OPERATIONAL AMPLIFIER WITH EVR

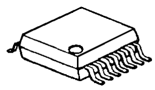
■ GENERAL DESCRIPTION

The NJM2172 is single supply, dual OP-AMP with electric variable resistor (EVR), which contains buffer amplifier, OP-AMP, reference voltage circuit, EVR and EVR control circuit.

The reference is fixed around 1/2 V^+ level internally, and only required few external parts.

The A and B EVR is control separately, and amp drive up to 100Ω(typ.) load. The NJM2172 is suitable for camcorder, CD, MD, and other audio signal process system.

■ PACKAGE OUTLINE

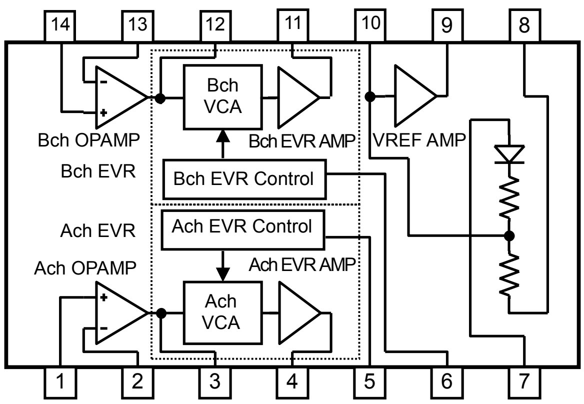


NJM2172V

■ FEATURES

● Low Power Supply Voltage	V^+ = 2.7 to 5.5V
● Low Operating Current	Icc = 5.0mA typ.
● A/Bch EVR adjust is separately	
● EVR range	-3.0 to -95dB
● Drivability	100Ω typ.
● Bipolar Technology	
● Package Outline	SSOP14

■ BLOCK DIAGRAM



■ PIN CONFIGURATION

1: $OP_{+IN}A$
2: $OP_{-IN}A$
3: $OP_{OUT}A$
4: $EVR_{OUT}A$
5: $V_{CNT}A$
6: $V_{CNT}B$
7: V^+
8: GND
9: Vref
10: REF_{IN}
11: $EVR_{OUT}B$
12: $OP_{OUT}B$
13: $OP_{-IN}B$
14: $OP_{+IN}B$

■ ABSOLUTE MAXIMUM RATING (Ta=25°C)

PARAMETER	RATINGS	SYMBOL(UNIT)	OTHERS
Supply Voltage	+7.0	V_{DD} (V)	
Storage Temperature Range	-50 to +150	Tstg (°C)	
Operating Temperature Range	-40 to +85	Topr (°C)	
Power Dissipation	300	P_D (mW)	SSOP14（ONLY）

■ERECTRICAL CHARACTERISTICS (V^+=3.5V, Crefin=10pF,Cref=1μF, f=1kHz, Ta=25°C unless otherwise noted)

● SUPPLY

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	TEST CIRCUIT
Operating Current	I_{CC}	RL=∞	-	5.0	7.5	mA	1
Reference Voltage	Vref	RL=∞	1.45	1.55	1.65	V	1

● OP-AMP SECTION

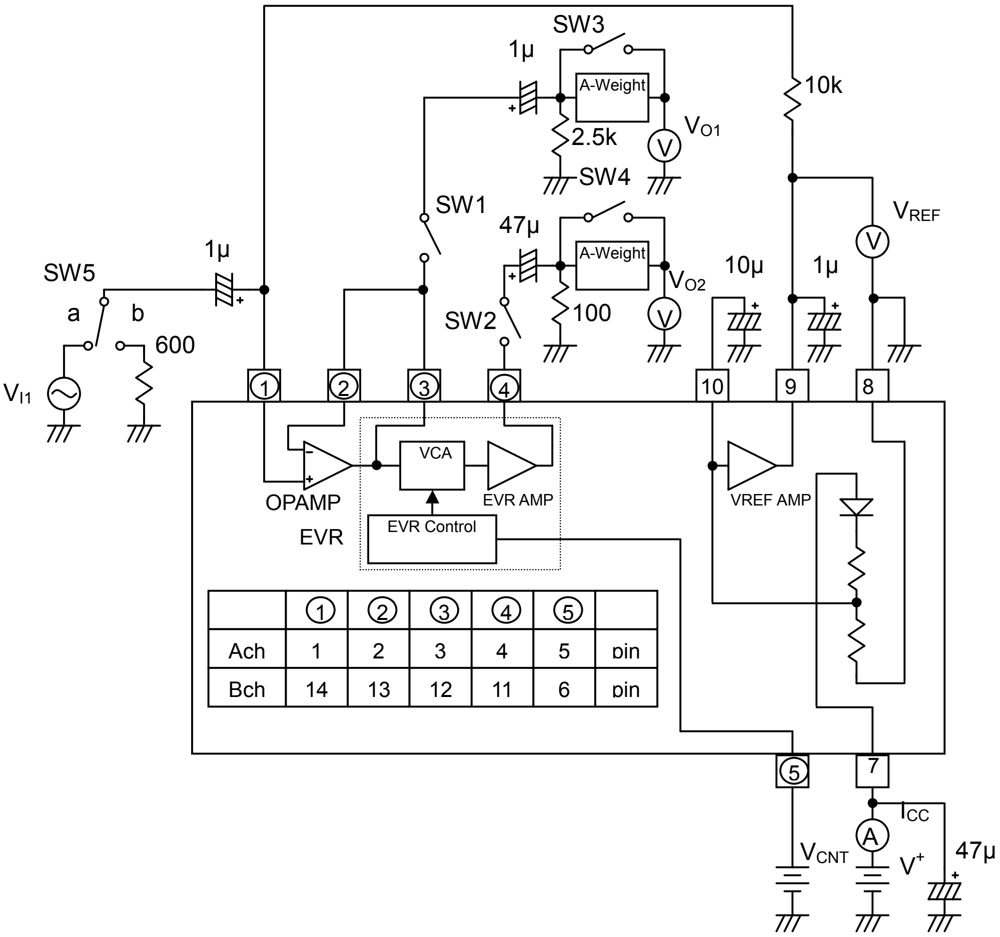
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	TEST CIRCUIT
Input Offset Voltage	V_{IO}	R_S≤10kΩ	-	1.0	6.0	mV	3
Input Bias Current	I_{IB}		-	100	300	nA	3
Voltage Gain 1	G_{V1}	R_L≤10kΩ	60	80	-	dB	3
Maximum Output Voltage Swing 1	V_{OM1}	THD=1%, RL≥2.5kΩ	-3.0 (0.7)	0 (1.0)	- (-)	dBV (Vrms)	2
Input Common Mode Voltage Range	V_{ICM}	-	0.55 to 2.55	-	-	V	-
Output Noise Voltage	V_{ON1}	Rs=600Ω / A-Weighted	-	-100 (10.0)	-90 (30.0)	dBV (μVrms)	1
Common Mode Rejection Ratio	CMR	R_S≤10kΩ	60	74	-	dB	3
Supply Voltage Rejection Ratio	SVR	R_S≤10kΩ	60	80	-	dB	3
Gain Bandwidth Product	GB		-	2	-	MHz	-

● EVR SECTION (V$_{CNT}$=2.7V, RL=100Ω unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	TEST CIRCUIT
Voltage Gain 2	G_{V2}	V_{IN} = -10dBV	-6.0	-3.0	0.0	dB	1
Total Harmonic Distortion	THD	V_{IN} = -10dBV	-	0.15	1.0	%	2
EVR Gain	G_{EVR}	V_{IN}=-10dBV/V_{CNT}=2.7Vto GND	80	90	-	dB	1
Output Noise Voltage 2	V_{NO2}	R_S = 600Ω / A - Weighted	-	-95 (18.0)	-85 (56.0)	dBV (μVrms)	1
Maximum Output Voltage Swing 2	V_{OM2}	THD = 1%	-5.0 (0.56)	-3.0 (0.71)	-	dBV (Vrms)	2
Channel Separation	CS	V_{IN}=-10dBV / A - Weighted	-	-79 (110)	-70 (320)	dBV (μVrms)	1
EVR Deviation	A/B1	V_{CNT}=1.5V,V_{INA}=V_{INB}=-50dBV f=1kHz, A/B ; *1	-3.0	0.0	3.0	dB	1
	A/B2	V_{CNT}=2.0V,V_{INA}=V_{INB}=-50dBV f=1kHz, A/B ; *1	-3.0	0.0	3.0		

*1: Ach Amp with Bch=0dB

■ TEST CIRCUIT 1

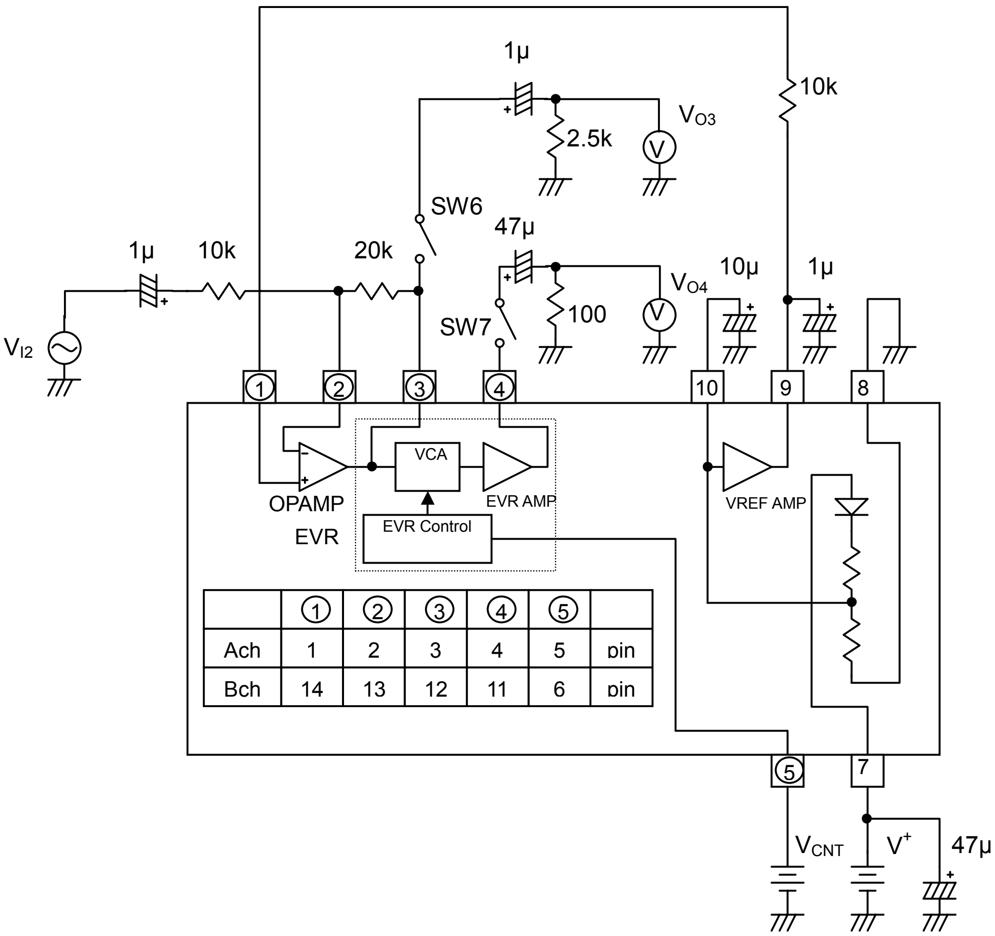


	①	②	③	④	⑤	
Ach	1	2	3	4	5	pin
Bch	14	13	12	11	6	pin

Fig.1

Test circuit 1 shows only Ach.

■ TEST CIRCUIT 2

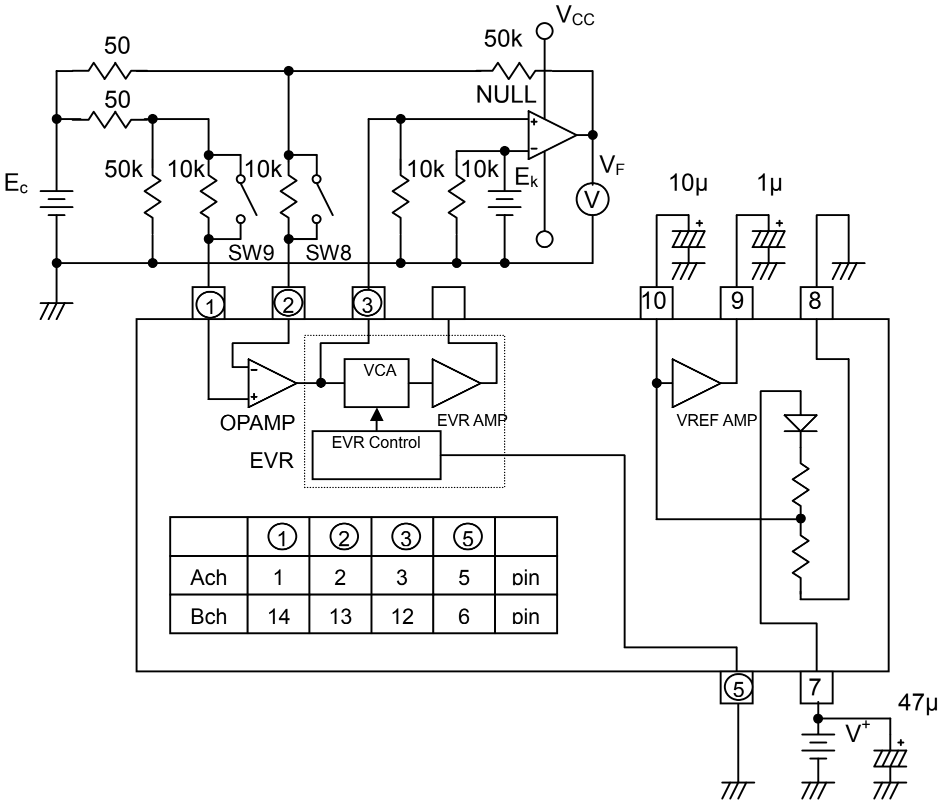


	①	②	③	④	⑤	
Ach	1	2	3	4	5	pin
Bch	14	13	12	11	6	pin

Fig.2

Test circuit 2 shows only Ach.

■ TEST CIRCUIT 3



	①	②	③	⑤	
Ach	1	2	3	5	pin
Bch	14	13	12	6	pin

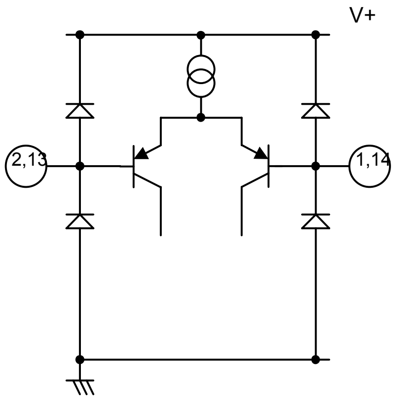
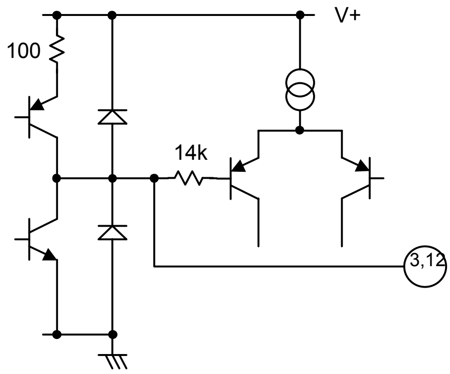
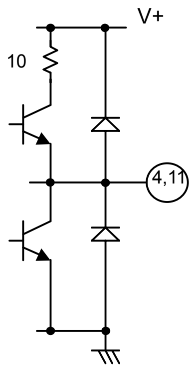
Fig.3

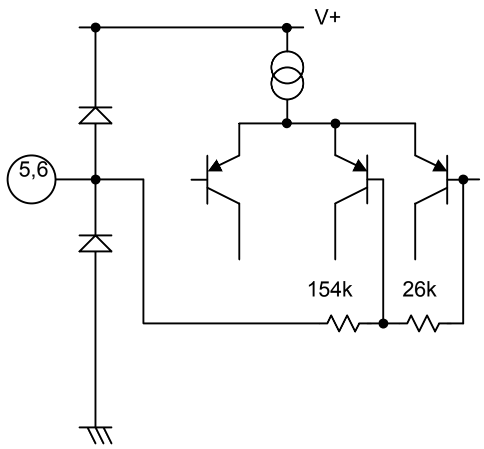
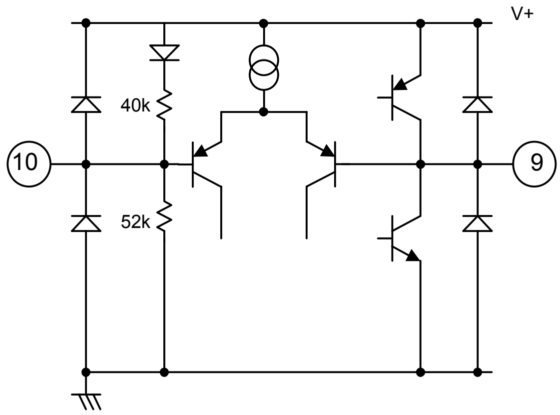
Test circuit 3 shows only Ach.

■ PIN INFORMATION

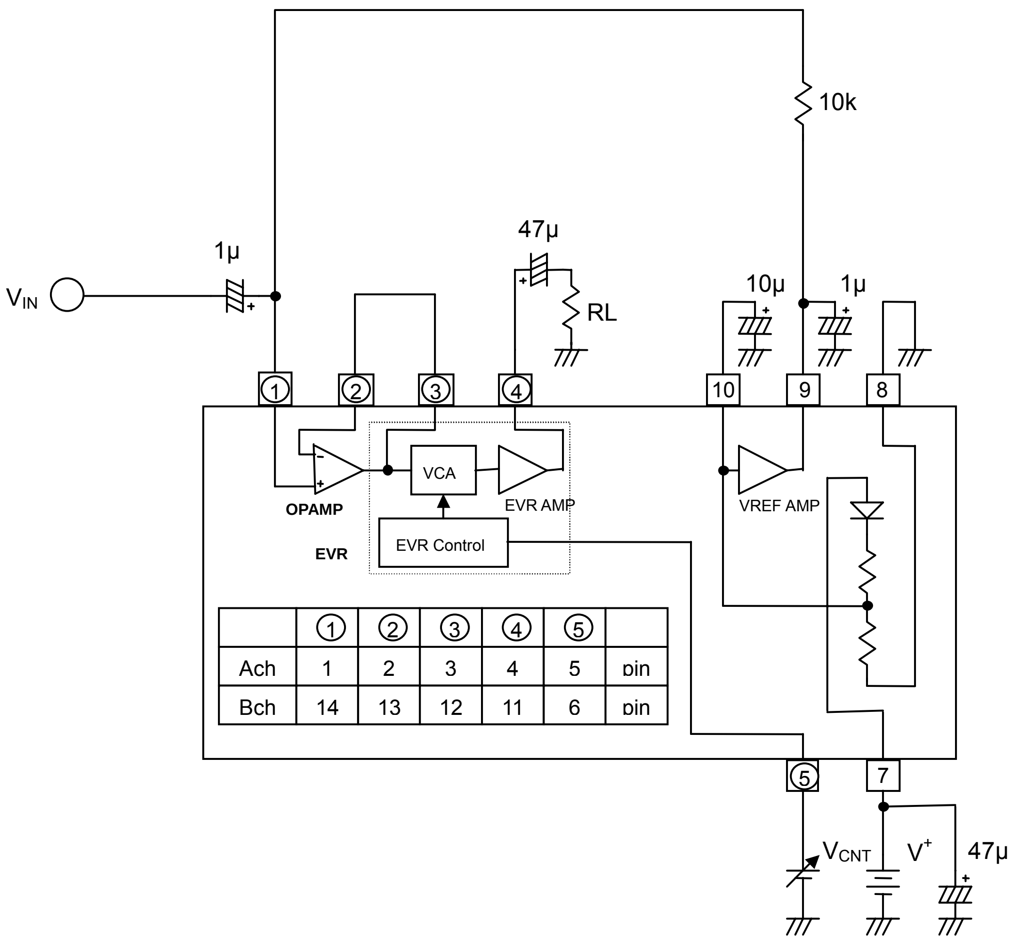
Pin No.	Pin Name	Function
1	OP+IN A	Ach OP-AMP + Input
2	OP-IN A	Ach OP-AMP - Input
3	OPOUTA	Ach OP-AMP Output / EVR Input
4	EVROUT A	Ach EVR Output
5	VCNT A	Ach EVR Control
6	VCNT B	Bch EVR Control
7	V^+	Power Supply
8	GND	GND
9	VREF	Internal Reference Output
10	REFIN	Internal Reference Input
11	EVROUT B	Bch EVR Output
12	OPOUT B	Bch OP-AMP Output / EVR Input
13	OP-IN B	Bch OP-AMP - Input
14	OP+IN B	Bch OP-AMP + Input

■ EQUIVALENT CIRCUIT

Term. No.	Term. Name	Equivalent Circuit	Terminal Voltage	Note
1 2 13 14	OP+INA OP-INA OP-INB OP+INB		1.55V	-
3 12	OPOUTA OPOUTB		1.55V	OPOUTA / OPOUTB Load: RL≥2.5kΩ
4 11	EVROUTA EVROUTB		1.55V	EVROUTA / EVROUTB Load: RL≥100Ω

Term. No.	Term. Name	Equivalent Circuit	Terminal Voltage	Note
5 6	VCNT A VCNT B		-	Input EVR control voltage
9 10	VREF REFIN		-	Terminal Voltage is 52 / (52+40)× (V^+ - V_{BE}) RL≥2KΩ

■ APPLICATION CIRCUIT 1
Voltage follower

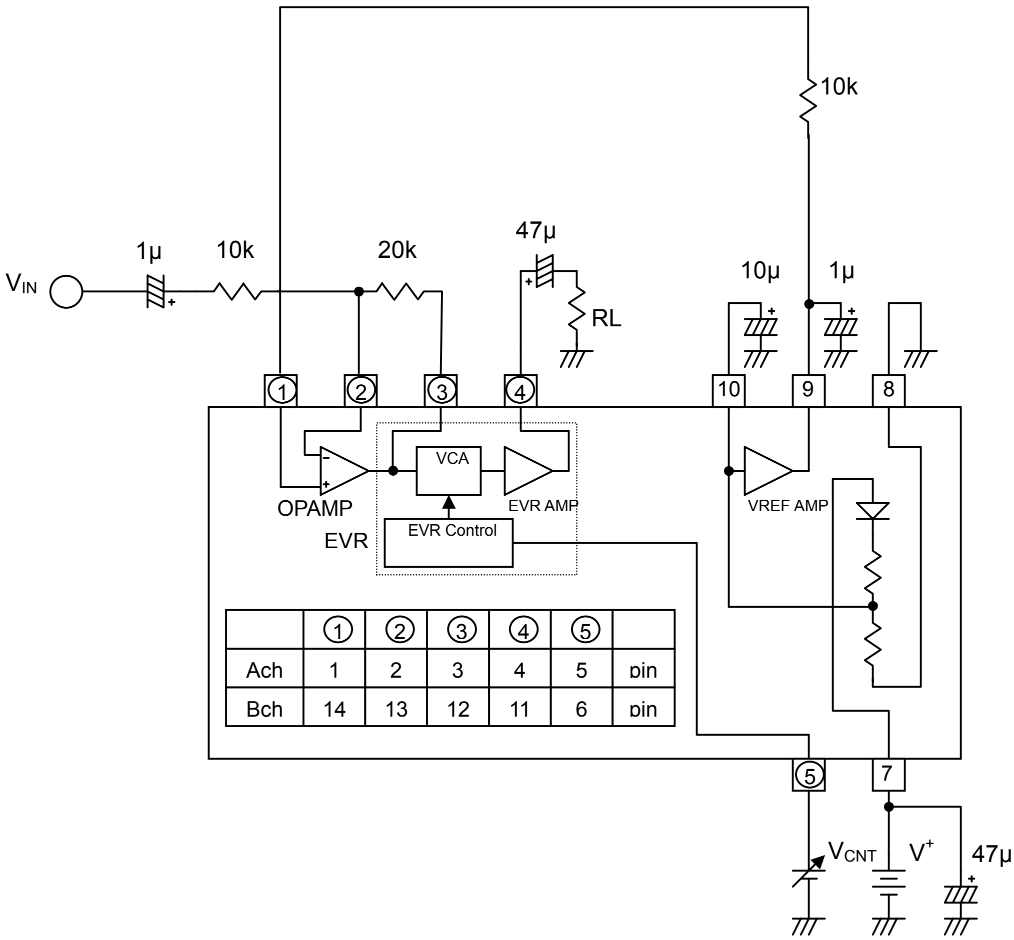


	①	②	③	④	⑤	
Ach	1	2	3	4	5	pin
Bch	14	13	12	11	6	pin

Fig.4

Application circuit 1 shows only Ach.

■ APPLICATION CIRCUIT 2
Invert Circuit (Gv=6dB)



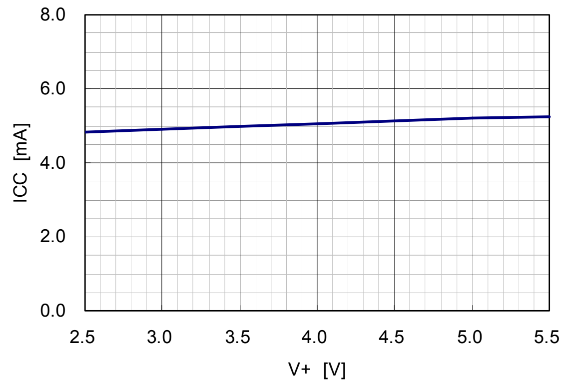
	①	②	③	④	⑤	
Ach	1	2	3	4	5	pin
Bch	14	13	12	11	6	pin

Fig.5

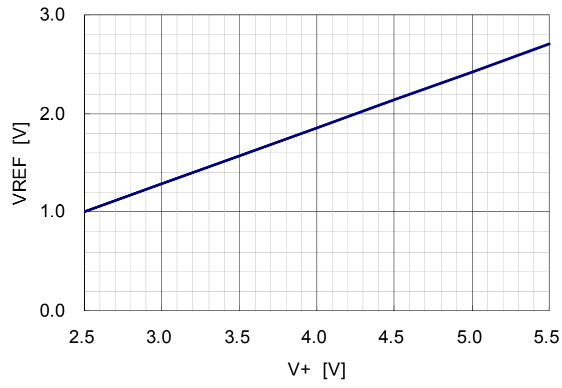
Application circuit 2 shows only Ach.

■ TYPICAL CHARACTERISTICS

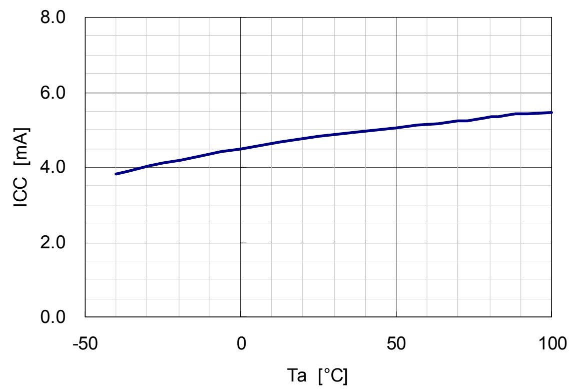
Quiescent Current vs. Supply Voltage Ta=25°C



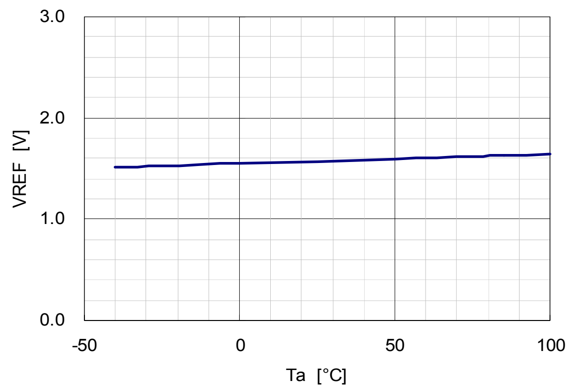
Internal Reference Voltage vs. Supply Voltage Ta=25°C



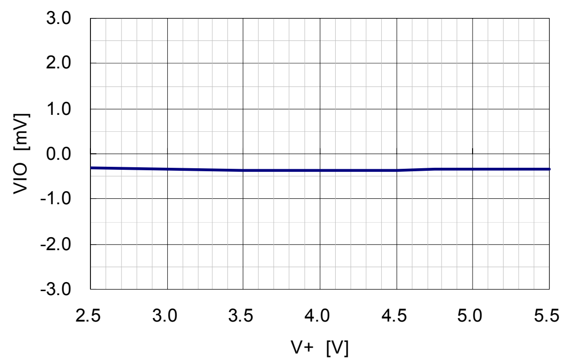
Quiescent Current vs. Temperature V+=3.5V



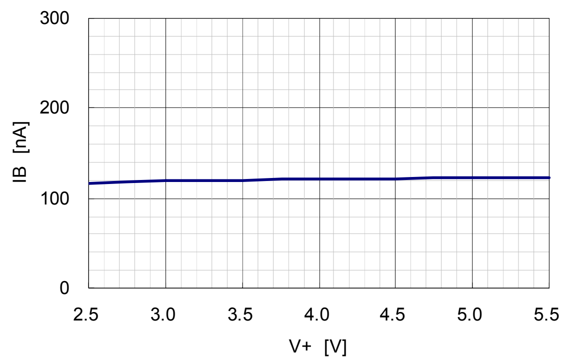
Internal Reference Voltage vs. Temperature V+=3.5V



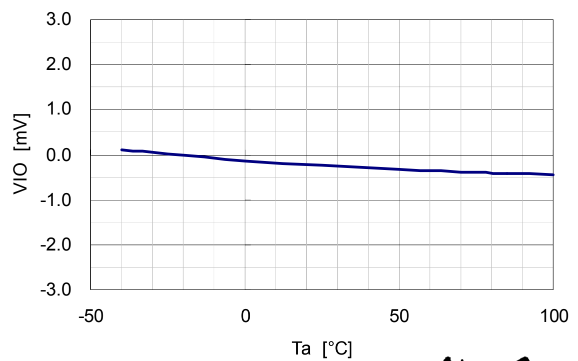
Input Offset Voltage vs. Supply Voltage Ta=25°C



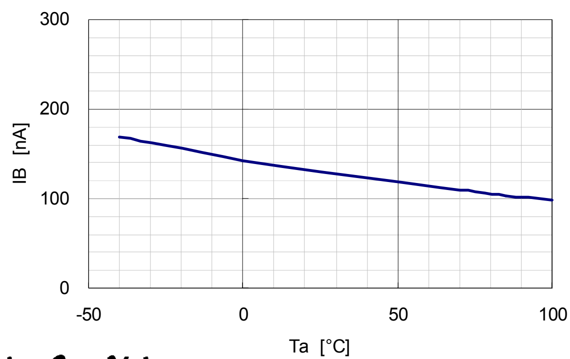
Input Bias Current vs. Supply Voltage Ta=25°C



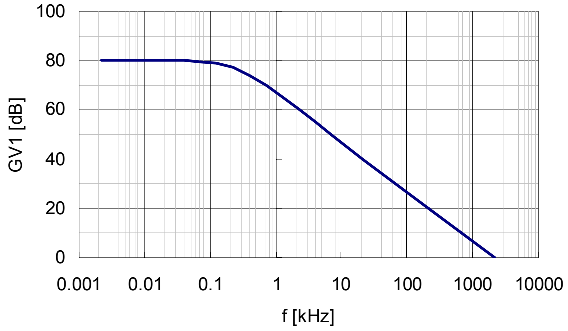
Input Offset Voltage vs. Temperature V+=3.5V



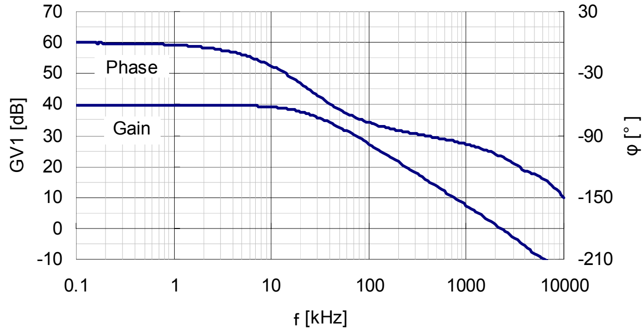
Input Bias Current vs. Temperature V+=3.5V



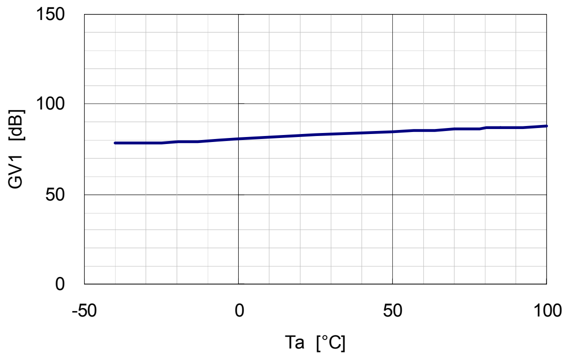
Voltage Gain 1 vs. Frequency
V+=3.5V,Ta=25°C,RL=2.5kΩ



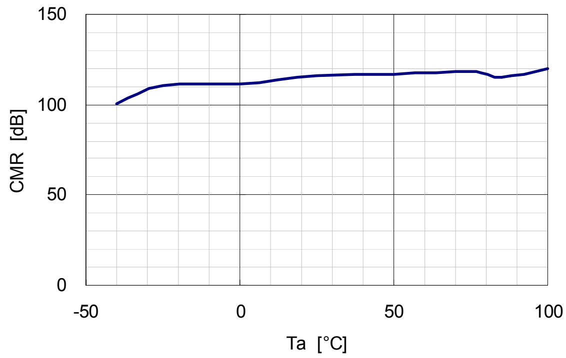
Voltage Gain 1 / Phase vs. Frequency
V+=3.5V,Ta=25°C,RL=2.5kΩ,40dB Inverted Amp



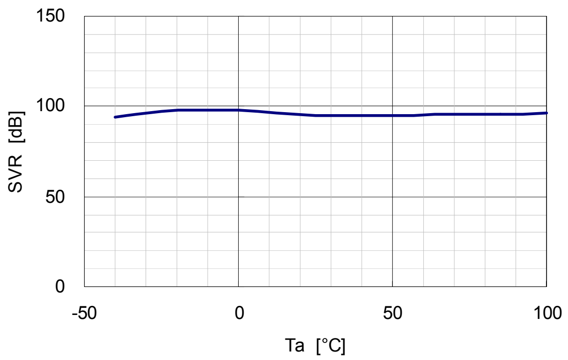
Voltage Gain1 vs. Temperature V+=3.5V



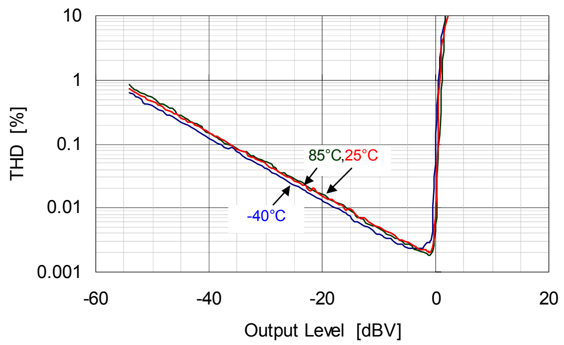
Common Mode Rejection Ratio vs. Temperature V+=3.5V



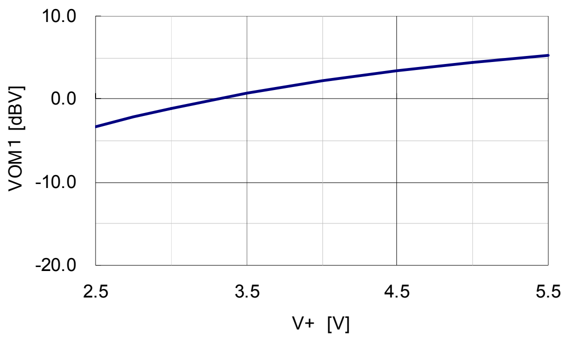
Supply Voltage Rejection Ratio vs. Temperature V+=3.5V



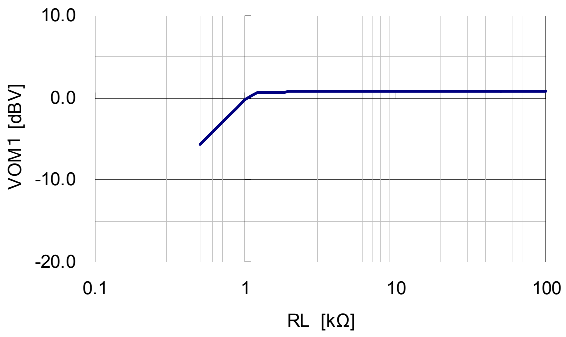
Total Harmonic Distortion (OPAMP) vs. Output Level
(Temperature)
V+=3.5V,f=1kHz,BW=400Hz-30kHz



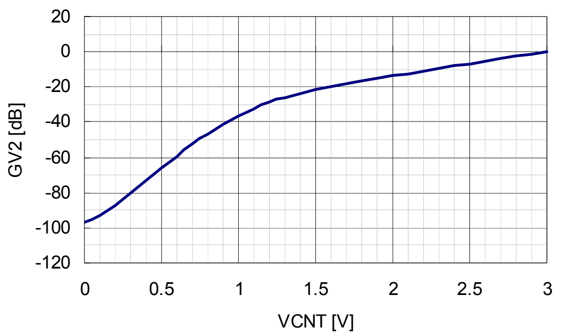
Maximum Output Voltage 1 vs. Supply Voltage
RL=2.5kΩ,f=1kHz,THD=1%,Ta=25°C



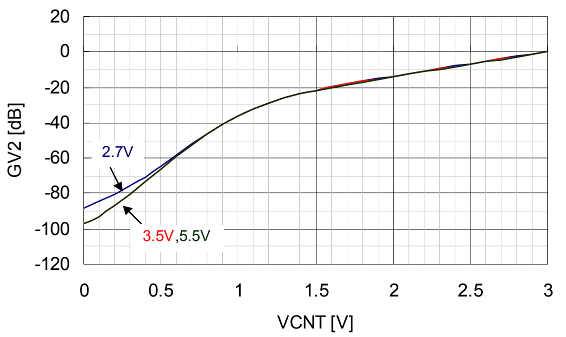
Maximum Output Voltage 1 vs. Load Resistance
V+=3.5V,f=1kHz,THD=1%,Ta=25°C



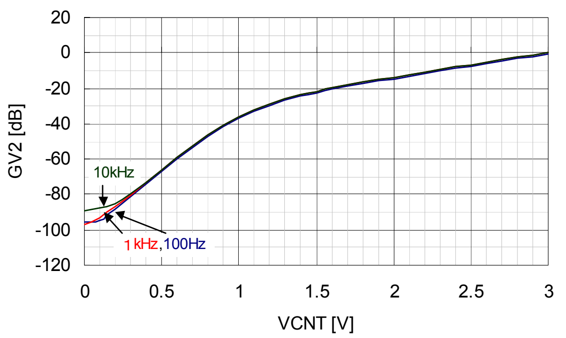
Voltage Gain 2 vs. EVR Control Voltage
V+=3.5V,f=1kHz,Vin=-10dBV,Ta=25°C



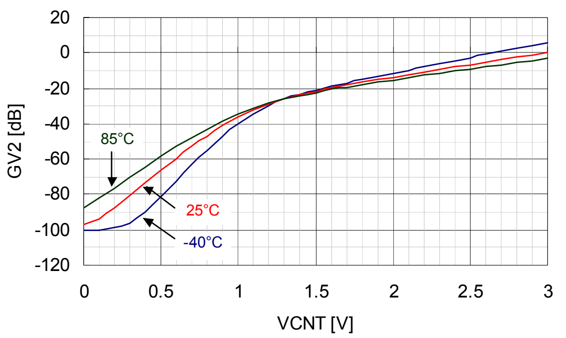
Voltage Gain 2 / Supply Voltage vs. EVR Control Voltage
f=1kHz,Vin=-10dBV,Ta=25°C



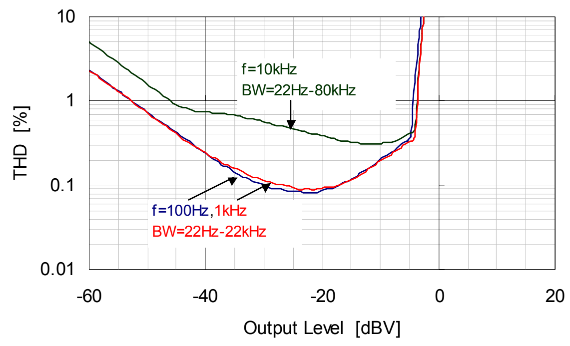
Voltage Gain 2 / Frequency vs. EVR Control Voltage
V+=3.5V,Vin=-10dBV,Ta=25°C



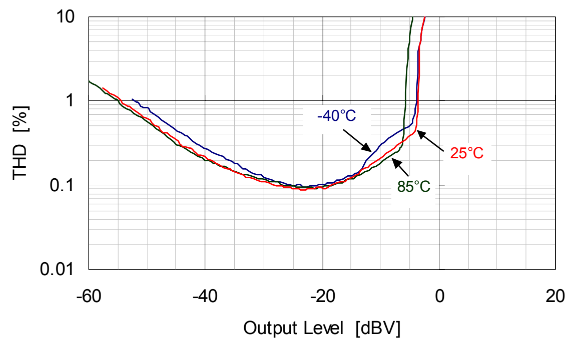
Voltage Gain 2 / Temperature vs. EVR Control Voltage
V+=3.5V,f=1kHz,Vin=-10dBV



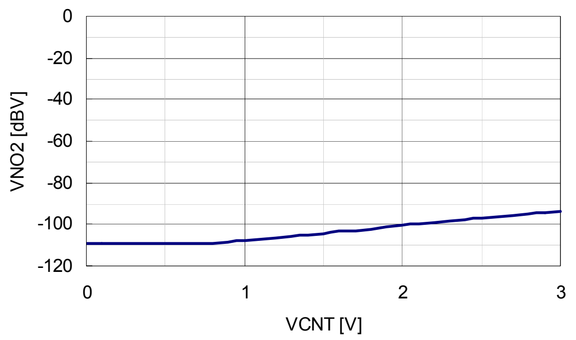
Total Harmonic Distortion (EVR) vs. Output Level
(Frequency)
V+=3.5V,Ta=25°C



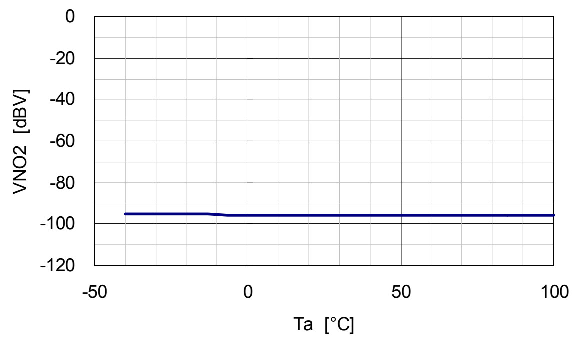
Total Harmonic Distortion (EVR) vs. Output Level
(Temperature)
V+=3.5V,f=1kHz,BW=400Hz-30kHz



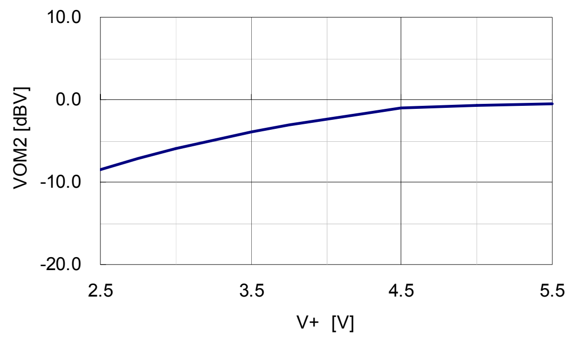
Output Noise Voltage 2 vs. EVR Control Voltage
V+=3.5V,Ta=25°C,A-Weighted



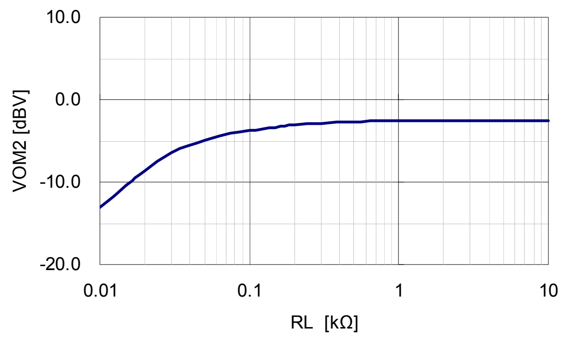
Output Noise Voltage 2 vs. Temperature
V+=3.5V,VCNT=2.7V,A-Weighted



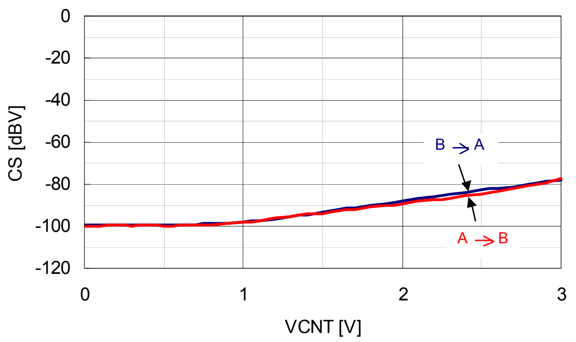
Maximum Output Voltage 2 vs. Supply Voltage
RL=100Ω,f=1kHz,THD=1%,Ta=25°C



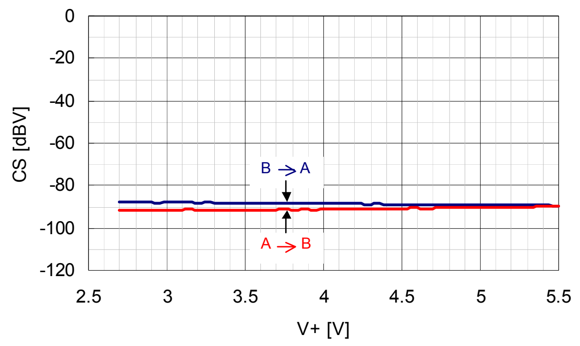
Maximum Output Voltage 2 vs. Load Resistance
V+=3.5V,f=1kHz,THD=1%,Ta=25°C



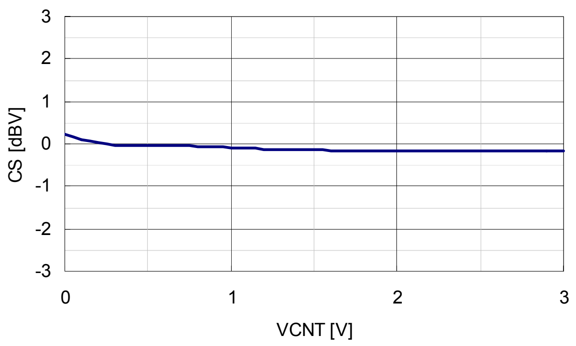
Channel Separation vs. EVR Control Voltage
V+=3.5V,Vin=-10dBV,f=1kHz,Ta=25°C,A-Weighted



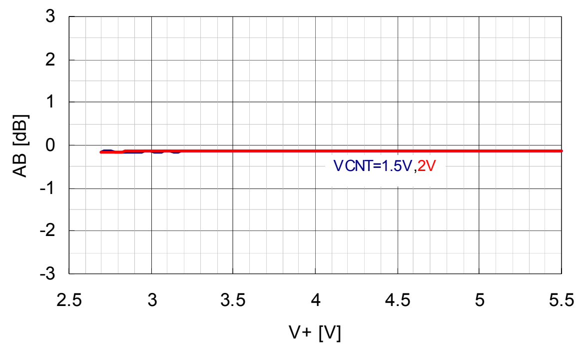
Channel Separation vs. Supply Voltage
VCNT=2.7V,Vin=-10dBV,f=1kHz,Ta=25°C,A-Weighted



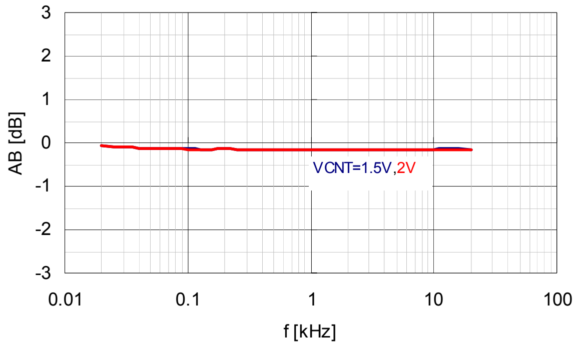
Channel Separation vs. EVR Control Voltage
V+=3.5V,Vin=-50dBV,f=1kHz,Ta=25°C,A-Weighted



EVR Deviation vs. Supply Voltage
VCNT=2.7V,Vin=-50dBV,f=1kHz,Ta=25°C,A-Weighted



EVR Deviation vs. Frequency
VCNT=2.7V,Vin=-50dBV,Ta=25°C



EVR Deviation vs. Temperature
V+=3.5V,Vin=-50dBV,f=1kHz,VCNT=2.7V,A-Weighted