# HIGH PERFORMANCE LOW-NOISE OPERATIONAL AMPLIFIER

## ■ GENERAL DESCRIPTION

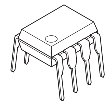
The NJM5534 is a high performance low noise operational amplifier. This amplifier features popular pin-out, superior noise performance, and high output drive capability. And also, features guaranteed noise performance with substantially higher gain-bandwidth product, power bandwidth, and slew rate which far exceeds that of the NJM741 type amplifiers.

The specially designed low noise input transistors allow the NJM5534 to be used in very low noise signal processing applications such as audio pre-amplifiers and servo error amplifiers.

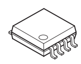
The NJM5534 is internally compensated for a gain of three or higher. Externally compensation for optimizing specific performance can be obtained by use of an external compensation capacitor between COMPENSATION(5PIN) and BALANCE/COMPENSATION(8PIN).

If very low noise characteristic is of prime importance, it is recommended D-Rank type products(NJM5534DD/MD). These have specified maximum limits for equivalent input noise voltage.

## ■ PACKAGE OUTLINE



**NJM5534D (DIP8)**



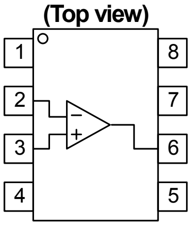
**NJM5534M (DMP8)**

## ■ FEATURES

- Operating Voltage ±3V~±22V
- Single Circuit
- With BALANCE Terminal
- Low Input Noise Voltage 3.3nV/√Hz typ.@1kHz
- Power Bandwidth 200kHz typ.
- Slew Rate 13V/µs typ.
- Package Outline DIP8, DMP8
- Bipolar Technology

## ■ PIN CONFIGURATION

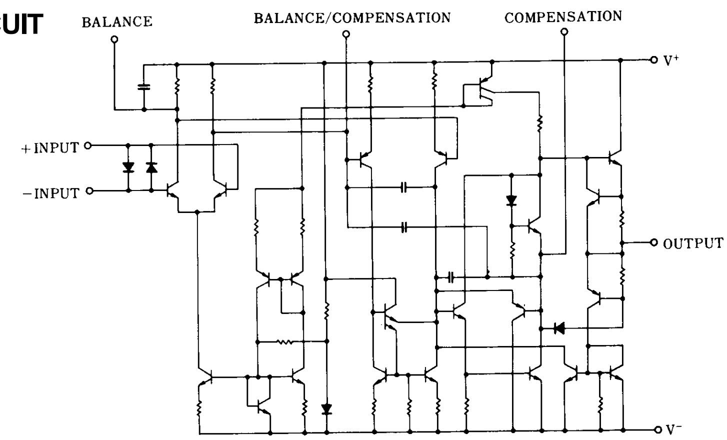
**(Top view)**




**DIP8, DMP8 Package**

**PIN FUNCTION**
**1.BALANCE**
**2.–INPUT**
**3.+INPUT**
**4.$V^-$**
**5.COMPENSATION**
**6.OUTPUT**
**7.$V^+$**
**8.BALANCE/COMPENSATION**

## ■ EQUIVALENT CIRCUIT



## ■ ABSOLUTE MAXIMUM RATINGS (Ta=25˚C)

| PARAMETER | SYMBOL | RATING | UNIT |
|---|---|---|---|
| Supply Voltage | $V^+/V^-$ | ±22 | V |
| Differential Input Voltage | $V_{ID}$ | ±0.5 | V |
| Common Mode Input Voltage | $V_{IC}$ | $V^+/V^-$ | V |
| Power Dissipation | $P_D$ | DIP8: 500<br>DMP8: 300 | mW |
| Operating Temperature Range | $T_{opr}$ | -20~+75 | °C |
| Storage Temperature Range | $T_{stg}$ | -40~+125 | °C |

## ■ RECOMMENDED OPERATING VOLTAGE (Ta=25˚C)

| PARAMETER | SYMBOL | RATING | UNIT |
|---|---|---|---|
| Supply Voltage | $V^+/V^-$ | ±3~±22 | V |

## ■ ELECTRICAL CHARACTERISTICS (Ta=25˚C,$V^+/V^-$=±15V, unless otherwise noted.)

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Input Offset Voltage | $V_{IO}$ | $R_S$≤10kΩ | - | 0.5 | 4 | mV |
| Input Offset Current | $I_{IO}$ | | - | 20 | 300 | nA |
| Input Bias Current | $I_B$ | | - | 500 | 1500 | nA |
| Input Resistance | $R_{IN}$ | | 30 | 100 | - | kΩ |
| Large Signal Voltage Gain | $A_V$ | $R_L$≥2kΩ, $V_O$=±10V | 88 | 100 | - | dB |
| Maximum Output Voltage | $V_{OM}$ | $R_L$≥600Ω | ±12 | ±13 | - | V |
| Common Mode Input Voltage Range | $V_{ICM}$ | | ±12 | ±13 | - | V |
| Common Mode Rejection Ratio | CMR | $R_S$≤10kΩ | 70 | 100 | - | dB |
| Supply Voltage Rejection Ratio | SVR | $R_S$≤10kΩ | 80 | 100 | - | dB |
| Supply Current | $I_{CC}$ | $R_L$=∞ | - | 4 | 8 | mA |
| Trainsient Response Rise Time | $t_R$ | $V_{IN}$=50mV, $R_L$=600Ω, $C_L$=100pF, Cc=22pF | - | 35 | - | ns |
| Overshoot | | $V_{IN}$=50mV, $R_L$=600Ω, $C_L$=100pF, Cc=22pF | - | 17 | - | % |
| Slew Rate | SR | Cc=0 | - | 13 | - | V/µs |
| Gain Bandwidth Product | GB | Cc=22pF, $C_L$=100pF | - | 10 | - | MHz |
| Power Bandwidth | $W_{PG}$ | Vo=20$V_{PP}$, Cc=0 | - | 200 | - | kHz |
| Equivalent Input Noise Voltage | $V_{NI}$ | f=20Hz~20kHz | - | 1 | - | µVrms |
| Equivalent Input Noise Current | $I_{NI}$ | f=20Hz~20kHz | - | 25 | - | pArms |
| Equivalent Input Noise Voltage | $e_n$ | $f_O$=30Hz | - | 5.5 | - | nV/√Hz |
| | | $f_O$=1kHz | - | 3.3 | - | nV/√Hz |
| Equivalent Input Noise Current | $i_n$ | $f_O$=30Hz | - | 1.5 | - | pA/√Hz |
| | | $f_O$=1kHz | - | 0.4 | - | pA/√Hz |
| Broadband Noise Figure | NF | f=10Hz~20kHz, $R_S$=5kΩ | - | 0.9 | - | dB |

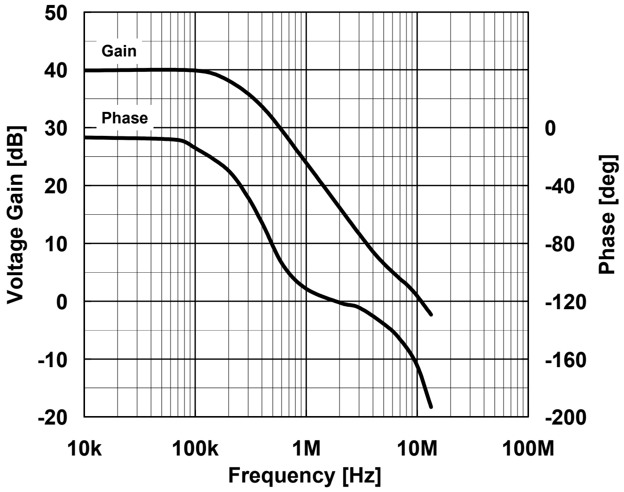
## ■ ELECTRICAL CHARACTERISTICS (D-rank type(Note1), $V^+/V^-$=±15V, Ta=25°C, unless otherwise noted.)

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Equivalent Input Noise Voltage | $V_{NI}$ | RIAA, $R_S$=2.2kΩ | - | - | 1.4 | µVrms |

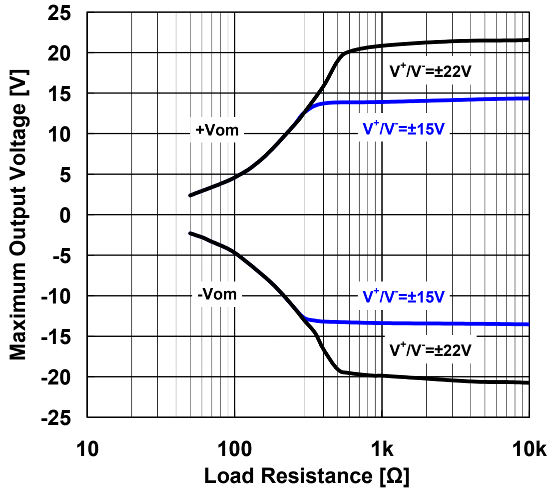
(Note1)D-rank type is a Equivalent Input Noise Voltage selected product.

## ■ TYPICAL CHARACTERISTICS

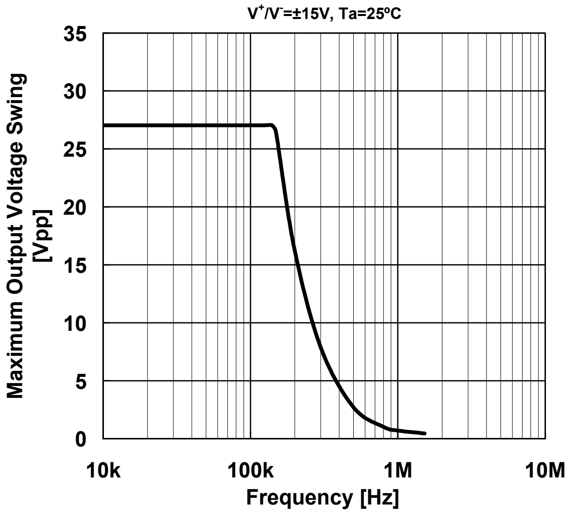
**Gain/Phase vs. Frequency**
Ta=25ºC



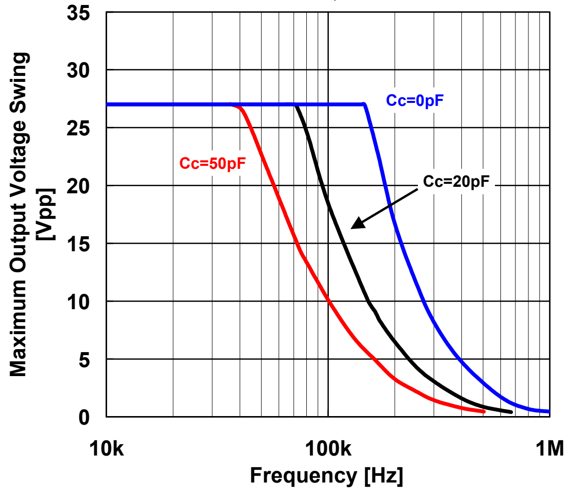

**Maximum Output Voltage vs. Load Resistance**
Ta=25ºC



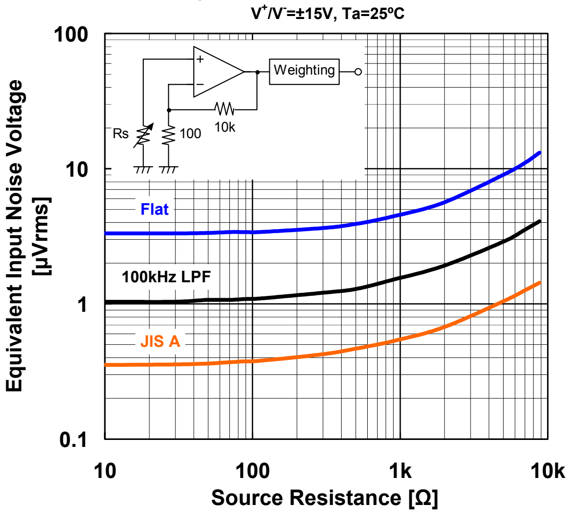

**Maximum Output Voltage Swing vs. Frequency**
V+/V-=±15V, Ta=25ºC



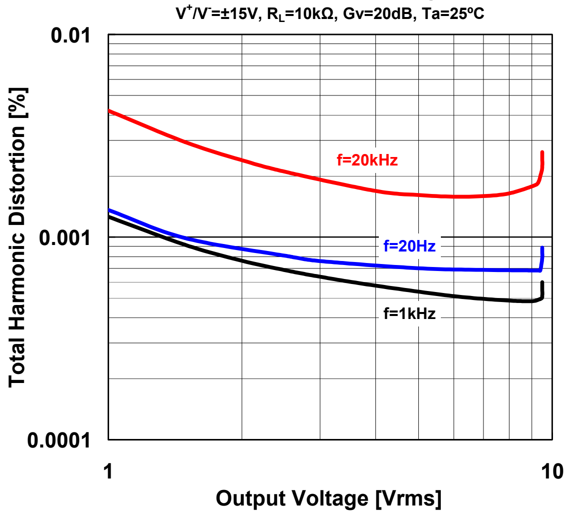

**Maximum Output Voltage Swing vs. Frequency**
V+/V-=±15V, Ta=25ºC



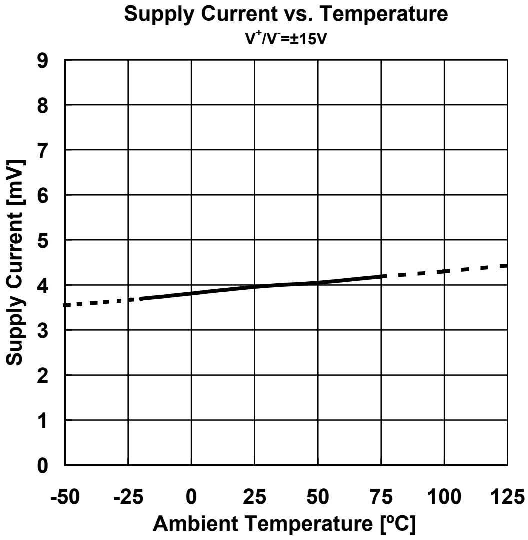

**Voltage Noise vs. Source Resistance**
V+/V-=±15V, Ta=25ºC

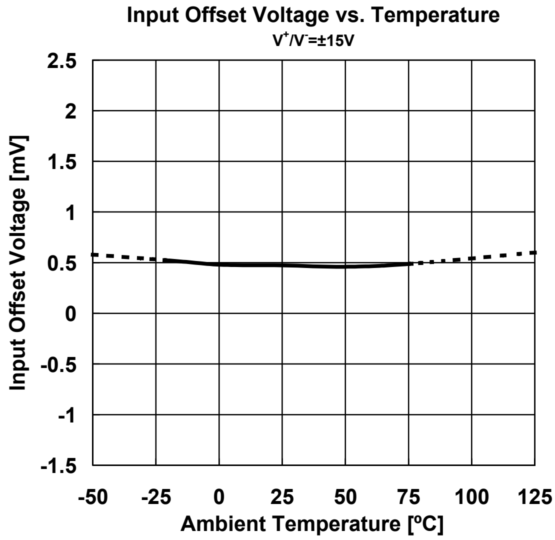


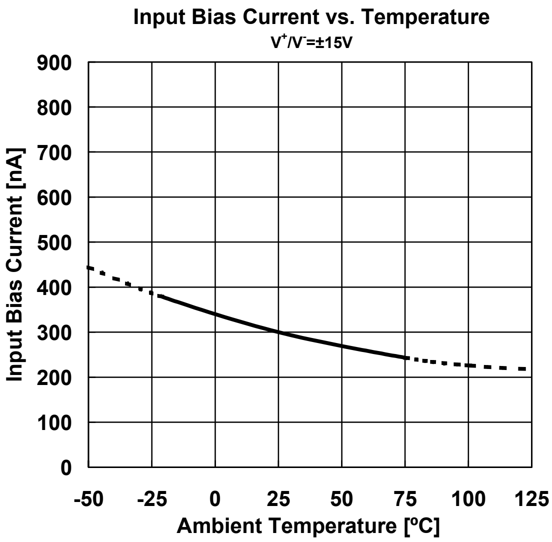

**THD vs. Output Voltage**
V+/V-=±15V, RL=10kΩ, Gv=20dB, Ta=25ºC

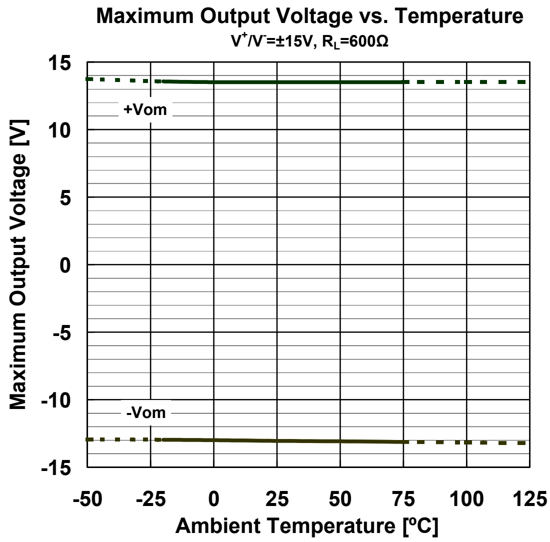


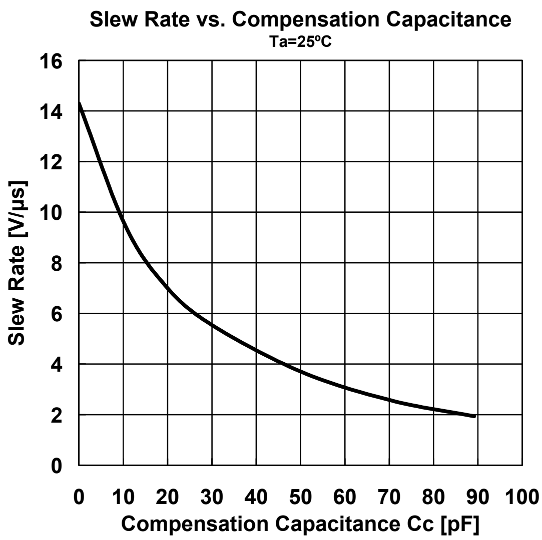
## ■ TYPICAL CHARACTERISTICS



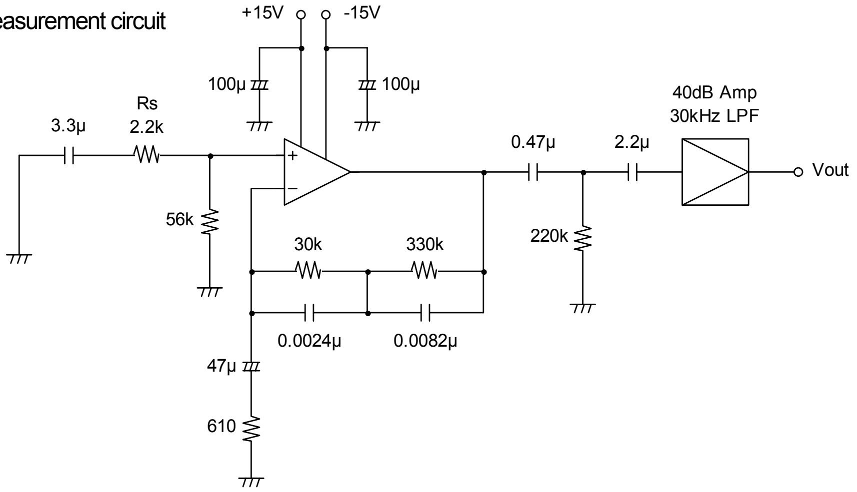



## ■ TEST CIRCUIT

Noise Voltage (RIAA) measurement circuit




## ■ ADJUSTMENT METHOD

Fig.1-1, Fig.1-2 shows the input offset voltage adjustment circuit, and frequency compensation circuit. Without these features, the adjustment pins are open.

**Fig.1-1 Input Offset Voltage Adjustment**

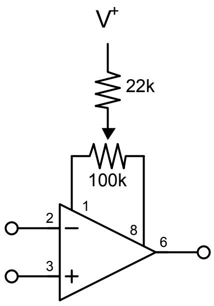
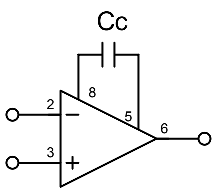



**Fig.1-2 Frequency Compensation**




## ■ NOTICE

When used in voltage follower circuit, put a current limit resistor into non-inverting input terminal in order to avoid inside input diode destruction when the power supply is turned on. ( ref.Fig.2 )

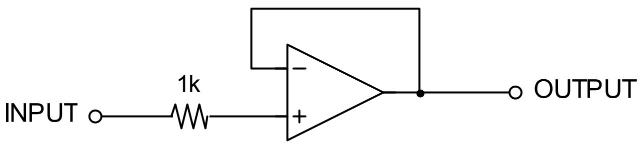



Fig.2