

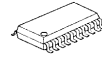
2-CHANNEL ELECTRONIC VOLUME WITH INPUT SELECTOR

■ GENERAL DESCRIPTION

NJW1156A is a two channel electronic volume with 5 input selector. It's suitable for Input signal trimmer of audio equipments such as DVD / HDD recorder and VCR. These functions are controlled by I²C Bus.

NJW1156A changes high input impedance (38.5kΩ) compared with NJW1156.

■ PACKAGE OUTLINE

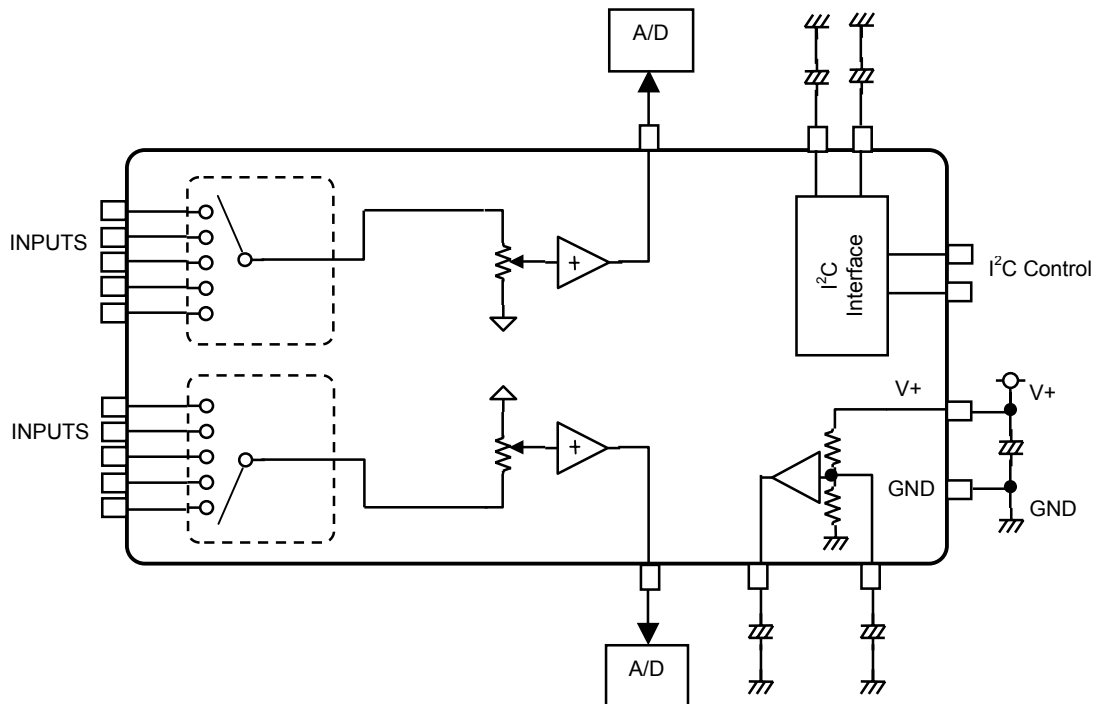


NJW1156AV

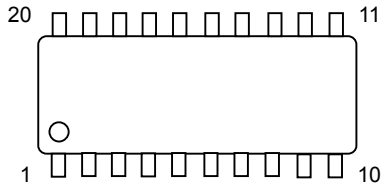
■ FEATURES

- Operating Voltage 8 to 13V
- I²C Bus control
- 5 Input Selector
- Volume 0 to -39.5dB/0.5dBstep, MUTE
- Bi-CMOS Technology
- Package Outline SSOP20

■ BLOCK DIAGRAM



■ PIN FUNCTION



No.	SYMBOL	FUNCTION
1	GND	Ground
2	R1IN	R channel Input 1
3	R2 IN	R channel Input 2
4	R3IN	R channel Input 3
5	R4IN	R channel Input 4
6	R5IN	R channel Input 5
7	ROUT	R channel Output
8	VSSOUT	Internal VSS Noise Rejection Capacitor Terminal
9	SCL	I ² C Clock Input
10	SDA	I ² C Data Input
11	VDDOUT	Internal VDD Noise Rejection Capacitor Terminal
12	VREFOUT	Reference Voltage Output
13	V+	Power Supply
14	VREFIN	Reference Voltage Noise Rejection Capacitor Terminal
15	LOUT	L channel Output
16	L5IN	L channel Input 5
17	L4IN	L channel Input 4
18	L3IN	L channel Input 3
19	L2IN	L channel Input 2
20	L1IN	L channel Input 1

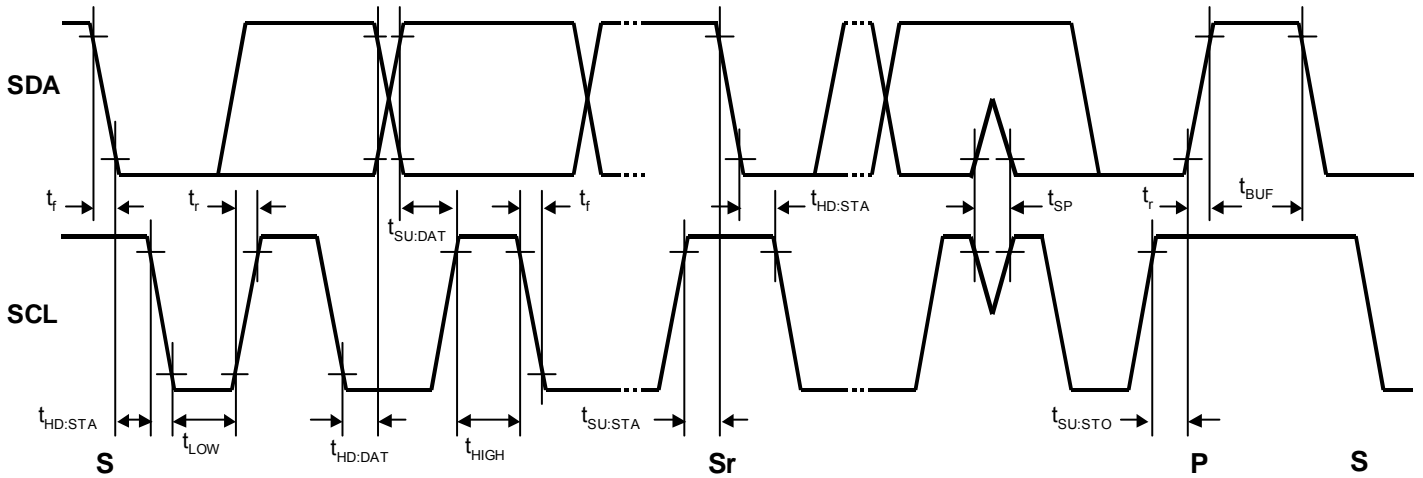
■ ABSOLUTE MAXIMUM RATING (Ta=25°C)

PARAMETER	SYMBOL	RATING	UNIT
Power Supply Voltage	V+	15	V
Power Dissipation	P _D	300	mW
Operating Temperature Range	Topr	-20 to +75	°C
Storage Temperature Range	Tstg	-40 to +125	°C

■ ELECTRICAL CHARACTERISTICS (Ta=25°C, V⁺=+12V, RL=10kΩ)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
◆ Power Supply						
Operating Voltage	V+	-	8	12	13	V
Reference Voltage	V _{ref}	-	5.5	6	6.5	V
Supply Current	I _{CC}	No signal	-	4.5	6.8	mA
◆ Input/Output Characteristics						
Maximum Output Voltage	V _{OM}	f=1kHz, THD=1% Volume=0dB	3.0	4.0	-	V _{rms}
Voltage Gain 1	G _{V1}	V _{IN} =1V _{rms} , f=1kHz Volume=0dB	-0.5	0	0.5	dB
Voltage Gain 2	G _{V2}	V _{IN} =1V _{rms} , f=1kHz Volume=-20dB	-21	-20	-19	dB
Voltage Gain 3	G _{V3}	V _{IN} =1V _{rms} , f=1kHz Volume=-39.5dB	-42.0	-39.5	-37.0	dB
Voltage Gain Error	ΔG _V	V _{IN} =1V _{rms} , f=1kHz Volume=-20dB, Ach - Bch	-0.5	0	0.5	dB
Mute Level	Mute	f=1kHz, V _{IN} =1V _{rms} Volume=Mute, A-weight	-	-100	-	dB
Output Noise	V _{NO}	Volume=0dB, Rg=0, A-weight	-	-110 (3.2μ)	-100 (10μ)	dBV (V _{rms})
Total Harmonic Distortion	THD	f=1kHz, V _o =1V _{rms} , Volume=0dB BW : 400Hz - 30kHz	-	0.0015	0.05	%
Channel Separation	CS	f=1kHz, V _o =1V _{rms} , Volume=0dB Rg=0Ω, A-weight	-	-100	-90	dB

■TIMING ON THE I²C BUS (SDA,SCL)



■CHARACTERISTICS OF I/O STAGES FOR I²C BUS (SDA,SCL)

I²C BUS Load Conditions

STANDARD MODE: Pull up resistance 4k Ω (Connected to +5V), Load capacitance 200pF (Connected to GND)

PARAMETER	SYMBOL	Standard mode			UNIT
		MIN.	TYP.	MAX.	
Low Level Input Voltage	V_{IL}	0.0	-	1.5	V
High Level Input Voltage	V_{IH}	2.5	-	5.0	V
Low level output voltage (3mA at SDA pin)	V_{OL}	0	-	0.4	V
Input current each I/O pin with an input voltage between 0.1V _{DD} and 0.9V _{DDmax}	I_i	-10	-	10	μ A

■CHARACTERISTICS OF BUS LINES (SDA,SCL) FOR I²C-BUS DEVICES

PARAMETER	SYMBOL	Standard mode			UNIT
		MIN.	TYP.	MAX.	
SCL clock frequency	f_{SCL}	-	-	100	kHz
Hold time (repeated) START condition.	$t_{HD:STA}$	4.0	-	-	μs
Low period of the SCL clock	t_{LOW}	4.7	-	-	μs
High period of the SCL clock	t_{HIGH}	4.0	-	-	μs
Set-up time for a repeated START condition	$t_{SU:STA}$	4.7	-	-	μs
Data hold time ^(NOTE)	$t_{HD:DAT}$	0	-	-	μs
Data set-up time	$t_{SU:DAT}$	250	-	-	ns
Rise time of both SDA and SCL signals	t_r	-	-	1000	ns
Fall time of both SDA and SCL signals	t_f	-	-	300	ns
Set-up time for STOP condition	$t_{SU:STO}$	4.0	-	-	μs
Bus free time between a STOP and START condition	t_{BUF}	4.7	-	-	μs
Capacitive load for each bus line	C_b	-	-	400	pF
Noise margin at the Low level	V_{nL}	0.5	-	-	V
Noise margin at the High level	V_{nH}	1	-	-	V

C_b ; total capacitance of one bus line in pF.

NOTE). Data hold time : $t_{HD:DAT}$

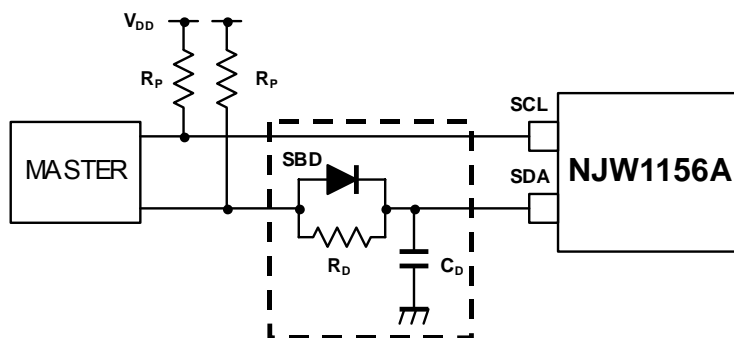
Please hold the Data Hold Time ($t_{HD:DAT}$) to 300ns or more to avoid status of unstable at SCL falling edge.

The SDA block in the NJW1156A does not hold data. Add external data-delay-circuit of the SDA terminal, in case of not providing a hold time of at least 300nsec for the SDA in the master device.

The time-consists of the data-delay-circuit of the SDA terminal are as follows.

- (a) Low level \rightarrow High level: $T_{LH} \approx R_P * C_D$
- (b) High level \rightarrow Low level: $T_{HL} \approx R_D * C_D$

In addition, Schottky barrier diode (SBD) influences a Low level at the Acknowledge. Therefore choose the low forward voltage (V_f) as much as possible.



■ TERMINAL DESCRIPTION

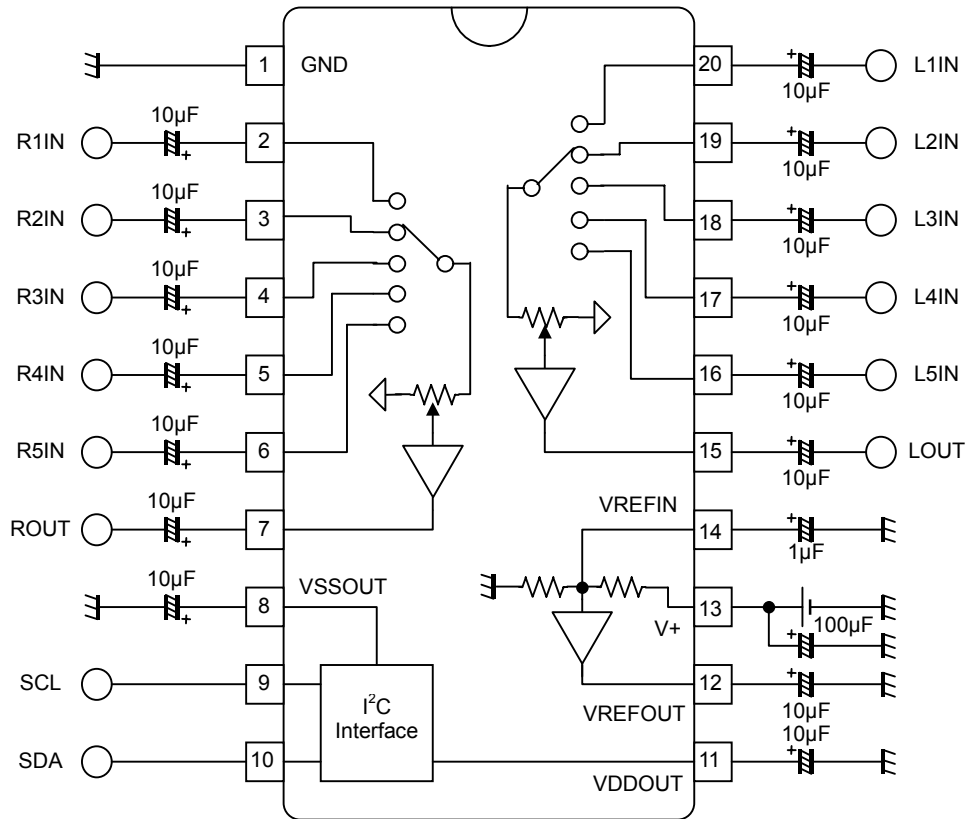
PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL DC VOLTAGE
2 3 4 5 6 16 17 18 19 20	R1IN R2IN R3IN R4IN R5IN L5IN L4IN L3IN L2IN L1IN	R channel Input 1 R channel Input 2 R channel Input 3 R channel Input 4 R channel Input 5 L channel Input 5 L channel Input 4 L channel Input 3 L channel Input 2 L channel Input 1		$V^+/2$
7 15	ROUT LOUT	Rch Output Lch Output		$V^+/2$
8 11	VSS_OUT VDD_OUT	Internal VSS Noise Rejection Capacitor Terminal Internal VDD Noise Rejection Capacitor Terminal		$VSS_OUT = V_{ref} - 2.5V$ $VDD_OUT = V_{ref} + 2.5V$
9	SCL	I ² C Clock Input		-

NJW1156A

■ TERMINAL DESCRIPTION

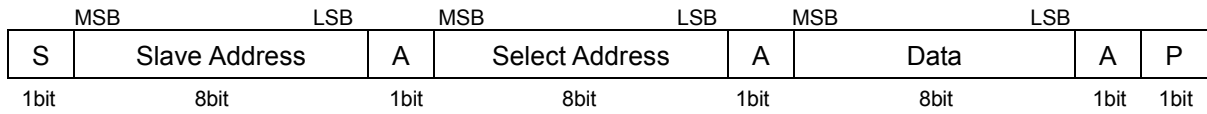
PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL DC VOLTAGE
10	SDA	I ² C Data Input		-
12	VREFOUT	Reference Voltage Output		V ⁺ /2
13	V+	Power Supply		V ⁺
14	VREFIN	Reference Voltage Noise Rejection Capacitor Terminal		V ⁺ /2

APPLICATION CIRCUIT



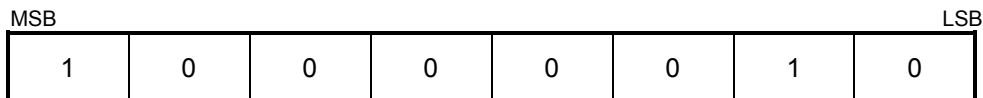
■ DEFINITION OF I²C REGISTER

◆ I²C BUS FORMAT



S: Starting Term
 A: Acknowledge Bit
 P: Ending Term

◆ SLAVE ADDRESS



◆ CONTROL REGISTER TABLE

The select address sets each function (Volume, Selector).
 The auto increment function cycles the select address as follows.
 00H → 01H → 02H → 00H

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
00H	Don't Care	VOL-L						
01H	Don't Care	VOL-R						
02H	Don't Care	TEST		Don't Care		Selector		

◆ CONTROL REGISTER DEFAULT VALUE

Control register default values are as follows :

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
00H	1	1	1	1	1	1	1	1
01H	1	1	1	1	1	1	1	1
02H	0	0	0	0	0	0	0	0

■ CONTROL COMMAND TABLE

a) Master Volume

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
00H	Don't Care	VOL-L						
01H	Don't Care	VOL-R						

•VOL-L / VOL-R: Lch and Rch volume level setting from 0dB to -39.5dB with 0.5dB step.

Gain (dB)	VOL-L / VOL-R						
	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	0	0	0	0
-0.5	0	0	0	0	0	0	1
-1	0	0	0	0	0	1	0
-1.5	0	0	0	0	0	1	1
-2	0	0	0	0	1	0	0
-2.5	0	0	0	0	1	0	1
-3	0	0	0	0	1	1	0
-3.5	0	0	0	0	1	1	1
-4	0	0	0	1	0	0	0
-4.5	0	0	0	1	0	0	1
-5	0	0	0	1	0	1	0
-5.5	0	0	0	1	0	1	1
-6	0	0	0	1	1	0	0
-6.5	0	0	0	1	1	0	1
-7	0	0	0	1	1	1	0
-7.5	0	0	0	1	1	1	1
-8	0	0	1	0	0	0	0
-8.5	0	0	1	0	0	0	1
-9	0	0	1	0	0	1	0
-9.5	0	0	1	0	0	1	1
-10	0	0	1	0	1	0	0
-10.5	0	0	1	0	1	0	1
-11	0	0	1	0	1	1	0
-11.5	0	0	1	0	1	1	1
-12	0	0	1	1	0	0	0
-12.5	0	0	1	1	0	0	1
-13	0	0	1	1	0	1	0
-13.5	0	0	1	1	0	1	1
-14	0	0	1	1	1	0	0
-14.5	0	0	1	1	1	0	1
-15	0	0	1	1	1	1	0
-15.5	0	0	1	1	1	1	1
-16	0	1	0	0	0	0	0
-16.5	0	1	0	0	0	0	1
-17	0	1	0	0	0	1	0
-17.5	0	1	0	0	0	1	1
-18	0	1	0	0	1	0	0
-18.5	0	1	0	0	1	0	1
-19	0	1	0	0	1	1	0
-19.5	0	1	0	0	1	1	1
-20	0	1	0	1	0	0	0
...
-39.5	1	0	0	1	1	1	1
Mute	1	1	1	1	1	1	1

b) Input Selector

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
02H	Don't Care	TEST		Don't Care		Selector		

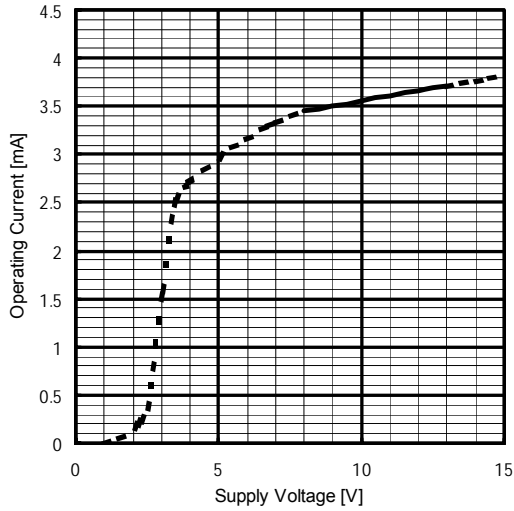
•TEST : Test Mode(User Inhibit). The command "TEST"(D6, D5) must be "0".

•Selector : Input signal selecting

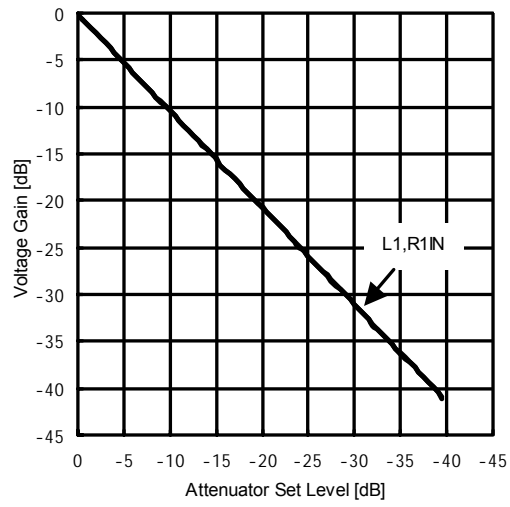
Input	Selector		
	D2	D1	D0
L1IN / R1IN	0	0	0
L2IN / R2IN	0	0	1
L3IN / R3IN	0	1	0
L4IN / R4IN	0	1	1
L5IN / R5IN	1	0	0

TYPICAL CHARACTERISTICS

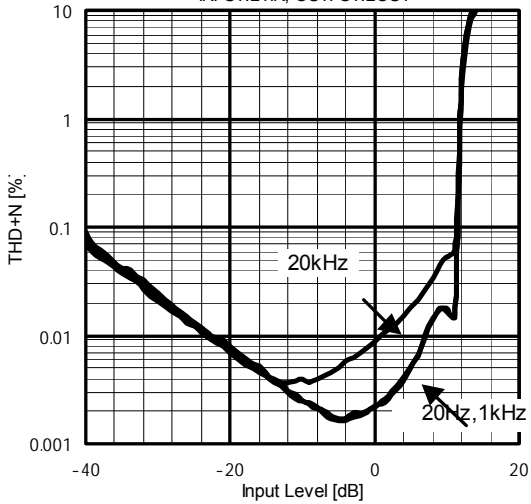
Operating Current vs. Supply Voltage
Ta=25°C



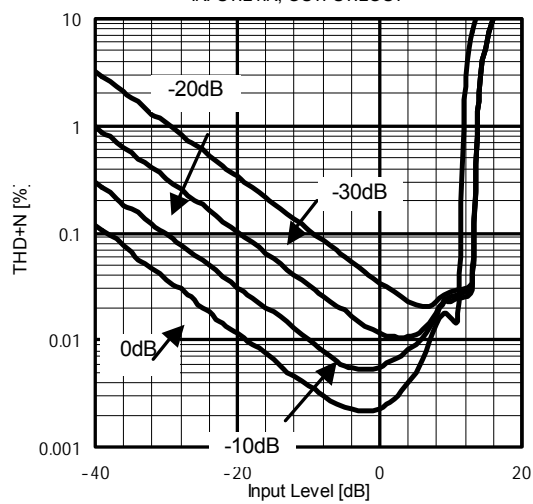
Voltage Gain vs. Attenuator Set Level
Ta=25°C



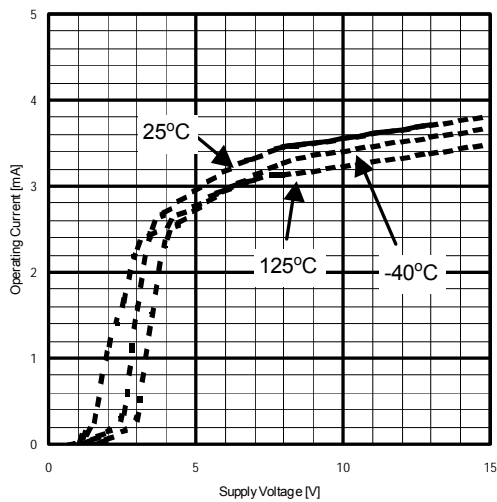
THD+N vs. Input Level
V+=12V, VOL=0dB, BW=10Hz-80kHz
INPUT:L1IN, OUTPUT:L0UT



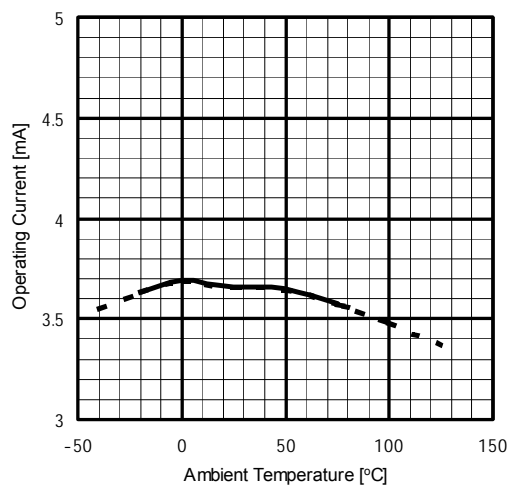
THD+N vs. Input Level
V+=12V, f=1kHz, BW=10Hz-80kHz
INPUT:L1IN, OUTPUT:L0UT



Operating Current vs. Supply Voltage

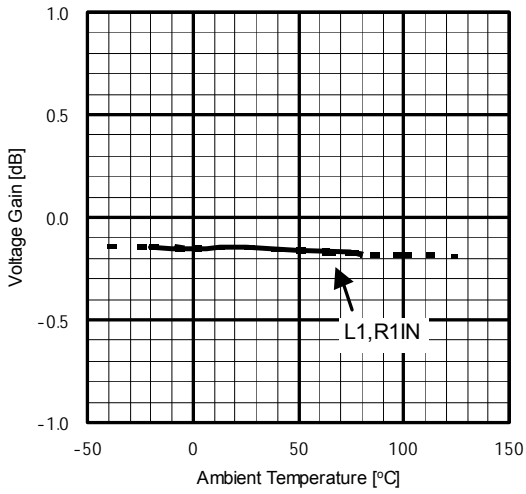


Operating Current vs. Ambient Temperature
V+=12V

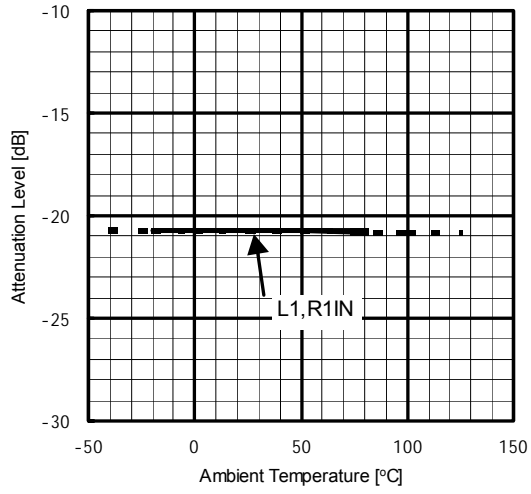


TYPICAL CHARACTERISTICS

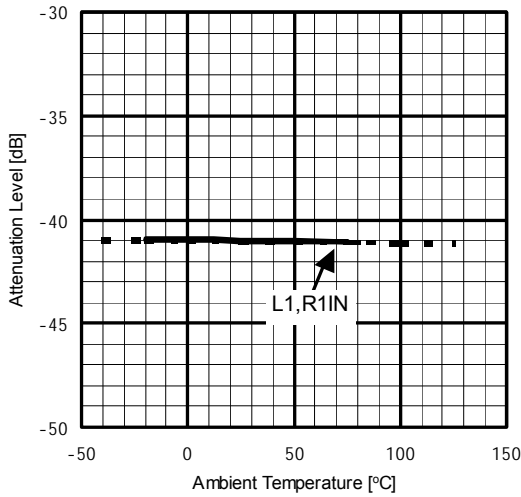
Voltage Gain vs. Ambient Temperature
 $V^+=12V, V_{in}=1V, f=1kHz, Vol=0dB$



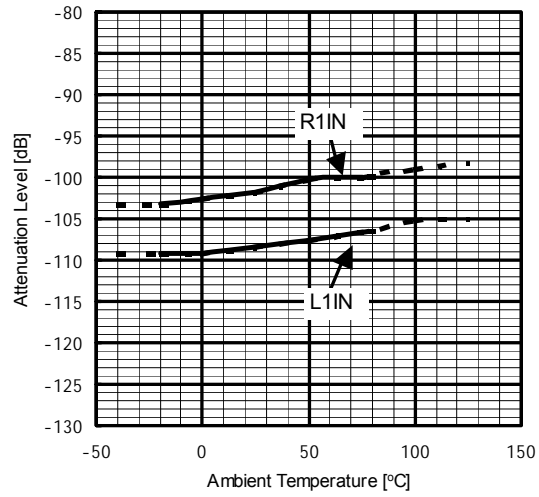
Attenuation Level vs. Ambient Temperature
 $V^+=12V, V_{in}=1V, f=1kHz, Vol=-20dB$



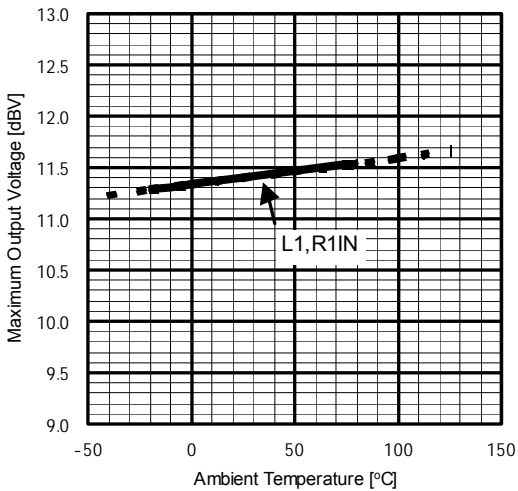
Attenuation Level vs. Ambient Temperature
 $V^+=12V, V_{in}=1V, f=1kHz, Vol=-39.5dB$



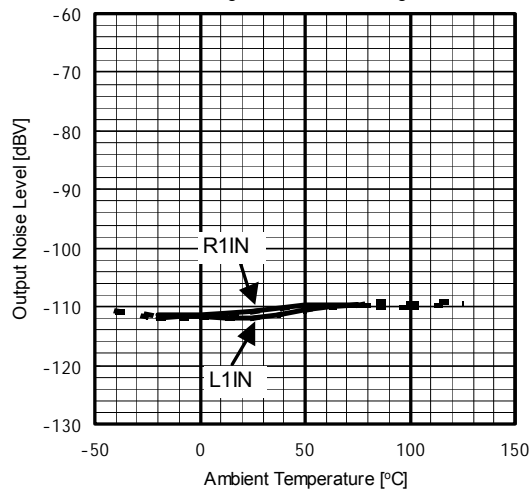
Attenuation Level vs. Ambient Temperature
 $V^+=12V, V_{in}=1V, f=1kHz, Vol=Mute$



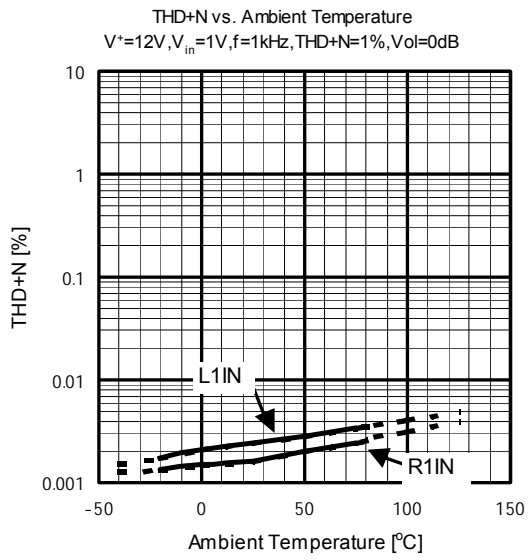
Maximum Output Voltage vs. Ambient Temperature
 $V^+=12V, f=1kHz, THD+N=1%, Vol=0dB$



Output Noise Level vs. Ambient Temperature
 $V^+=12V, R_g=0\Omega, Vol=0dB, A-w eight$



■ TYPICAL CHARACTERISTICS



[CAUTION]
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