Headphone Amplifier for Portable Audio

■ GENERAL DESCRIPTION

The **NJM2776** is a low voltage headphone amplifier for portable audio applications.

The **NJM2776** operates directly for one battery supply with independent power supply terminals (V^+1 and V^+2).

Also it provides shock-noise less standby mode.

The **NJM2776** is suitable for portable MD, portable CD and others.

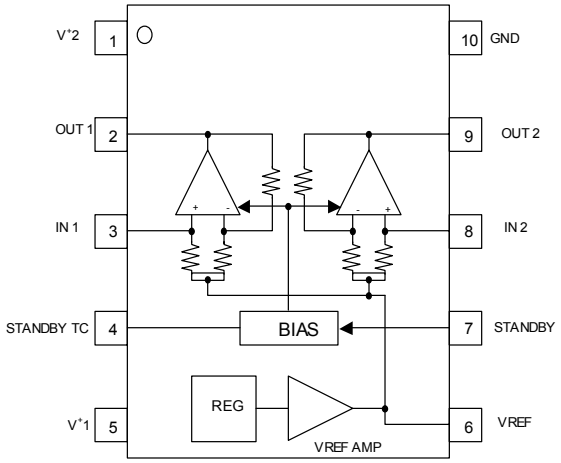
■ PACKAGE OUTLINE

NJM2776RB2
MSOP10 (TVSP10)

■ FEATURES

- Operating Voltage — V^+1(from step-up converter) =1.8 to 4.5V (however, $V^+1 > V^+2$)
  V^+2(from battery) =0.9 to 4.5V (however, $V^+1 > V^+2$)
- Low Operating Current — I_{CC4}(V^+1 side)=200μA typ. (V^+1=2.3V, V^+2=1.2V, No signal)
  I_{CC3}(V^+2 side)=350μA typ. (V^+1=2.3V, V^+2=1.2V, No signal)
- Supply Current in Standby mode — I_{CC2}(V^+1 side)=25μA typ. (V^+1=2.3V, V^+2=1.2V)
  I_{CC1}(V^+2 side)= 6μA typ. (V^+1=2.3V, V^+2=1.2V)
- Output Power Exceeds — P_O=8.5mW typ. (R_L=16Ω, THD=10%)
- Shock-noise less Standby mode
- Bipolar Technology
- Package Outline — MSOP10 (TVSP10)*
  *MEET JEDEC MO-187-DA / THIN TYPE

■ PIN CONFIGURATION AND BLOCK DIAGRAM



1. V^+2
2. OUT1
3. IN1
4. STADBY_TC
5. V^+1
6. VREF
7. STANDBY
8. IN2
9. OUT2
10. GND

■ **ABSOLUTE MAXIMUM RATINGS** (Ta=25°C)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V^+	5	V
Power Dissipation	P_D	320 (note)	mW
Operating Temperature range	T_{opr}	-20 to +75	°C
Storage Temperature Range	T_{stg}	-40 to +125	°C

■ **RECOMMENDED OPERATING CONDITIONS**

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Voltage Range	V^+1	-	1.8	2.3	4.5	V
	V^+2	-	0.9	1.2	4.5	

■ **ELECTRICAL CHARACTERISTICS** (Ta=25°C, V^+1=2.3V, V^+2=1.2V, V_{IN}=-30dBV (31.6mVrms), f=1kHz, R_L=16Ω, Active mode, unless otherwise specified)

●**Power Supply**

PARAMETER	SYMBOL	TEST CONDITION	pin	MIN.	TYP.	MAX.	UNIT
Operating Current	I_{CC0}	V^+1=0V	V^+2	-	-	1.0	μA
	I_{CC1}	Standby mode	V^+2	-	6.0	10.0	
	I_{CC2}		V^+1	-	25	35	
	I_{CC3}	No signal	V^+2	-	350	750	
	I_{CC4}		V^+1	-	200	400	
	I_{CC5}	P_O=0.1mW+0.1mW	V^+2	-	2.5	-	mA
	I_{CC6}		V^+1	-	200	-	
Reference Voltage	V_{REF}	No signal		0.50	0.60	0.65	V

●**Amplifier**

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Closed loop Gain	G_V		10.0	11.5	12.5	dB
Output Power	P_O	THD=10%	5.0	8.5	-	mW
Total Harmonic Distortion	THD	P_O=1mW	-	0.20	0.50	%
Output Noise Voltage	V_{NO}	A-Weighted	-	-100 (10.0)	-96 (15.8)	dBV (μV)
Channel Separation	CS		44	55	-	dB
Mute Level	MUTE	Standby mode 1kHz Band Pass	-	-100	-80	dB
Supply Voltage Rejection Ratio	PSRR1	V^+1=1.8V + 0.1Vrms V^+2=0.9V	46	52	-	dB
	PSRR2	V^+1=1.8V V^+2=0.9V + 0.1Vrms	70	77	-	

●**Mode Control**

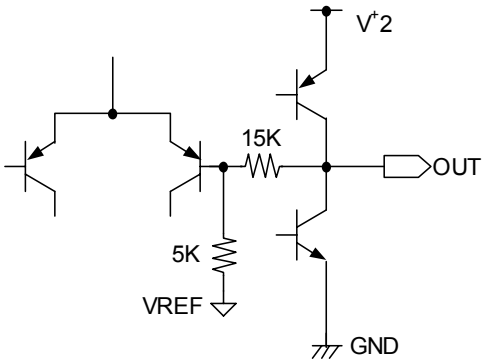
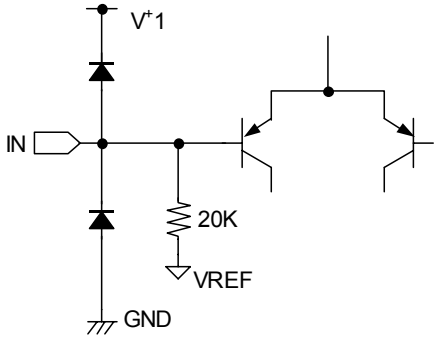
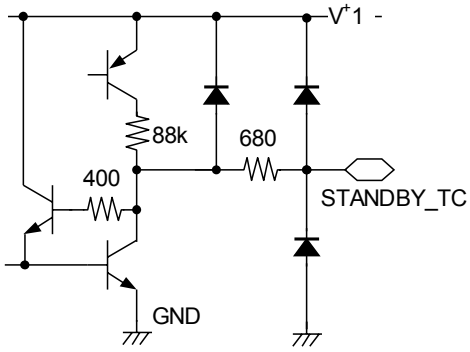
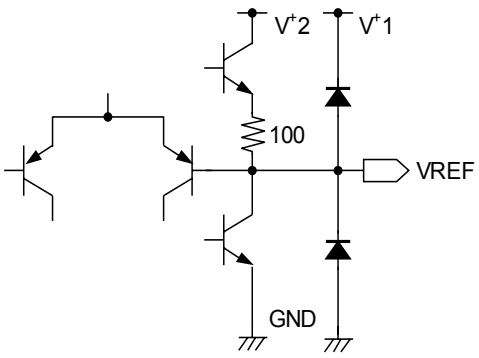
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
High Level Input Voltage	V_{IH}	V_{IN}=High Level	1.2	-	V^+1	V
Low Level Input Voltage	V_{IL}	V_{IN}=Low Level	0.0	-	0.3	

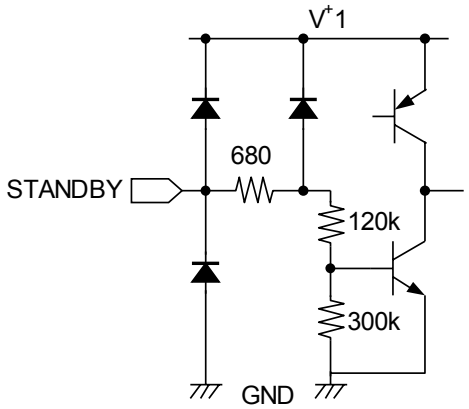
■ **MODE SWITHCH FUNCTION**

●**STANDBY (7PIN)**

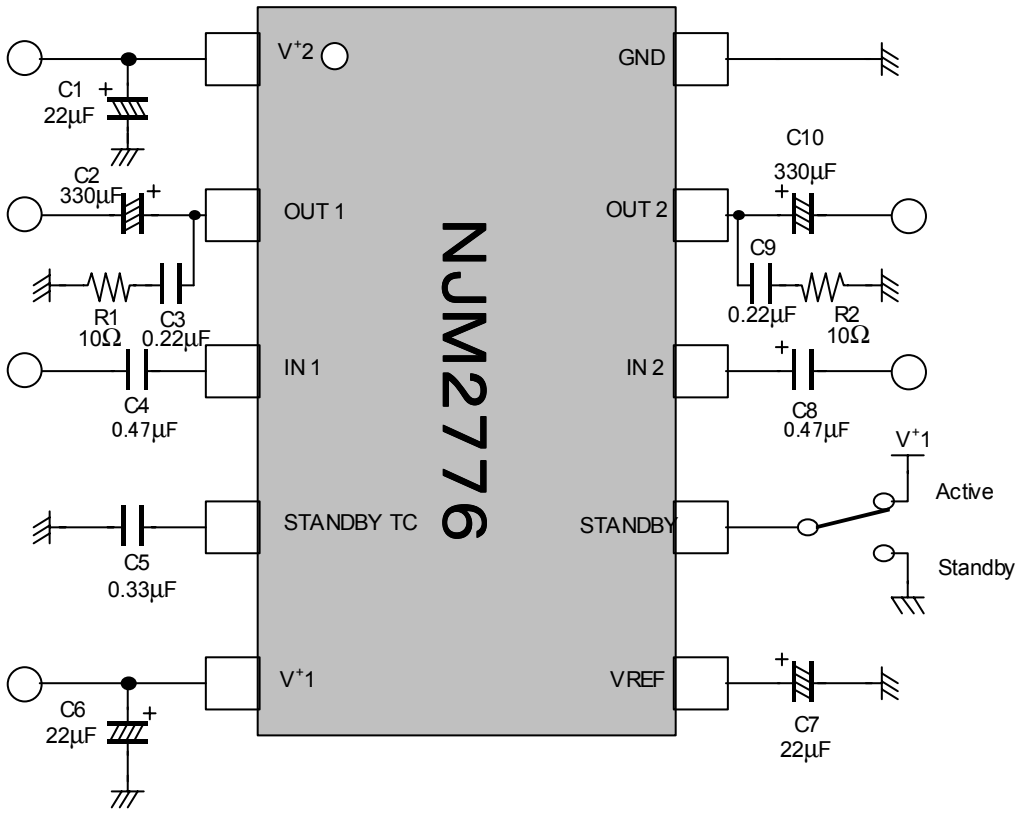
PARAMETER	CONTROL SIGNAL	STATUS
Standby	L, open	IC is non-active.
Active	H	IC is active.

■ **TERMINAL DESCRIPTION**

PIN No.	SYMBOL	EQUIVALENT CIRCUIT	VOLTAGE	NOTE
2,9	OUT1, OUT2		0.6V	
3,8	IN1, IN2		0.6V	
4	STANDBY_TC		1.2V	
6	VREF		0.6V	

PIN No.	SYMBOL	EQUIVALENT CIRCUIT	VOLTAGE	NOTE
7	STANDBY		-	

■ **APPLICATION CIRCUIT**



Note) Recommended the capacitors — C1, C3, C6 and C9 — are featuring higher frequency efficiency to prevent the oscillation.

■ APPLICATION NOTE

1. Procedure for Supplying Power

Supply the power to first V^+2(Battery side) and then V^+1(Step-up Converter side).

2. Input Dynamic Voltage Range

The reference voltage is fixed at 0.6V. Therefore input dynamic voltage range is not proportion to the power supply voltage.

The input signal over dynamic range makes distortion. For prevent the distortion, adjust the maximum input signal level.

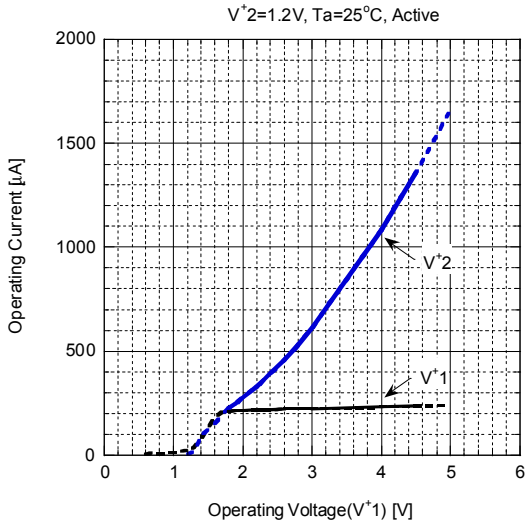
3. Charge Sequence

Pop noise may not be happened with mode switch operation once output voltage becomes reference voltage. The "Charge Sequence" may shorter the time for power up initialization.

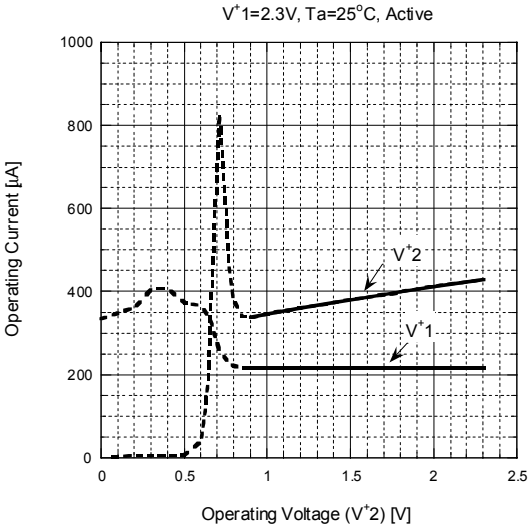
Charge Sequence: To set mode switch from standby to active during power up initialization, activate rapid charge circuit for stabilizing the output voltage.

■ TYPICAL CHARACTERISTICS

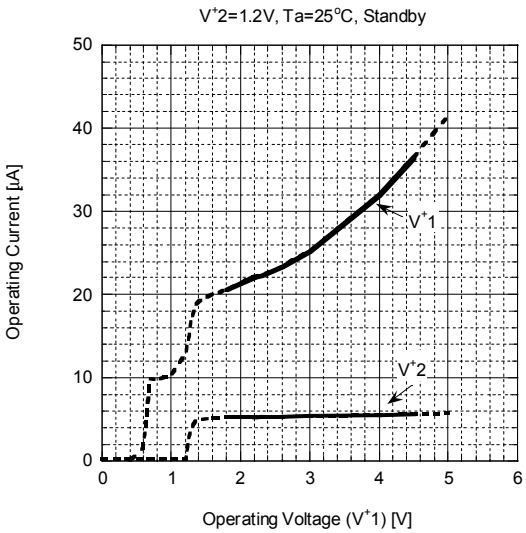
Operating Current vs. Operating Voltage



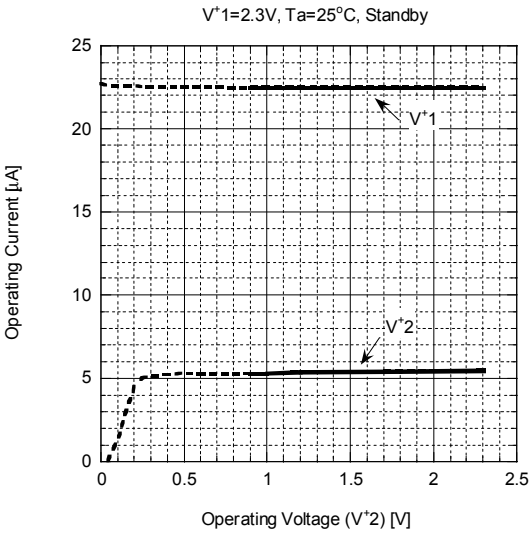
Operating Current vs. Operating Voltage



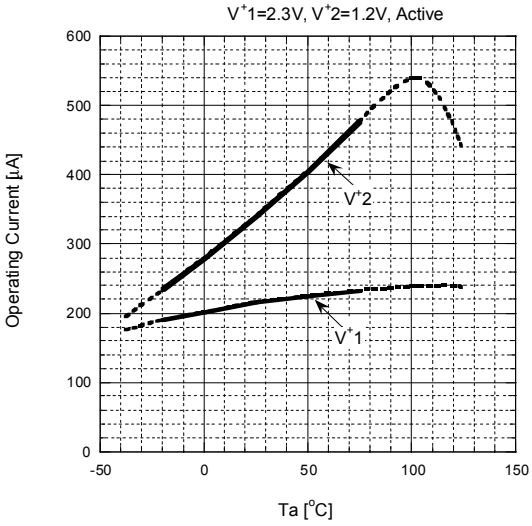
Operating Current vs. Operating Voltage



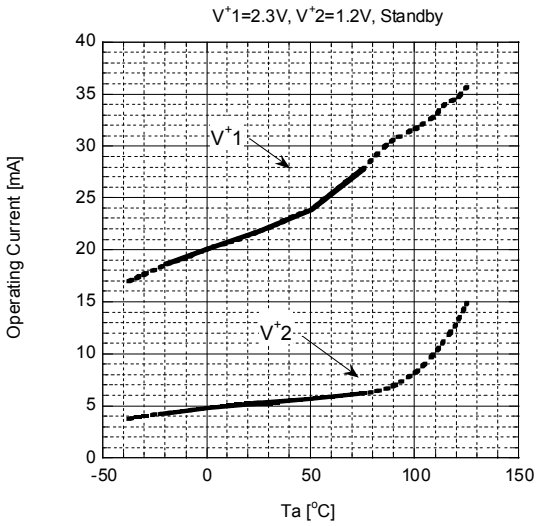
Operating Current vs. Operating Voltage



Operating Current vs. Temperature

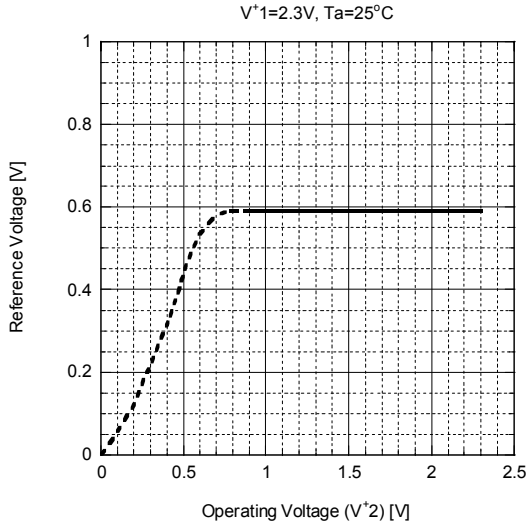


Operating Current vs. Temperature

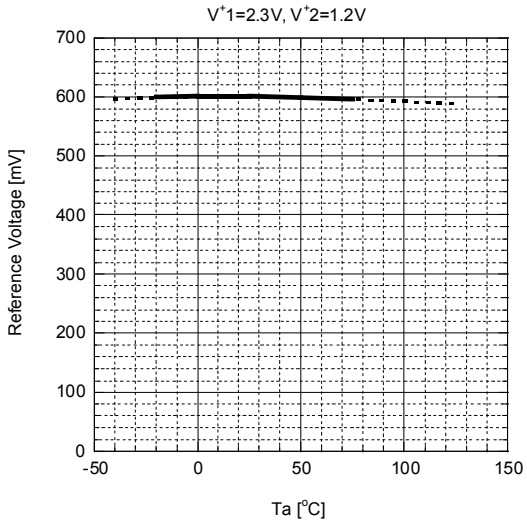


■ TYPICAL CHARACTERISTICS

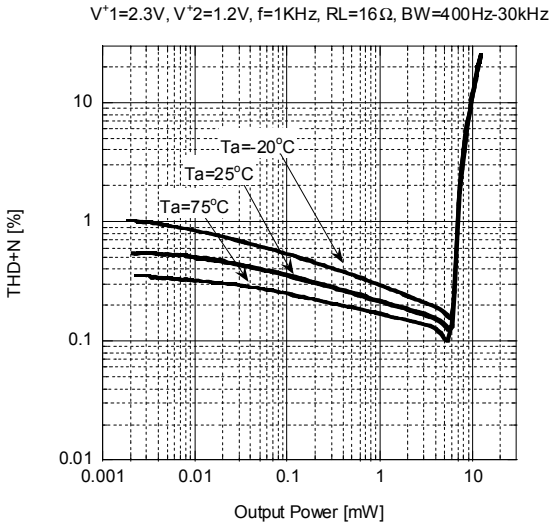
Reference Voltage vs. Operating Voltage



Reference Voltage vs. Temperature



Total Harmonic Distortion vs. Output Power



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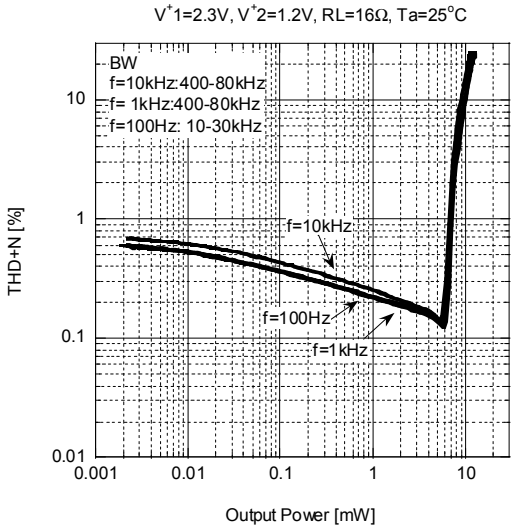
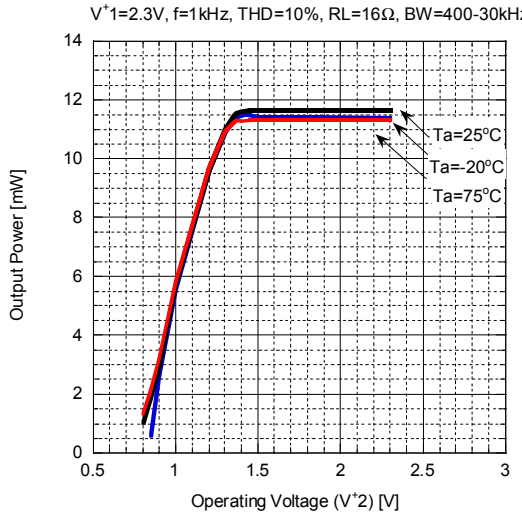
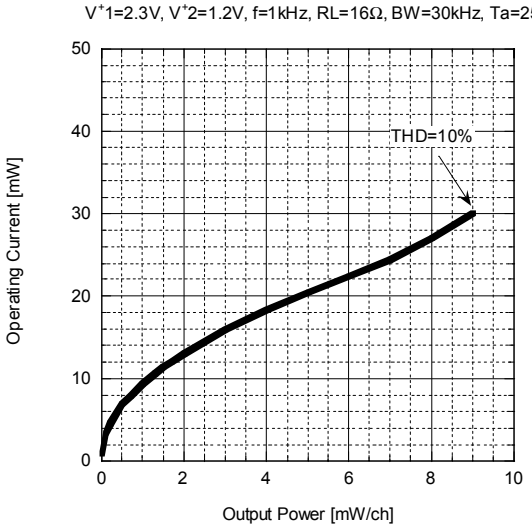


Output Power vs. Operating Voltage



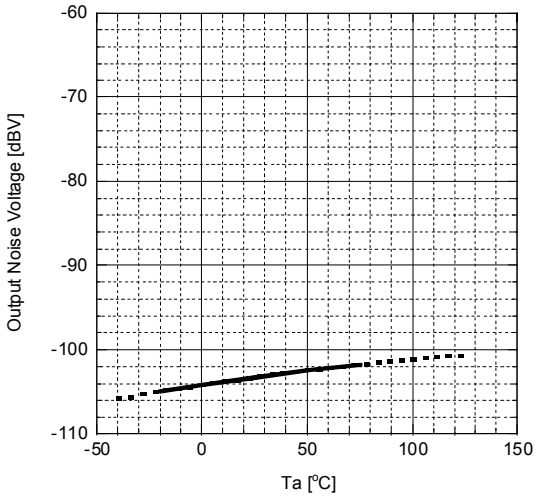
Power Dissipation vs. Output Power



■ TYPICAL CHARACTERISTICS

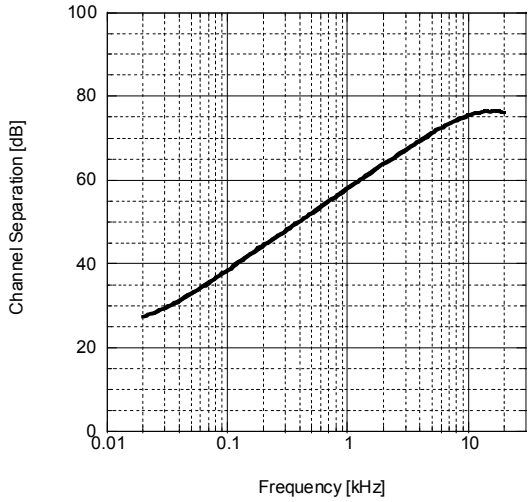
Output Noise Voltage vs. Temperature

V^+1=2.3V, V^+2=1.2V, RL=16Ω, Rg=600Ω, A-Weighted



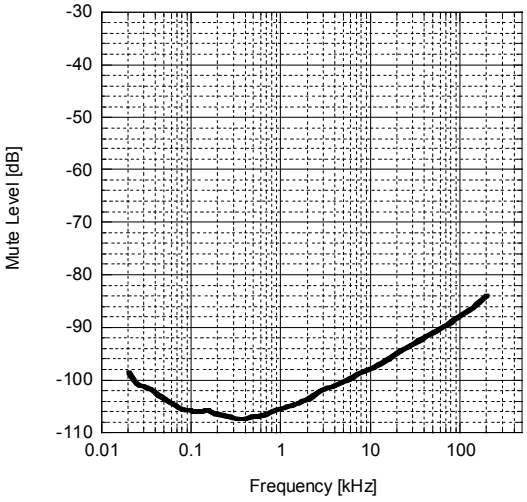
Channel Separation vs. Frequency

V^+1=2.3V, V^+2=1.2V, Vin=-30dBV, RL=16Ω, Ta=25°C



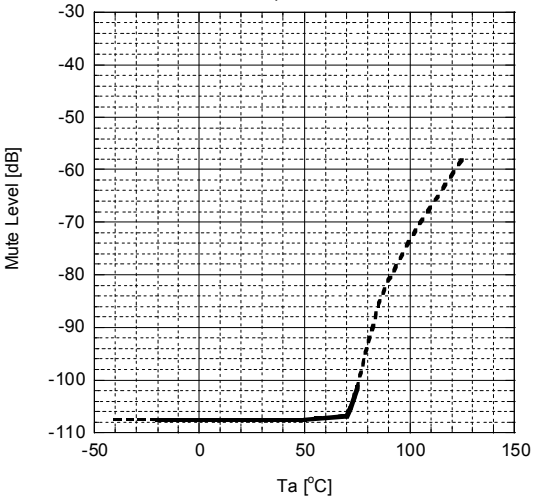
Mute Level vs. Frequency

V^+1=2.3V, V^+2=1.2V, Vin=-30dBV=0dB, RL=16Ω, Ta=25°C
1kHz Band pass, STANDBY



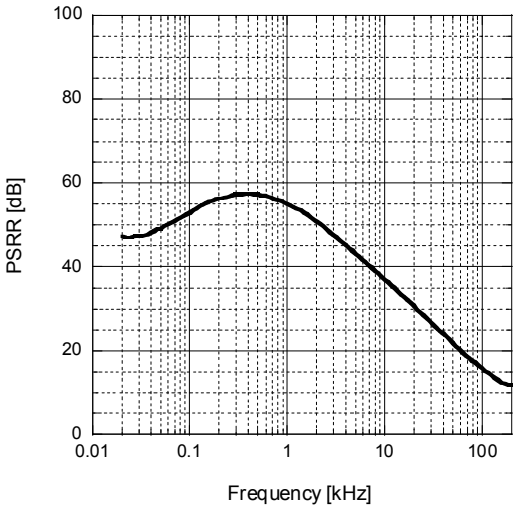
Mute Level vs. Temperature

V^+1=2.3V, V^+2=1.2V, Vin=-30dBV=0dB, f=1KHz, RL=16Ω
1kHz Band pass STANDBY



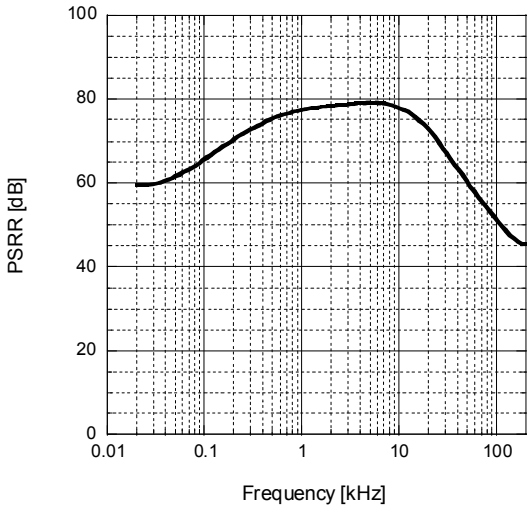
PSRR vs. frequency (V^+1)

V^+1=1.8V+0.1Vrms, V^+2=0.9V, Rg=600Ω, RL=16Ω, Ta=25°C



PSRR vs. frequency (V^+2)

V^+1=1.8V, V^+2=0.9V+0.1Vrms, Rg=600Ω, RL=16Ω, Ta=25°C



■ TYPICAL CHARACTERISTICS