



2ch Pushbutton Interface EVR with eala Stereo Expander

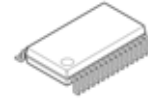
■ GENERAL DESCRIPTION

The **NJU7392** is a 2-channel electronic volume which include a Volume control, 2-in stereo input selector (with 1 x Differential input), eala Stereo Expander control (Stereo enhancement for narrow speakers), Bass boost control with ALC feature and a Stand-by function (Power-saving mode).

The **NJU7392** has also built-in push button interface for its volume, Bass Boost and eala Stereo Expander controls - making application possible without the use of micro-controller.

The **NJU7392** is suitable for low power application and also for application with narrow speaker such as mobile audio player and cradle speaker for mobile game.

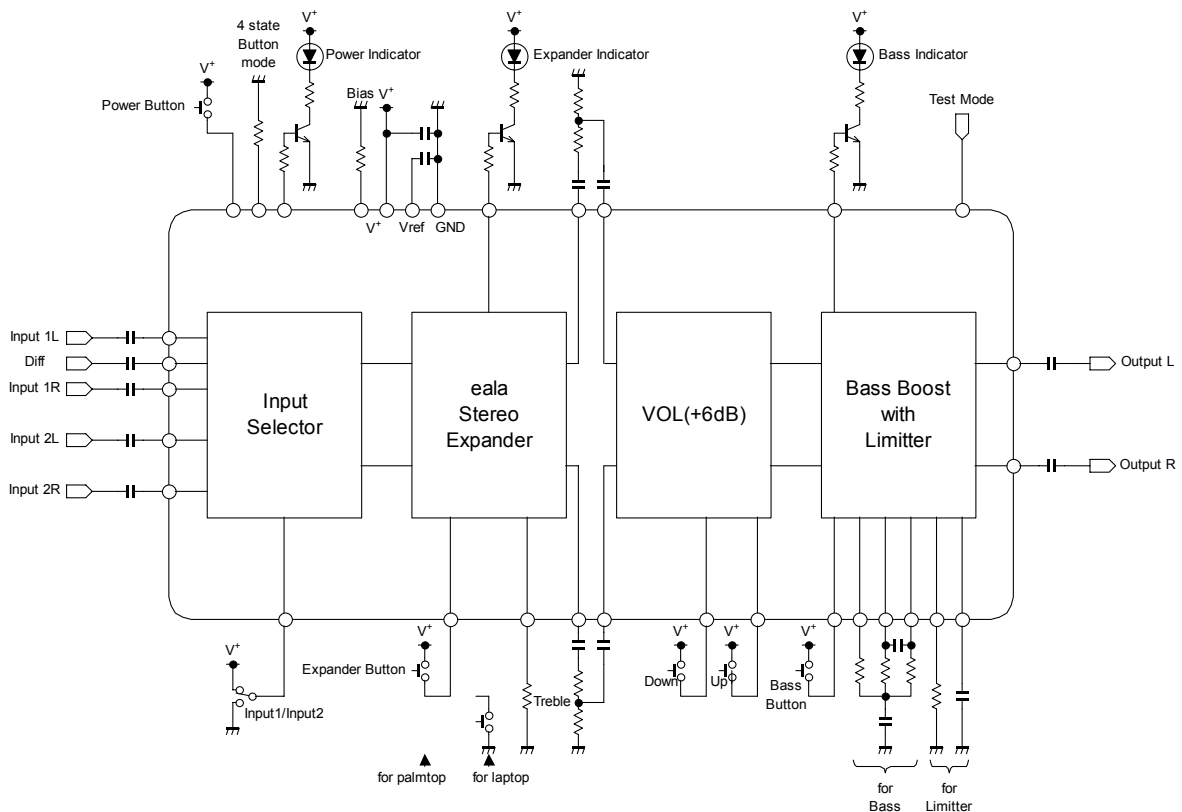
■ PACKAGE OUTLINE



■ FEATURES

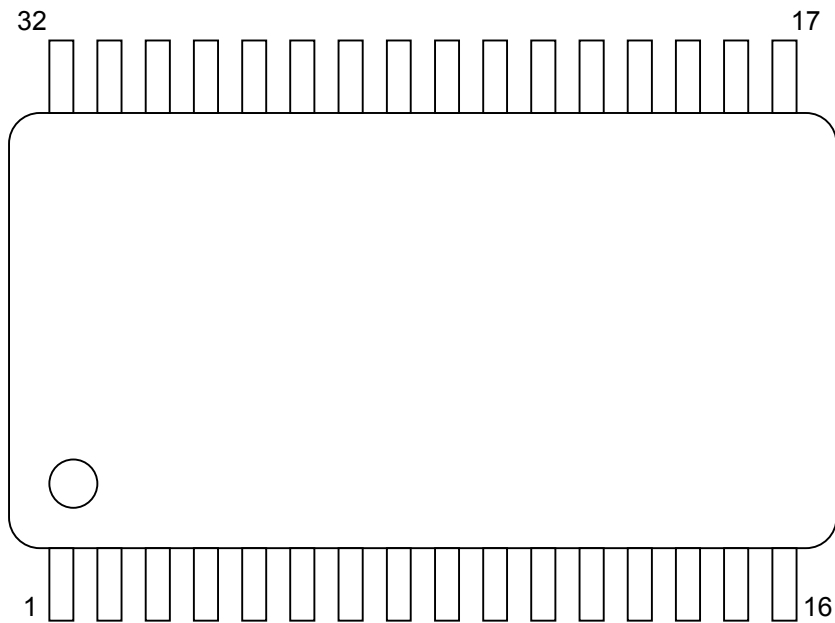
- Operating Voltage +2.7 to +5.5V
- Low operating current 5mA typ. (Active mode)
1μA typ. (stand-by mode)
- Low output noise 20μVrms typ. (eala Stereo Expander : ON)
- Input Selector 2ch (single-end / quasi-differential)
- Sound Space adjustment for narrow speaker
- Pushbutton interface EVR 0 to -68dB, MUTE
- Bass Boost with ALC
- CMOS Technology
- Package Outline SSOP32

■ BLOCK DIAGRAM



NJU7392

■ PIN CONFIGURATION



No.	Symbol	Function	No.	Symbol	Function
1	IN1L	Lch Input 1	17	BBIND	Bass Boost Indicator
2	IN1G	Common Input 1	18	EXIND	Stereo Expander Indicator
3	IN1R	Rch Input 1	19	PWIND	Power Indicator
4	IN2L	Lch Input 2	20	TREBLE	Treble Gain Setting
5	IN2R	Rch Input 2	21	SWMODE	Control Mode Setting
6	EXOUTL	Stereo Expander Output L	22	IREF	Reference Current
7	VOLINL	Volume Input L	23	VREF	Reference Voltage
8	EXOUTR	Stereo Expander Output R	24	V+	Power Supply
9	VOLINR	Volume Input R	25	GND	Ground
10	SELSW	Input Selector Setting	26	INT	Limiter Recovery Time Setting
11	PWSW	Power Switch	27	SENSE	Limiter Threshold Setting
12	EXSW	Stereo Expander Switch	28	BB1	Bass Boost Filter Terminal 1
13	BBSW	Bass Boost Switch	29	BB2	Bass Boost Filter Terminal 2
14	UP	Volume Up Switch	30	BB3	Bass Boost Filter Terminal 3
15	DOWN	Volume Down Switch	31	OUTR	Rch Output
16	TEST	Test Terminal	32	OUTL	Lch Output

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

PARAMETER	SYMBOL	RATING	UNIT
Power Supply Voltage	V ⁺	+7	V
Power Dissipation	P _D	950 ^{*1)}	mW
Maximum Input Voltage	V _{IMAX}	0 ~ V ⁺ ^{*2)}	V
Operating Temperature Range	Topr	-40 ~ +85	°C
Storage Temperature Range	Tstg	-40 ~ +125	°C

*1) EIA/JEDEC STANDARD Test board (76.2x114.3x1.6mm, 2layer, FR-4) mounting

*2) Don't apply the input voltage that exceeds supply voltage.

■ **ELECTRICAL RECOMMENDED OPERATING CONDITION** (Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Voltage	V ⁺	-	2.7	3.3	5.5	V

■ **ELECTRICAL CHARACTERISTICS**

● **DC CHARACTERISTICS** (Ta=25°C, V⁺=3.3V, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Current	I _{DD1}	No Signal, Active	-	5.0	8.0	mA
	I _{DD2}	No Signal, Standby	-	0.1	1.0	μA
Reference Voltage	V _{REF}	No signal	1.5	1.65	1.8	V

● **AC CHARACTERISTICS**

(Ta=25°C, V⁺=3.3V, V_{IN}=500mVrms, f=1kHz, Expander: OFF, Treble:0dB, Bass Boost: OFF, VOL:0dB, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITION	TEST CONDITION			MIN.	TYP.	MAX.	UNIT
			IN		OUT				
			L	R					
Maximum Input Voltage 1	V _{IM1}	THD=1% BW=400Hz-30kHz	V _{IN} -	- V _{IN}	L R	550	580	-	mVrms
Maximum Input Voltage 2	V _{IM2}	Expander: Palmtop THD=1%, BW=400Hz-30kHz	V _{IN} 0	0 V _{IN}	L R	550	580	-	mVrms
Maximum Input Voltage 3	V _{IM3}	Expander: Palmtop Bass: ON, f=1kHz THD=1%, BW=400Hz-30kHz	V _{IN} V _{IN}	V _{IN} V _{IN}	L R	550	580	-	mVrms
Output Noise Voltage 1	V _{NO1}	Rg=0Ω, A-weighted	0 0	0 0	L R	-	-100 (10)	-94 (20)	dBV (μVrms)
Output Noise Voltage 2	V _{NO2}	Rg=0Ω, A-weighted VOL=-68dB	0 0	0 0	L R	-	-100 (10)	-94 (20)	dBV (μVrms)
Output Noise Voltage 3	V _{NO3}	Expander: Palmtop Rg=0Ω, A-weighted	0 0	0 0	L R	-	-90 (32)	-80 (100)	dBV (μVrms)
Output Noise Voltage 4	V _{NO4}	Expander: Palmtop Bass: ON, Rg=0Ω, A-weighted	0 0	0 0	L R	-	-90 (32)	-80 (100)	dBV (μVrms)
Total Harmonic Distortion 1	THD+N ₁	BW=400Hz-30kHz	V _{IN} -	- V _{IN}	L R	-	0.05	0.1	%
Total Harmonic Distortion 2	THD+N ₃	Expander: Palmtop BW=400Hz-30kHz	V _{IN} 0	0 V _{IN}	L R	-	0.1	0.5	%
Total Harmonic Distortion 3	THD+N ₃	Expander: Palmtop Bass: ON BW=400Hz-30kHz	V _{IN} 0	0 V _{IN}	L R	-	0.1	0.5	%

PARAMETER	SYMBOL	TEST CONDITION	TEST CONDITION			MIN.	TYP.	MAX.	UNIT
			IN		OUT				
			L	R					
Bypass Gain	G_{VBYP}	Treble=0dB	V_{IN} -	- V_{IN}	L R	-1.0	0.0	1.0	dB
Treble Gain	G_{VTRE}	f=10kHz	V_{IN} -	- V_{IN}	L R	2.0	3.0	4.0	dB
Expander Gain 1	G_{VEXP1}	Expander: Laptop f=10kHz	V_{IN} V_{IN}	V_{IN} V_{IN}	L R	1.7	3.7	5.7	dB
Expander Gain 2	G_{VEXP2}	Expander: Palmtop f=10kHz	V_{IN} V_{IN}	V_{IN} V_{IN}	L R	3.0	5.0	7.0	dB
Expander Gain 3	G_{VEXP3}	Expander: Laptop	V_{IN} 0	0 V_{IN}	L R	2.1	4.1	6.1	dB
Expander Gain 4	G_{VEXP4}	Expander: Palmtop	V_{IN} 0	0 V_{IN}	L R	3.3	5.3	7.3	dB
Bass Gain	G_{VBASS}	Bass: ON $V_{IN}=100mV_{rms}$ f=100Hz	V_{IN} V_{IN}	V_{IN} V_{IN}	L R	4.0	6.0	8.0	dB
Maximum Attenuate level	G_{VOL-68}	VOL=-68dB BW=400Hz-30kHz	V_{IN} -	- V_{IN}	L R	-70	-68	-66	dB
Mute Level	Mute	VOL=Mute BW=400Hz-30kHz	V_{IN} -	- V_{IN}	L R	-	-90	-86	dB
Channel Balance	G_{CB}		V_{IN} -	- V_{IN}	L R	-1.0	0.0	1.0	dB
Bass Limit Level	V_{LIM}	Bass: ON $V_{IN}=0.7V_{rms}$ f=100Hz	V_{IN} V_{IN}	V_{IN} V_{IN}	L R	0.75	1.0	1.25	Vrms
Cross Talk	CT	Selected Input: No Signal, $R_g=0\Omega$ BW=400Hz-30kHz	V_{IN} -	- V_{IN}	L R	70	80	-	dB
Channel Separation	CS	$R_g=0\Omega$ BW=400Hz-30kHz	0 V_{IN}	V_{IN} 0	L R	70	80	-	dB

● **Indicator Output Block** ($T_a=25^\circ C$, $V^+=3.3V$, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
High Input Voltage	V_{OH}	$I_{SOURCE}=1mA$ (pin 17, pin 18, pin 19)	$V^+*0.8$	-	V^+	V
Low Input Voltage	V_{OL}	$I_{SINK}=1mA$ (pin 17, pin 18, pin 19)	0	-	$V^+*0.2$	V

● **Control Block** ($T_a=25^\circ C$, $V^+=3.3V$, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
High Input Voltage	V_{IH}		$V^+*0.8$	-	V^+	V
Low Input Voltage	V_{IL}		0	-	$V^+*0.2$	V
Pull-Up Resistance	R_{PULLUP}		-	100	-	k Ω
Mode Resistance range 1/4	R_{MODE1}	pin 20, pin 21	0	-	40	k Ω
Mode Resistance range 2/4	R_{MODE2}	pin 20, pin 21	60	-	85	k Ω
Mode Resistance range 3/4	R_{MODE3}	pin 20, pin 21	110	-	130	k Ω
Mode Resistance range 4/4	R_{MODE4}	pin 20, pin 21	165	-	∞	k Ω
Pulse Distinction Time			15	20	25	ms
Auto Increment Distinction Time			0.7	1	1.2	s
Auto Increment cycle			120	167	200	ms


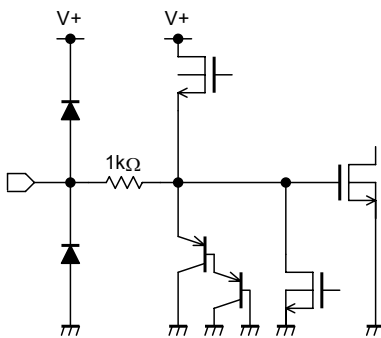
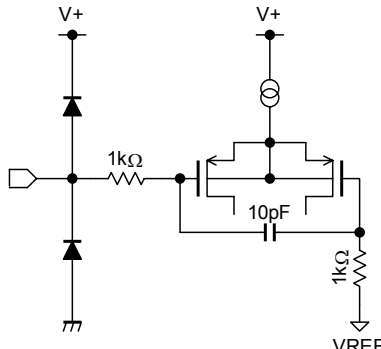
■ TERMINAL DESCRIPTION

PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL DC VOLTAGE
1 3	IN1L IN1R	Lch Input 1 Rch Input 1		$V^+/2$ $V^+/2$
2	IN1G	Common Input 1		$V^+/2$
4 5	IN2L IN2R	Lch Input 2 Rch Input 2		$V^+/2$ $V^+/2$
6 8 17 18 19 28 30 31 32	EXOUTL EXOUTR BBIND EXIND PWIND BB1 BB3 OUTR OUTL	Stereo Expander Output L Stereo Expander Output R Bass Boost Indicator Stereo Expander Indicator Power Indicator Bass Boost Filter Terminal 1 Bass Boost Filter Terminal 3 Rch Output Lch Output		$V^+/2$ $V^+/2$ 0V or V^+ 0V or V^+ 0V or V^+ $V^+/2$ $V^+/2$ $V^+/2$ $V^+/2$

NJU7392

PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL DC VOLTAGE
7 9	VOLINL VOLINR	Volume Input L Volume Input R		$V^+/2$ $V^+/2$
10	SELSW	Input Selector Setting		0V
11 14 15 16	PWSW UP DOWN TEST	Power Switch Volume Up Switch Volume Down Switch Test Terminal		0V 0V 0V 0V
12 13	EXSW BBSW	Stereo Expander Switch Bass Boost Switch		$V^+/2$ $V^+/2$

PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL DC VOLTAGE
20 21 27	TREBLE SWMODE SENSE	Treble Gain Setting Control Mode Setting Limiter Threshold Setting		It depends on a test circuit.
22	IREF	Reference Current		1.2V
23	VREF	Reference Voltage		$V^+/2$
24	V+	Power Supply		V^+

PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL DC VOLTAGE
25	GND	Ground		0V
26	INT	Limiter Recovery Time Setting		0V
29	BB2	Bass Boost Filter Terminal 2		$V^+/2$

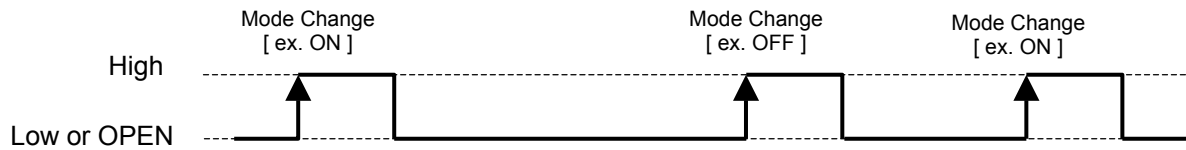
■ PIN DESCRIPTION

SWMODE (pin 21)

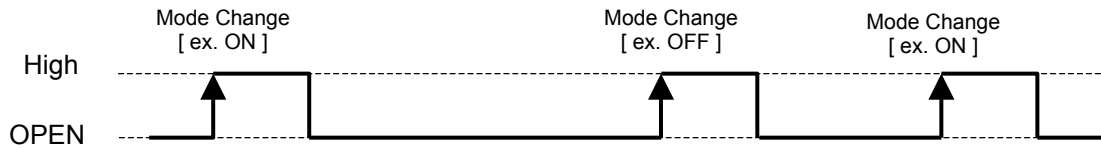
PIN CONDITION	FUNCTION
0Ω to 45kΩ	PWSW (Pin 11) and EXSW (Pin 12) - both as Momentary SW mode.
55kΩ to 90kΩ	PWSW (Pin 11) - Momentary SW mode, EXSW (Pin 12) - Alternative SW mode.
110kΩ to 135kΩ	PWSW (Pin 11) - Alternative SW mode, EXSW (Pin 12) - Momentary SW mode.
165kΩ to OPEN	PWSW (Pin 11) and EXSW (Pin 12) - both as Alternative SW mode.

Momentary SW mode data format

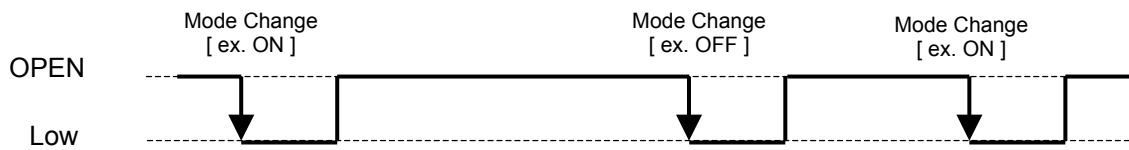
● Momentary SW mode 1



● Momentary SW mode 2

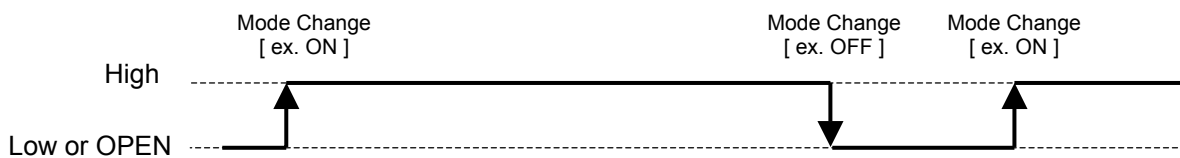


● Momentary SW mode 3

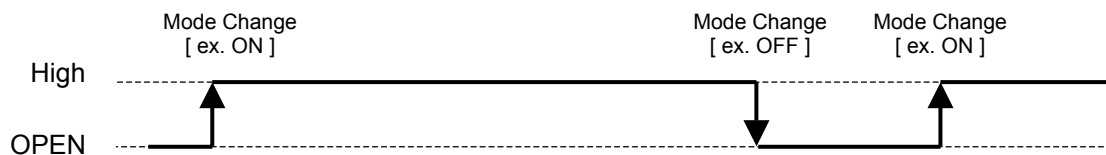


Alternative SW mode data format

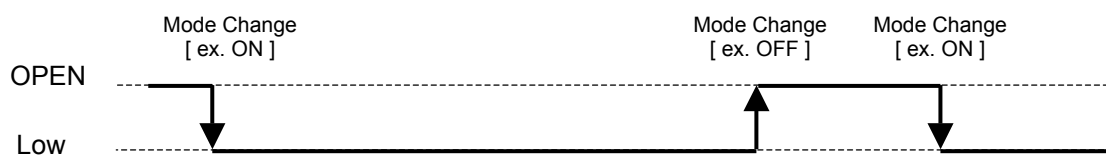
● Alternative SW mode 1



● Alternative SW mode 2



● Alternative SW mode 3



NJU7392

SELSW (pin 10)

PIN CONDITION	FUNCTION
L(OPEN)	Input 1 is selected.
H	Input 2 is selected.

* The "Momentary SW mode" does not support.

PWSW (pin 11)

●Momentary SW mode setting (* Momentary SW mode 1)

PIN CONDITION	FUNCTION
OPEN(L)→H	System status is changed to active mode and standby mode alternately.
H→OPEN(L)	No change.

●Alternative SW mode setting (* Alternative SW mode 1)

PIN CONDITION	FUNCTION
H	Active mode
OPEN(L)	Standby Mode.

EXSW (pin 12)

●Momentary SW mode setting

PIN CONDITION	FUNCTION
OPEN→H	Stereo Expander setting is changed to ON and OFF alternately. (Palmtop Mode) (* Momentary SW mode 2)
H→OPEN	No change. (* Momentary SW mode 2)
OPEN→L	Stereo Expander setting is changed to ON and OFF alternately. (Laptop Mode) (* Momentary SW mode 3)
L→OPEN	No change. (* Momentary SW mode 3)

●Alternative SW mode setting

PIN CONDITION	FUNCTION
H	Stereo Expander setting is set to ON. (Palmtop Mode) (* Alternative SW mode 2)
L	Stereo Expander Setting is set to ON. (Laptop Mode) (* Alternative SW mode 3)
OPEN	Stereo Expander Setting is set to OFF.

BBSW (pin 13)

* As for the bass boost setting, a control data to 13pin arranges a control mode ("Momentary" or "Alternative") regardless of the condition on 21pin.

●Momentary SW mode setting (* Momentary SW mode 2)

PIN CONDITION	FUNCTION
OPEN→H	Bass Boost Setting is changed to ON and OFF alternately.
H→OPEN	No change.

●Alternative SW mode setting (* Alternative SW mode 3)

PIN CONDITION	FUNCTION
OPEN→L	Bass Boost Setting is set to ON.
L→OPEN	Bass Boost Setting is set to OFF.

UP (pin 14)
●Momentary SW mode setting (* Momentary SW mode 1)

PIN CONDITION	FUNCTION
OPEN(L)→H	Volume setting is increased 1 step. Long push increase volume setting continuously.
H→OPEN(L)	No change.

* The "Alternative SW mode" does not support.

DOWN (pin 15)
●Momentary SW mode setting (* Momentary SW mode 1)

PIN CONDITION	FUNCTION
OPEN(L)→H	Volume setting is decreased 1 step. Long push decrease volume setting continuously.
H→OPEN(L)	No change.

* The "Alternative SW mode" does not support.

TEST (pin 16)

PIN CONDITION	FUNCTION
L	Normal operation mode
H	Test mode. Do not use for normal operation.

TREBLE (pin 20)

PIN CONDITION	FUNCTION
0Ω to 45kΩ	Frequency response is set to flat under Stereo Expander setting OFF condition.
55kΩ to 90kΩ	Treble gain is set to +2dB under Stereo Expander setting OFF condition.
110kΩ to 135kΩ	Treble gain is set to +3dB under Stereo Expander setting OFF condition.
165kΩ to OPEN	Treble gain is set to +4dB under Stereo Expander setting OFF condition.

NJU7392

■ CONTROL DATA

● INITIAL CONDITION (POWER ON)

FUNCTION	TERMINAL	CONDITION
Stereo Expander	pin 12	OFF
Bass Boost	pin 13	OFF
Volume	pin 14, pin15	-12dB

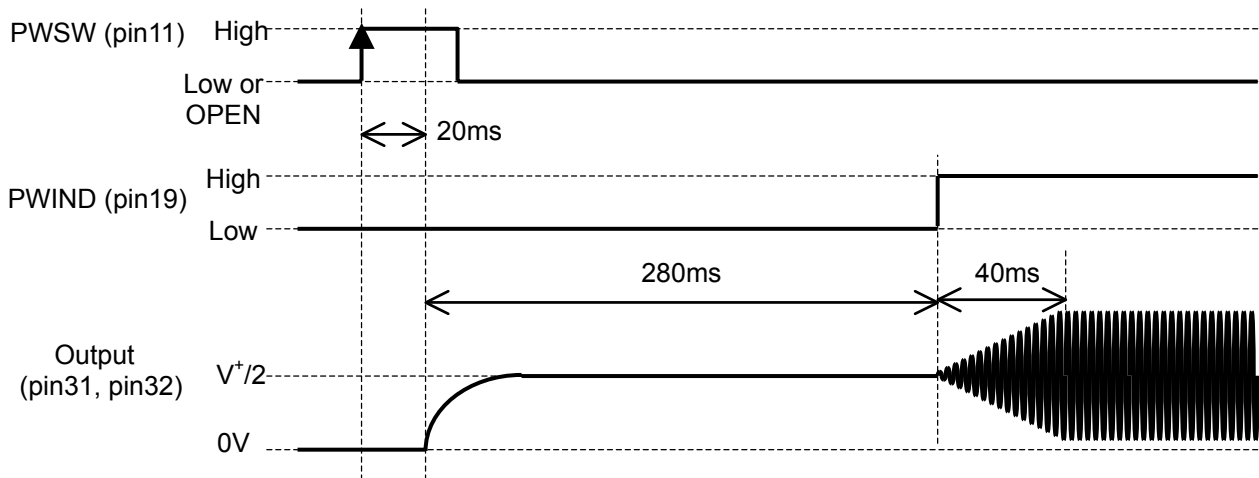
● Volume gain step setting

Step No.	Volume [dB]
0	MUTE
1	-68
2	-64
3	-60
4	-56
5	-52
6	-48
7	-45
8	-42
9	-39
10	-36
11	-34
12	-32
13	-30
14	-28
15	-26
16	-24
17	-22
18	-20
19	-18
20	-16
21	-14
22	-12^(*)
23	-10
24	-8
25	-6
26	-5
27	-4
28	-3
29	-2
30	-1
31	0

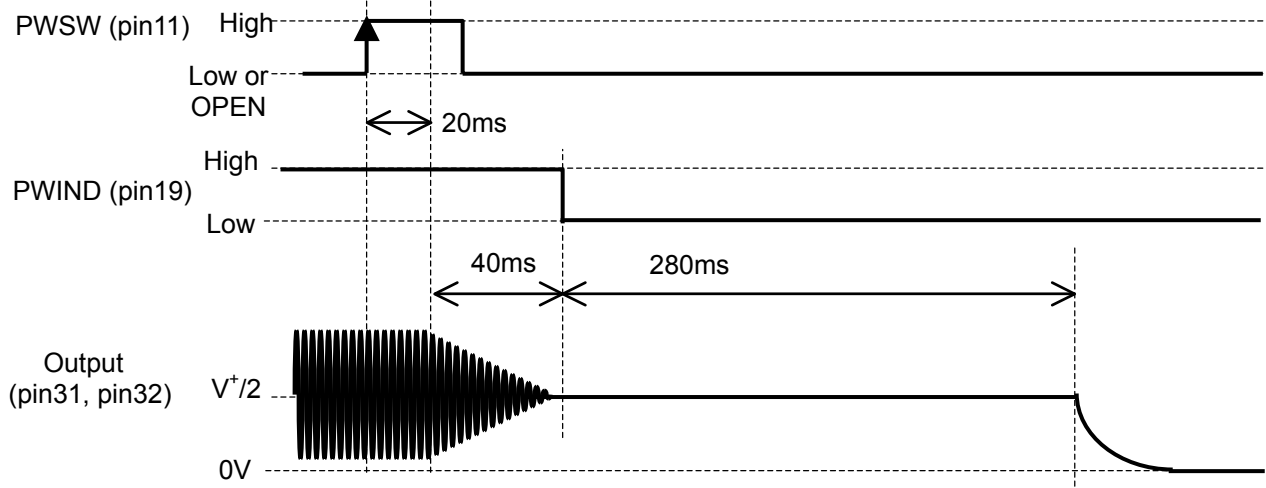
^(*)Initial Setting

■ TIMING CHART (Momentary SW mode)

● Standby release (Standby mode → Active mode)



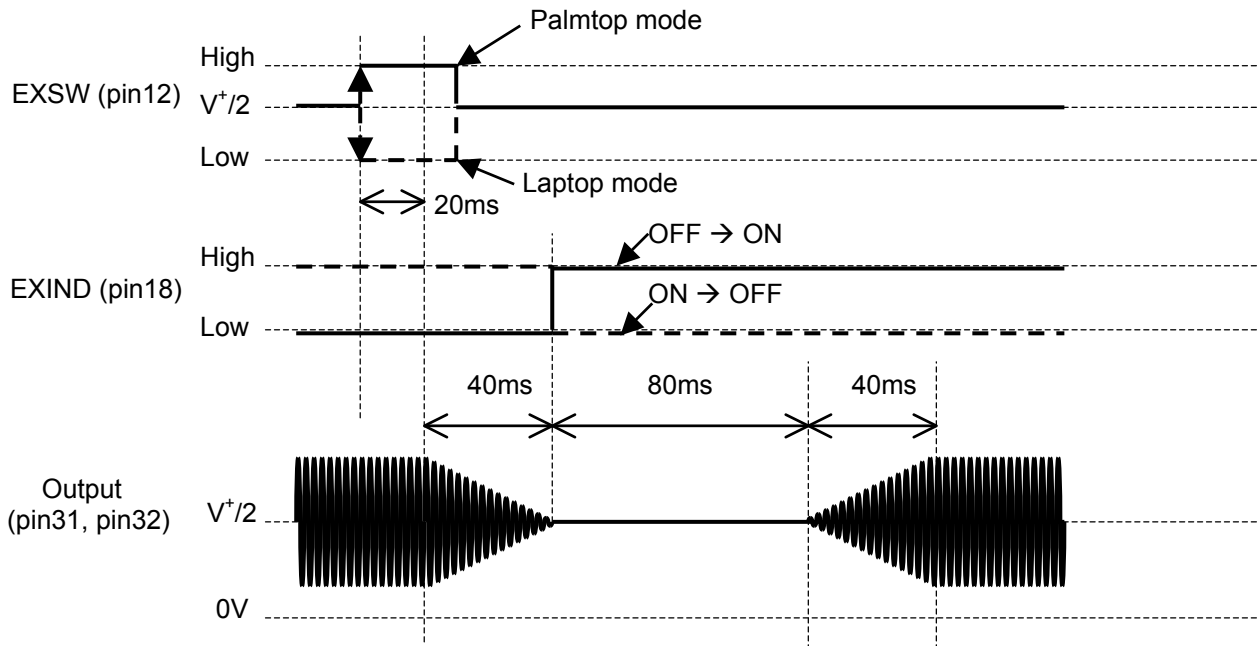
● Standby (Active mode → Standby mode)



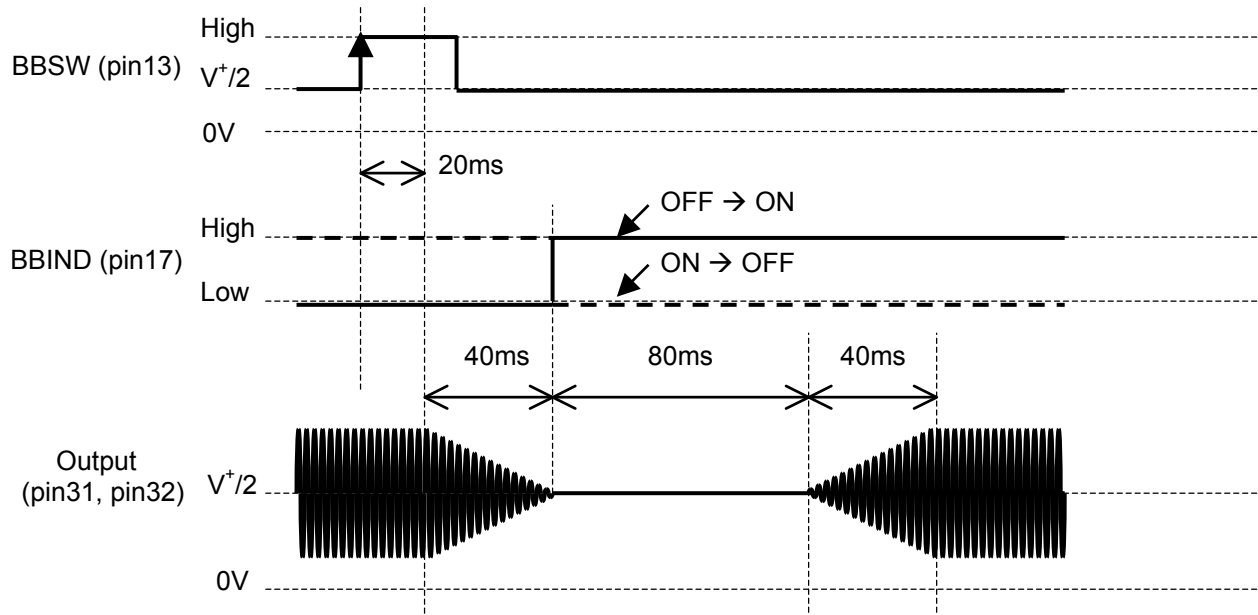
NJU7392

■ TIMING CHART (Momentary SW mode)

● Stereo Expander ON/OFF

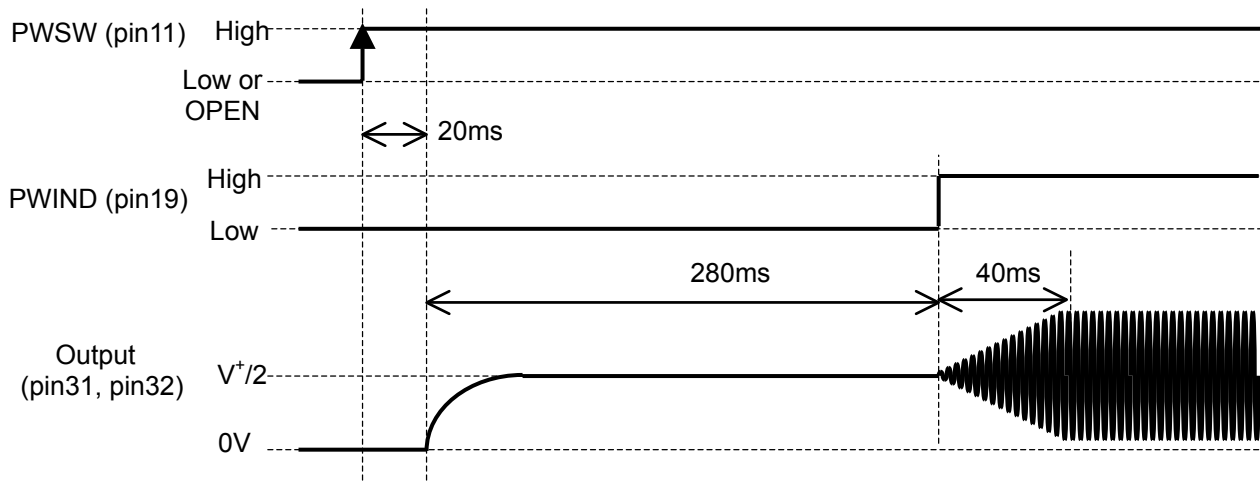


● Bass Boost ON/OFF

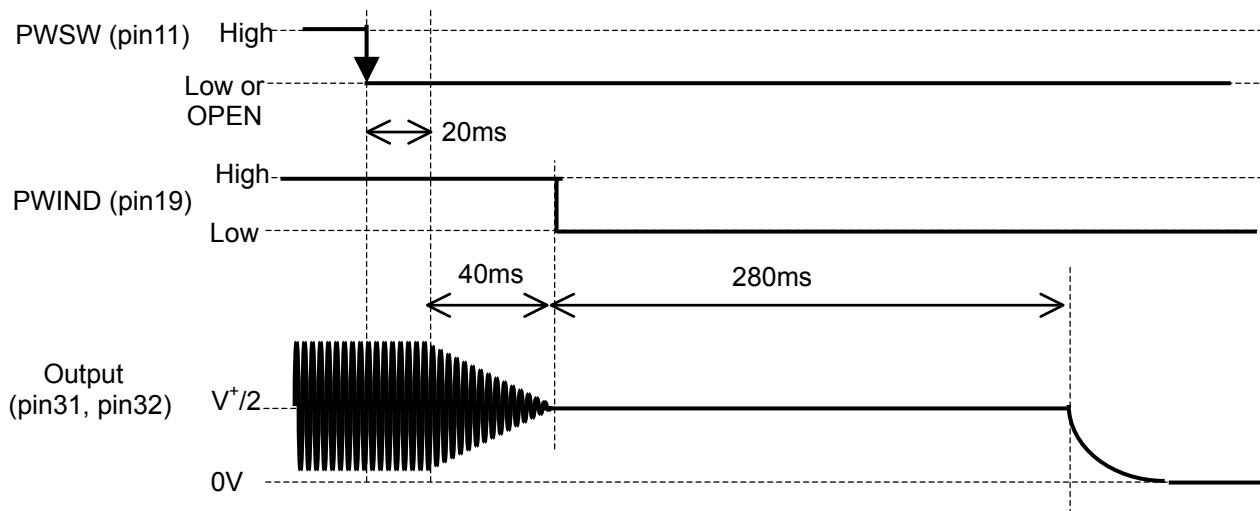


■ TIMING CHART (Alternative SW mode)

● Standby release (Standby mode → Active mode)



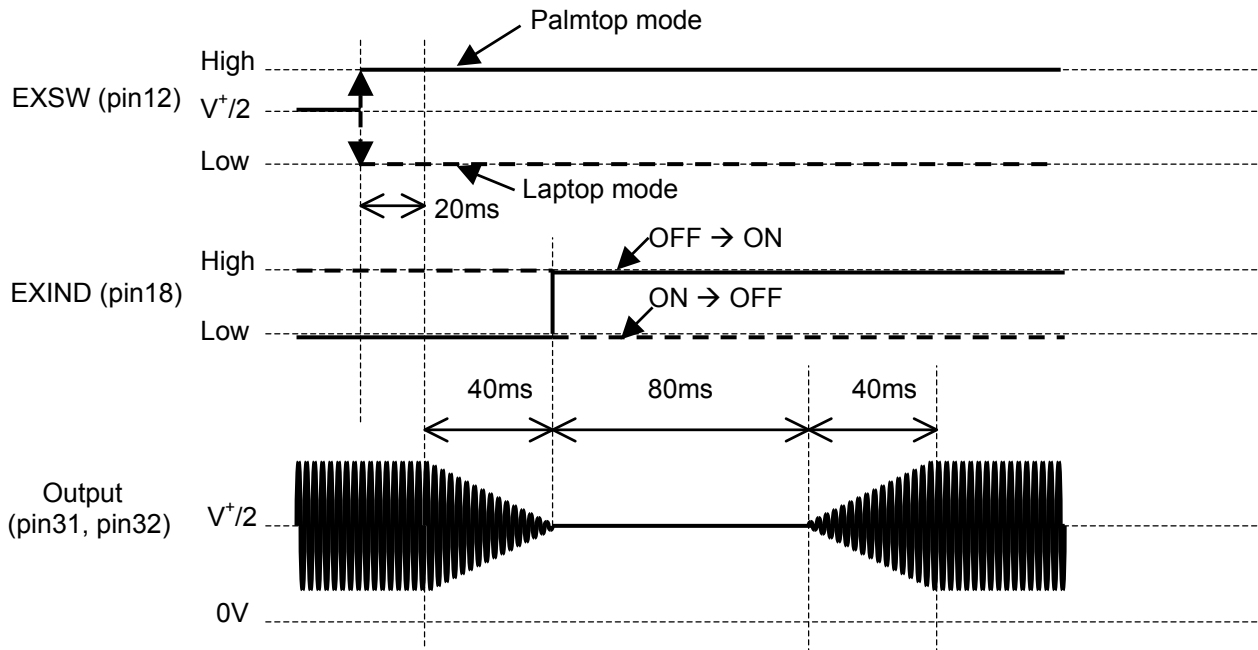
● Standby (Active mode → Standby mode)



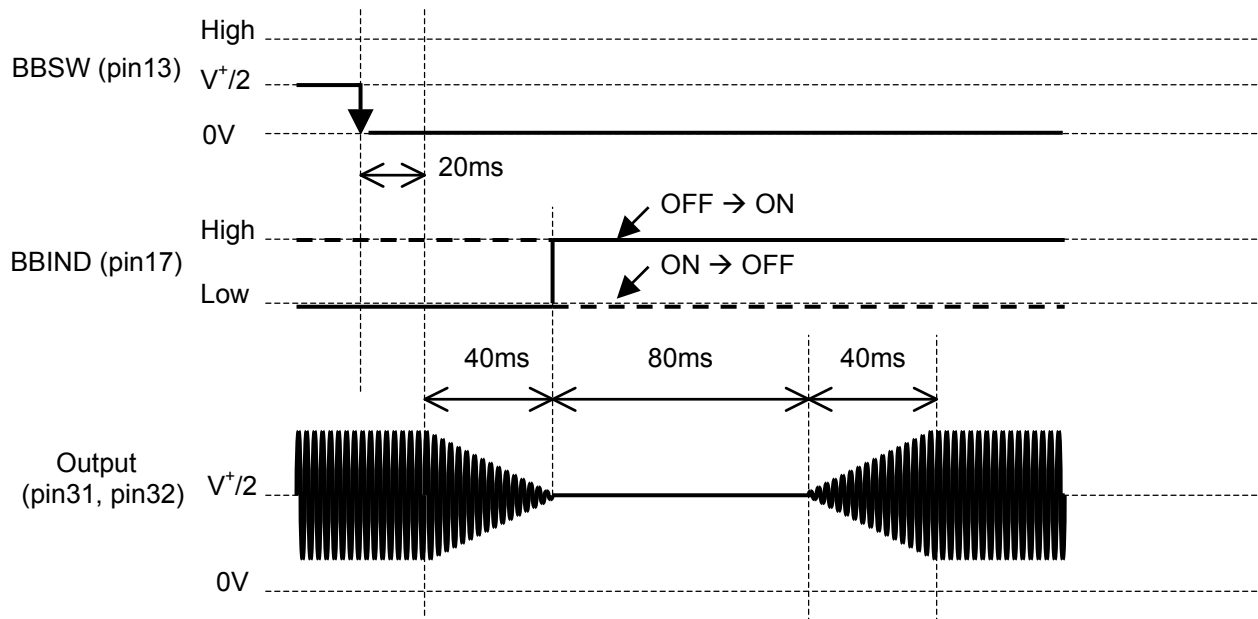
NJU7392

■ TIMING CHART (Alternative SW mode)

● Stereo Expander ON/OFF

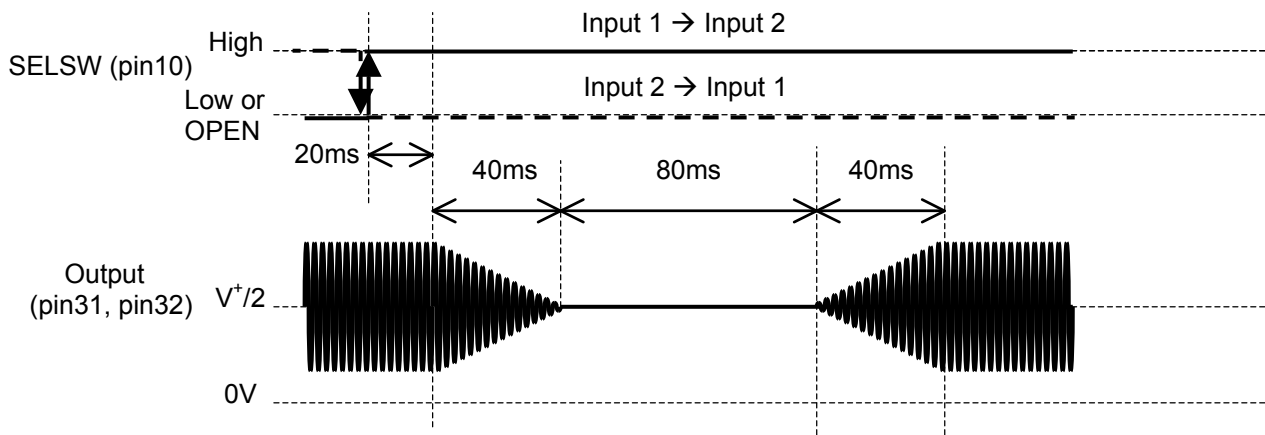


● Bass Boost ON/OFF



■ TIMING CHART (Alternative SW mode)

● Input Selector

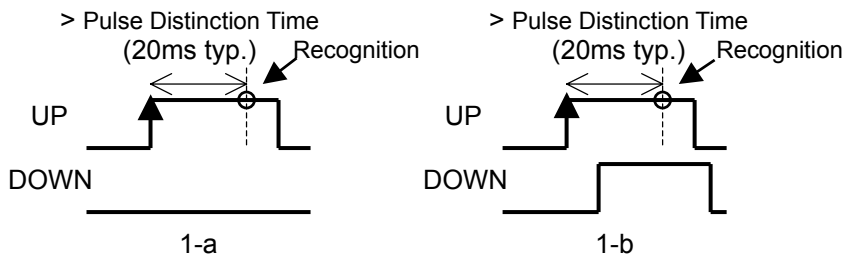


■ TIMING CHART (Volume UP/DOWN control)

1. Recognition condition of Volume UP/DOWN push button I/F

1-a.) The Volume UP/(DOWN) recognizes the data-command to **the case that the DOWN(UP) button has not been pushed, besides that the UP(DOWN) button is pushed for the longer time than the “Pulse Distinction Time: 20ms”.**

1-b.) The Volume UP/(DOWN) recognizes the data-command to **the case that the UP(DOWN) button has pushed earlier than the DOWN(UP) button, besides the UP(DOWN) button is pushed for the longer time than the “Pulse Distinction Time: 20ms”.**

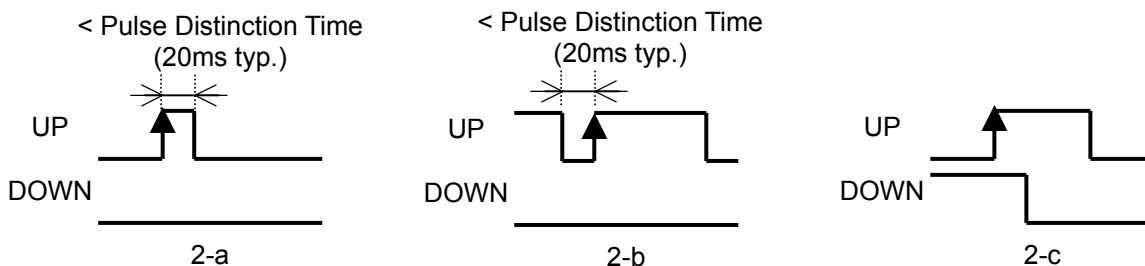


2. Invalidity condition of Volume UP/DOWN push button I/F

2-a.) The Volume UP/(DOWN) **does NOT** recognize the data-command to **the case that the UP(DOWN) button has pushed for the shorter time than the “Pulse Distinction Time: 20ms”.** (The Chattering prevention function operates.)

2-b.) The Volume UP/(DOWN) **does NOT** recognize the data-command to **the case that the UP(DOWN) button has pushed for the shorter time than the “Pulse Distinction Time: 20ms” after released button.** (The Chattering prevention function operates.)

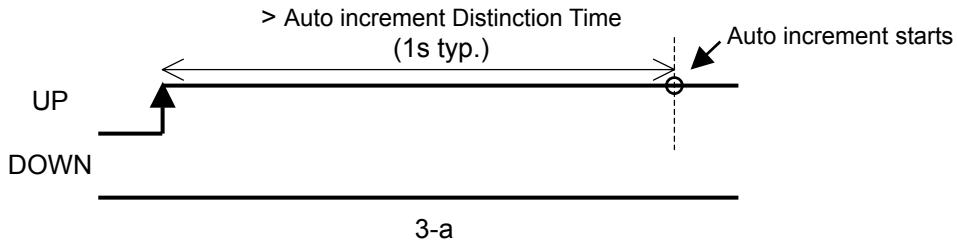
2-c.) The Volume UP/(DOWN) **does NOT** recognize the data-command to **the case that the UP(DOWN) button has pushed before releasing DOWN(UP) button.**



■ TIMING CHART (Volume UP/DOWN control)

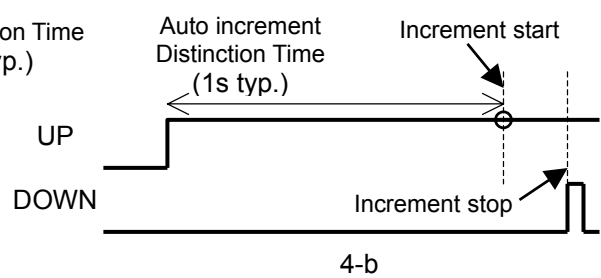
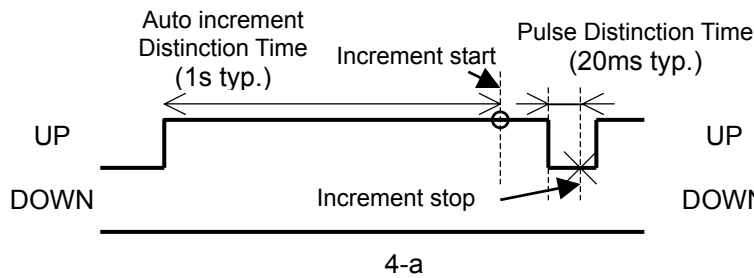
3. Start condition of Volume UP/DOWN Auto increment function

3-a.) The Auto increment of volume UP(DOWN) is started to **the case that the DOWN(UP) button has not been pushed, besides that the UP(DOWN) button is pushed for the longer time than the "Auto increment Distinction Time: 1s"**.



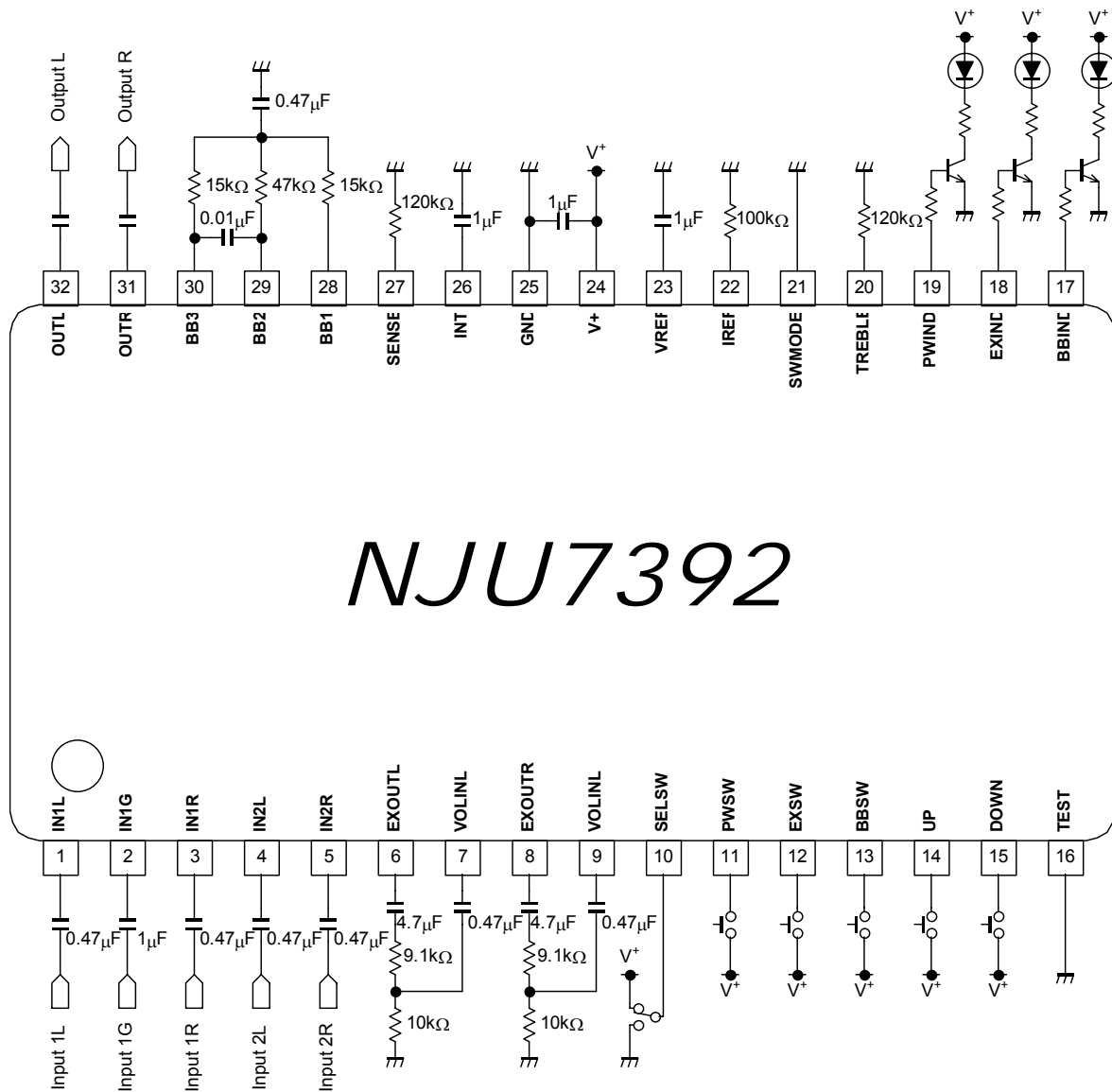
4. Stop condition of Volume UP/DOWN Auto increment function

4-a.) The Auto increment of volume UP(DOWN) is stopped to **the case that the UP(DOWN) button has released for the longer time than the "Pulse Distinction Time: 20ms"** for the Auto increment period.



NJU7392

■ APPLICATION CIRCUIT



[CAUTION]
 The specifications on this databook are only given for information, without any guarantee as regards either mistakes or omissions. The application circuits in this databook are described only to show representative usages of the product and not intended for the guarantee or permission of any right including the industrial rights.