eala

3D SURROUND AUDIO PROCESSOR FOR HEADPHONE

■ **GENERAL DESCRIPTION**

The **NJM2704** is a high quality 3D surround audio processor designed for headphone applications.

It includes mode control switches for surround function and standby function and realizes low consumption power design by standby function.

In addition to SSOP14, ultra small and thin package FFP12 (Flip-chip Fine Package) is applied. It is suitable for portable telephone, PDA and any portable audio applications.

■ **PACKAGE OUTLINE**
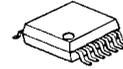
NJM2704V   **NJM2704PB1**

■ **FEATURES**

- ● Operating Voltage — 1.8 to 6V
- ● Low Operating Current — 0.45mA typ. (at Active mode)
  0.1μA typ. (at Standby mode)
- ● Low Output Noise — 10μV typ. (at Surround mode, VR: max.)
- ● Variable Surround Effect by external resistor
- ● Internal Mode Control Switch
- ● Bipolar Technology
- ● Package Outline — SSOP14, FFP12

■ **PIN CONFIGURATION**
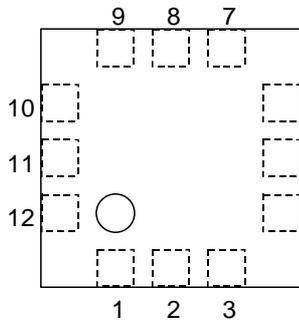
(FFP12)

1. VREF
2. MODE SW
3. RIN
4. LIN
5. STANDBY SW
6. LOUT
7. ROUT
8. NFL
9. NFR
10. V+
11. DNC
12. GND
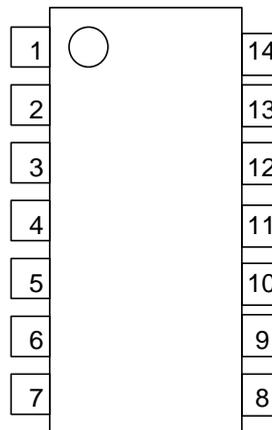
(SSOP14)

1. STANDBY SW
2. LIN
3. RIN
4. MODE SW
5. VREF
6. GND
7. NC
8. DNC
9. V+
10. NFL
11. NFR
12. ROUT
13. LOUT
14. NC

New Japan Radio Co.,Ltd.

NJM2704

■ **BLOCK DIAGRAM**
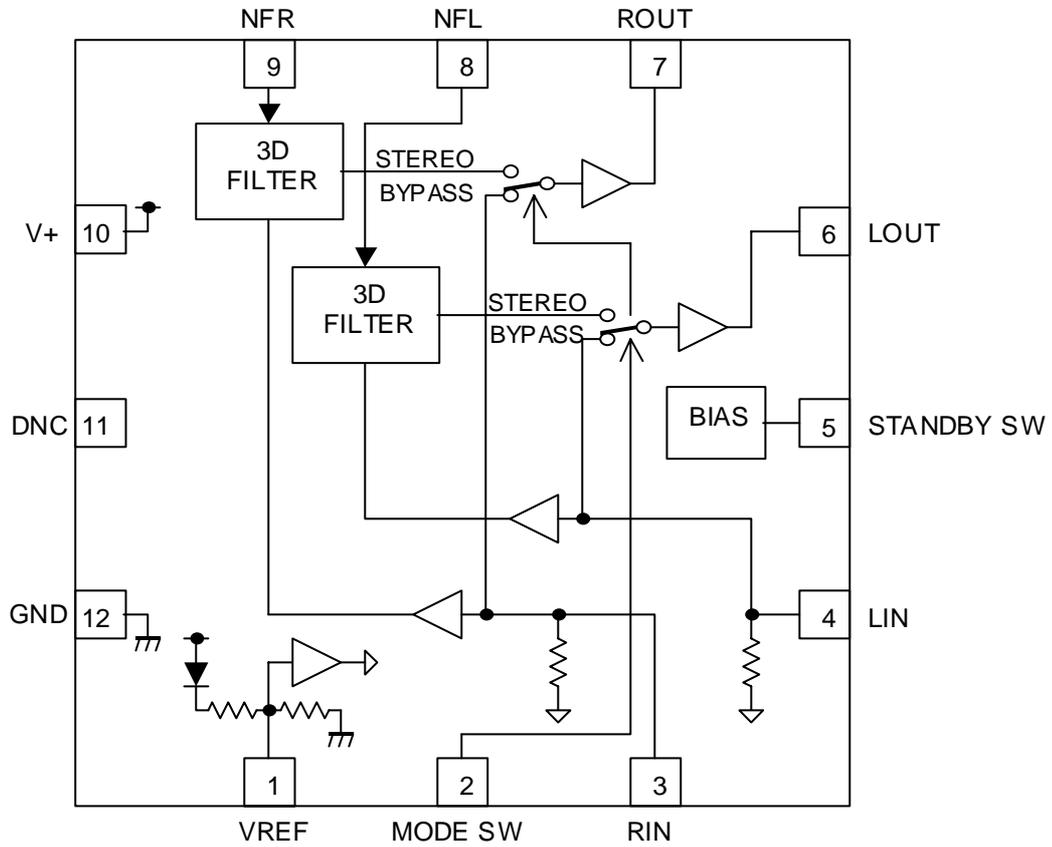
■**ABSOLUTE MAXIMUM RATING** (Ta=25°C)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V$^+$	7	V
Power Dissipation	P$_D$	320	mW
Operating Temperature Range	T$_{opr}$	-20 to +75	°C
Storage Temperature Range	T$_{stg}$	-40 to +125	°C

■**OPERATING VOLTAGE**

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Voltage	V+	-	1.8	3.0	6.0	V

■**ELECTRICAL CHARACTERISTICS** (V+=3V, Ta=25°C unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITION						MIN.	TYP.	MAX.	UNIT
			INPUT		OUTPUT	MODE	VR				
			L	R							
Operating Current	I$_{CC}$	No Signal	0	0	-	Active	-	-	450	700	μA
			0	0	-	Standby	-	-	0.1	1.0	
Reference Voltage	Vref	No Signal	0	0	-	-	-	1.0	1.15	1.3	V

●**AC CHARACTERISTICS**

(V+=3V, Ta=25°C, V$_{IN}$=-20dBV(100mVrms), f=1kHz, RL=10kΩ, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITION						MIN.	TYP.	MAX.	UNIT
			INPUT		OUTPUT	MODE	VR				
			L	R							
Maximum Input Voltage	V$_{IM}$	f=1kHz T.H.D.=1%	V$_{IN}$ 0	0 V$_{IN}$	L R	Bypass	-	-	-2.0 (790)	-	dBV (mVrms)
		f=100Hz T.H.D.=1%	V$_{IN}$ 0	0 V$_{IN}$	L R	Surround	MAX	-	-16.0 (160)	-	
		V+=1.8V f=1kHz T.H.D.=1%	V$_{IN}$ 0	0 V$_{IN}$	L R	Bypass	-	-10.5 (300)	-8.5 (380)	-	
		V+=1.8V f=100Hz T.H.D.=1%	V$_{IN}$ 0	0 V$_{IN}$	L R	Surround	MAX	-24.5 (60)	-22.5 (75)	-	
Output Noise	V$_{NO}$	Rg=0Ω A-Weighted	0	0	L R	Bypass	-	-	-112 (2.5)	-106 (5.0)	dBV (μVrms)
		Rg=0Ω A-Weighted	0	0	L R	Surround	MAX	-	-100 (10)	-94 (20)	
Total Harmonic Distortion	T.H.D	f=1kHz	V$_{IN}$ 0	0 V$_{IN}$	L R	Bypass	-	-	0.02	0.05	%
		f=1kHz	V$_{IN}$ 0	0 V$_{IN}$	L R	Surround	MAX	-	0.1	0.5	

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●AC CHARACTERISTICS
(V+=3V, Ta=25°C, V$_{IN}$=-20dBV(100mVrms), f=1kHz, RL=10kΩ, unless otherwise specified)

PARAMETER	SYMBOL		TEST CONDITION					MIN.	TYP.	MAX.	UNIT
			INPUT		OUTPUT	MODE	VR				
			L	R							
Bypass Gain	G$_{VBYP}$	f=1kHz	V$_{IN}$ 0	0 V$_{IN}$	L R	Bypass	-	-1.0	0.0	1.0	dB
Surround Gain	G$_{VSUR}$	f=100Hz	V$_{IN}$ 0	0 V$_{IN}$	L R	Surround	MAX	12.5	14.5	16.5	
		f=100Hz	0 V$_{IN}$	V$_{IN}$ 0	L R	Surround	MAX	10.5	12.5	14.5	dB
		f=100Hz	V$_{IN}$ 0	0 V$_{IN}$	L R	Surround	MIN	0.5	2.5	4.5	

●CONTROL CHARACTERISTICS (V+=3V, Ta=25°C unless otherwise specified)

PARAMETER	SYMBOL		TEST CONDITION					MIN.	TYP.	MAX.	UNIT
			INPUT		OUTPUT	MODE	VR				
			L	R							
Mode Select Control Voltage	V$_{MODE}$	V$_{IN}$= High Level	-	-	-	-	-	1.2	-	V+	V
		V$_{IN}$= Low Level	-	-	-	-	-	0.0	-	0.3	

■SWITCH FUNCTION
MODE SW

MODE	Terminal Status	NOTES
Bypass	L, open	Input Through
Surround	H	Surround Mode (Stereo Input)

STANDBY SW

MODE	Terminal Status	NOTES
Standby	L, open	IC is non-active
Active	H	IC is active

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■**TERMINAL DESCRIPTION**

PIN No.		SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	Voltage
FFP12	SSOP14				
1	5	VREF	Reference voltage		1.15V
2	4	MODE SW	Mode control switch		0V
3 4	3 2	RIN LIN	Rch Input Lch Input		1.15V
5	1	STANDBY SW	Standby switch		0V

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| PIN No. | | SYMBOL | FUNCTION | EQUIVALENT CIRCUIT | Voltage |
FFP12	SSOP14				
6 7	13 12	LOUT ROUT	Lch Output Rch Output		1.15V
8 9	11 10	NFL NFR	Filter terminal Filter terminal		1.15V
10	9	V+	Power Supply		V+
-	7 14	NC	No Connect		-
11	8	DNC	Do Not Connect		-

■**APPLICATION CIRCUIT**

FFP12

SSOP14

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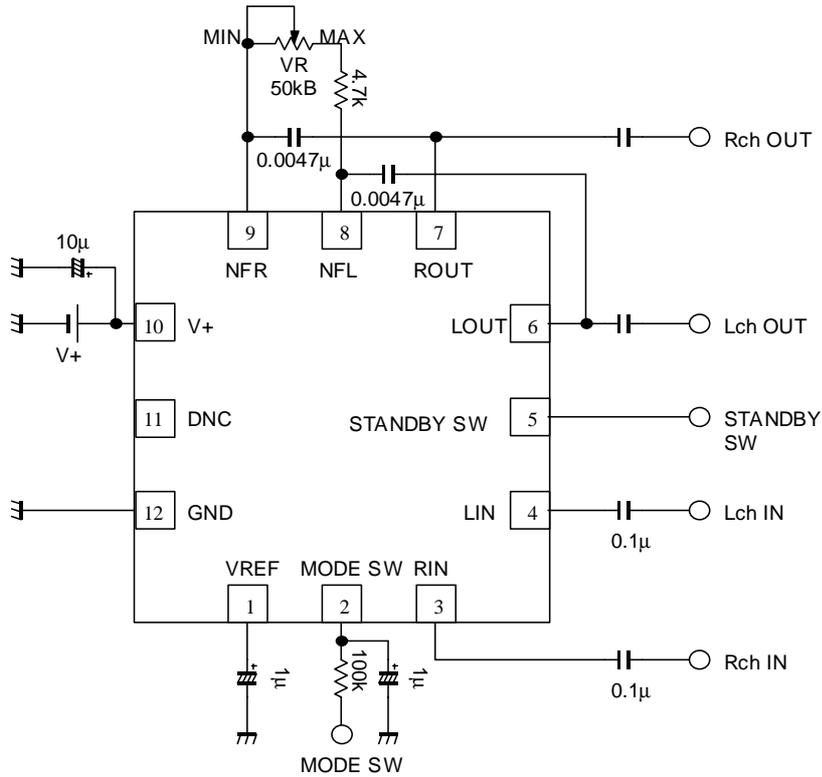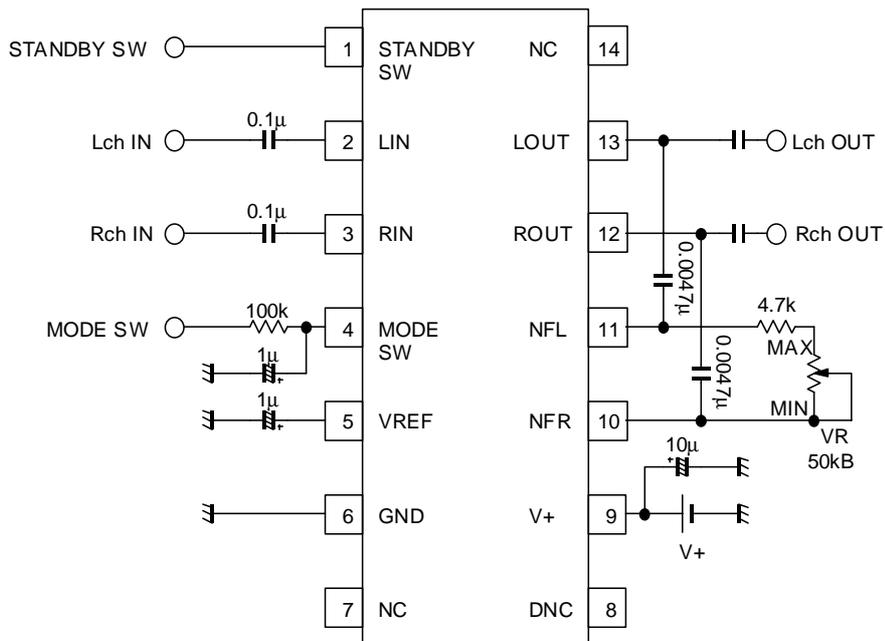
■**TYPICAL CHARACTERISTICS**

Supply Current vs. Supply Voltage
Ta=25degrees
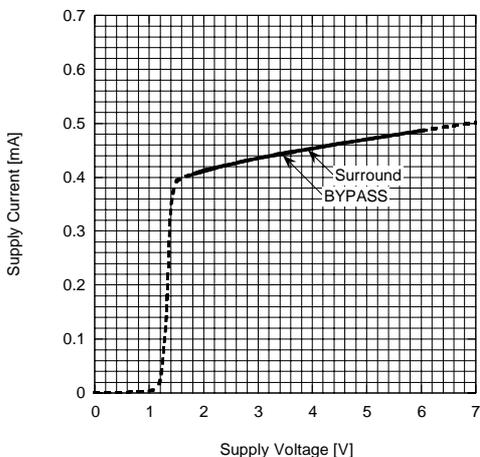
Supply Current vs. Ambient Temperature
V+=3V
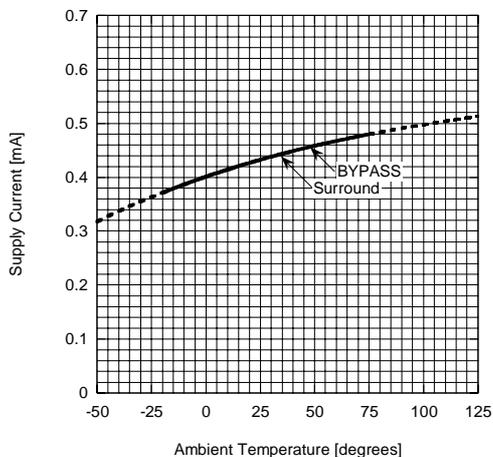
Reference Voltage vs. Supply Voltage
Ta=25degrees
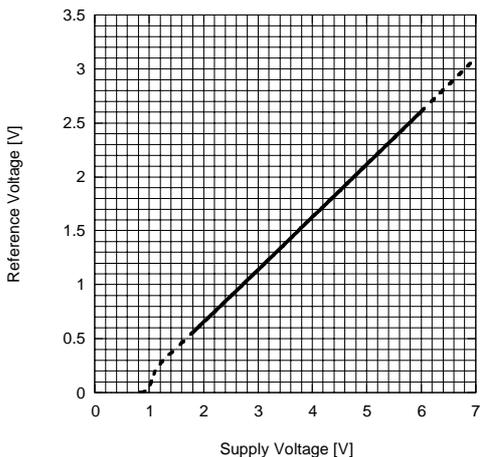
Reference Voltage vs. Ambient Temperature
V+=3V
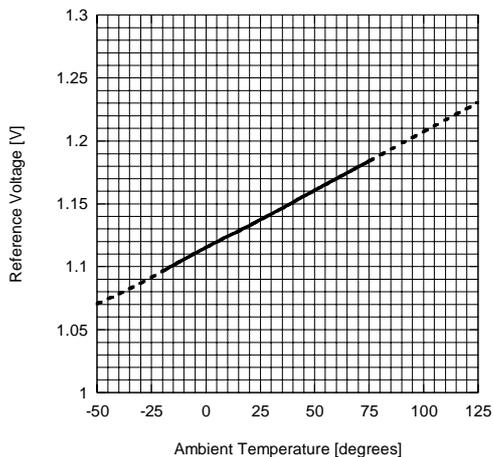
Maximum Input Voltage vs. Supply Voltage (BYPASS)
Vin=Lch f=1kHz Vout=Lch RL=10kohm
THD=1% Ta=25degrees
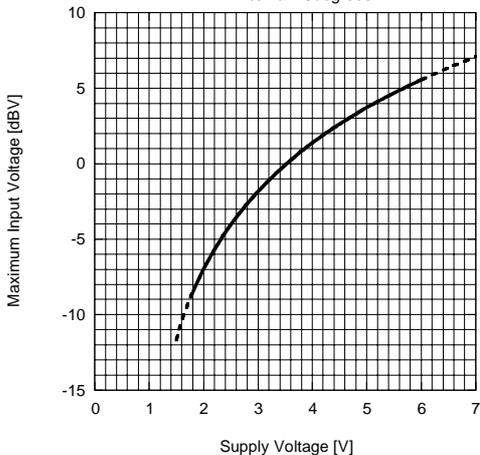
Maximum Input Voltage vs. Supply Voltage (Surround)
Vin=Lch f=100Hz Vout=Lch RL=10kohm VR=MAX
THD=1% Ta=25degrees

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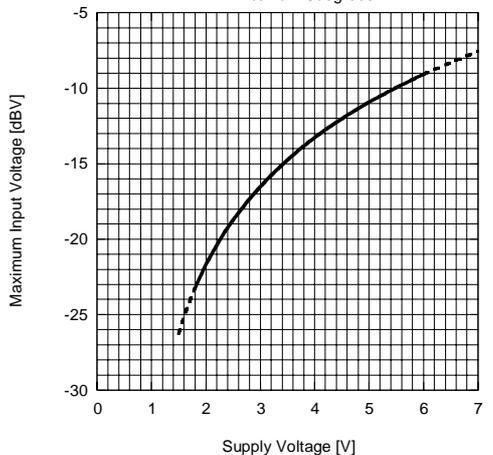
■TYPICAL CHARACTERISTICS

**Maximum Input Voltage vs. Ambient Temperature (BYPASS)**
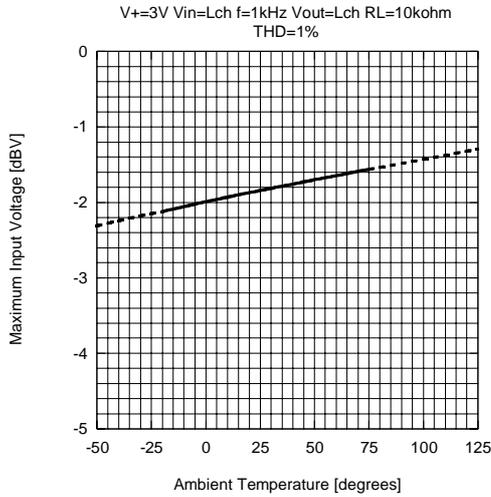
V+=3V Vin=Lch f=1kHz Vout=Lch RL=10kohm
THD=1%

Maximum Input Voltage vs. Ambient Temperature (Surround)

V+=3V Vin=Lch f=100Hz Vout=Lch RL=10kohm
VR=MAX THD=1%

Maximum Input Voltage vs. Ambient Temperature (BYPASS)

V+=1.8V Vin=Lch f=1kHz Vout=Lch RL=10kohm
THD=1%

Maximum Input Voltage vs. Ambient Temperature (Surround)

V+=1.8V Vin=Lch f=100Hz Vout=Lch RL=10kohm
VR=MAX THD=1%
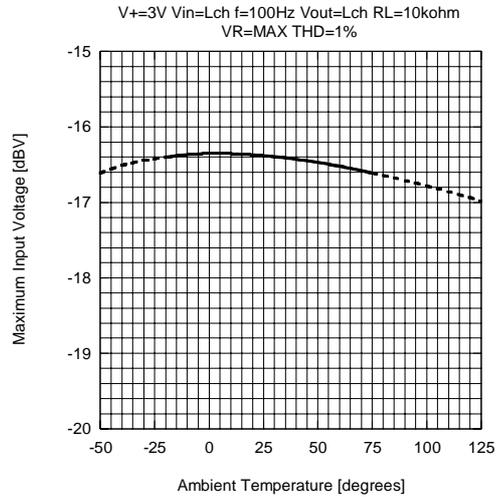
Output Noise Voltage vs. Ambient Temperature
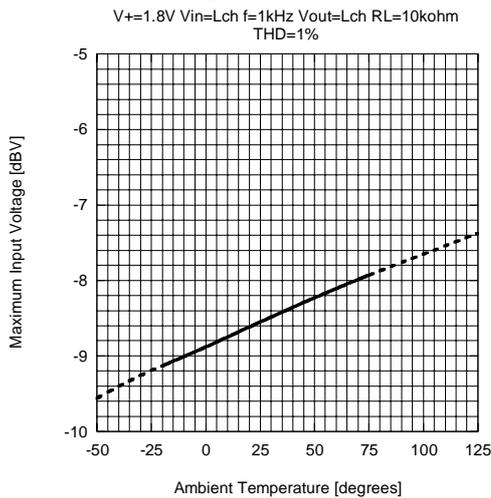
V+=3V Rg=0ohm Vout=Lch VR=MAX
FILTER=A-Weighted

Output Noise Voltage vs. Ambient Temperature

V+=3V Rg=0ohm Vout=Rch VR=MAX
FILTER=A-Weighted

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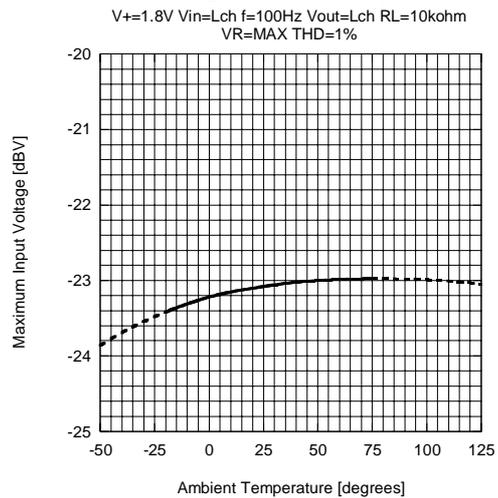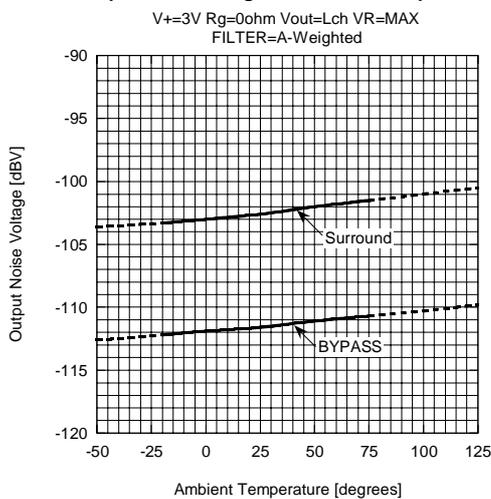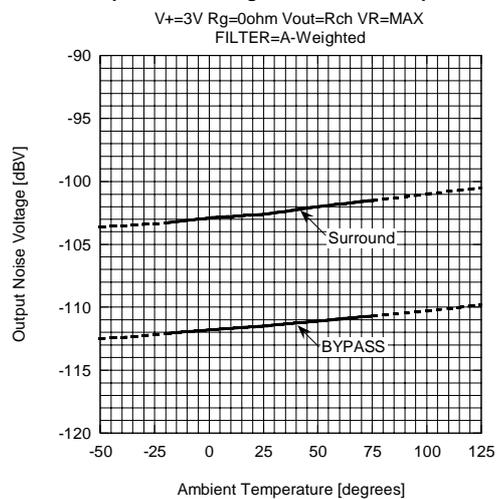
■TYPICAL CHARACTERISTICS

Total Harmonic Distortion vs. Input Voltage (BYPASS)

V+=3V Vin=Lch f=1kHz Vout=Lch
RL=10kohm BW=10Hz to 80kHz

Ta=75deg.
Ta=25deg.
Ta=-20deg.

THD+N [%] vs Input Voltage [dBV]
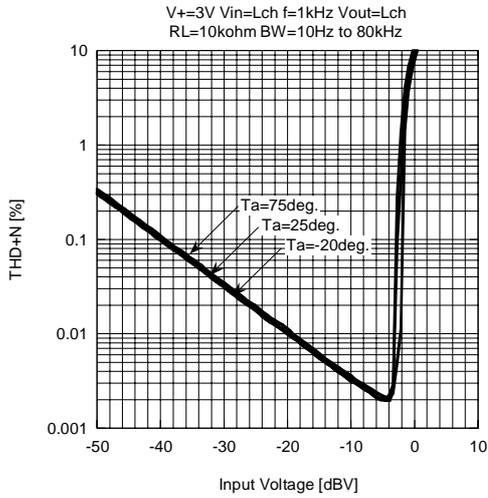
Total Harmonic Distortion vs. Input Voltage (Surround)

V+=3V Vin=Lch f=100Hz Vout=Lch
RL=10kohm BW=10Hz to 80kHz VR=MAX

Ta=75deg.
Ta=25deg.
Ta=-20deg.

THD+N [%] vs Input Voltage [dBV]
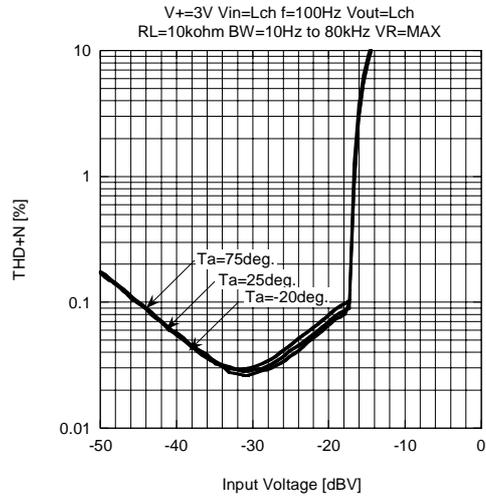
Voltage Gain vs. Frequency (BYPASS)

V+=3V Vin=-20dBV Lch Vout=Lch
RL=10kohm Rg=25ohm

Ta=-20deg.
Ta=25deg.
Ta=75deg.

Voltage Gain [dB] vs Frequency [Hz]

Voltage Gain vs. Frequency (Surround)

V+=3V Vin=-20dBV Lch Vout=Lch
RL=10kohm Rg=25ohm VR=MAX

Ta=75deg.
Ta=25deg.
Ta=-20deg.

Voltage Gain [dB] vs Frequency [Hz]

Voltage Gain vs. Frequency (Surround)

V+=3V Vin=-20dBV Rch Vout=Lch
RL=10kohm Rg=25ohm VR=MAX

Ta=75deg.
Ta=25deg.
Ta=-20deg.

Voltage Gain [dB] vs Frequency [Hz]

Voltage Gain vs. Frequency (Surround)

V+=3V Vin=-20dBV Lch Vout=Lch
RL=10kohm Rg=25ohm VR=MIN

Ta=75deg.
Ta=25deg.
Ta=-20deg.
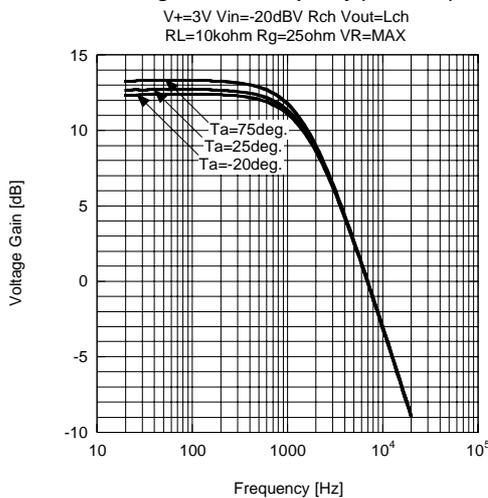
Voltage Gain [dB] vs Frequency [Hz]
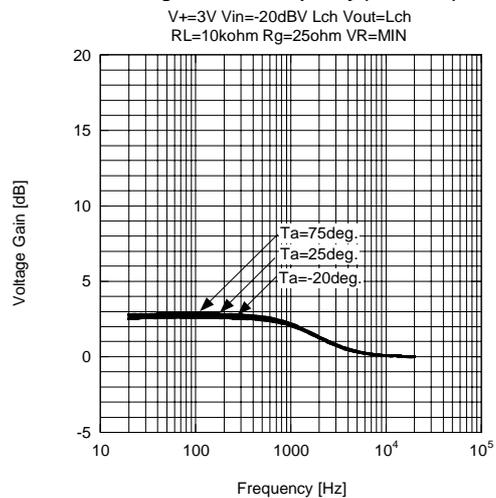
■**TYPICAL CHARACTERISTICS**

Voltage Gain vs. SW Terminal Input Voltage

V+=3V Vin=-20dBV Lch f=100Hz Vout=Lch VR=MAX
BYPASS to Surround

Voltage Gain [dB]

SW Terminal Input Voltage [V]

Ta=75deg.
Ta=25deg.
Ta=-20deg.
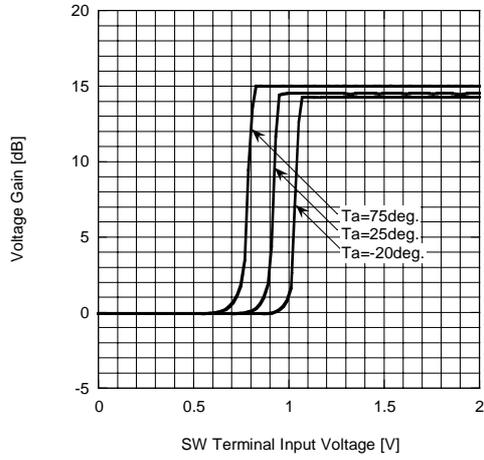
Output DC Offset Voltage vs. Ambient Temperature

V+=3V
BYPASS to Surround

Output DC Offset Voltage [mV]

Ambient Temperature [degrees]

Lch

Rch

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