eala
MOBILE

Surround Audio Processor for Mobile Applications

■ GENERAL DESCRIPTION

The **NJM2705** is the surround audio processor for mobile applications.

It regenerates the 3D surround sound with extremely narrow space two speakers (2SP mode), headphone surround with normal headphone (HP mode) and reverberation sound with only one speaker (1SP mode).

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

In addition to SSOP16, an ultra small and thin package FFP16 (Flip-Chip Fine Package) is applied.

It is suitable for cellular phone, PDA and portable game.

■ PACKAGE OUTLINE
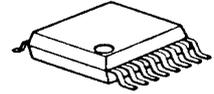
NJM2705PC1　　　　**NJM2705V**

## ■ FEATURES

- Operating Voltage   1.8 to 6V
- Operating Current   0.7mA typ. at Active mode
                                    1µA max. at Standby mode
- Low Output Noise   10µVrms typ
                                    (2SP/HP/1SP mode, VR : max.)
- Variable Surround Effect by external resistor
  (Adjustable for speaker and headphone independently.)
- Standby Function
- Internal Mode Control Switch
- Bipolar Technology
- Package Outline   FFP16, SSOP16

■ BLOCK DIAGRAM


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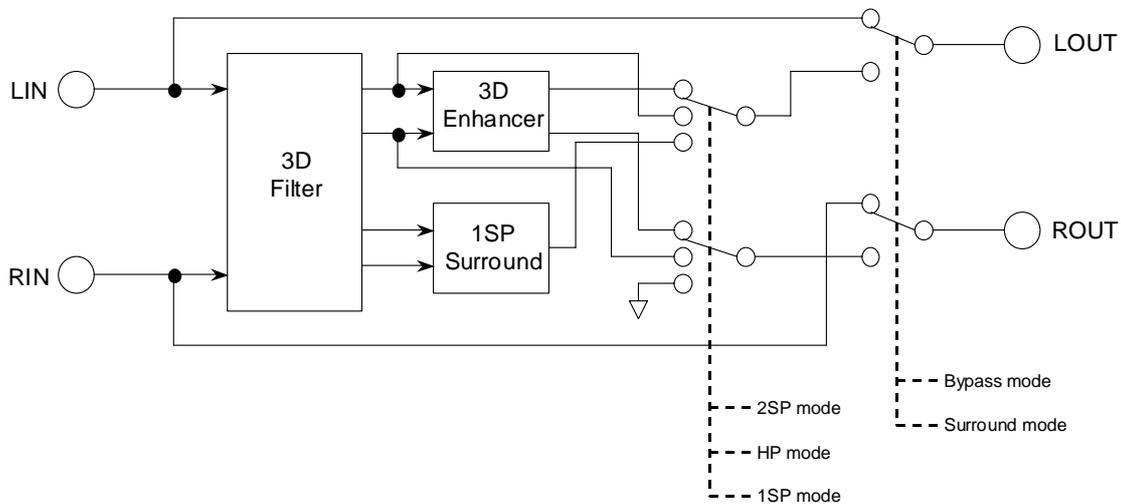
NJM2705
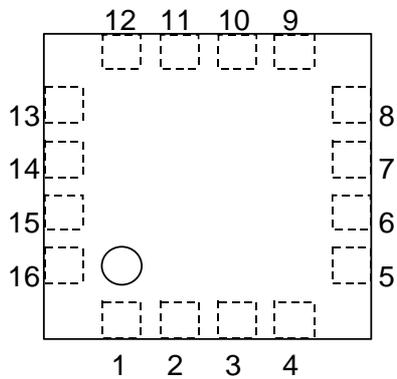
FFP16 (Top View)

1.	LIN	9. LMON
2.	RIN	10. PS
3.	LOUT	11. SW2
4.	ROUT	12. SW1
5.	NFSPR	13. STBY
6.	NFHPR	14. V+
7.	NFSPL	15. GND
8.	NFHPL	16. VREF

SSOP16 (Top View)
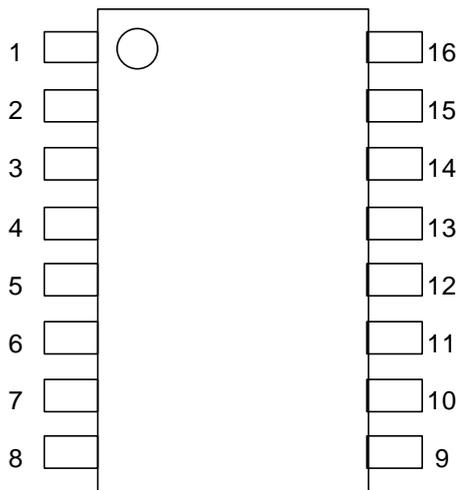
1.	NFHPR	9. V+
2.	NFSPR	10. STBY
3.	ROUT	11. SW1
4.	LOUT	12. SW2
5.	RIN	13. PS
6.	LIN	14. LMON
7.	VREF	15. NFHPL
8.	GND	16. NFSPL

■ABSOLUTE MAXIMUM RATING (Ta=25°C)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V^+	7	V
Power Dissipation	P_D	(FFP16) 400 (SSOP16) 300	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	SP VR	HP 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	SP VR	HP VR				
			L	R								
Maximum Input Voltage	V_{IM1}	f=1kHz THD=1%	V_{IN} 0	0 V_{IN}	L R	Bypass	-	-	-	-2.0 (790)	-	dBV (mVrms)
	V_{IM2}	f=100Hz THD=1%	V_{IN} 0	0 V_{IN}	L R	2SP	MAX	-	-	-16.0 (160)	-	
	V_{IM3}	f=100Hz THD=1%	V_{IN} 0	0 V_{IN}	L R	HP	-	MAX	-	-16.0 (160)	-	
	V_{IM4}	f=100Hz THD=1%	V_{IN}	0	L	1SP	MAX	-	-	-16.0 (160)	-	
	V_{IM5}	f=100Hz THD=1%	0	V_{IN}	L	1SP	MAX	-	-	-14.5 (190)	-	
	V_{IM6}	V^+=1.8V,f=1kHz THD=1%	V_{IN} 0	0 V_{IN}	L R	Bypass	-	-	-10.5 (300)	-8.5 (380)	-	
	V_{IM7}	V^+=1.8V,f=100Hz THD=1%	V_{IN} 0	0 V_{IN}	L R	2SP	MAX	-	-24.5 (60)	-22.5 (75)	-	
	V_{IM8}	V^+=1.8V,f=100Hz THD=1%	V_{IN} 0	0 V_{IN}	L R	HP	-	MAX	-24.5 (60)	-22.5 (75)	-	
	V_{IM9}	V^+=1.8V,f=100Hz THD=1%	V_{IN}	0	L	1SP	MAX	-	-24.5 (60)	-22.5 (75)	-	
	V_{IM10}	V^+=1.8V,f=100Hz THD=1%	0	V_{IN}	L	1SP	MAX	-	-23.0 (70)	-21.0 (90)	-	
Output Noise	V_{NO1}	Rg=0Ω A-Weighted	0	0	L R	Bypass	-	-	-	-112 (2.5)	-106 (5.0)	dBV (μVrms)
	V_{NO2}	Rg=0Ω A-Weighted	0	0	L R	1SP	MAX	-	-	-100 (10)	-94 (20)	
	V_{NO3}	Rg=0Ω A-Weighted	0	0	L R	HP	-	MAX	-	-100 (10)	-94 (20)	
	V_{NO4}	Rg=0Ω A-Weighted	0	0	L	1SP	MAX	-	-	-100 (10)	-94 (20)	

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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		OUT PUT	MODE	SP VR	HP VR				
			L	R								
Total Harmonic Distortion	THD1	f=1kHz	V$_{IN}$ 0	0 V$_{IN}$	L R	Bypass	-	-	-	0.02	0.05	%
	THD2	f=1kHz	V$_{IN}$ 0	0 V$_{IN}$	L R	2SP	MAX	-	-	0.1	0.5	
	THD3	f=1kHz	V$_{IN}$ 0	0 V$_{IN}$	L R	HP	-	MAX	-	0.1	0.5	
	THD4	f=1kHz	V$_{IN}$ 0	0 V$_{IN}$	L R	1SP	MAX	-	-	0.1	0.5	
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$_{VSUR1}$	f=100Hz	V$_{IN}$ 0	0 V$_{IN}$	L R	2SP	MAX	-	12.5	14.5	16.5	dB
	G$_{VSUR2}$	f=100Hz	V$_{IN}$ 0	0 V$_{IN}$	L R	2SP	MIN	-	0.5	2.5	4.5	
	G$_{VSUR3}$	f=100Hz	V$_{IN}$ 0	0 V$_{IN}$	L R	HP	-	MAX	12.5	14.5	16.5	
	G$_{VSUR4}$	f=100Hz	V$_{IN}$ 0	0 V$_{IN}$	L R	HP	-	MIN	0.5	2.5	4.5	
	G$_{VSUR5}$	f=100Hz	V$_{IN}$	0	L	1SP	MAX	-	6.5	8.5	10.5	
	G$_{VSUR6}$	f=100Hz	0	V$_{IN}$	L	1SP	MAX	-	2.0	4.0	6.0	
	G$_{VSUR7}$	f=100Hz	V$_{IN}$	0	L	1SP	MIN	-	-5.5	-3.5	-1.5	
	G$_{VSUR8}$	f=100Hz	0	V$_{IN}$	L	1SP	MIN	-	-12.0	-10.0	-8.0	

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

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
MODE Select Control Voltage	V$_{MODE}$	V$_{IN}$=High Level	1.2	-	V$^+$	V
		V$_{IN}$=Low Level	0.0	-	0.3	

■ SWITCH FUNCTION

SURROUND FUNCTION SW

MODE	SW1	SW2	NOTES
Bypass	L, OPEN	L, OPEN	Input Through
2SP mode	L, OPEN	H	Surround mode for narrow space two speakers
HP mode	H	L, OPEN	Surround mode for Headphone
1SP mode	H	H	Surround mode for monaural speaker (Surround signal from LOUT)

STANDBY SW

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

■**TERMINAL DESCRIPTION**

PIN No.		SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	Voltage
FFP16	SSOP16				
1 2	5 6	LIN RIN	Lch Input Rch Input		1.15V
3 4 9	4 3 14	LOUT ROUT LMON	Lch Output Rch Output Filter terminal		1.15V
5 6 7 8	2 1 16 15	NFSPR NFHPR NFSPL NFHPL	Filter terminal Filter terminal Filter terminal Filter terminal		1.15V
10	13	PS	Filter terminal		1.15V

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■**TERMINAL DESCRIPTION**

PIN No.		SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	Voltage
FFP16	SSOP16				
11 12	12 11	SW2 SW1	Mode control switch Mode control switch	(circuit: V+ diodes, 700, 25k, 275k, 3p, transistors)	0V
13	10	STBY	Standby switch	(circuit: V+ diodes, 700, 75k, 225k, 3p, transistor)	0V
14	9	V+	Power Supply	——	V+
15	8	GND	GND	——	0V
16	7	VREF	Reference voltage	(circuit: V+, 300k, 300k, 400, 400, 6p, 6p, transistors)	1.15V

■APPLICATION CIRCUIT (FFP16)

1) 2SP mode, HP mode
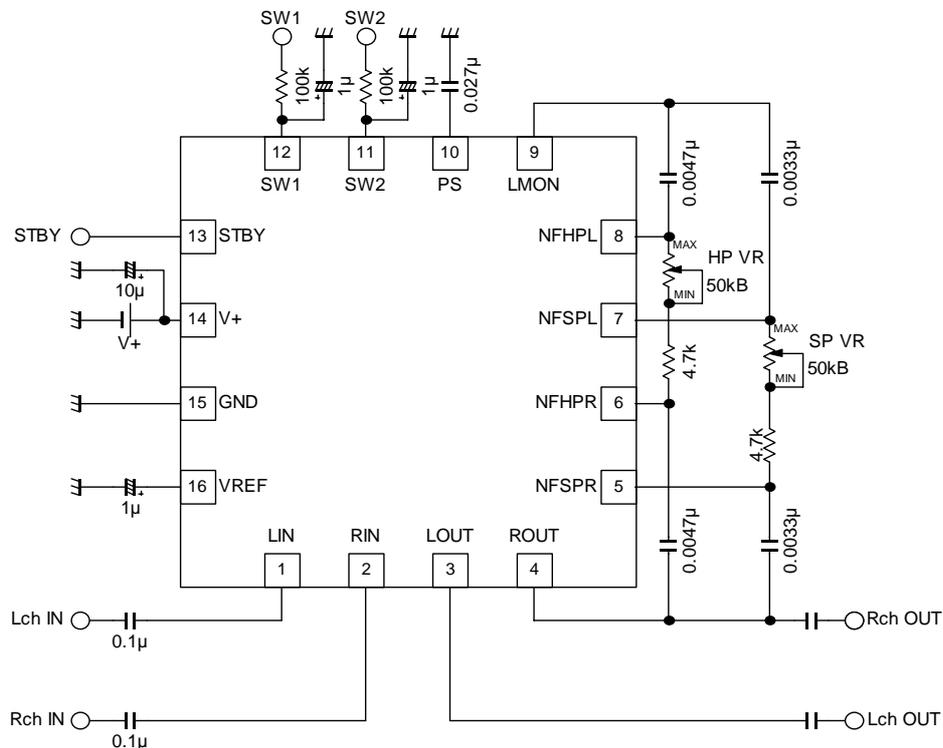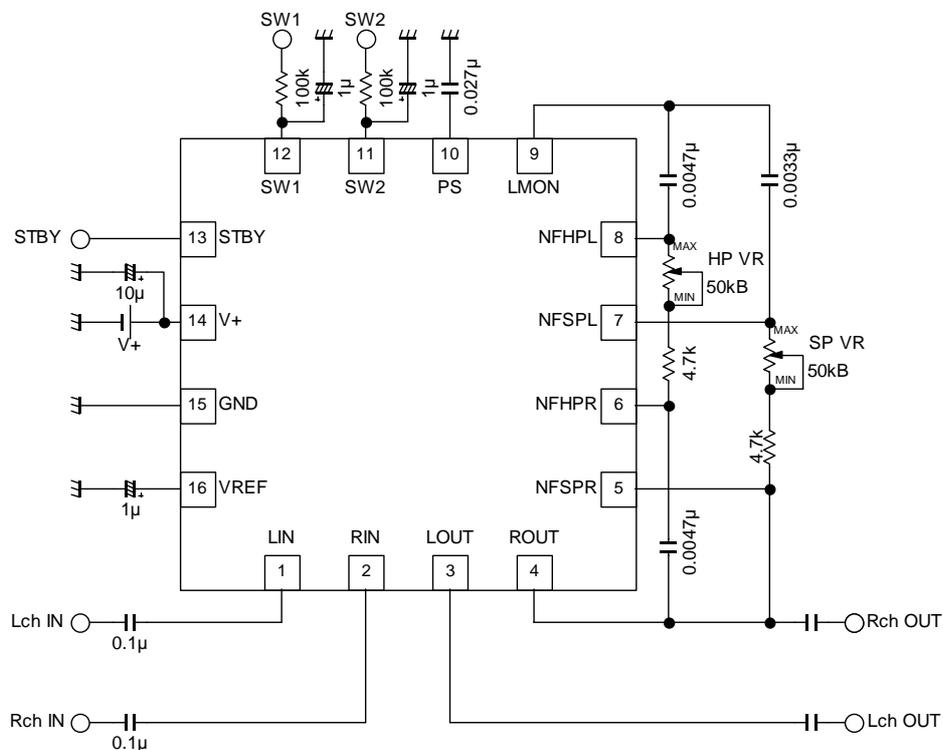
2) 1SP mode, HP mode

Surround signal is outputted from LOUT terminal at 1SP mode.

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■APPLICATION CIRCUIT (SSOP16)

1) 2SP mode, HP mode
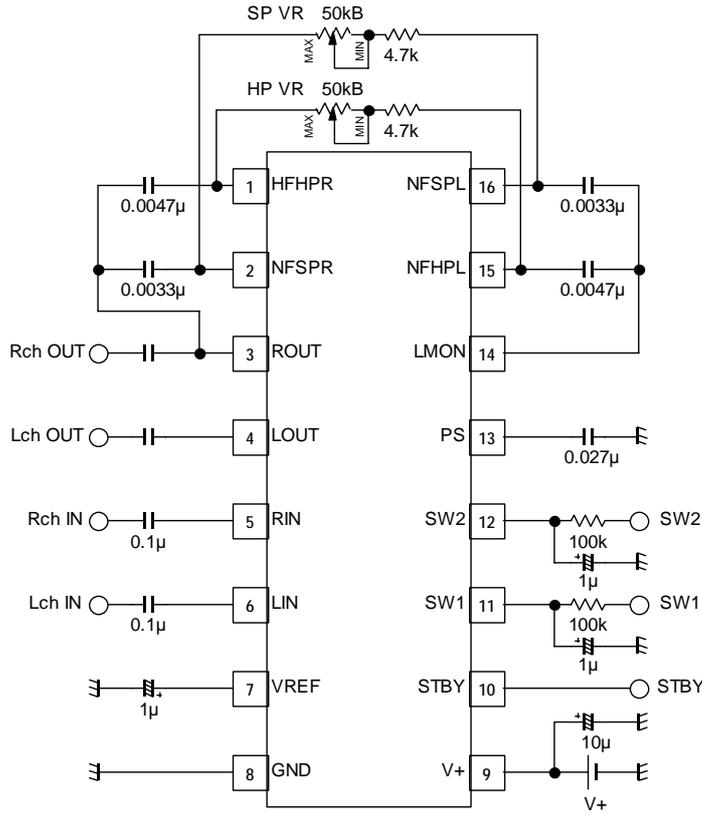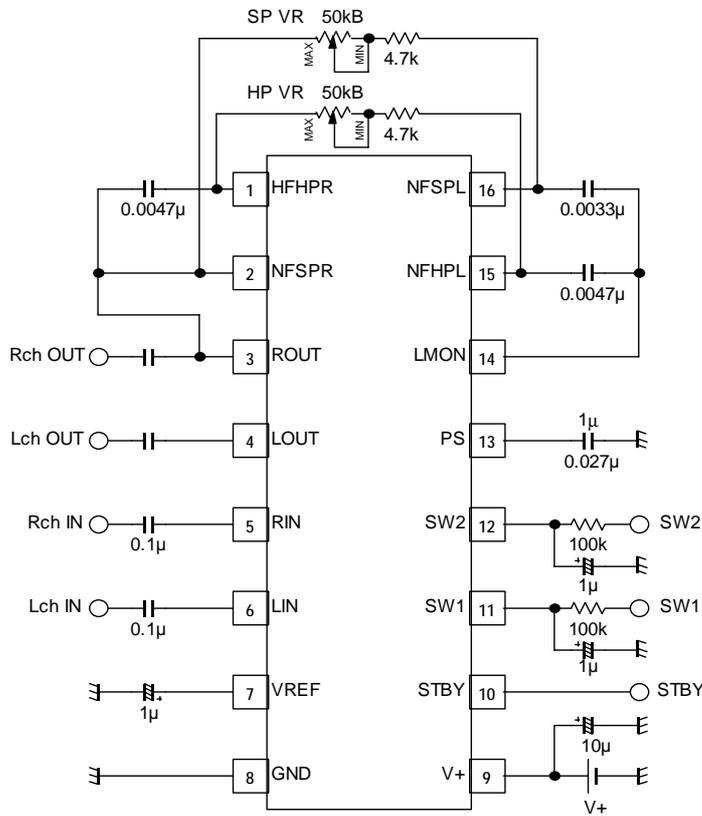
2) 1SP mode, HP mode

Surround signal is outputted from LOUT terminal at 1SP mode.

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Operating Current vs. Operating Voltage (STANDBY)

Ta=25°C
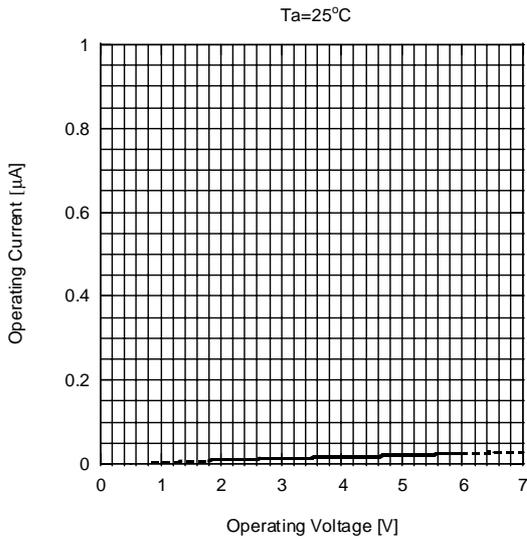
Operating Current vs. Temperature (STANDBY)

V+=3V
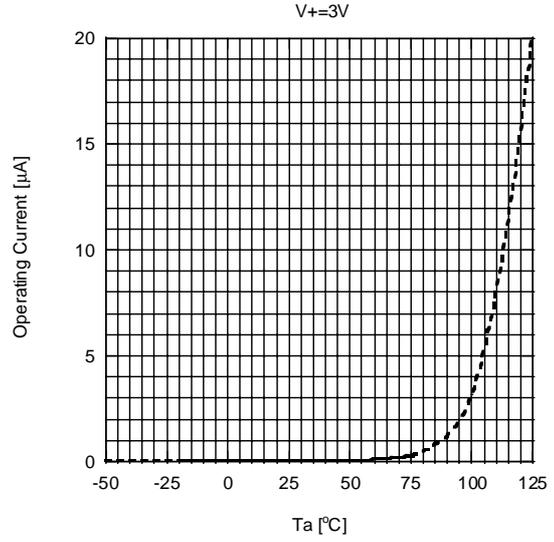
Operating Current vs. Operating Voltage (ACTIVE)

Ta=25°C

Bypass,2SP,HP,1SP mode
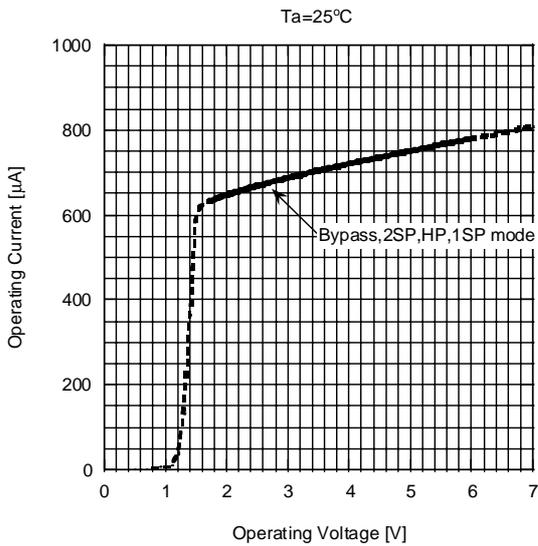
Operating Current vs. Temperature (ACTIVE)

V+=3V

Bypass,2SP,HP,1SP mode
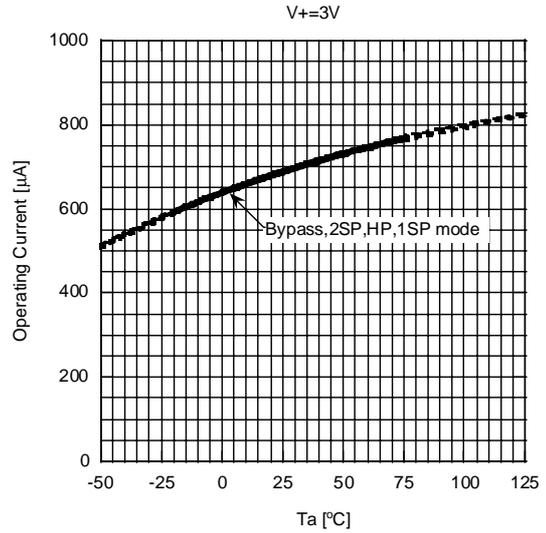
Reference Voltage vs. Operating Voltage

Ta=25°C
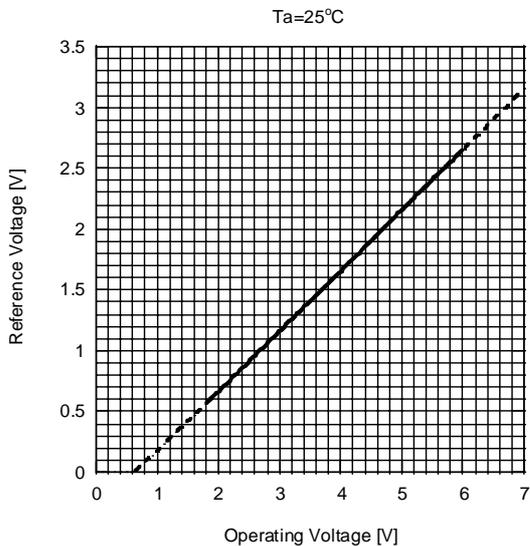
Reference Voltage vs. Temperature

V+=3V

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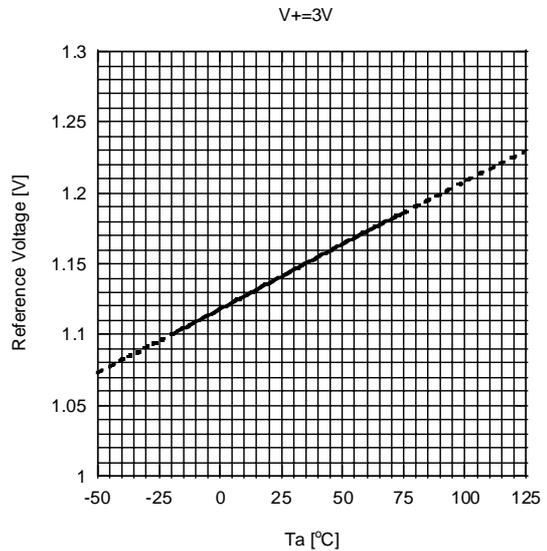
■TYPICAL CHARACTERISTICS

Maximum Input Voltage vs. Operating Voltage (BYPASS)
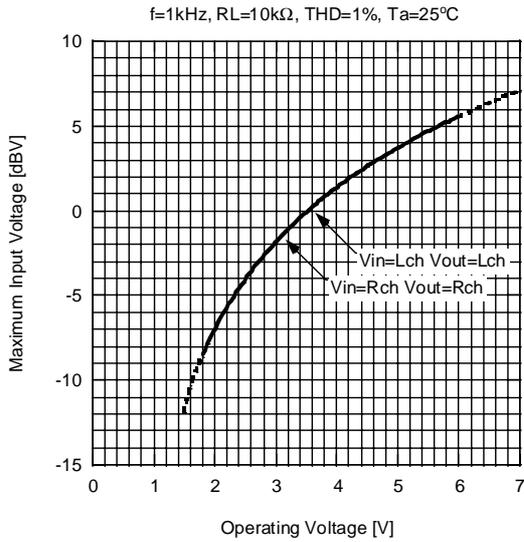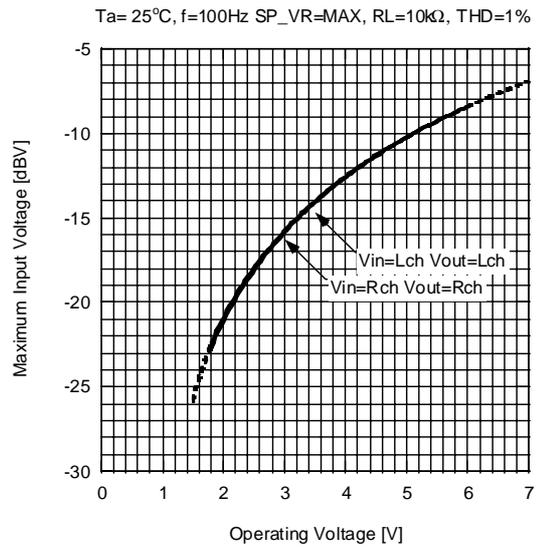
f=1kHz, RL=10kΩ, THD=1%, Ta=25°C

Vin=Lch Vout=Lch
Vin=Rch Vout=Rch

Maximum Input Voltage vs. Operating Voltage (2SP)

Ta= 25°C, f=100Hz SP_VR=MAX, RL=10kΩ, THD=1%

Vin=Lch Vout=Lch
Vin=Rch Vout=Rch

Maximum Input Voltage vs. Operating Voltage (HP)

Ta=25°C, f=100Hz, HP_VR=MAX, RL=10kΩ,THD=1%

Vin=Lch Vout=Lch
Vin=Rch Vout=Rch

Maximum Input Voltage vs. Temperature (1SP)

Ta= 25°C, f=100Hz, SP_VR=MAX, RL=10kΩ, THD=1%

Vin=Lch Vout=Lch
Vin=Rch Vout=Lch
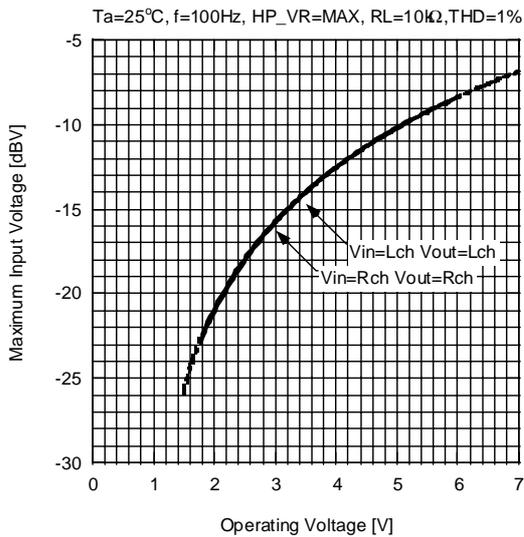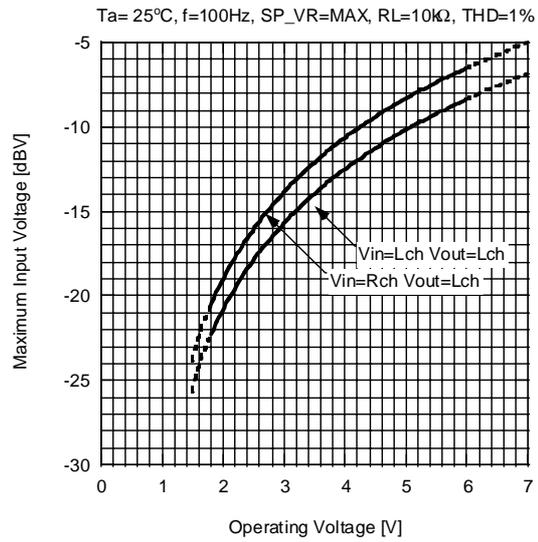
Maximum Input Voltage vs. Temperature (BYPASS)
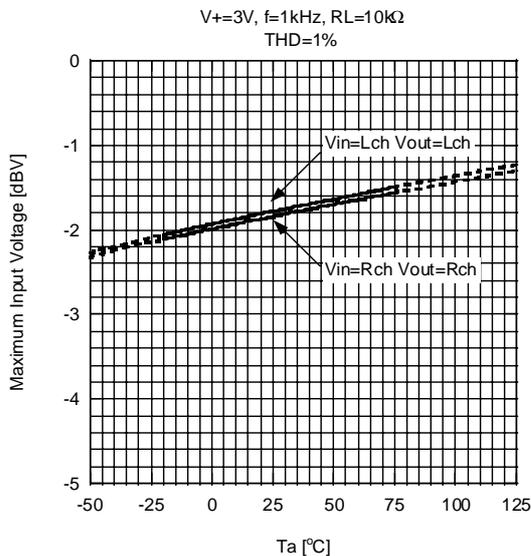
V+=3V, f=1kHz, RL=10kΩ
THD=1%

Vin=Lch Vout=Lch
Vin=Rch Vout=Rch

Maximum Input Voltage vs. Temperature (2SP)

V+=3V, f=100Hz, RL=10kΩ
SP_VR=MAX, THD=1%

Vin=Lch Vout=Lch
Vin=Rch Vout=Rch

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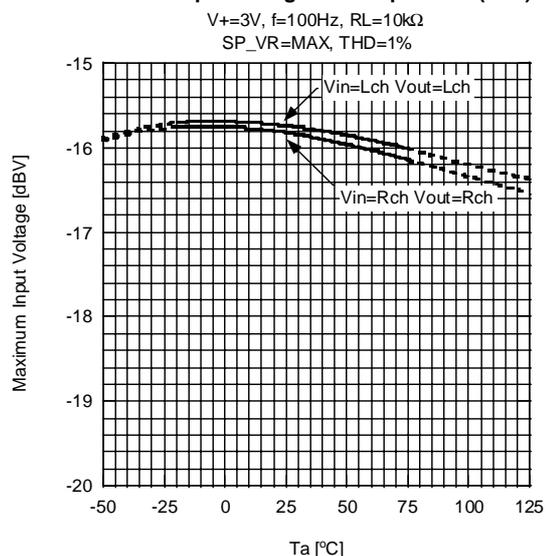
■**TYPICAL CHARACTERISTICS**

Maximum Input Voltage vs. Temperrature (HP)

V+=3V, f=100Hz, RL=10kΩ
HP_VR=MAX, THD=1%
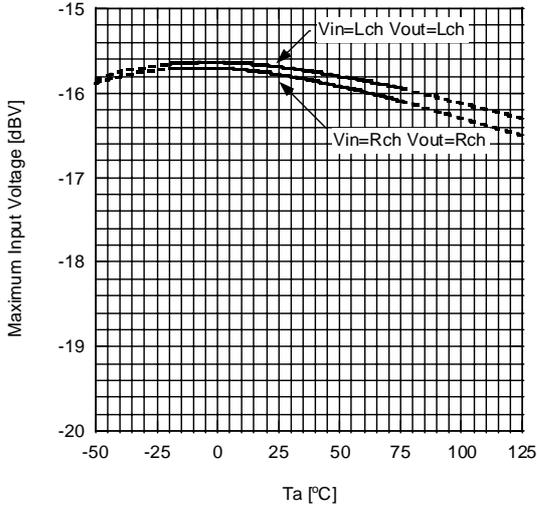
Maximum Input Voltage vs. Temperature (1SP)

V+=3V, f=100Hz, RL=10kΩ
SP_VR=MAX, THD=1%
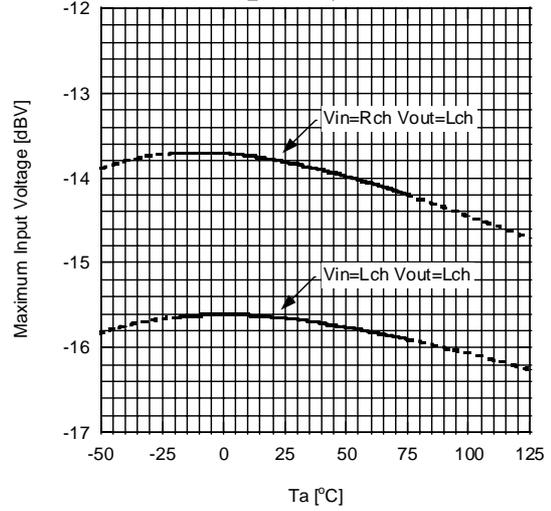
Output Noise Voltage vs. Temperature

V+=3V, Rg=0Ω, Vout=Lch
SP_VR=MAX, HP_VR=MAX, FILTER=A-Weighted
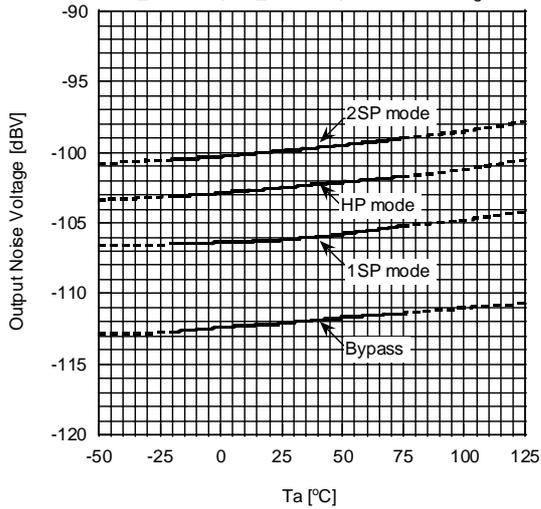
Output Noise Voltage vs. Temperature

V+=3V, Rg=0Ω, Vout=Rch
SP_VR=MAX, HP_VR=MAX, FILTER=A-Weighted
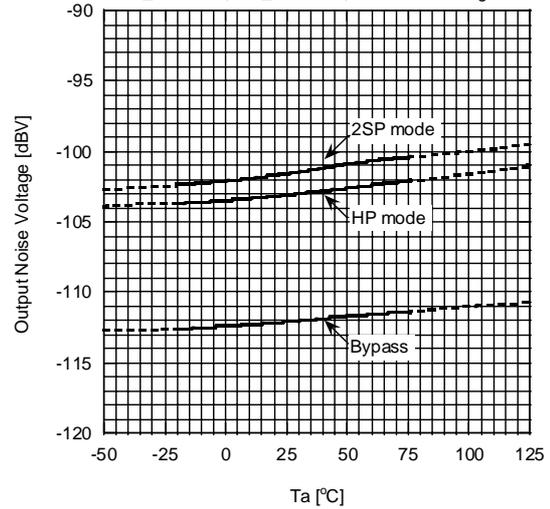
Total Harmonic Distortion vs. Input Voltage (BYPASS)

V+=3V, Vin=Lch, f=1kHz, Vout=Lch
RL=10kΩ, BW=10Hz-80kHz
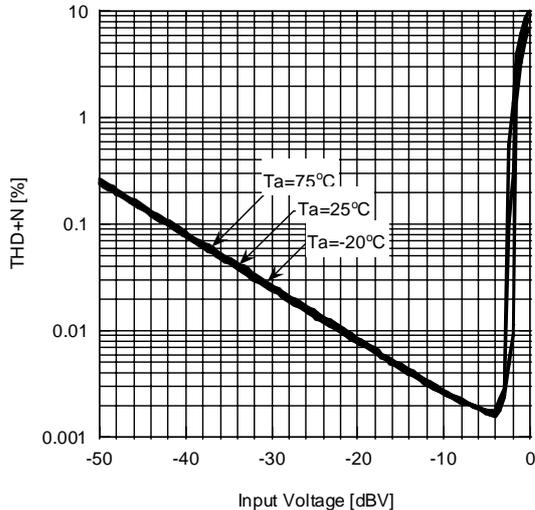
Total Harmonic Distortion vs. Input Voltage (2SP)

V+=3V, Vin=Lch, f=100Hz, Vout=Lch
RL=10kΩ, BW=10Hz-80kHz, SP_VR=MAX

NJM2705
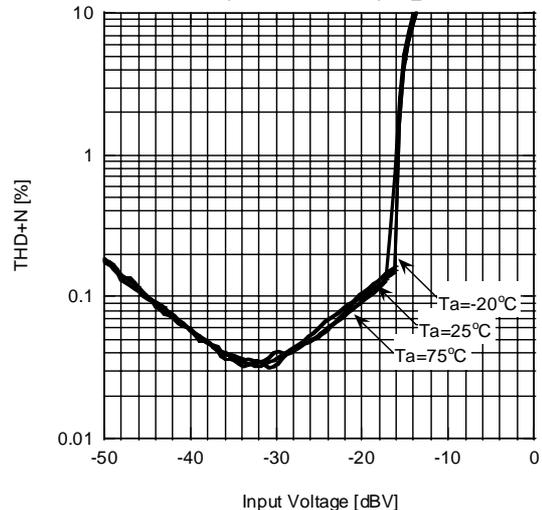
■TYPICAL CHARACTERISTICS

Total Harmonic Distortion vs. Input Voltage (HP)

V+=3V, Vin=Lch, f=100Hz, Vout=Lch
RL=10kΩ, BW=10Hz-80kHz, HP_VR=MAX

THD+N [%] vs Input Voltage [dBV]

Ta=-20°C
Ta=25°C
Ta=75°C

Total Harmonic Distortion vs. Input Voltage (1SP)

V+=3V, Vin=Lch, f=100Hz, Vout=Lch
RL=10kΩ, BW=10Hz-80kHz, SP_VR=MAX

THD+N [%] vs Input Voltage [dBV]

Ta=-20°C
Ta=25°C
Ta=75°C

Frequency Responce (BYPASS)

V+=3V, Vin=-20dBV Lch, Vout=Lch
RL=10kΩ, Rg=25Ω

Gain [dB] vs Frequency [Hz]

Ta=-20,25,75°C

Frequency Responce (2SP)

V+=3V, Vin=-20dBV Lch, Vout=Lch
RL=10kΩ, Rg=25Ω, SP_VR=MAX

Gain [dB] vs Frequency [Hz]

Ta=75°C
Ta=25°C
Ta=-20°C

Frequency Responce (2SP)

V+=3V, Vin=-20dBV Lch, Vout=Lch
RL=10kΩ, Rg=25Ω, SP_VR=MIN

Gain [dB] vs Frequency [Hz]

Ta=75°C
Ta=25°C
Ta=-20°C

Phase vs. Frequency (2SP)

V+=3V, Vin=-20dBV, Lch+Rch
RL=10kΩ, Rg=25Ω, SP_VR=MAX

Phase [dB] vs Frequency [Hz]

Ta=-20,25,75°C
Vout=Rch

Ta=-20,25,75°C
Vout=Lch

■TYPICAL CHARACTERISTICS

Frequency Responce (HP)

V+=3V, Vin=-20dBV Lch, Vout=Lch
RL=10kΩ, Rg=25Ω, HP_VR=MAX
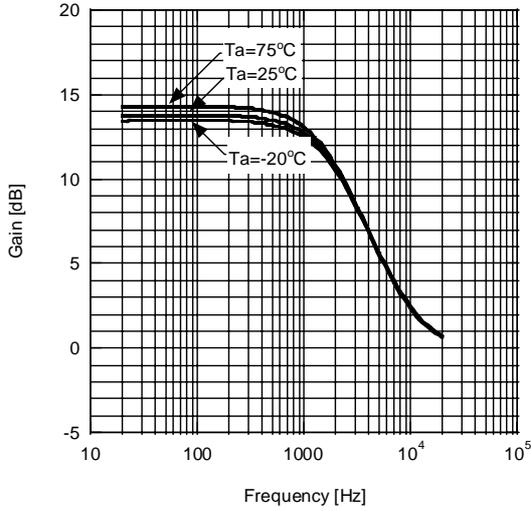
Frequency Responce (HP)

V+=3V, Vin=-20dBV Lch, Vout=Lch
RL=10kΩ, Rg=25Ω, HP_VR=MIN
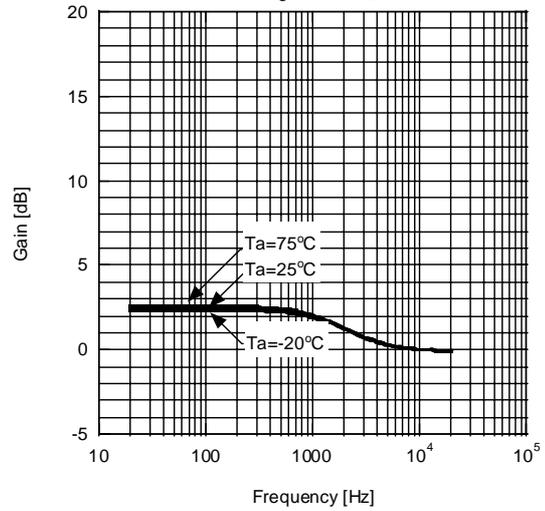
Frequency Responce (1SP)

V+=3V, Vin=-20dBV, Vout=Lch
RL=10kΩ, Rg=25Ω, SP_VR=MAX

Frequency Responce (1SP)

V+=3V, Vin=-20dBV, Vout=Lch
RL=10kΩ,Rg=25Ω, VR=MIN

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