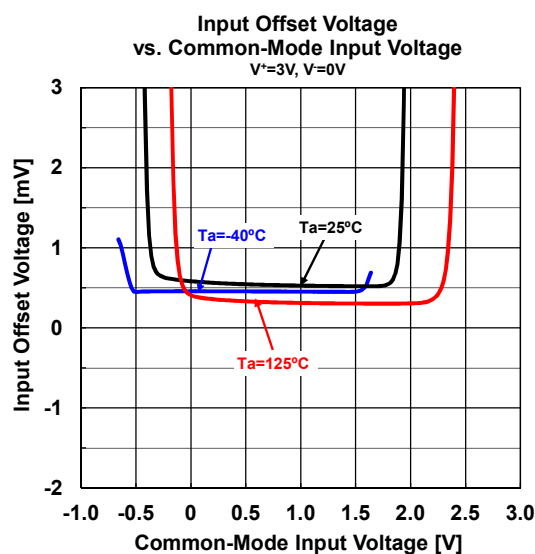
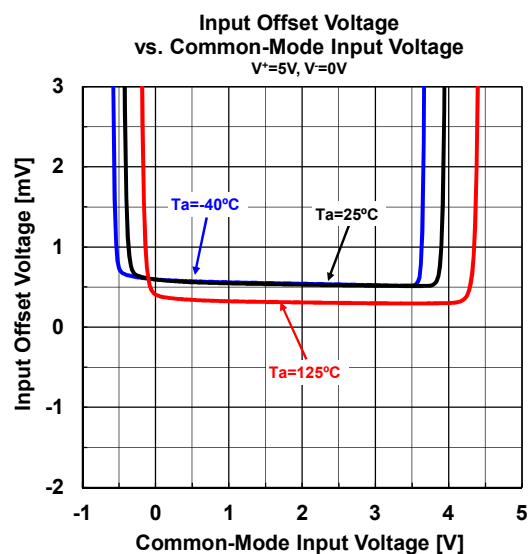
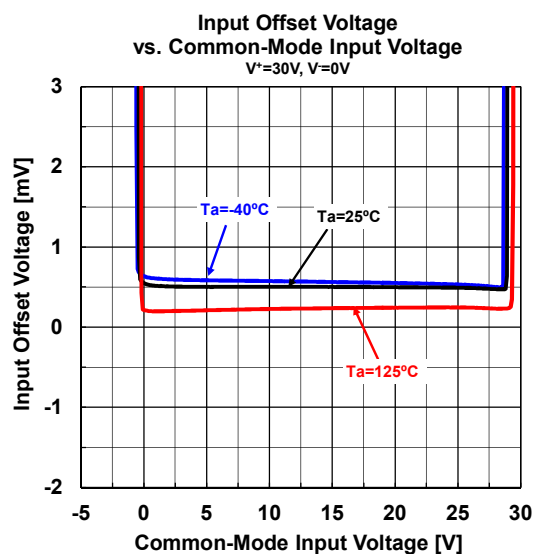
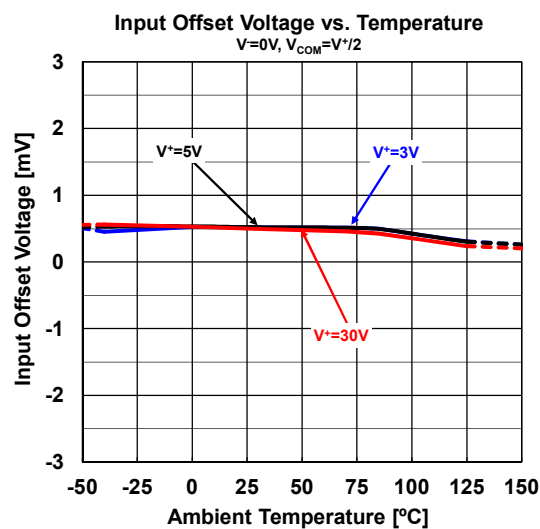
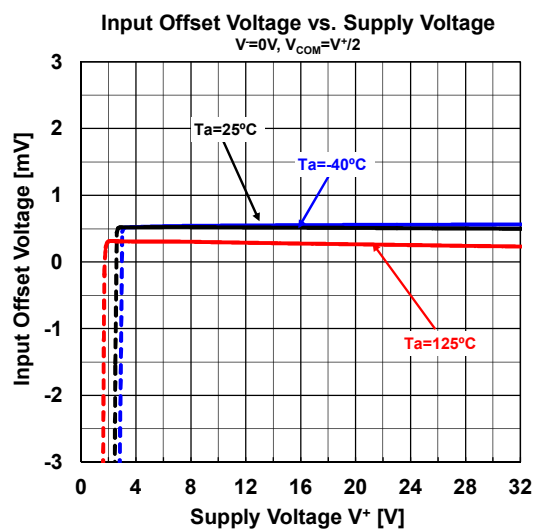
Supply Current vs. Supply Voltage  
 $V^- = 0V$ ,  $G_V = 0\text{dB}$



Supply Current vs. Temperature  
 $V^- = 0V$ ,  $G_V = 0\text{dB}$



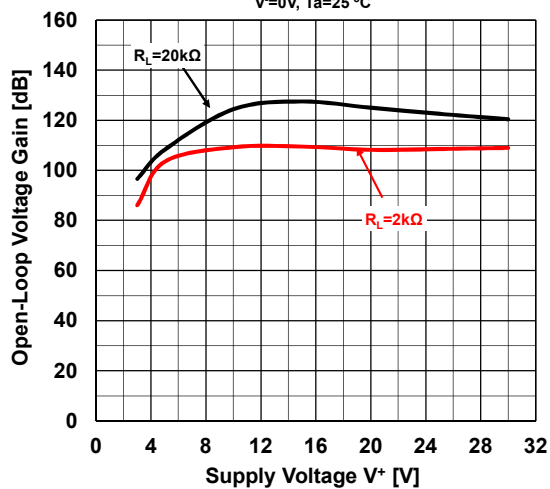
## ■ TYPICAL CHARACTERISTICS



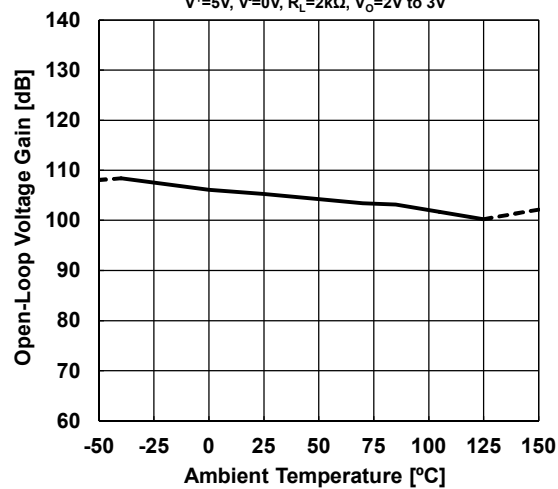
# NJM2902C / NJM2902CA

## ■ TYPICAL CHARACTERISTICS

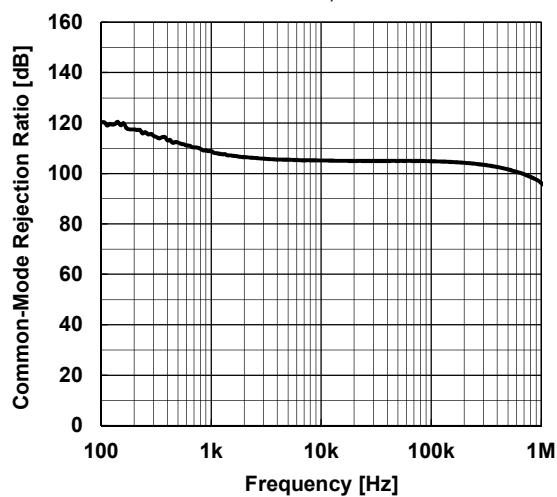
Open-Loop Voltage Gain vs. Supply Voltage  
 $V^- = 0V$ ,  $T_a = 25^\circ C$



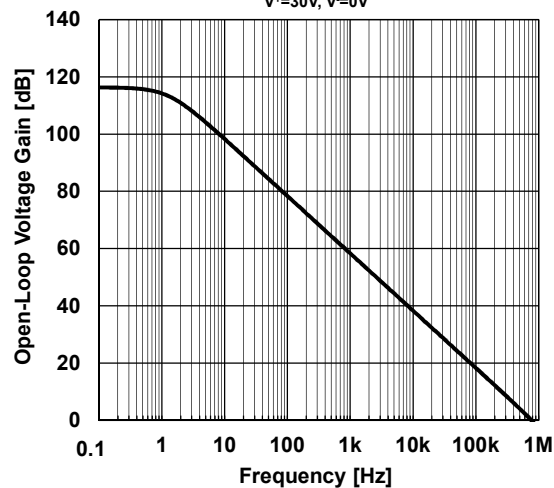
Open-Loop Voltage Gain vs. Temperature  
 $V^+ = 5V$ ,  $V^- = 0V$ ,  $R_L = 2k\Omega$ ,  $V_O = 2V$  to  $3V$



CMR vs. Frequency  
 $V^+/V^- = \pm 7.5V$ ,  $T_a = 25^\circ C$



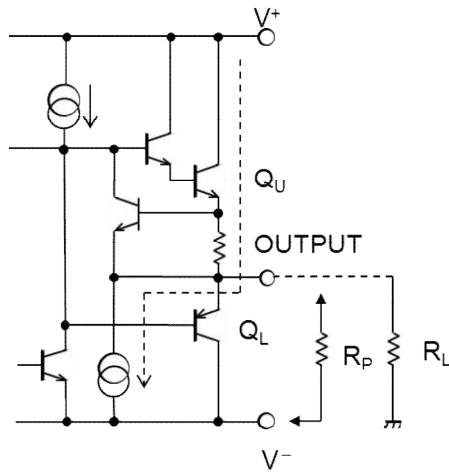
Open-Loop Voltage Gain vs. Frequency  
 $V^+ = 30V$ ,  $V^- = 0V$



## ■ APPLICATION

### Improvement of Cross-over Distortion

Equivalent circuit at the output stage

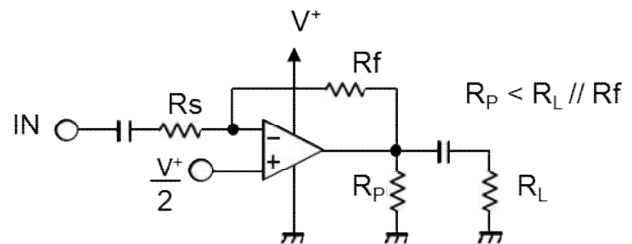
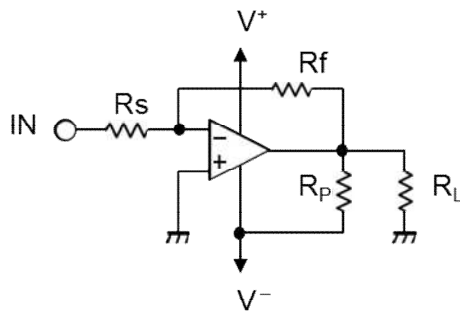


NJM2902C / NJM2902CA, in its static state ( No in and output condition ) when design,  $Q_U$  being biased by constant current ( break down beam ) yet,  $Q_L$  stays OFF.

While using with both power source mode, the cross-over distortion might occur instantly when  $Q_L$  ON.

There might be cases when application for amplifier of audio signals, not only distortion but also the apparent frequency bandwidth being narrowed remarkably.

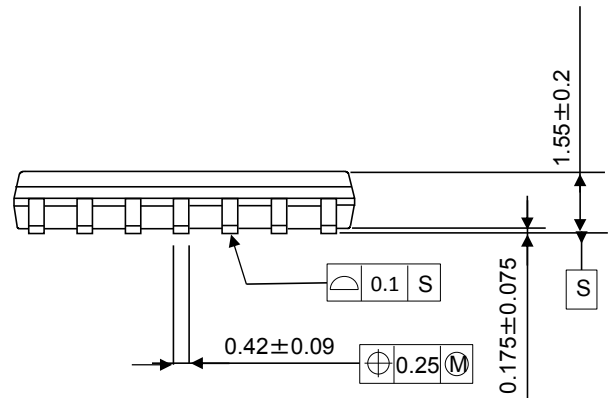
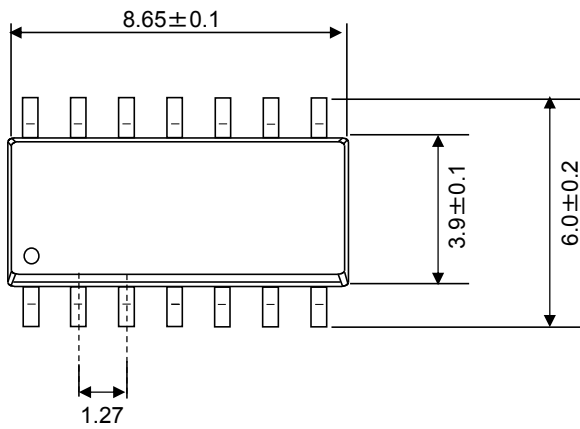
It is adjustable especially when using both power source mode, constantly to use with higher current on  $Q_U$  than the load current ( including feedback current ), and then connect the pull-down resistor  $R_P$  at the part between output and  $V^-$  pins.



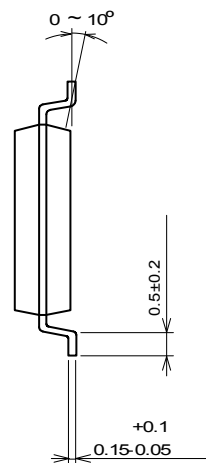
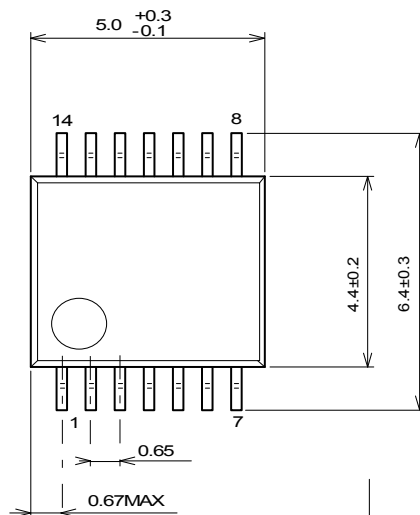
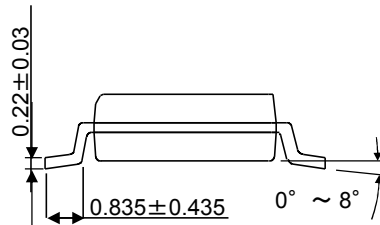
# NJM2902C / NJM2902CA

## ■PACKAGE OUTLINE UNIT : mm

SOP14



SSOP14



### [CAUTION]

The specifications on this databook are only given for information, without any guarantee as regards either mistakes or omissions.

The application circuits in this databook are described only to show representative usages of the product and not intended for the