# DUAL OPERATIONAL TRANSCONDUCTANCE AMPLIFIER

■ GENERAL DESCRIPTION

The NJM13600/13700 consist of two current controlled transconductance amplifiers each with differential inputs and a push pull output. The two amplifiers share common supplies but otherwise operate independently. Linearizing diodes are provided at the inputs to reduce distortion and allow higher input levels. The results is a 10 dB signal-to-noise improvement referenced to 0.5 percent THD. Controlled impedance buffers are provided which are especially designed to complement the dynamic range of the amplifiers.
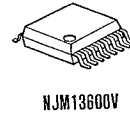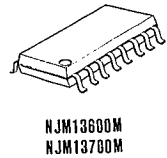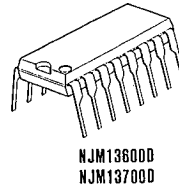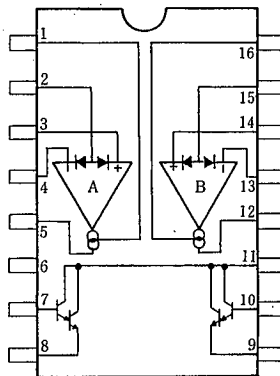
■ FEATURES

● Package Outline   DIP16, DMP16, (SSOP16)
● Bipolar Technology

■ PIN CONFIGURATION

■ PACKAGE OUTLINE

NJM13600D
NJM13700D

NJM13600M
NJM13700M

NJM13600V

NJM13600D, NJM13600M, NJM13600V
NJM13700D, NJM13700M,

PIN FUNCTION
1. Amp Bias Input A
2. Diode Bias A
3. + Input
4. − Input
5. Output A
6. V⁻
7. Buffer Input A
8. Buffer Output A
9. Buffer Output B
10. Buffer Input B
11. V⁺
12. Output B
13. − Input B
14. + Input B
15. Diode Bias B
16. Amp Bias Input B

■ EQUIVALENT CIRCUIT

V⁺

Buffer Input

Buffer Output

Diode Bias

− Input

+ Input

Output

note: A dotted line is only 13600.

Amp Bias Input

V⁻
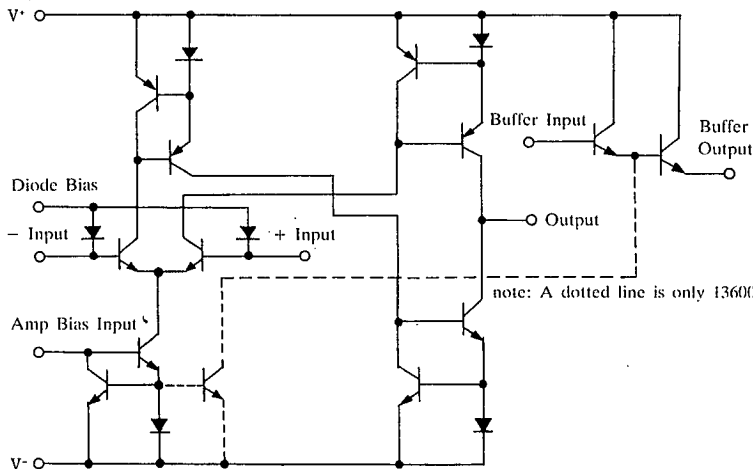
■ ABSOLUTE MAXIMUM RATINGS

(Ta=25℃)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V^+/V^-	36 or ±18	V
Differential Input Voltage	V_{ID}	±5	V
Diode Bias Current	I_D	2	mA
Amp Bias Current	I_{ABC}	2	mA
Buffer Output Current	I_O	20	mA
Power Dissipation	P_D	(DIP16) 570	mW
		(DMP16) 700	mW
DC Input Voltage	V_{IN}	$V^+ \sim V^-$	
Operating Temperature Range	T_{opr}	$-40 \sim +85$	℃
Storage Temperature Range	T_{stg}	$-40 \sim +125$	℃

(note) At on a ceramic PCB (10×20×0.635mm)
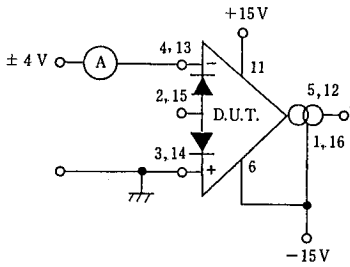
■ ELECTRICAL CHARACTERISTICS

$(V^+/V^- = \pm 15V, Ta=25℃, I_{ABC}=500\mu A)$

| PARAMETER	SYMBOL	TEST CONDITION	13600			13700			UNIT
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Input Offset Voltage (Vos)	V_{IO}		—	0.4	5	—	0.4	4	mV
Input Offset Voltage		$I_{ABC}=5\mu A$	—	0.3	5	—	0.3	4	mV
Vos Including Diodes		Diode Bias Current, $I_D=500\mu A$	—	0.5	5	—	0.5	5	mV
Input Offset Change		$5\mu A \leqq I_{ABC} \leqq 500\mu A$	—	0.1	—	—	0.1	3	mV
Input Bias Current	I_B		—	0.4	5	—	0.4	5	μA
Input Bias Current		$(-20\sim+75℃)$	—	1	8	—	1	8	μA
Forward Transconductance(gm)	gm		6,700	9,600	13,000	6,700	9,600	13,000	$\mu \Omega$
		$(-20\sim+75℃)$	5,400	—	—	5,400	—	—	$\mu \Omega$
gm Tracking		$R_L=0, I_{ABC}=5\mu A$	—	0.3	—	—	0.3	—	dB
Peak Output Current	I_{OP}	$R_L=0, I_{ABC}5\mu A$	—	5	—	—	0	—	μA
Peak Output Current		$R_L=0, I_{ABC}=500\mu A$	350	500	650	350	500	650	μA
Peak Output Current		$R_L=0, -20\sim+75℃$	300	—	—	300	—	—	μA
Peak Output Voltage Positive	V_{OP}	$R_L=\infty, 5\mu A \leqq I_{ABC} \leqq 500\mu A$	+12	+14.2	—	+12	+14.2	—	V
Peak Output Voltage Negative		$R_I=\infty, 5\mu A \leqq_{ABC} \leqq 500\mu A$	−12	−14.4	—	−12	−14.4	—	V
Operating Current	I_{CC}	$I_{ABC}=500\mu A$, two circuit	—	2.6	—	—	2.6	—	mA
Vos Sensitivity Positive	SVR	$\Delta V_{OS}/\Delta V^+$	76.5	94	—	76.5	94	—	dB
Vos Sensitivity Negative		$\Delta V_{OS}/\Delta V^-$	76.5	94	—	76.5	94	—	dB
Input Offset Curent	I_{IO}		—	0.1	0.6	—	0.1	0.6	μA
CMRR	CMR		80	110	—	80	110	—	dB
Common Mode Range	V_{ICM}		±12	±13.5	—	±12	±13.5	—	V
Cross talk	CT	20Hz<f<20kHz (note 2)	—	−100	—	—	−100	—	dB
Differential Input Current	I_{ID}	$I_{ABC}=0$, Input=±4V	—	0.02	100	—	0.02	100	nA
Leakage Curent	I_{LEAK}	$I_{ABC}=0$ (Refer to Test Circuit)	—	0.2	100	—	0.2	100	nA
Input Resistance	R_{IN}		10	26	—	10	26	—	kΩ
Open Loop Bandwidh			—	2	—	—	2	—	MHz
Slew Rate	SR		—	50	—	—	50	—	V/μS
Buffer Input Current		(note 2)	—	0.4	5	—	0.4	5	μA
Peak Buffer Output Voltage		(note 2)	10	—	—	10	—	—	V

(note 1) Open unless otherwise specified. The inputs to the buffers are grounded and outputs are open.
(note 2) $R_{OUT}=5k\Omega$ connected from the buffer output to V^- and the input of buffer is connected to the transconductance amplifier output.
　　　　$I_{ABC}=500\mu A$

NJM13600/13700
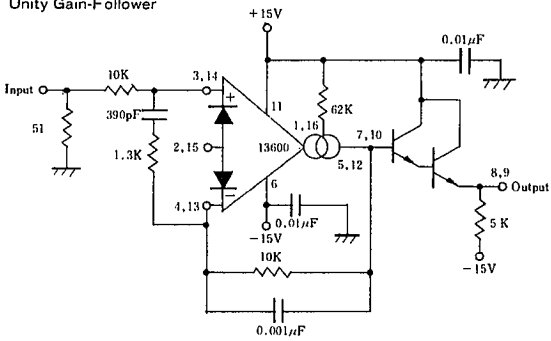
■ **TEST CIRCUIT**

Differential Input Current
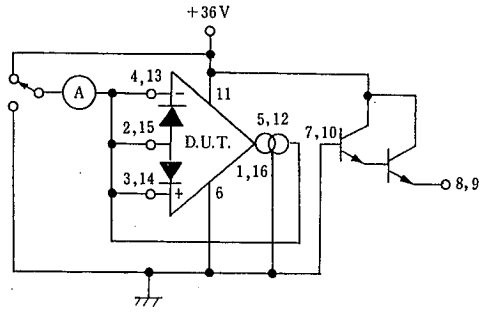
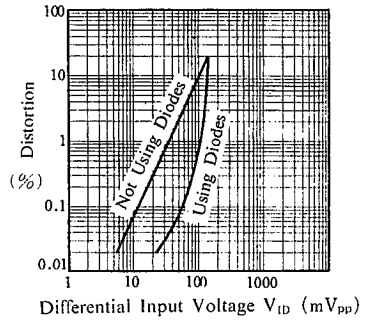Leakage Current

■ **TYPICAL APPLICATIONS**
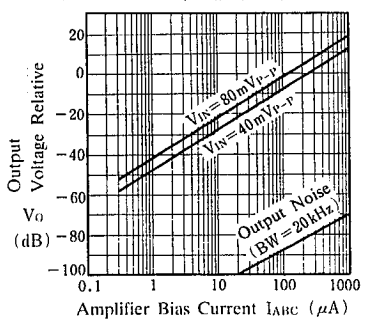
Unity Gain-Follower

■ **TYPICAL CHARACTERISTICS**

Distortion
vs. Differential Input Voltage

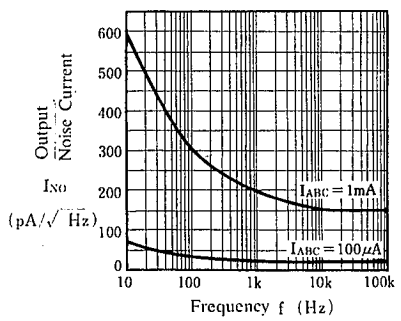$(V^+/V^- = \pm 15V, \ R_L = 10k\Omega, \ I_{ABC} = 1mA, \ Ta = 25°C)$

Differential Input Voltage V_{ID} (mV$_{PP}$)

Voltage
vs. Amplifier Bias Current

$(V^+/V^- = \pm 15V, \ R_L = 10k\Omega, \ Ta = 25°C)$

Amplifier Bias Current I_{ABC} (μA)

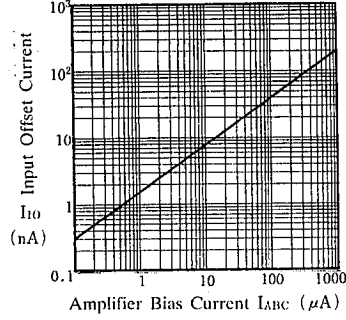### Output Noise Current
vs. Frequency
$(Ta = 25°C)$

Frequency f (Hz)

■ TYPICAL CHARACTERISTICS

Input Offset Voltage
($V^+/V^- = \pm 15V$, Ta = 25°C)
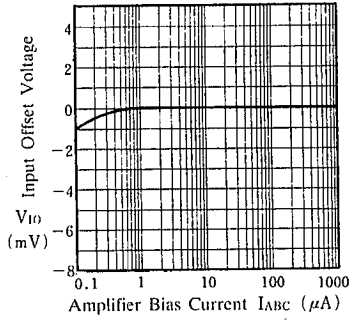
Input Offset Current
($V^+/V^- = \pm 15V$, Ta = 25°C)
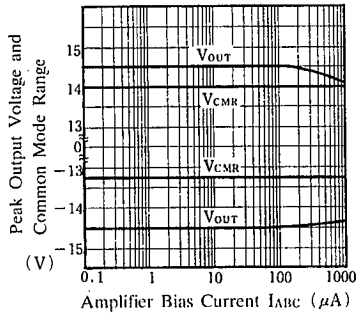

Input Bias Current
($V^+/V^- = \pm 15V$, Ta = 25°C)
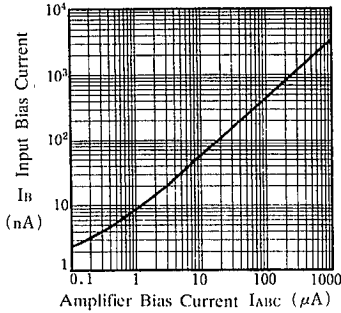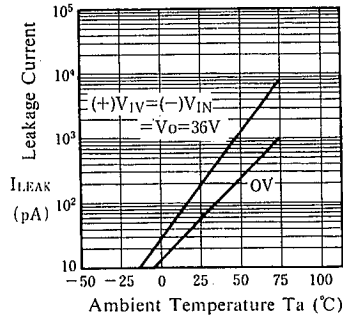

Peak Output Current
($V^+/V^- = \pm 15V$, Ta = 25°C)
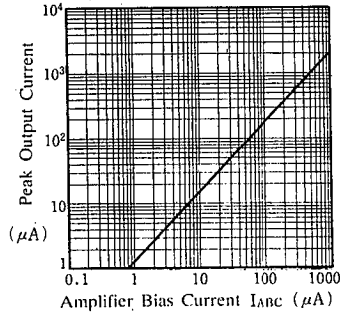
Peak Output Voltage and Common Mode Range
($V^+/V^- = \pm 15V$, $R_L = \infty$, Ta = 25°C)

Leakage Current vs. Temperature
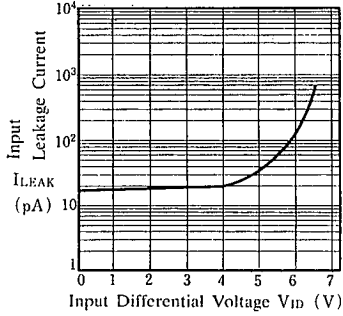($+V_{IN} = -V_{IN} = V_O$)

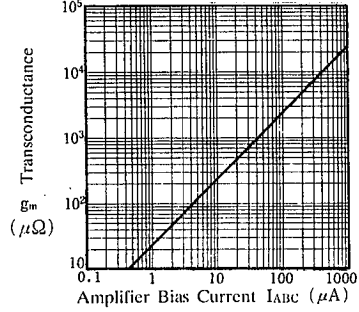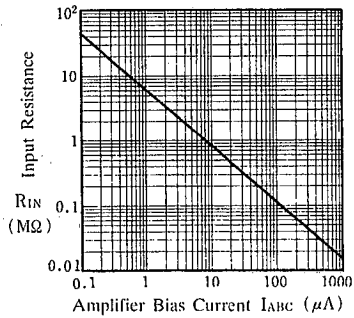■ **TYPICAL CHARACTERISTICS**

Input Leakage Current
(Ta = 25℃)

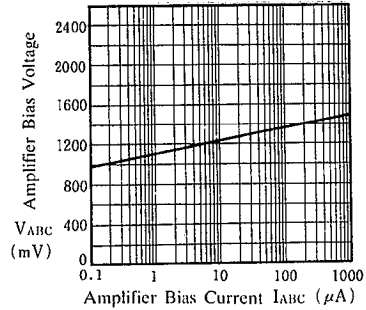Input Leakage Current I_{LEAK} (pA) vs. Input Differential Voltage V_{ID} (V)

Transconductance
(V⁺/V⁻ = ±15V, Pin2.15 Open, Ta = 25℃)

Transconductance g_m (μΩ) vs. Amplifier Bias Current I_{ABC} (μA)

Input Resistance
(Pin2.15 Open, Ta = 25℃)

Input Resistance R_{IN} (MΩ) vs. Amplifier Bias Current I_{ABC} (μA)

Amplifier Bias Voltage
vs. Amplifier Bias Current
(Ta = 25℃)

Amplifier Bias Voltage V_{ABC} (mV) vs. Amplifier Bias Current I_{ABC} (μA)

Input and Output Capacitance
(V⁺/V⁻ = ±15V, Ta = 25℃)

Capacitance (pF) C_{In}, C_{Out} vs. Amplifier Bias Current I_{ABC} (μA)

Output Resistance
(Ta = 25℃)

Output Resistance R_{OUT} (MΩ) vs. Amplifier Bias Current I_{ABC} (μA)

NJM13600/13700

MEMO