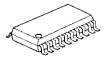
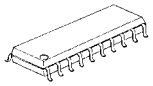
2-CHANNEL ELECTRONIC VOLUME WITH INPUT SELECTOR

■ GENERAL DESCRIPTION

NJW1156 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 I^2C Bus.

■ PACKAGE OUTLINE



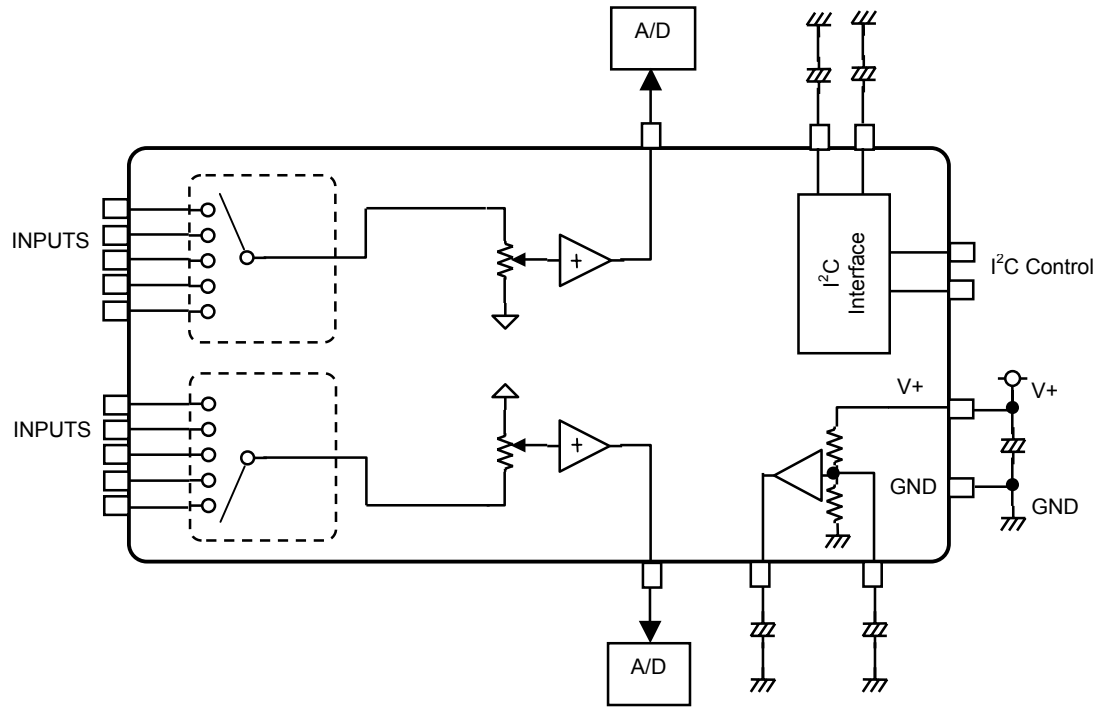


NJW1156V **NJW1156M**

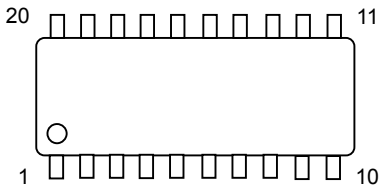
■ FEATURES

- Operating Voltage 8 to 13V
- I^2C Bus control
- 5 Input Selector
- Volume 0 to –39.5dB/0.5dBstep, MUTE
- Bi-CMOS Technology
- Package Outline SSOP20, DMP20

■ 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^2C Clock Input
10	SDA	I^2C 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

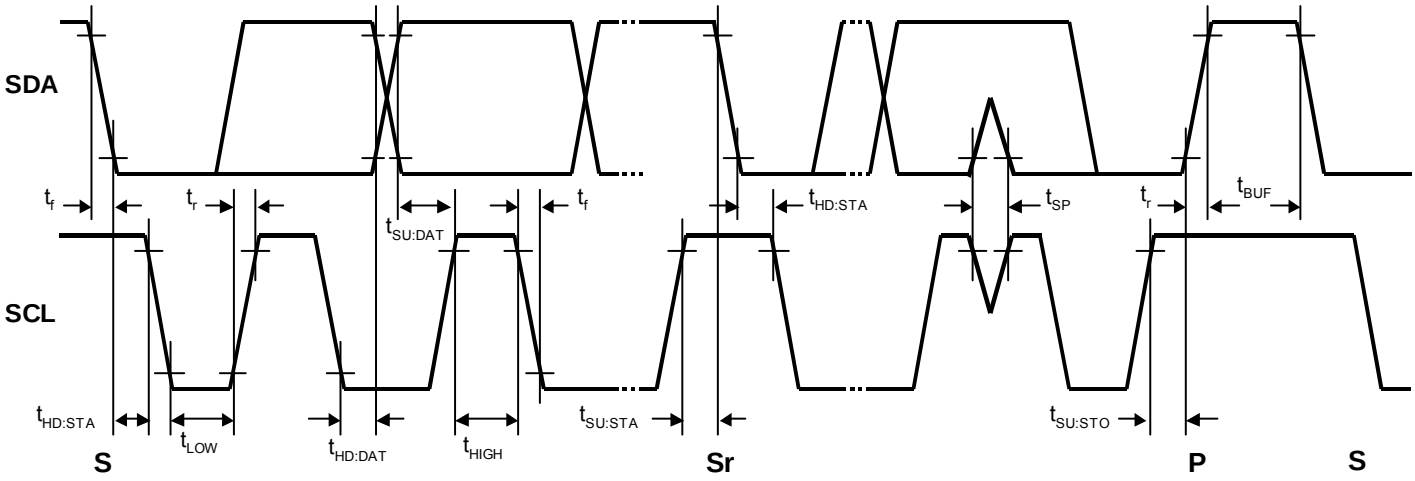
■ **ABSOLUTE MAXIMUM RATING (Ta=25°C)**

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)**

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	-	Vrms
Voltage Gain 1	G_{V1}	V_{IN}=1Vrms, f=1kHz Volume=0dB	-0.5	0	0.5	dB
Voltage Gain 2	G_{V2}	V_{IN}=1Vrms, f=1kHz Volume=-20dB	-21	-20	-19	dB
Voltage Gain 3	G_{V3}	V_{IN}=1Vrms, f=1kHz Volume=-39.5dB	-42.0	-39.5	-37.0	dB
Voltage Gain Error	ΔG_V	V_{IN}=1Vrms, f=1kHz Volume=-20dB , Ach - Bch	-0.5	0	0.5	dB
Mute Level	Mute	f=1kHz, V_{IN}=1Vrms Volume=Mute, A-weight	-	-100	-	dB
Output Noise	V_{NO}	Volume=0dB, Rg=0,A-weight	-	-110 (3.2μ)	-100 (10μ)	dBV (Vrms)
Total Harmonic Distortion	THD	f=1kHz,Vo=1Vrms, Volume=0dB BW : 400Hz - 30kHz	-	0.0015	0.05	%
Channel Separation	CS	f=1kHz,Vo=1Vrms, Volume=0dB Rg=0Ω, A-weight	-	-100	-90	dB

■TIMING ON THE I^2C BUS (SDA,SCL)



■CHARACTERISTICS OF I/O STAGES FOR I^2C BUS (SDA,SCL)

I^2C BUS Load Conditions

STANDARD MODE: Pull up resistance 4kΩ (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	μA

■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.

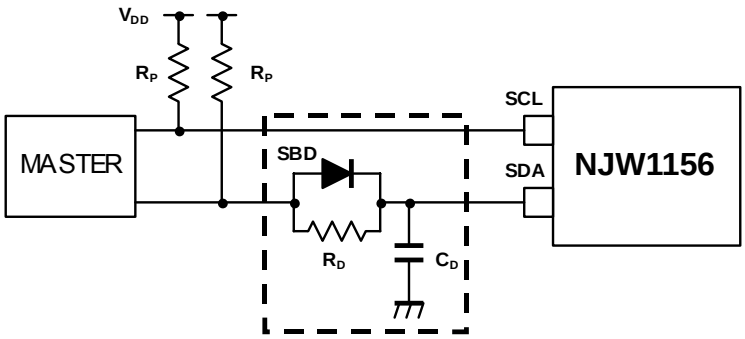
NOTE). Data hold time : $t_{HD:DAT}$

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

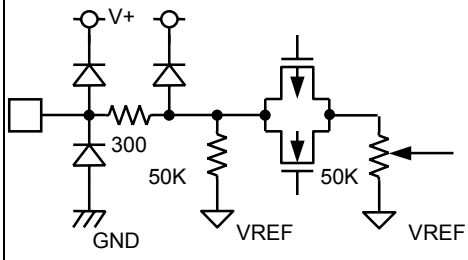
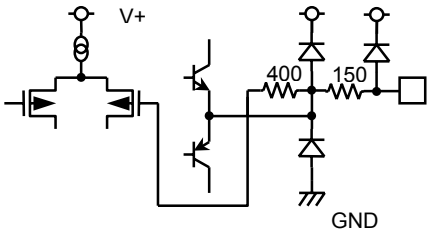
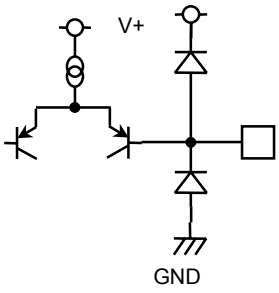
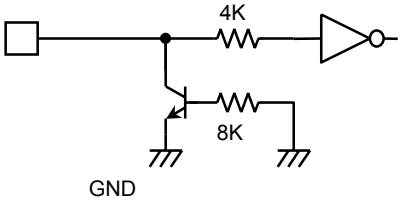
The SDA block in the NJW1156 does not hold data. Add external data-delay-circuit of the SDA terminal, in case of not providing a hold time of at least 300nsec for the SDA in the master device.
The time-consists of the data-delay-circuit of the SDA terminal are as follows.

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

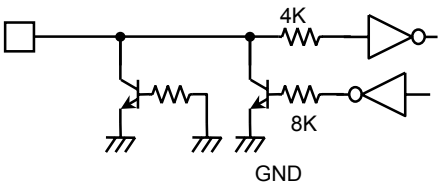
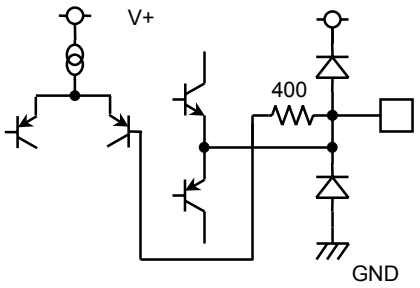
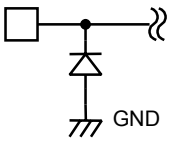
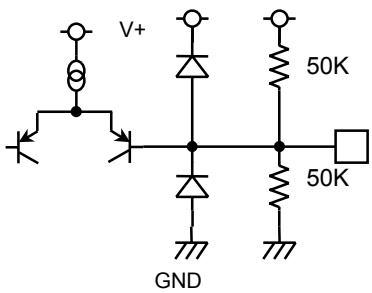
In addition, Schottky barrier diode (SBD) influences a Low level at the Acknowledge. Therefore choose the low forward voltage (Vf) as much as possible.



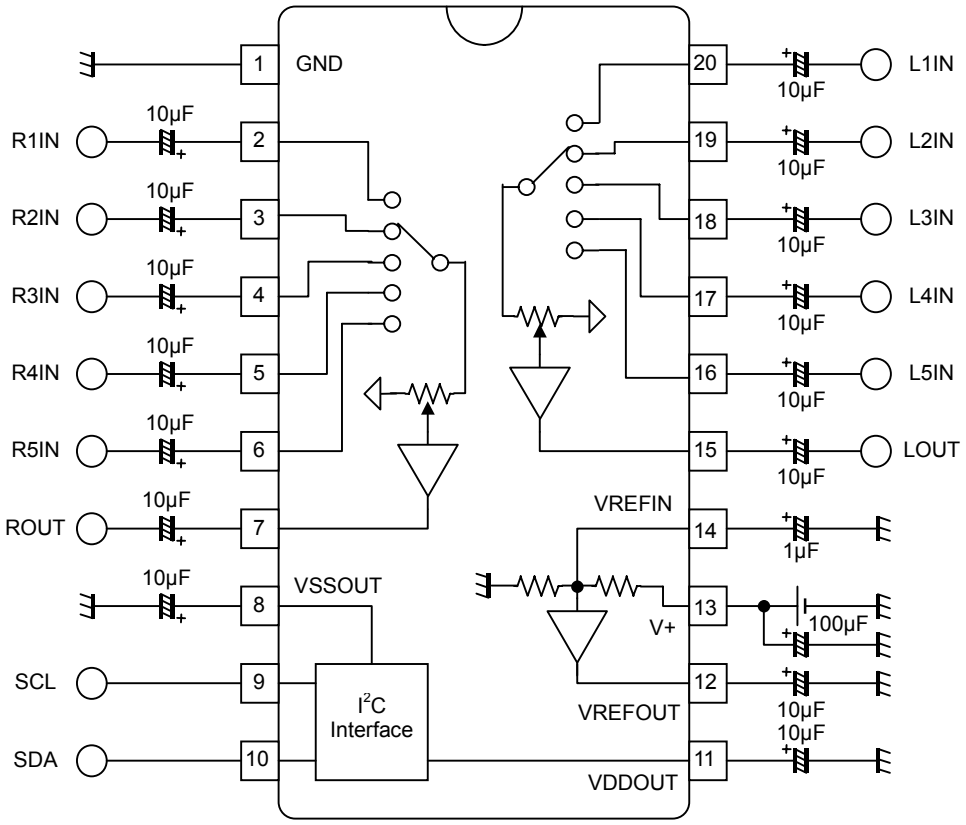
■ TERMINAL DESCRIPTION

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 =Vref – 2.5V VDD_OUT =Vref + 2.5V
9	SCL	I^2C Clock Input		-

■ **TERMINAL DESCRIPTION**

PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL DC VOLTAGE
10	SDA	I^2C 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

	MSB LSB		MSB LSB		MSB LSB		
S	Slave Address	A	Select Address	A	Data	A	P
1bit	8bit	1bit	8bit	1bit	8bit	1bit	1bit

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

♦SLAVE ADDRESS

MSB							LSB
1	0	0	0	0	0	1	0

♦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.

	VOL-L / VOL-R						
Gain (dB)	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		

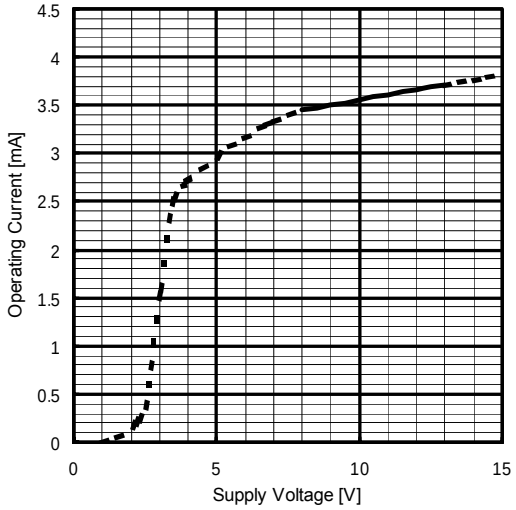
•TEST : Test Mode(User Inhibit). The command "TEST"(D6, D5) must be "0".

•Selector : Input signal selecting

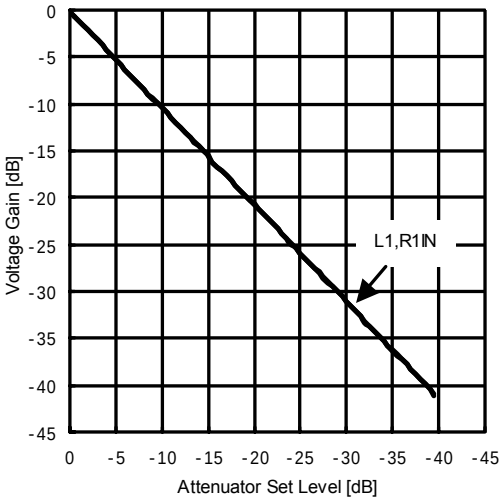
	Selector		
Input	D2	D1	D0
L1IN / R1IN	0	0	0
L2IN / R2IN	0	0	1
L3IN / R3IN	0	1	0
L4IN / R4IN	0	1	1
L5IN / R5IN	1	0	0

■ TYPICAL CHARACTERISTICS

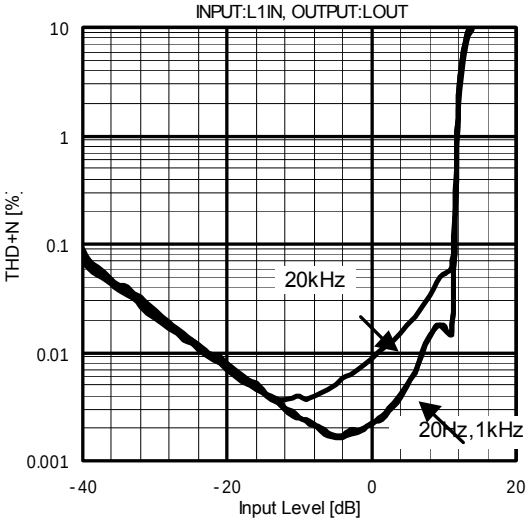
Operating Current vs. Supply Voltage
Ta=25°C



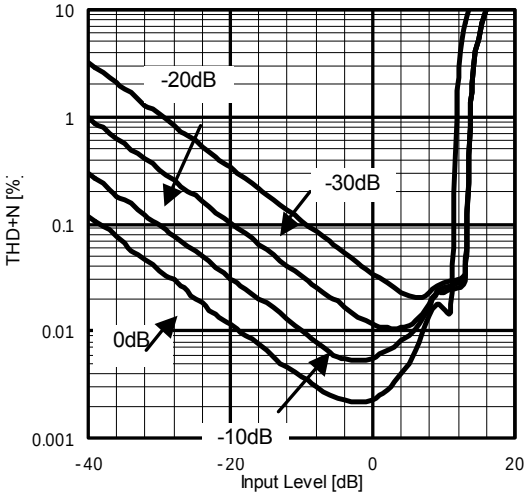
Voltage Gain vs. Attenuater Set Level
Ta=25°C



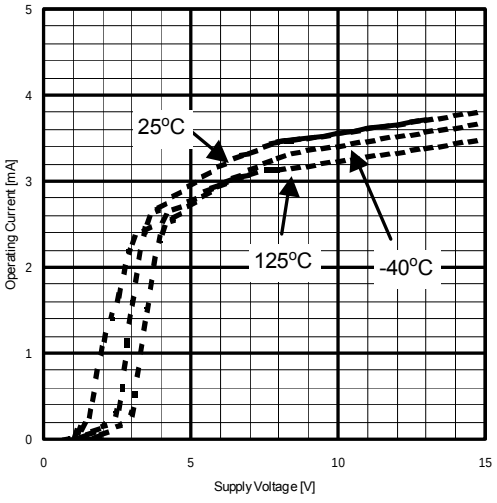
THD+N vs. Input Level
V⁺=12V, VOL=0dB, BW=10Hz-80kHz
INPUT:L1IN, OUTPUT:LOUT



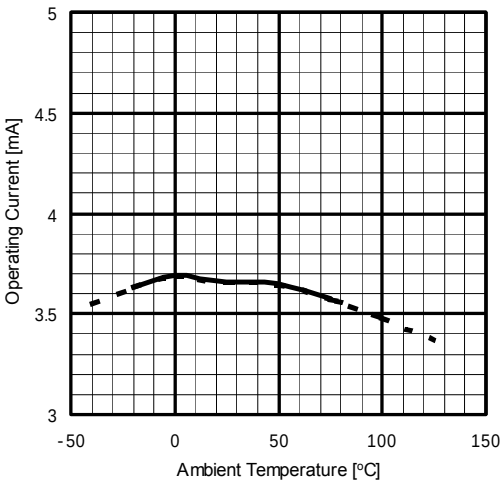
THD+N vs. Input Level
V⁺=12V, f=1kHz, BW=10Hz-80kHz
INPUT:L1IN, OUTPUT:LOUT



Operating Current vs. Supply Voltage

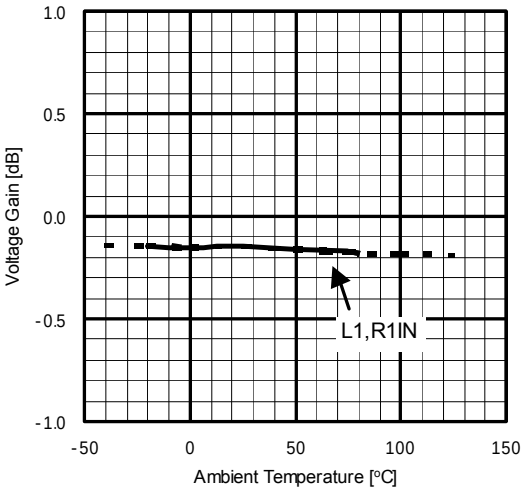


Operating Current vs. Ambient Temperature
V⁺=12V

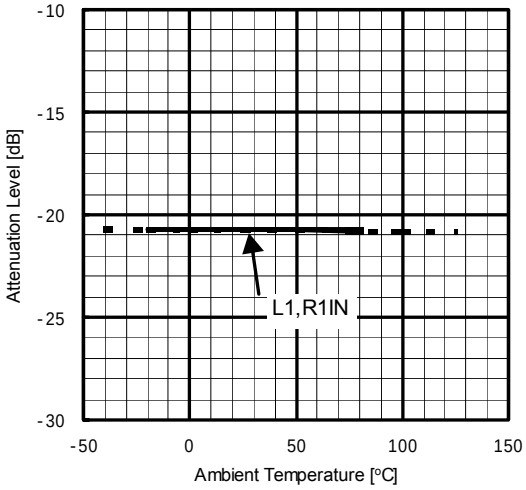


■ TYPICAL CHARACTERISTICS

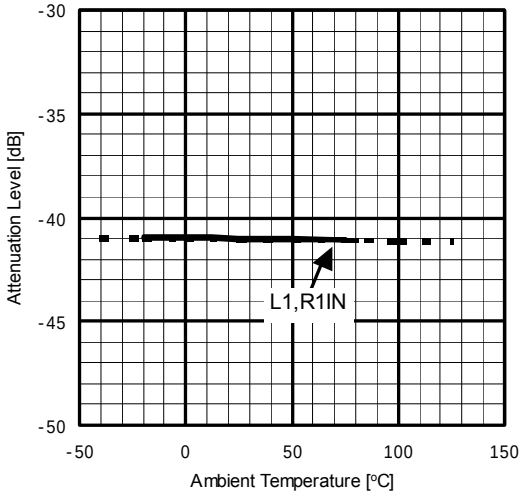
Voltage Gain vs. Ambient Temperature
V^+=12V,V_{in}=1V,f=1kHz,Vol=0dB



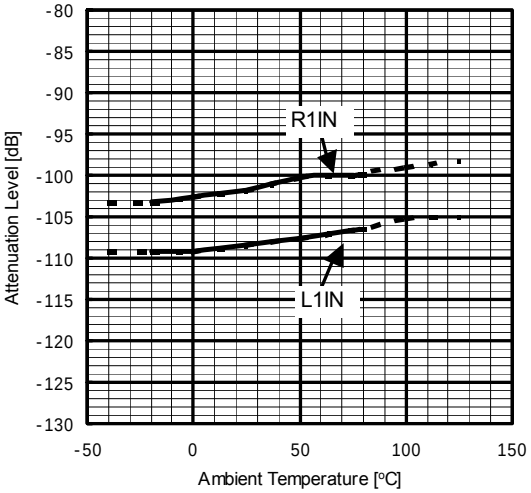
Attenuation Level vs. Ambient Temperature
V^+=12V,V_{in}=1V,f=1kHz,Vol=-20dB



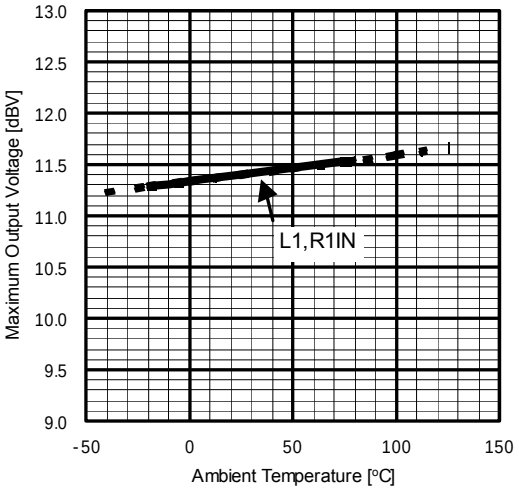
Attenuation Level vs. Ambient Temperature
V+=12V,Vin=1V,f=1kHz,Vol=-39.5dB



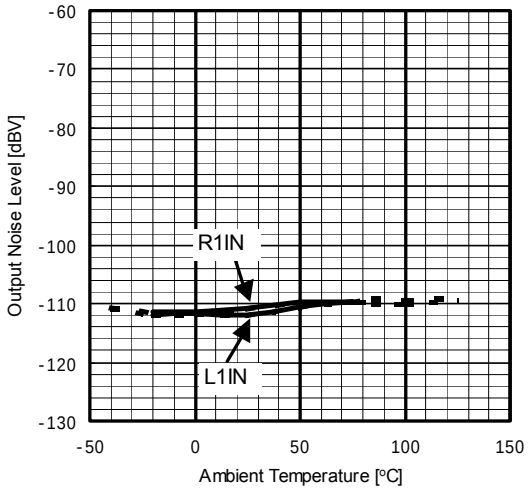
Attenuation Level vs. Ambient Temperature
V+=12V,Vin=1V,f=1kHz,Vol=Mute



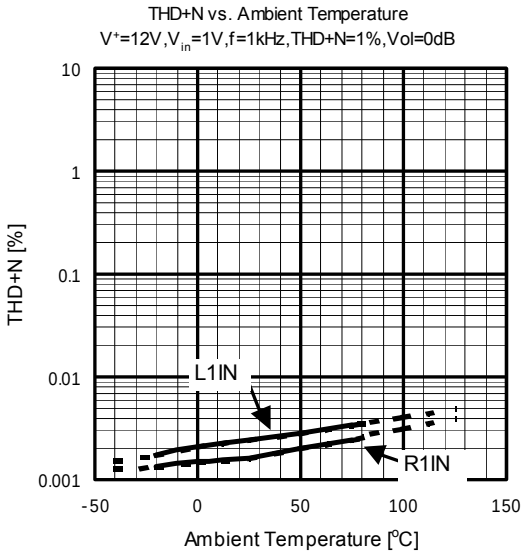
Maximam Output Voltage vs. Ambient Temperature
V+=12V,f=1kHz,THD+N=1%,Vol=0dB



Output Noise Level vs. Ambient Temperature
V+=12V,Rg=0Ω,Vol=0dB,A-w eight



■ TYPICAL CHARACTERISTICS



[CAUTION]
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