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).

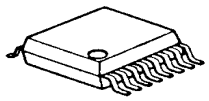
It includes mode control switches for surround function and standby function and realizes low consumption power design by standby function.

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

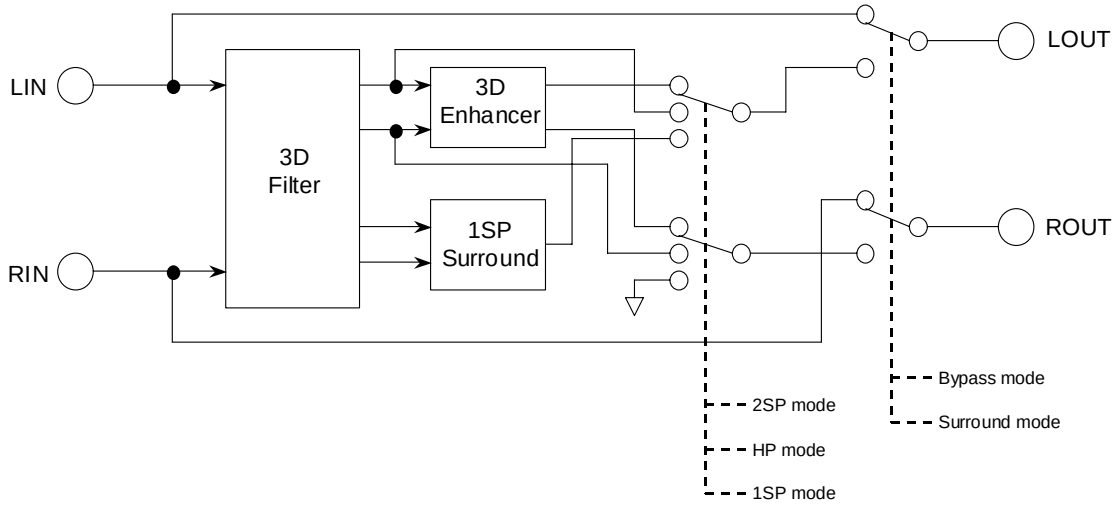


NJM2705V

■ FEATURES

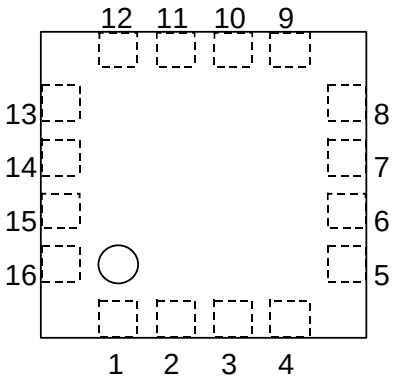
- Operating Voltage 1.8 to 6V
- Operating Current 0.7mA typ. at Active mode
  1μA max. at Standby mode
- Low Output Noise 10μVrms typ
  (2SP/HP/1SP mode, VR : max.)
- Variable Surround Effect by external resistor
  (Adjustable for speaker and headphone independently.)
- Standby Function
- Internal Mode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

■ BLOCK DIAGRAM



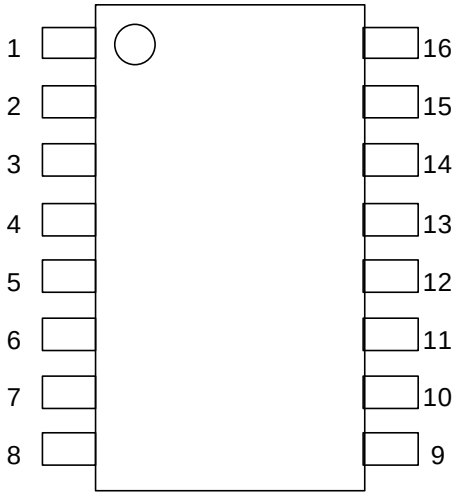
■ PIN CONFIGURATION

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	INPUT L	INPUT R	OUTPUT	MODE	SP VR	HP VR	MIN	TYP	MAX	UNIT
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	INPUT L	INPUT R	OUTPUT	MODE	SP VR	HP VR	MIN	TYP	MAX	UNIT
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)	

●AC CHARACTERISTICS

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

PARAMETER	SYMBOL	TEST CONDITION	INPUT L	INPUT R	OUTPUT	MODE	SP VR	HP VR	MIN	TYP	MAX	UNIT
Total Harmonic Distortion	THD1	f=1kHz	V_{IN}	0	L	Bypass	-	-	-	0.02	0.05	%
			0	V_{IN}	R							
	THD2	f=1kHz	V_{IN}	0	L	2SP	MAX	-	-	0.1	0.5	
			0	V_{IN}	R							
	THD3	f=1kHz	V_{IN}	0	L	HP	-	MAX	-	0.1	0.5	
			0	V_{IN}	R							
	THD4	f=1kHz	V_{IN}	0	L	1SP	MAX	-	-	0.1	0.5	
			0	V_{IN}	R							
BYPASS Gain	G_{VBYP}	f=1kHz	V_{IN}	0	L	Bypass	-	-	-1.0	0.0	1.0	dB
			0	V_{IN}	R							
Surround Gain	G_{VSUR1}	f=100Hz	V_{IN}	0	L	2SP	MAX	-	12.5	14.5	16.5	dB
			0	V_{IN}	R							
	G_{VSUR2}	f=100Hz	V_{IN}	0	L	2SP	MIN	-	0.5	2.5	4.5	
			0	V_{IN}	R							
	G_{VSUR3}	f=100Hz	V_{IN}	0	L	HP	-	MAX	12.5	14.5	16.5	
			0	V_{IN}	R							
	G_{VSUR4}	f=100Hz	V_{IN}	0	L	HP	-	MIN	0.5	2.5	4.5	
			0	V_{IN}	R							
	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

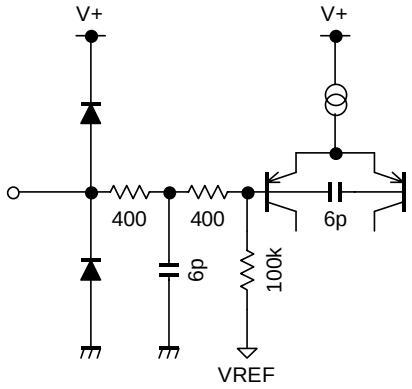
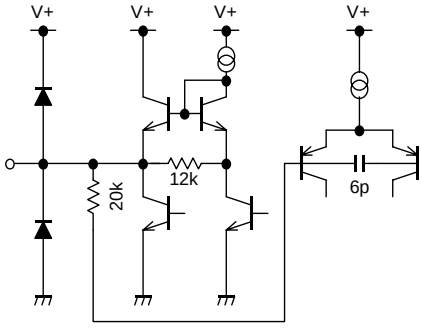
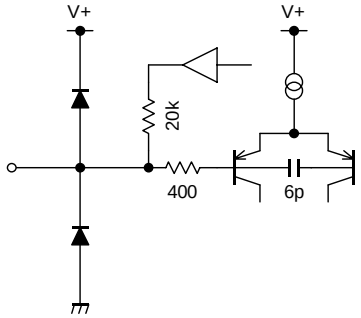
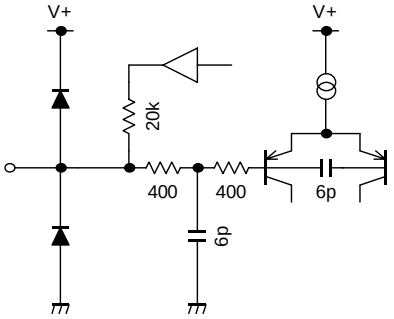
SURROUND FUNCTION SW

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)

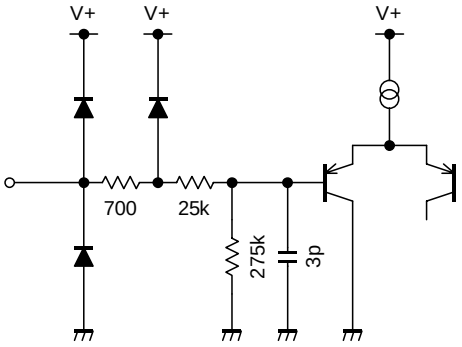
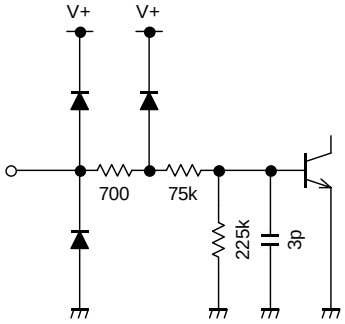
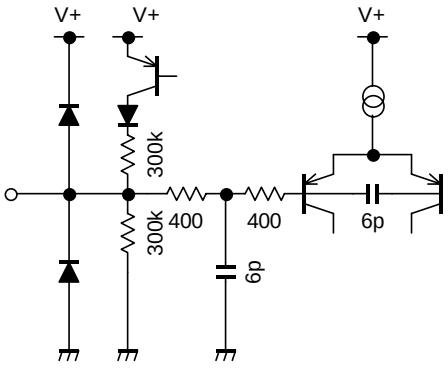
STANDBY SW

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

■TERMINAL DESCRIPTION

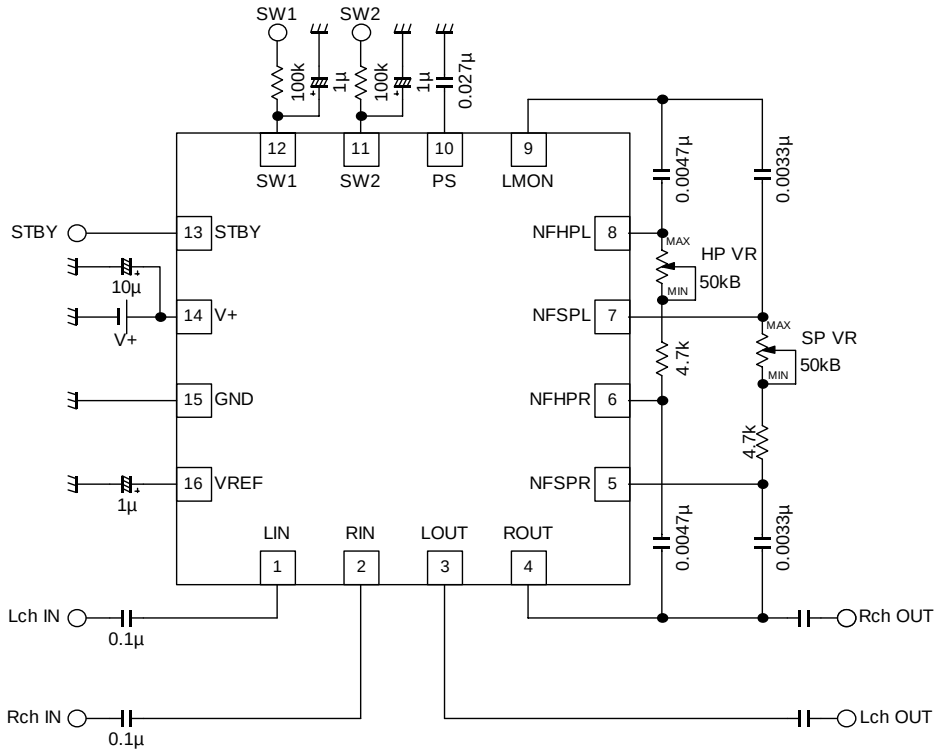
PIN No. FFP16	PIN No. SSOP16	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	Voltage
1 2	5 6	LIN RIN	Lch Input Rch Input		1.15V
3 4 9	4 3 14	LOUT ROUT LMON	Lch Output Rch Output Filter terminal		1.15V
5 6 7 8	2 1 16 15	NFSPR NFHPR NFSPL NFHPL	Filter terminal Filter terminal Filter terminal Filter terminal		1.15V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

■TERMINAL DESCRIPTION

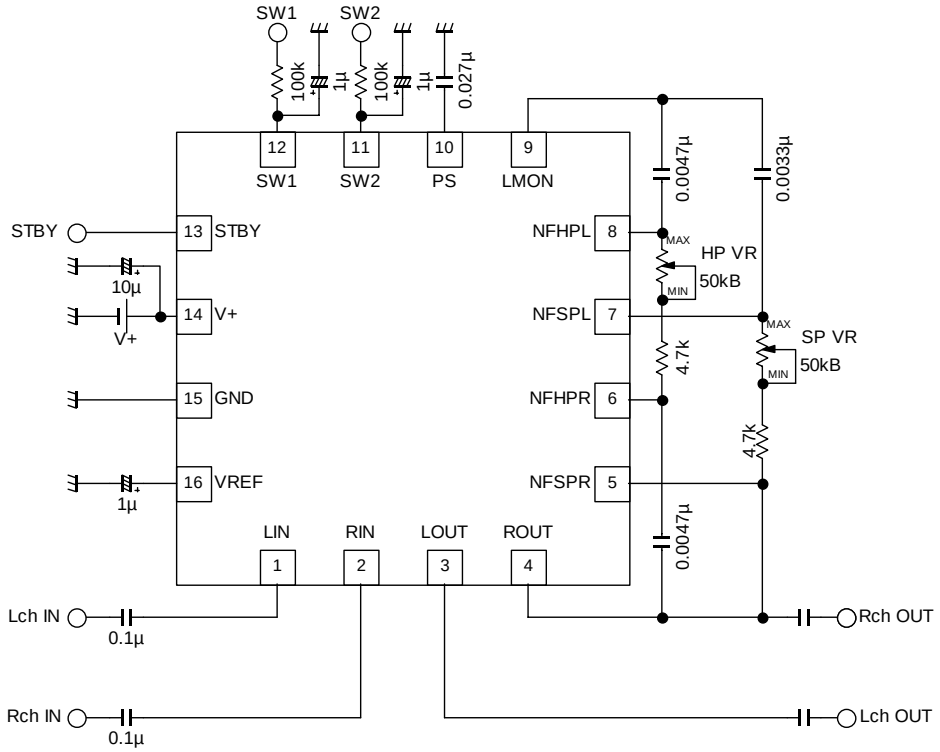
PIN No. FFP16	PIN No. SSOP16	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	Voltage
11 12	12 11	SW2 SW1	Mode control switch Mode control switch		0V
13	10	STBY	Standby switch		0V
14	9	V+	Power Supply	———	V+
15	8	GND	GND	———	0V
16	7	VREF	Reference voltage		1.15V

■APPLICATION CIRCUIT (FFP16)

1) 2SP mode, HP mode



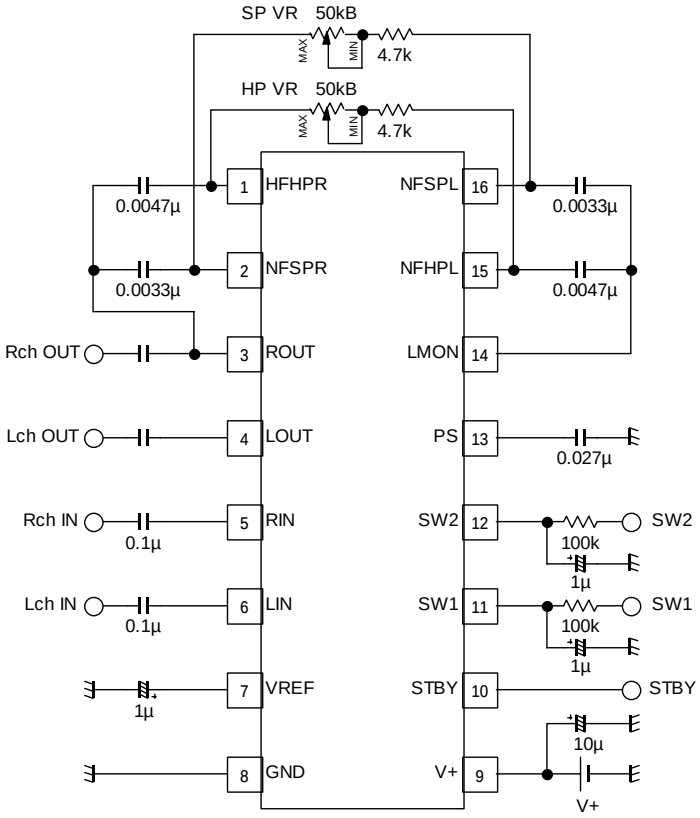
2) 1SP mode, HP mode



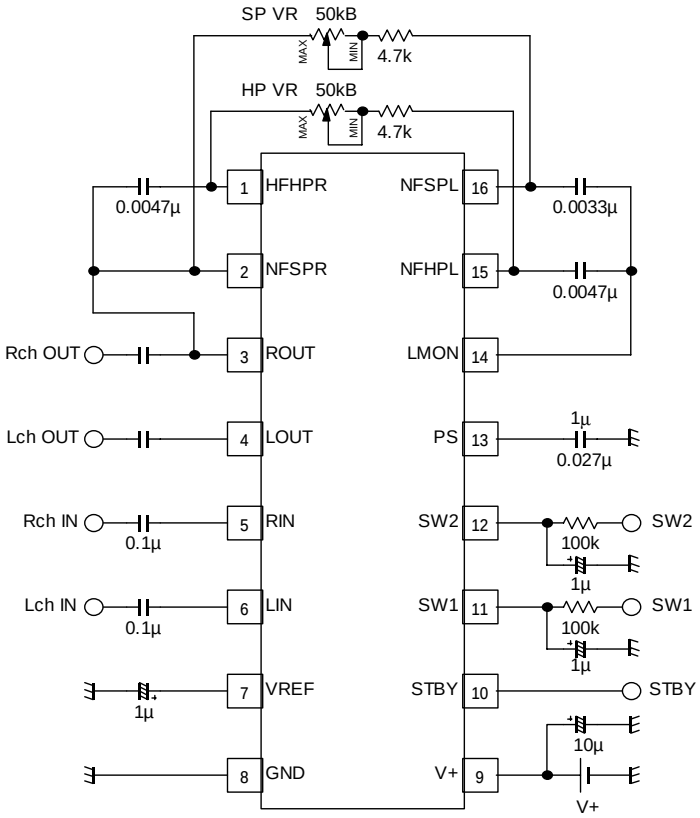
Surround signal is outputted from LOUT terminal at 1SP mode.

■APPLICATION CIRCUIT (SSOP16)

1) 2SP mode, HP mode



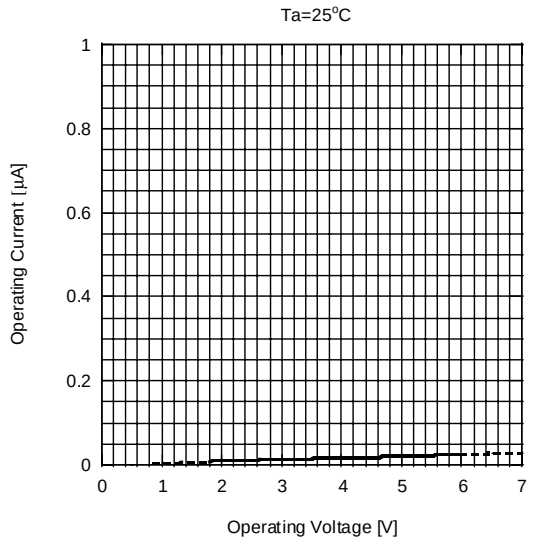
2) 1SP mode, HP mode



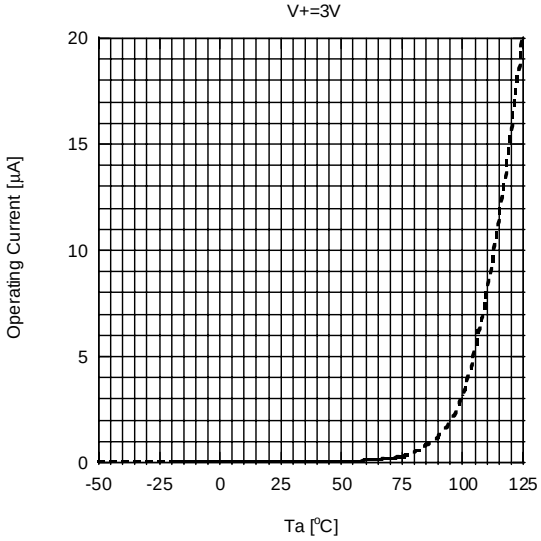
Surround signal is outputted from LOUT terminal at 1SP mode.

■TYPICAL CHARACTERISTICS

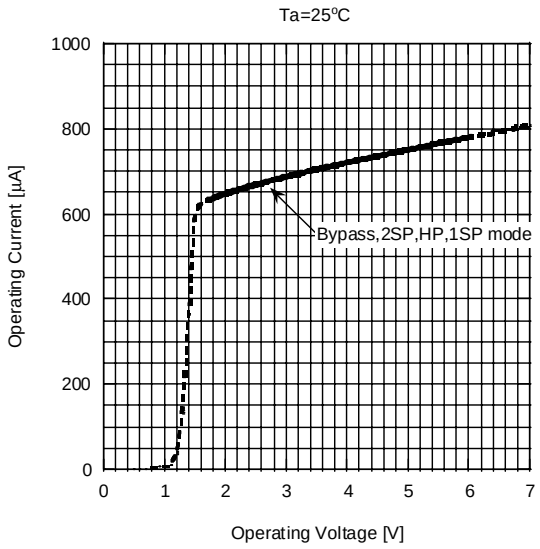
Operating Current vs. Operating Voltage (STANDBY)



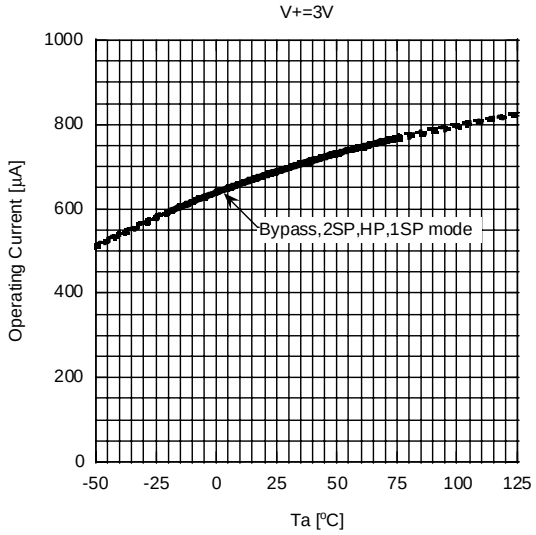
Operating Current vs. Temperature (STANDBY)



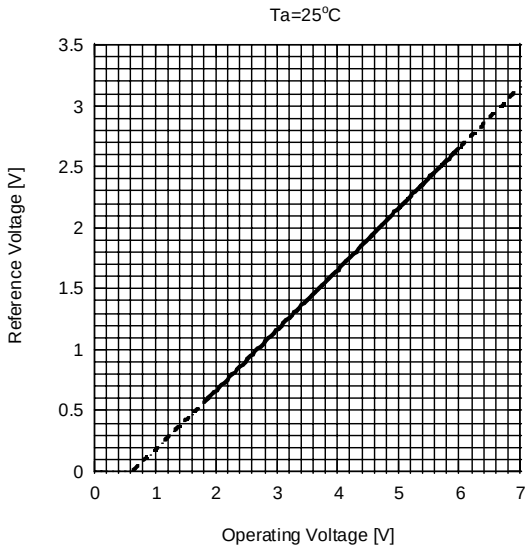
Operating Current vs. Operating Voltage (ACTIVE)



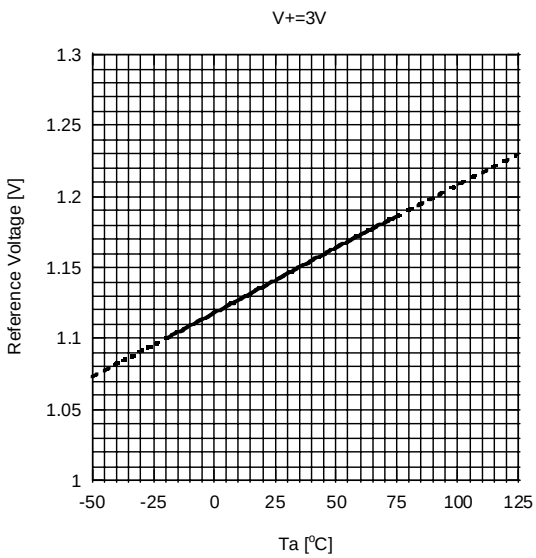
Operating Current vs. Temperature (ACTIVE)



Reference Voltage vs. Operating Voltage



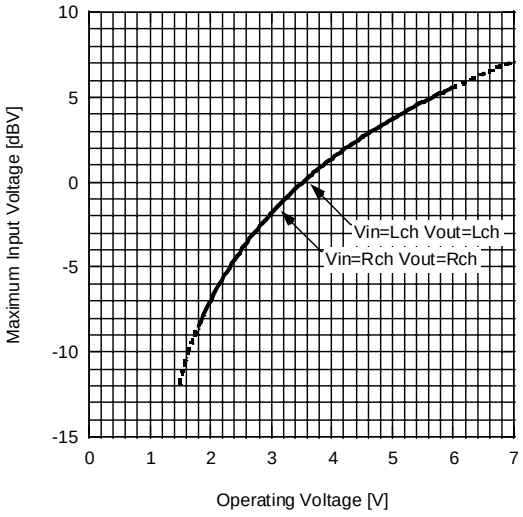
Reference Voltage vs. Temperature



■TYPICAL CHARACTERISTICS

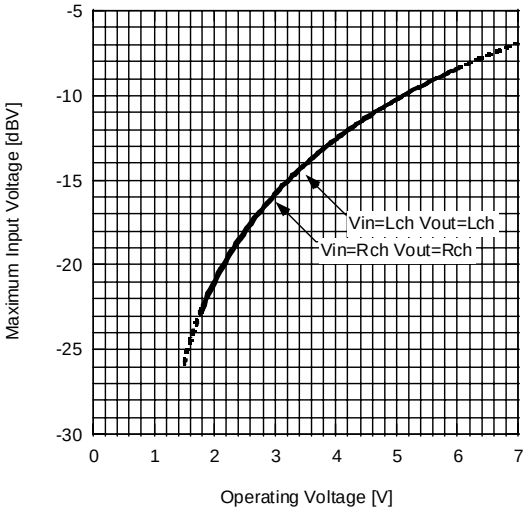
Maximum Input Voltage vs. Operating Voltage (BYPASS)

f=1kHz, RL=10kΩ, THD=1%, Ta=25°C



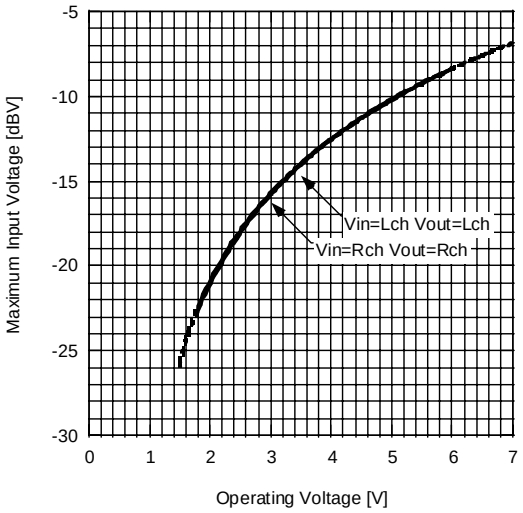
Maximum Input Voltage vs. Operating Voltage (2SP)

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



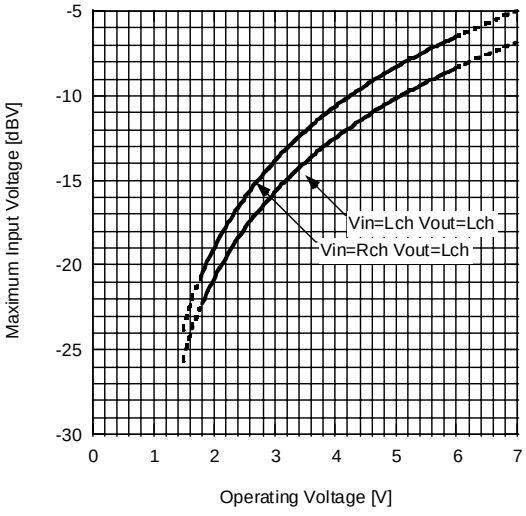
Maximum Input Voltage vs. Operating Voltage (HP)

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



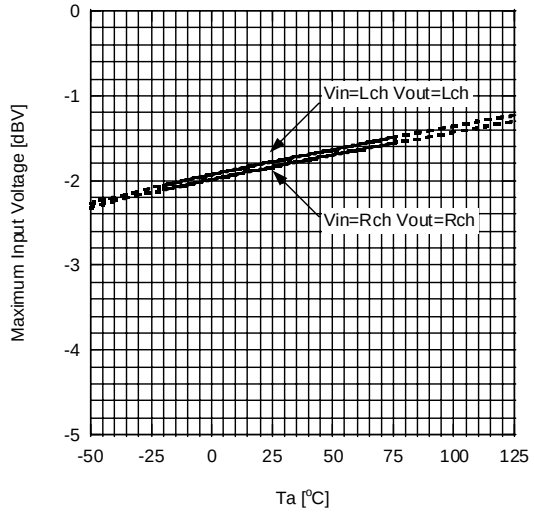
Maximum Input Voltage vs. Temperature (1SP)

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



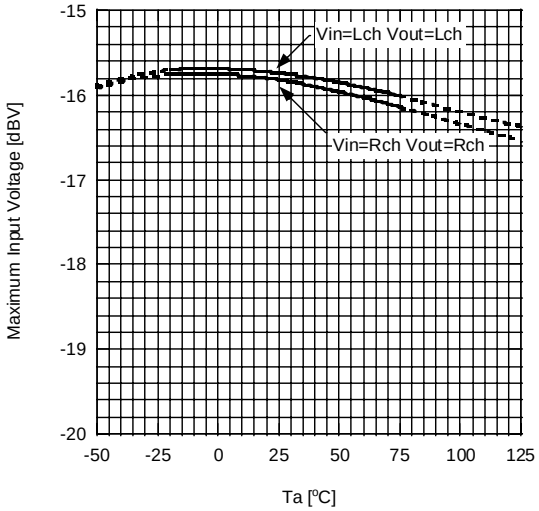
Maximum Input Voltage vs. Temperature (BYPASS)

V+=3V, f=1kHz, RL=10kΩ
THD=1%



Maximum Input Voltage vs. Temperature (2SP)

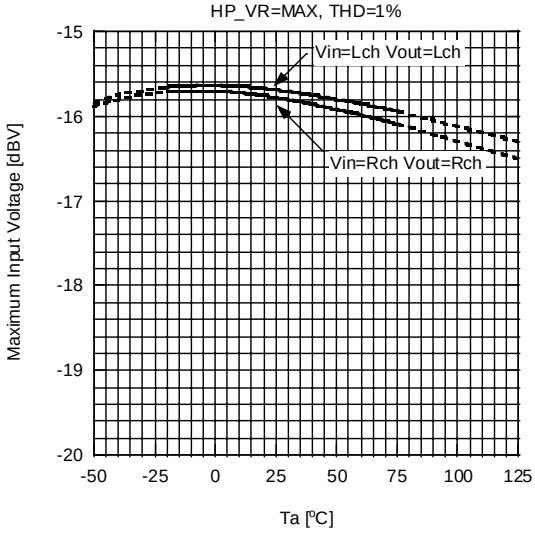
V+=3V, f=100Hz, RL=10kΩ
SP_VR=MAX, THD=1%



■TYPICAL CHARACTERISTICS

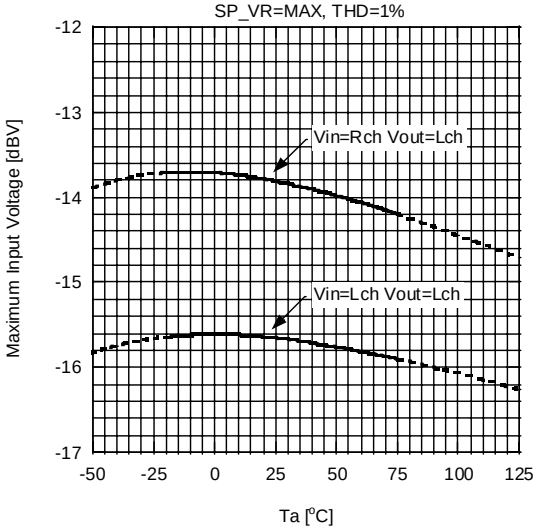
Maximum Input Voltage vs. Temperrature (HP)

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



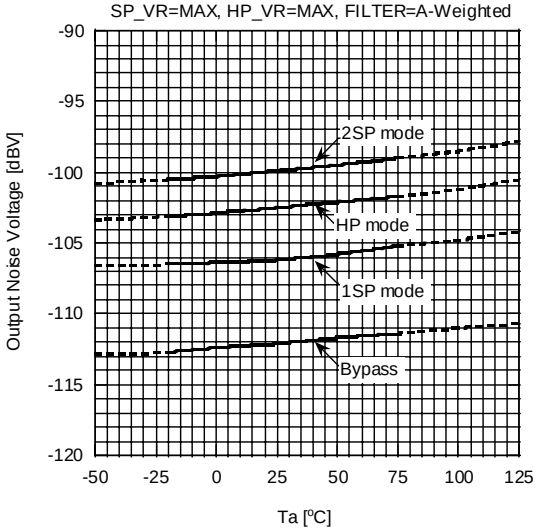
Maximum Input Voltage vs. Temperature (1SP)

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



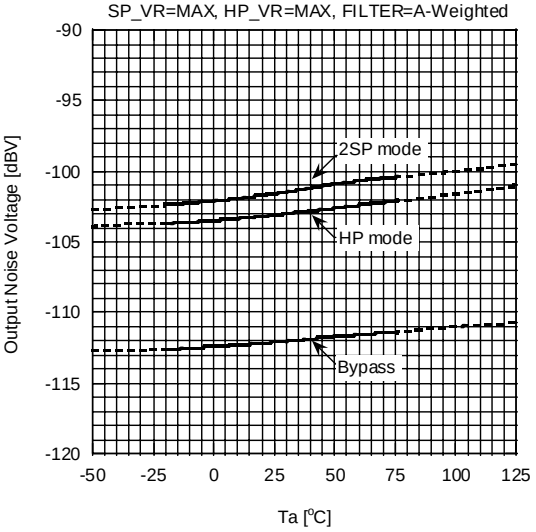
Output Noise Voltage vs. Temperature

V+=3V, Rg=0Ω, Vout=Lch
SP_VR=MAX, HP_VR=MAX, FILTER=A-Weighted



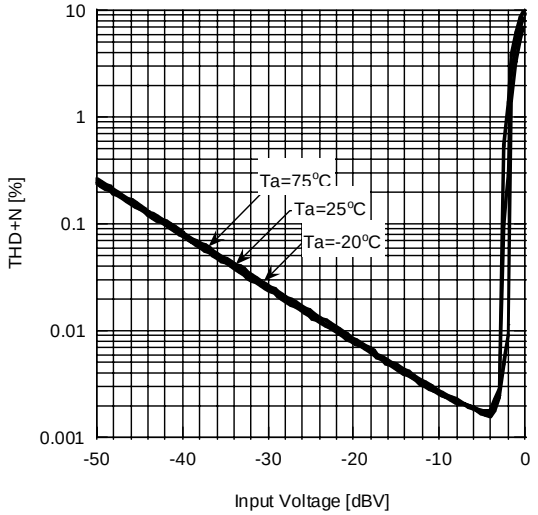
Output Noise Voltage vs. Temperature

V+=3V, Rg=0Ω, Vout=Rch
SP_VR=MAX, HP_VR=MAX, FILTER=A-Weighted



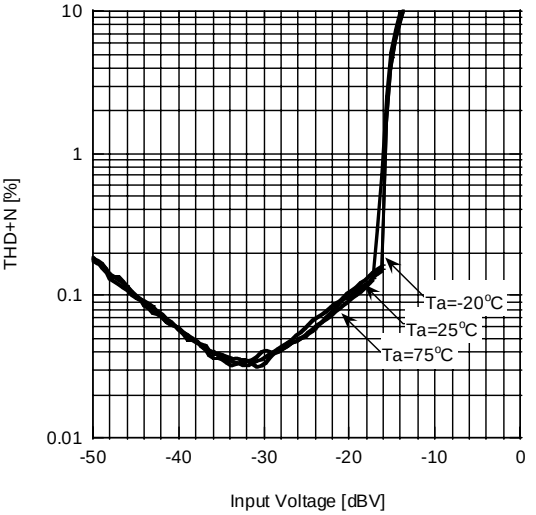
Total Harmonic Distortion vs. Input Voltage (BYPASS)

V+=3V, Vin=Lch, f=1kHz, Vout=Lch
RL=10kΩ, BW=10Hz-80kHz



Total Harmonic Distortion vs. Input Voltage (2SP)

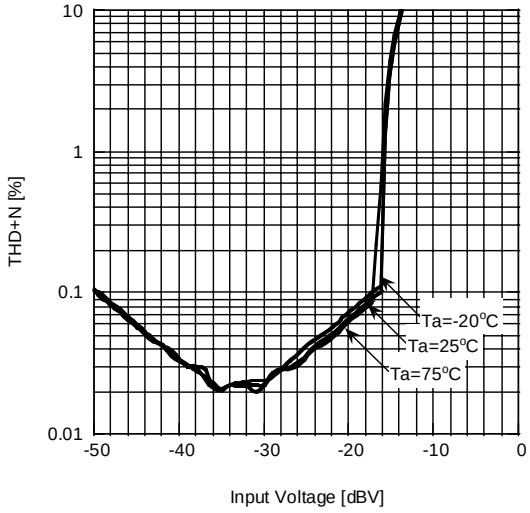
V+=3V, Vin=Lch, f=100Hz, Vout=Lch
RL=10kΩ, BW=10Hz-80kHz, SP_VR=MAX



■TYPICAL CHARACTERISTICS

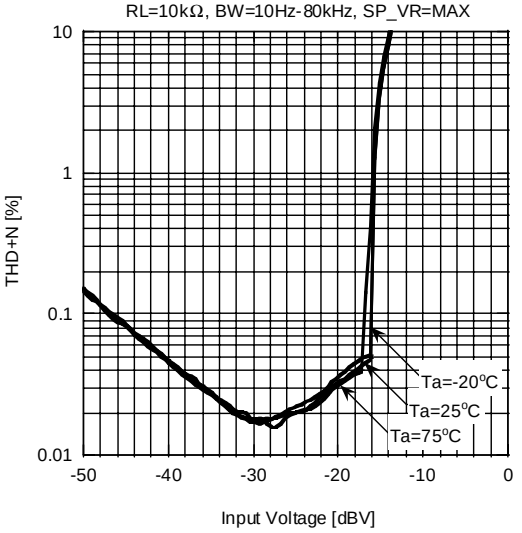
Total Harmonic Distortion vs. Input Voltage (HP)

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



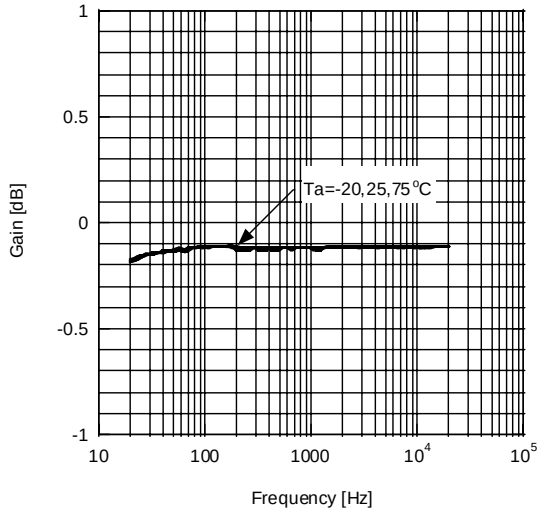
Total Harmonic Distortion vs. Input Voltage (1SP)

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



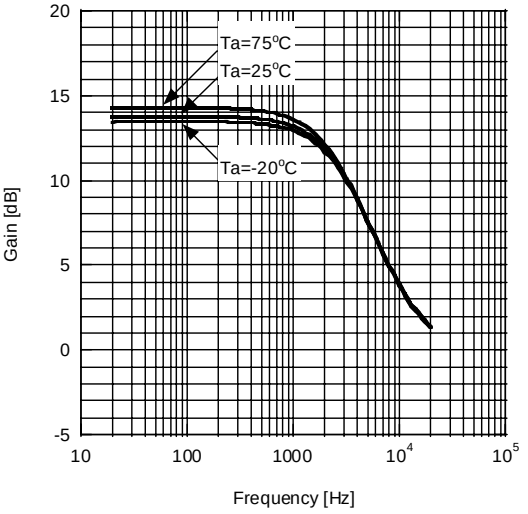
Frequency Responce (BYPASS)

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



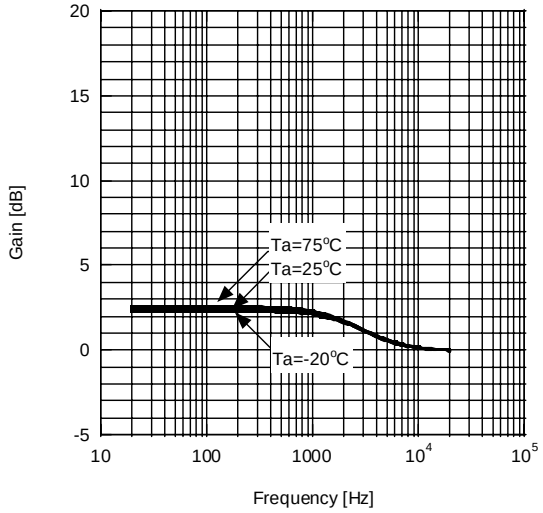
Frequency Responce (2SP)

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



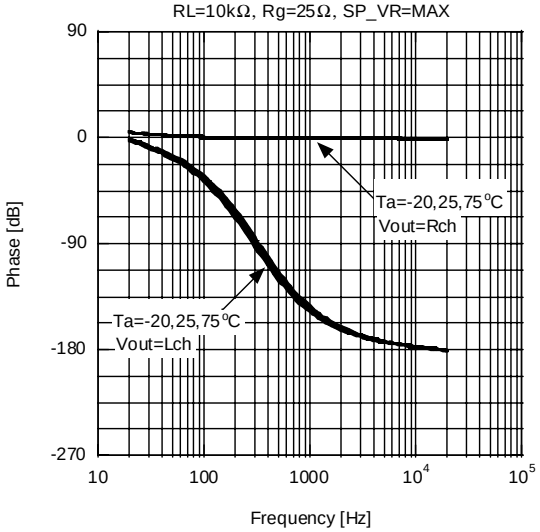
Frequency Responce (2SP)

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



Phase vs. Frequency (2SP)

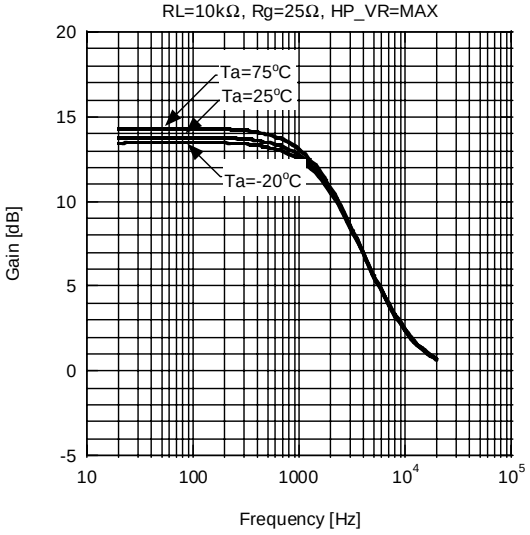
V+=3V, Vin=-20dBV, Lch+Rch
RL=10kΩ, Rg=25Ω, SP_VR=MAX



■TYPICAL CHARACTERISTICS

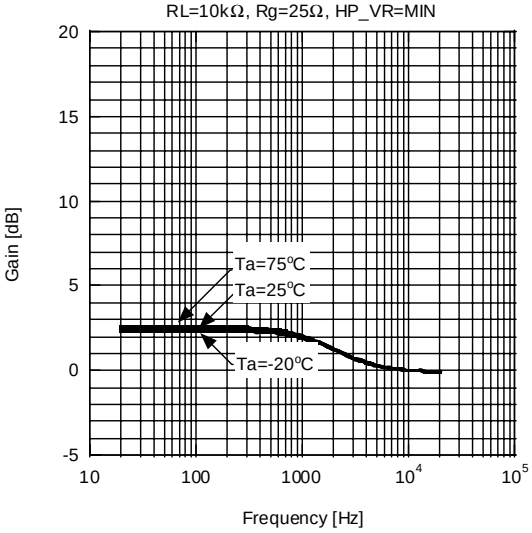
Frequency Responce (HP)

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



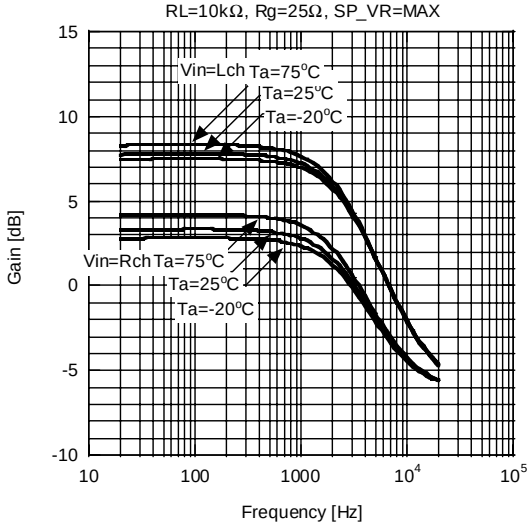
Frequency Responce (HP)

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