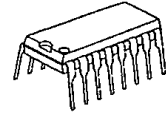# (●)HEADPHONE
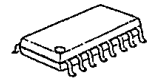## SRS Headphone 3D SURROUND PROCESSOR

■GENERAL DESCRIPTION

The NJM2190 is a headphone surround processor based on SRS technology. It provides a realistic and spacious listening experience through standard headphones.

The features of low operating voltage, low output noise, and low operating current are very suitable for portable audio applications.
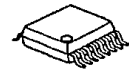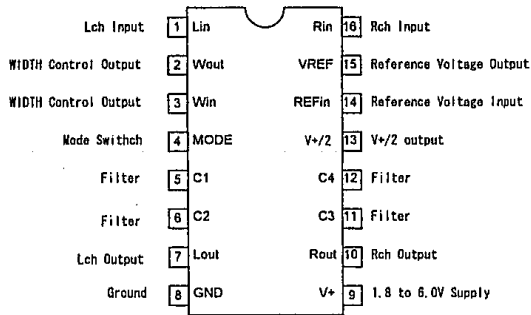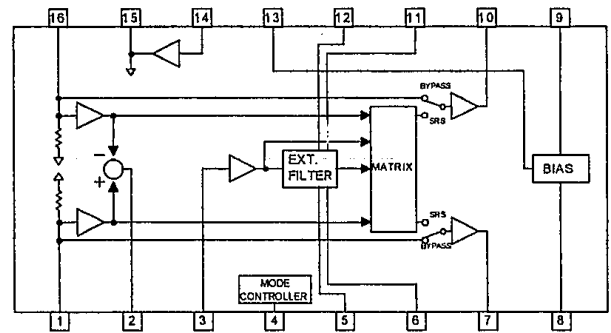
■FEATURES

- ●Operating Voltage   (1.8 to 6.0V)
- ●Low Operating Current   (1.3mA typ. at SRS mode)
- ●Low Output Noise   (12.0 μ Vrms typ. at SRS mode)
- ●WIDTH Control
- ●Bipolar Technology
- ●Package Outline   DIP16, DMP16, SSOP16

■PACKAGE OUTLINE

NJM2190D

NJM2190M

NJM2190V

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■PIN CONFIGURATION

Lch Input	1	Lin	Rin	16	Rch Input
WIDTH Control Output	2	Wout	VREF	15	Reference Voltage Output
WIDTH Control Output	3	Win	REFin	14	Reference Voltage Input
Mode Swithch	4	MODE	V+/2	13	V+/2 output
Filter	5	C1	C4	12	Filter
Filter	6	C2	C3	11	Filter
Lch Output	7	Lout	Rout	10	Rch Output
Ground	8	GND	V+	9	1.8 to 6.0V Supply

■BLOCK DIAGRAM

SRS Headphone is a trademark of SRS Labs, Inc. SRS and the SRS symbol are registered trademarks of SRS Labs, Inc. SRS Headphone technology is incorporated under license from SRS Labs, Inc., and protected under patents either issued or pending in selected countries worldwide.

For further information, please contact:
S R S   L a b s ,   I n c .
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Tel:714-442-1070 Fax:714-852-1099 http://www.srslabs.com

NJM2190

■ABSOLUTE MAXIMUM RATING (Ta=25℃)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V^+	7	V
Power Dissipation	P_D	(DIP16) 500 (DMP16) 300 (SSOP16) 300	mW
Operating Temperature Range	T_{opr}	-20 to +75	℃
Storage Temperature Range	T_{stg}	-40 to +125	℃

■ELECTRICAL CHARACTERISTICS (V^+=3V, V_{IN}=-26dBV(50mVrms), Ta=25℃, unless otherwise specified.)

PARAMETER	SYMBOL		INPUT L	INPUT R	OUTPUT	MODE	WIDTH VR(*1)	MIN	TYP	MAX	UNIT
Operating Voltage	V^+		–	–	–	–	–	1.8	3.0	6.0	V
Operating Current	I_{CC}	No Signal	0	0	–	BYPASS	–	–	0.7	1.0	mA
			0	0	–	SRS	MIN	–	1.3	1.8	
			0	0	–	SRS	MAX	–	1.3	1.8	
Reference Voltage	V_{REF}	V^+/2	–	–	–	–	–	1.3	1.5	1.7	V
Maximum Input Voltage	V_{IM}	f=1kHz THD=1%	V_{IN}	0	L	BYPASS	–	–	0.1 (1012)	–	dBV (mVrms)
			0	V_{IN}	R						
		f=100Hz THD=1%	V_{IN}	0	L	SRS	MIN	–	-11.8 (257)	–	
			0	V_{IN}	R						
		f=100Hz THD=1%	V_{IN}	0	L	SRS	MAX	–	-15.8 (162)	–	
			0	V_{IN}	R						
		V^+=1.8V f=1kHz THD=1%	V_{IN}	0	L	BYPASS	–	-6.7 (462)	-4.7 (582)	–	
			0	V_{IN}	R						
		V^+=1.8V f=100Hz THD=1%	V_{IN}	0	L	SRS	MIN	–	-16.7 (146)	–	
			0	V_{IN}	R						
		V^+=1.8V f=100Hz THD=1%	V_{IN}	0	L	SRS	MAX	-22.5 (75)	-20.5 (94)	–	
			0	V_{IN}	R						

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■ELECTRICAL CHARACTERISTICS (V⁺=3V, V_{IN}=−26dBV(50mVrms), Ta=25°C, unless otherwise specified.)

PARAMETER	SYMBOL		INPUT L	INPUT R	OUTPUT	MODE	WIDTH VR(*1)	MIN	TYP	MAX	UNIT
Maximum Input Voltage (*2)	V_{IM}	V⁺=1.8V f=1kHz THD=1%	V_{IN}	V_{IN}	L	SRS	MIN	–	−16.7 (146)	–	dBV (mVrms)
					R						
		V⁺=1.8V f=1kHz THD=1%	V_{IN}	V_{IN}	L	SRS	MAX	–	−16.7 (146)	–	
					R						
		V⁺=1.8V f=100Hz THD=1%	V_{IN}	−V_{IN}	L	SRS	MIN	–	−22.9 (72)	–	
					R						
		V⁺=1.8V f=100Hz THD=1%	V_{IN}	−V_{IN}	L	SRS	MAX	−28.5 (38)	−26.5 (47)	–	
					R						
Output Noise	V_{NO}		0	0	L	BYPASS	–	–	−110 (3.0)	−104 (6.0)	dBV (μVrms)
					R						
		Rg=0Ω A-Weighted	0	0	L	SRS	MIN	–	−98 (12.0)	–	
					R						
			0	0	L	SRS	MAX	–	−98 (12.0)	−92 (24.0)	
					R						
Total Harmonic Distortion	THD		V_{IN}	0	L	BYPASS	–	–	0.02	–	%
			0	V_{IN}	R						
		V⁺=1.8V f=1kHz	V_{IN}	0	L	SRS	MIN	–	0.10	–	
			0	V_{IN}	R						
			V_{IN}	0	L	SRS	MAX	–	0.25	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						
L+R Gain	G_{L+R}		V_{IN}	V_{IN}	L	SRS	MIN	–	0.0	–	dB
		f=1kHz			R						
			V_{IN}	V_{IN}	L	SRS	MAX	−1.0	0.0	1.0	
					R						

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NJM2190

■ELECTRICAL CHARACTERISTICS (V$^+$=3V, V$_{IN}$=-26dBV(50mVrms), Ta=25°C, unless otherwise specified.)

PARAMETER	SYMBOL		CONDITION					MIN	TYP	MAX	UNIT
			INPUT		OUTPUT	MODE	WIDTH VR(*1)				
			L	R							
L－R Gain (*2)	G$_{L-R}$	f=100Hz	V$_{IN}$	–V$_{IN}$	L	SRS	MIN	3.7	5.7	7.7	dB
					R						
			V$_{IN}$	–V$_{IN}$	L	SRS	MAX	19.3	21.3	23.3	
					R						
Channel Separation	CS	f=1kHz	0	V$_{IN}$	L	BYPASS	–	60.0	80.0	–	dB
			V$_{IN}$	0	R						
MODE Select Control Voltage	V$_{IH}$	High Level	–	–	–	–	–	1.3	–	V$^+$	V
	V$_{IL}$	Low Level	–	–	–	–	–	0.0	–	0.5	

(*1) Refer to application circuit 1.
(*2) The word '–V$_{IN}$' signifies opposite phase of 'V$_{IN}$'.

■MODE Switch

	MODE
BYPASS MODE	L
SRS MODE	H

■TERMINAL DESCRIPTION
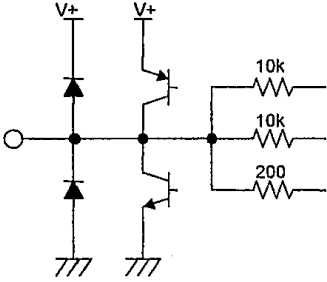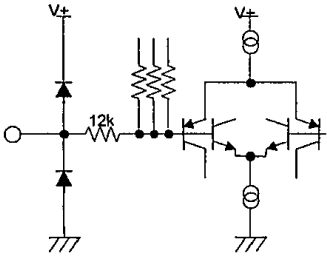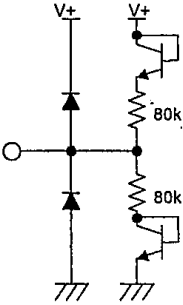
PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	VOLTAGE
1 16	Lin Rin	Audio Input		$V^+/2$
2	Wout	WIDTH Control Output		$V^+/2$
3	Win	WIDTH Control Input		$V^+/2$
4	MODE	Mode Switch		—

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PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	VOLTAGE
5	C1	Capacitor Terminal 1 for Filter		$V^+/2$
6	C2	Capacitor Terminal 2 for Filter		$V^+/2$
7 10	Lout Rout	Audio Output		$V^+/2$
8	GND	Ground	————	0V

■TERMINAL DESCRIPTION

PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	VOLTAGE
9	V⁺	Power Supply		V⁺
11	C3	Capacitor Terminal 3 for Filter		V⁺/2
12	C4	Capacitor Terminal 4 for Filter		V⁺/2
13	V+/2	V+/2 Output		V⁺/2

■TERMINAL DESCRIPTION

PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	VOLTAGE
14	REFin	Reference Voltage Input		$V^+/2$
15	VREF	Reference Voltage Output		$V^+/2$

■APPLICATION CIRCUIT 1
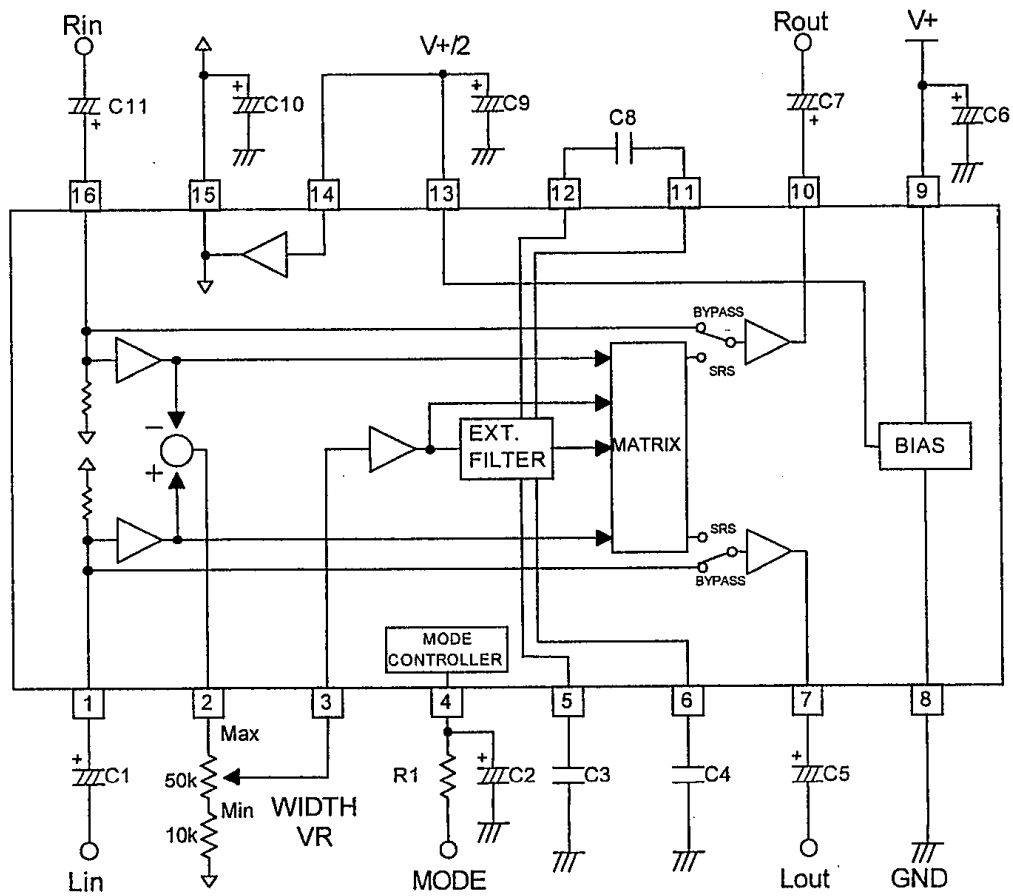
Parts No.	Value	Tolerance	Parts No.	Value	Tolerance
R1	22kΩ	±5%	C6	22 to 100μF	–
C1	10μF	–	C7	10μF	–
C2	10μF	–	C8	4.7nF	±5%
C3	3.3nF	±5%	C9	1 to 10μF	–
C4	0.1μF	±5%	C10	10 to 7μF	–
C5	10μF	–	C11	10μF	–

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■APPLICATION CIRCUIT 2 (Without using internal V+/2.)
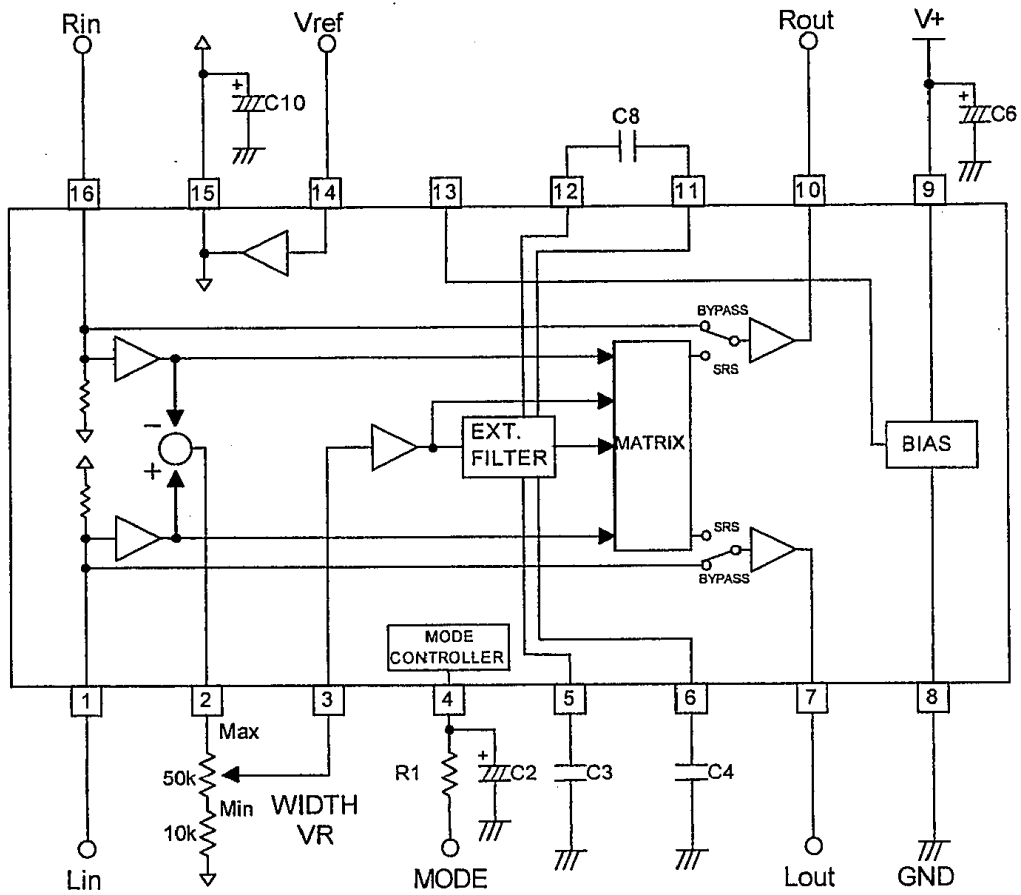
Parts No.	Value	Tolerance	Parts No.	Value	Tolerance
R1	22kΩ	±5%	C6	22 to 100μF	–
C2	10μF	–	C8	4.7nF	±5%
C3	3.3nF	±5%	C10	10 to 47μF	–
C4	0.1μF	±5%			

■TYPICAL CHARACTERISTICS

GAIN STURUCTURE (WIDTH VR:MAX)

Conditions : SRS MODE , WIDTH VR=MAX , V+=3V
a:Vin=-26dBV(Lch.)   Vout=Lch.   b:Vin=-26dBV(Rch.)   Vout=Lch.
c:Vin=-26dBV(L+Rch.) Vout=Lch.   d:Vin=-26dBV(L-Rch.) Vout=Lch.
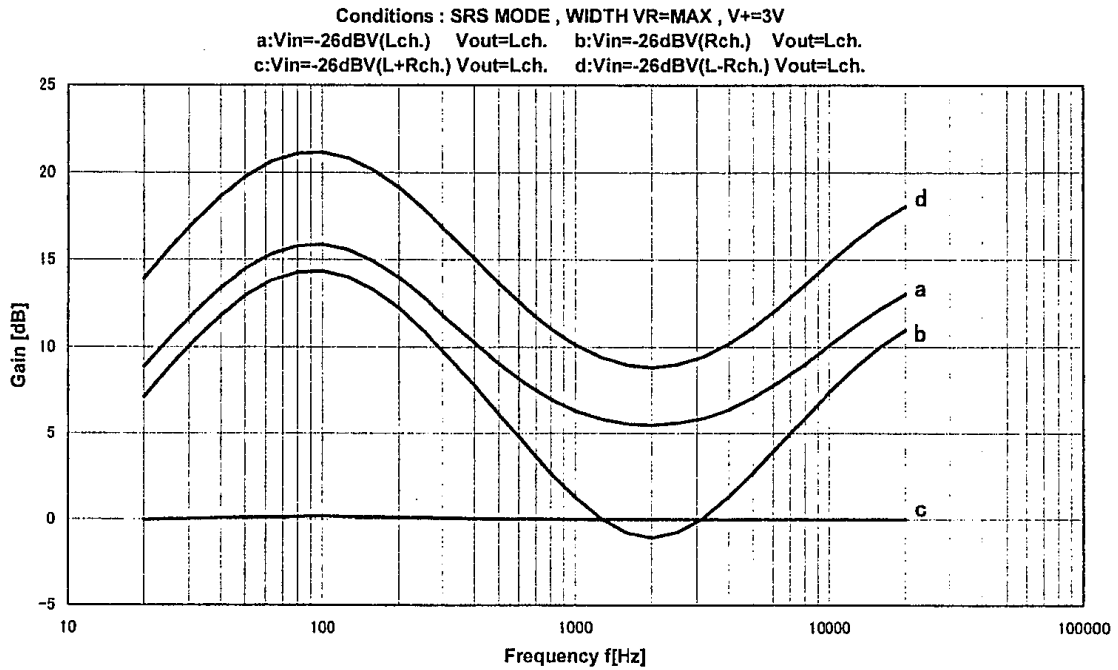
GAIN STRUCTURE (WIDTH VR:MIN)

Conditions : SRS MODE , WIDTH VR=MIN , V+=3V
a:Vin=-26dBV(Lch.)   Vout=Lch.   b:Vin=-26dBV(Rch.)   Vout=Lch.
c:Vin=-26dBV(L+Rch.) Vout=Lch.   d:Vin=-26dBV(L-Rch.) Vout=Lch.
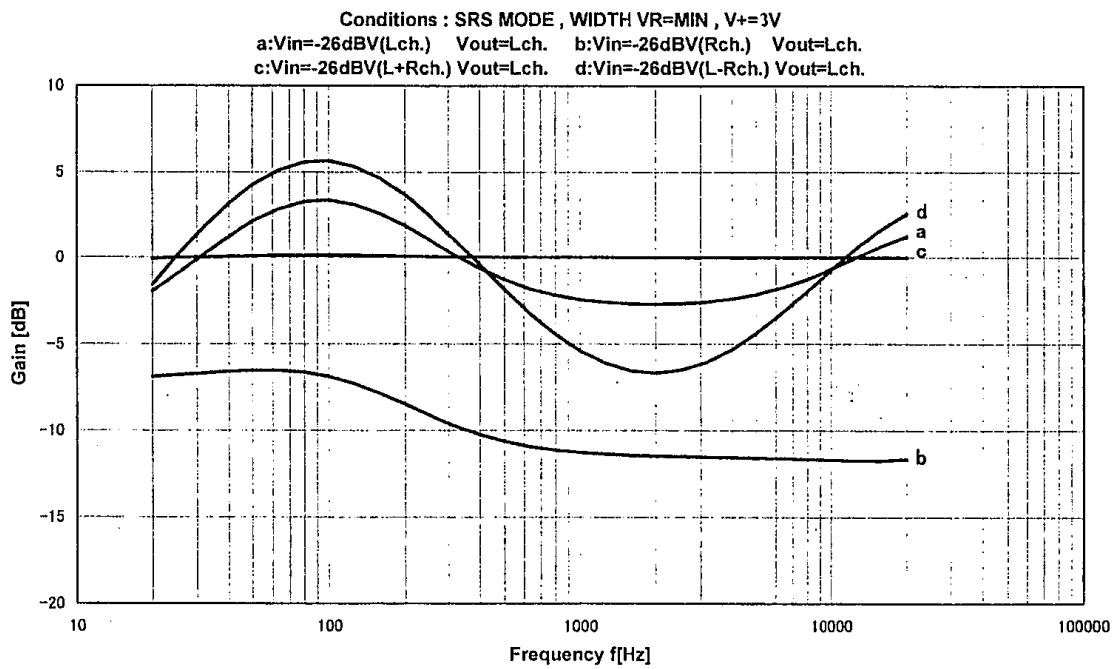
■TYPICAL CHARACTERISTICS

Maximum Input Voltage vs. Supply Voltage

Maximum Input Voltage vs. Supply Voltage
conditions : SRS MODE , WIDTH VR=MAX , f=100Hz
a.Vin=Lch.   Vout=Lch.(at THD=1%)
b.Vin=L-Rch. Vout=Lch.(at THD=1%)
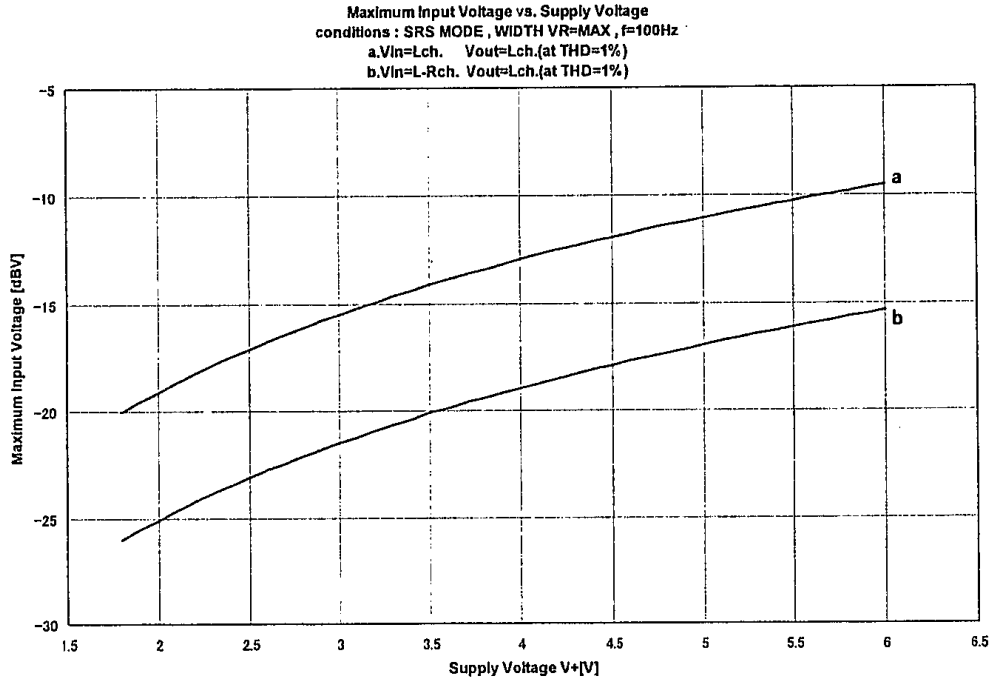
Maximum Input Voltage vs. WIDTH VR

Conditions : SRS MODE , V+=1.8V , f=100Hz
a:Vin=Lch.   Vout=Lch.(at THD=1%) b:Vin=Lch.   Vout=Rch.(at THD=1%)
c:Vin=L-Rch. Vout=Lch.(at THD=1%) d:Vin=L-Rch. Vout=Rch.(at THD=1%)

MEMO