

## QUAD OPERATIONAL AMPLIFIER

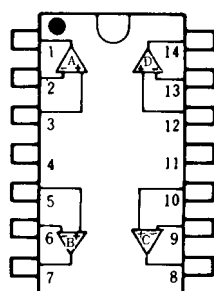
### ■ GENERAL DESCRIPTION

The NJM2060 integrated circuit is a high-gain, wide-bandwidth, quad operational amplifier capable of driving 20V peak-to-peak into 400Ω loads. The NJM2060 combines many of the features of the NJM2058 as well as providing the capability of wider bandwidth, and higher slew rate make the NJM2060 ideal for active filters, data and telecommunications, and many instrumentation applications. The availability of the NJM2060 in the surface mounted micro-package allows the NJM2060 to be used in critical applications requiring very high packing densities. Each amplifier of the NJM2060 has the same electrical characteristics of the NJM4560.

### ■ FEATURES

- Operating Voltage (  $\pm 4V \sim \pm 18V$  )
- Low Noise Voltage ( RIAA 1.2μVrms typ. )
- Slew Rate ( 4V/μs typ. )
- Unity gain Bandwidth ( 10MHz typ. )
- High Output Current ( 25mA )
- Package Outline DIP14,DMP14,SSOP14
- Bipolar Technology

### ■ PIN CONFIGURATION

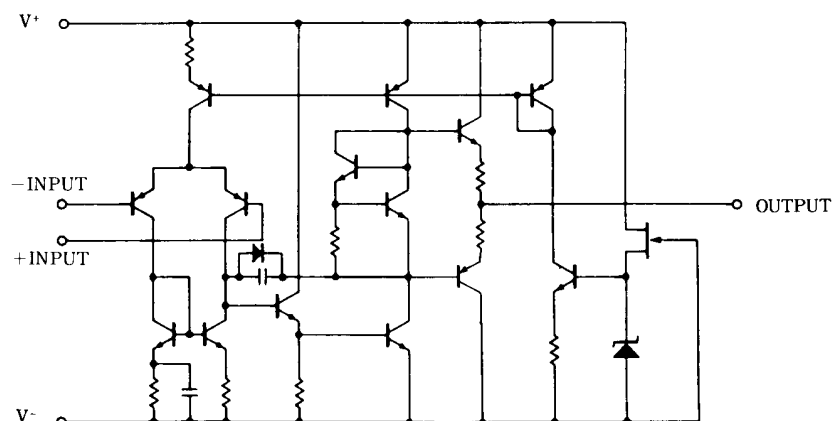


NJM2060D  
NJM2060M  
NJM2060V

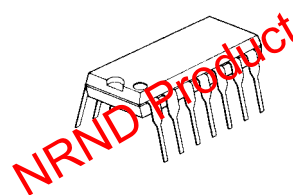
### PIN FUNCTION

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

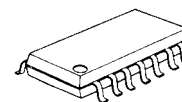
### ■ EQUIVALENT CIRCUIT ( 1/4 Shown )



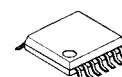
### ■ PACKAGE OUTLINE



NJM2060D



NJM2060M



NJM2060V

## ■ ABSOLUTE MAXIMUM RATINGS

( Ta=25°C )

| PARAMETER                   | SYMBOL    | RATINGS                                                    | UNIT |
|-----------------------------|-----------|------------------------------------------------------------|------|
| Supply Voltage              | $V^+/V^-$ | $\pm 18$                                                   | V    |
| Differential Input Voltage  | $V_{ID}$  | $\pm 30$                                                   | V    |
| Input Voltage               | $V_{IC}$  | $\pm 15$ ( note1 )                                         | V    |
| Power Dissipation           | $P_D$     | ( DIP14 ) 700<br>( DMP14 ) 700 ( note2 )<br>( SSOP14 ) 300 | mW   |
| Operating Temperature Range | $T_{opr}$ | -20~+75                                                    | °C   |
| Storage Temperature Range   | $T_{stg}$ | -40~+125                                                   | °C   |

( note1 ) For supply voltage less than  $\pm 15V$ , the absolute maximum input voltage is equal to the supply voltage.

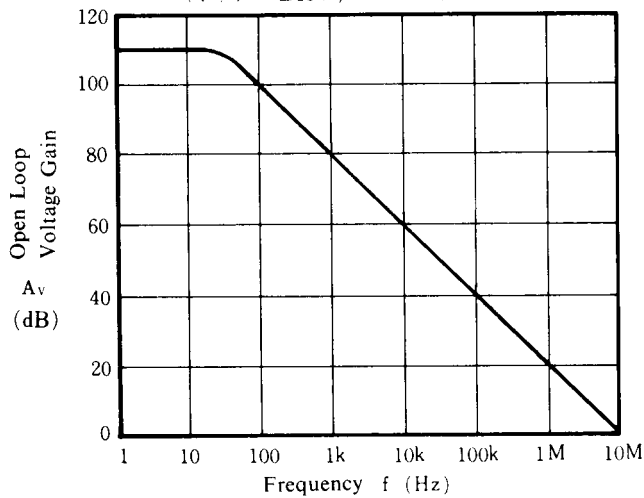
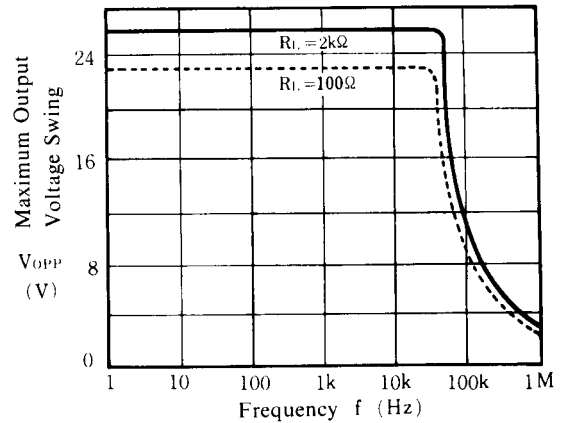
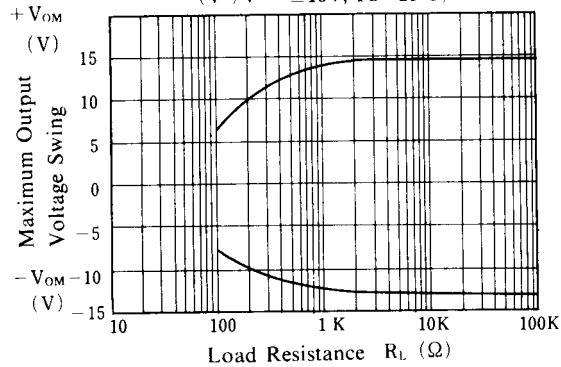
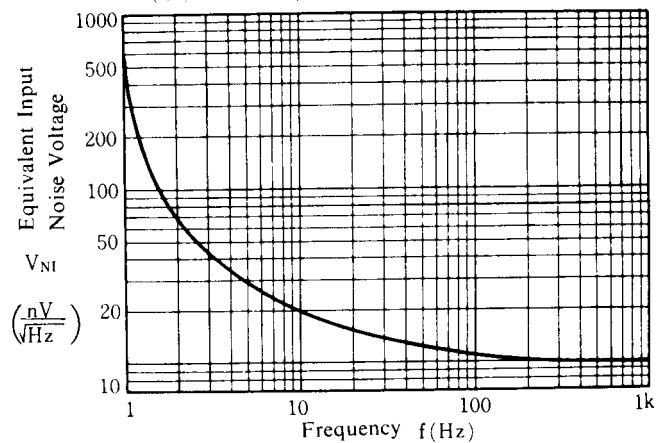
( note2 ) At on PC board

## ■ ELECTRICAL CHARACTERISTICS

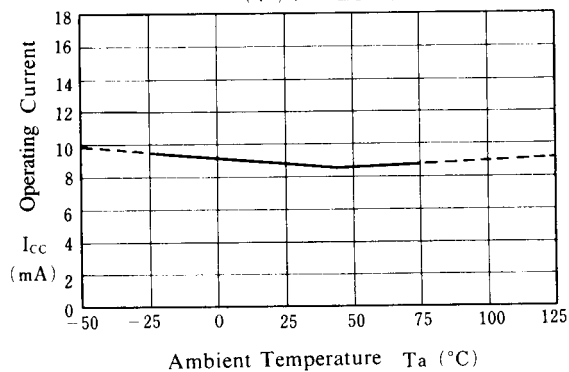
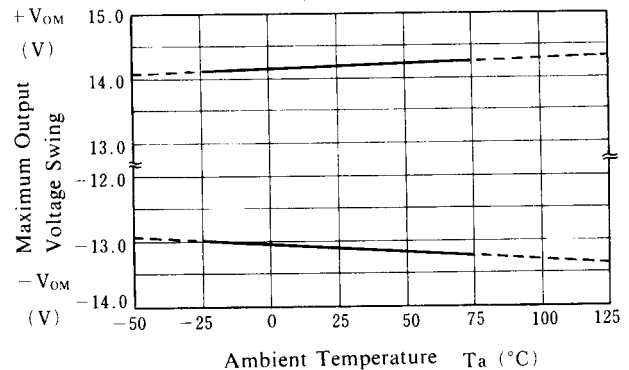
( Ta=25°C,  $V^+=15V$ ,  $V^-=-15V$  )

| PARAMETER                       | SYMBOL    | TEST CONDITION                        | MIN.     | TYP.       | MAX. | UNIT          |
|---------------------------------|-----------|---------------------------------------|----------|------------|------|---------------|
| Input Offset Voltage            | $V_{IO}$  | $R_S \leq 10k\Omega$                  | -        | 0.5        | 6    | mV            |
| Input Offset Current            | $I_{IO}$  |                                       | -        | 5          | 200  | nA            |
| Input Bias Current              | $I_B$     |                                       | -        | 40         | 500  | nA            |
| Input Resistance                | $R_{IN}$  |                                       | 100      | 500        | -    | k $\Omega$    |
| Large Signal Voltage Gain       | $A_V$     | $R_L \geq 2k\Omega$ , $V_O = \pm 10V$ | 86       | 100        | -    | dB            |
| Maximum Output Voltage Swing 1  | $V_{OM1}$ | $R_L \geq 10k\Omega$                  | $\pm 12$ | $\pm 14$   | -    | V             |
| Maximum Output Voltage Swing 2  | $V_{OM2}$ | $I_O = 25mA$                          | $\pm 10$ | $\pm 11.5$ | -    | V             |
| Input Common Mode Voltage Range | $V_{ICM}$ |                                       | $\pm 12$ | $\pm 14$   | -    | V             |
| Common Mode Rejection Ratio     | CMR       | $R_S \leq 10k\Omega$                  | 70       | 90         | -    | dB            |
| Supply Voltage Rejection Ratio  | SVR       | $R_S \leq 10k\Omega$                  | 76       | 90         | -    | dB            |
| Operating Current               | $I_{CC}$  |                                       | -        | 9          | 14   | mA            |
| Slew Rate                       | SR        |                                       | -        | 4          | -    | V/ $\mu s$    |
| Gain Bandwidth Product          | GB        |                                       | -        | 10         | -    | MHz           |
| Equivalent Input Noise Voltage  | $V_{NI}$  | RIAA, $R_S = 2.2k\Omega$ , 30kHz LPF  | -        | 1.2        | -    | $\mu V_{rms}$ |

## ■ TYPICAL CHARACTERISTICS

Open Loop Voltage Gain  
vs. Frequency(V<sup>+</sup>/V<sup>-</sup> = ±15V, R<sub>L</sub> = 2kΩ, T<sub>a</sub> = 25°C)Maximum Output Voltage Swing  
vs. Frequency(V<sup>+</sup>/V<sup>-</sup> = +15V, T<sub>a</sub> = 25°C)Maximum Output Voltage Swing  
vs. Load Resistance(V<sup>+</sup>/V<sup>-</sup> = ±15V, T<sub>a</sub> = 25°C)Equivalent Input Noise Voltage  
vs. Frequency(V<sup>+</sup>/V<sup>-</sup> = ±15V, R<sub>S</sub> = 50Ω, A<sub>v</sub> = 60dB, T<sub>a</sub> = 25°C)

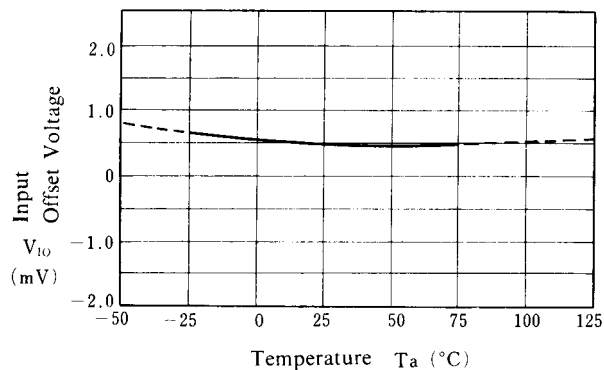
Operating Current vs. Temperature

(V<sup>+</sup>/V<sup>-</sup> = ±15V)Maximum Output Voltage Swing  
vs. Temperature(V<sup>+</sup>/V<sup>-</sup> = ±15V)

■ TYPICAL CHARACTERISTICS

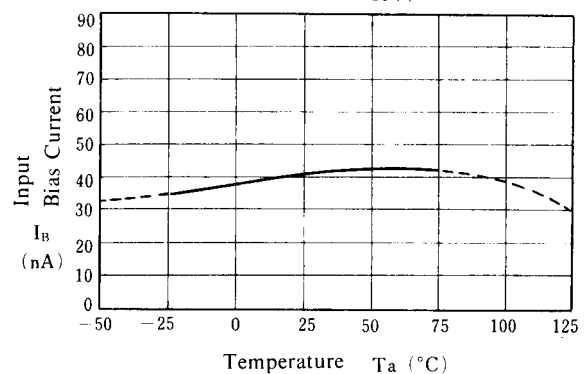
**Input Offset Voltage vs. Temperature**

( $V^+/V^- = \pm 15V$ )



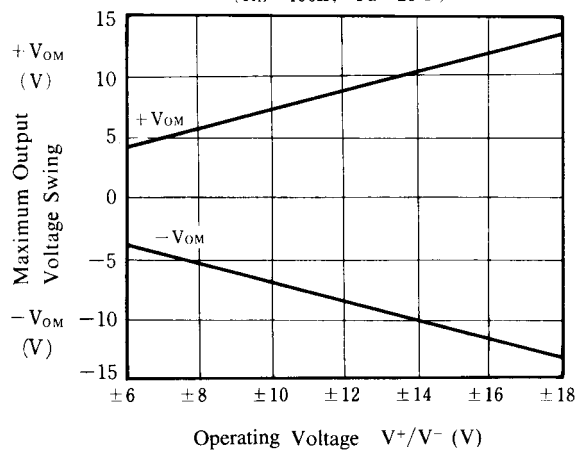
**Input Bias Current vs. Temperature**

( $V^+/V^- = \pm 15V$ )



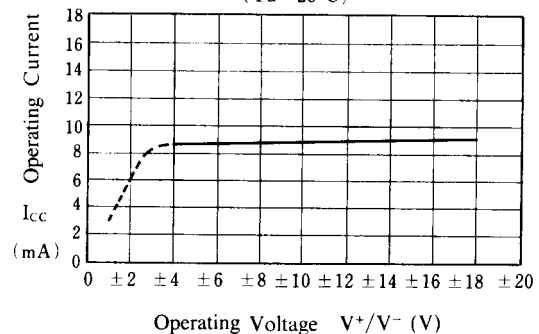
**Maximum Output Voltage Swing vs. Operating Voltage**

( $R_L = 400\Omega$ ,  $T_a = 25^\circ C$ )



**Operating Current vs. Operating Voltage**

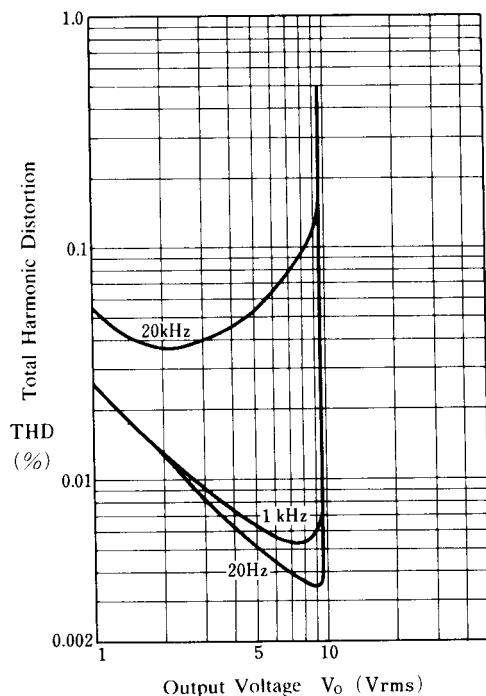
( $T_a = 25^\circ C$ )



## ■ TYPICAL CHARACTERISTICS

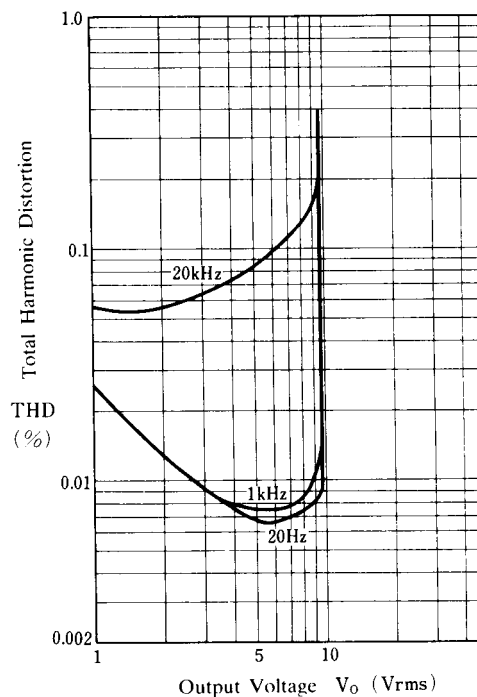
### Total Harmonic Distortion

( $V^+/V^- = \pm 15V$ , Gain=40dB,  $R_L = 10k\Omega$ ,  
 $T_a = 25^\circ C$ )



### Total Harmonic Distortion

( $V^+/V^- = \pm 15V$ , Gain=40dB,  $R_L = 2k\Omega$ ,  
 $T_a = 25^\circ C$ )



#### [CAUTION]

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