

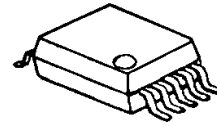
## Monaural BTL Output Clock-less Switching Driver for Class D Amplifier

### ■ GENERAL DESCRIPTION

The **NJU8789** is a monaural BTL output switching driver for class D amplifier including Separated Power Source terminals between Input and Output. It converts 1bit digital signal input, such as PWM or PDM signal.

The **NJU8789** realizes very high power-efficiency by class D operation. Therefore, it is suitable for portable set with speaker.

### ■ PACKAGE OUTLINE

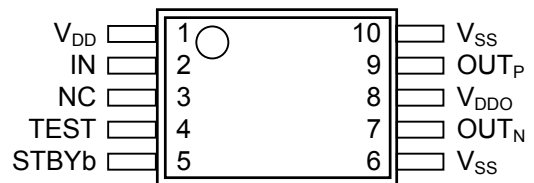


NJU8789V

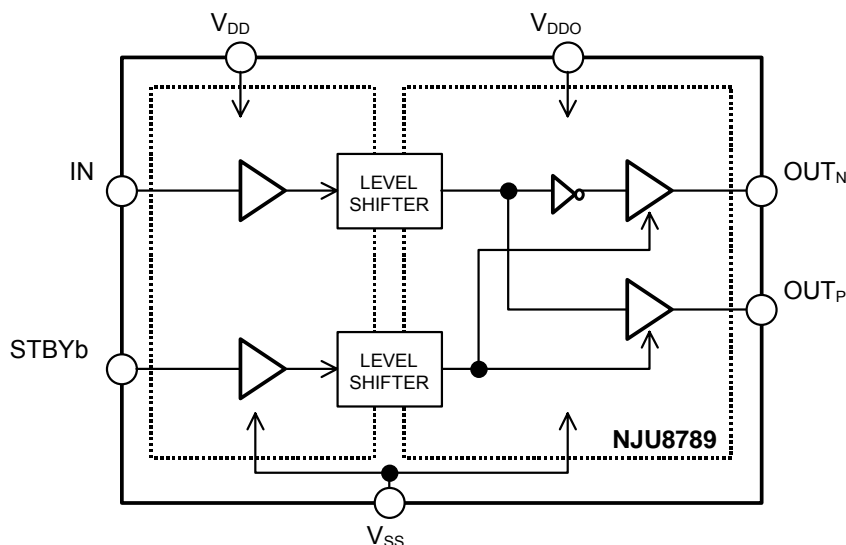
### ■ FEATURES

- Clock-less switching driver
- 1-channel 1bit Audio Signal Input
- Monaural BTL Output
- Standby(Hi-Z) Control Function
- Operating Voltage : 1.8V to 4.5V
- Driving Voltage :  $V_{DD}$  to 4.5V
- CMOS Technology
- Package Outline : SSOP10

### ■ PIN CONFIGURATION



### ■ BLOCK DIAGRAM

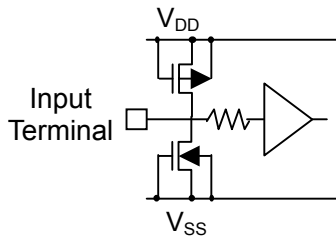


## ■ TERMINAL DESCRIPTION

No.	SYMBOL	I/O	Function
1	$V_{DD}$	–	Power Supply
8	$V_{DDO}$	–	Output Power Supply
6 10	$V_{SS}$	–	GND terminal
2	IN	I	1-bit Data Input Terminal
9	OUT <sub>P</sub>	O	Positive output
7	OUT <sub>N</sub>	O	Negative output
5	STBYB	I	Standby Control Terminal L: Standby
4	TEST	I	Maker test Terminal L: Normal operation
3	NC	–	Non connection

\* $V_{SS}$ (Terminal No.6,10) should be connected at a nearest point to the IC.

## ■ INPUT TERMINAL STRUCTURE



## ■ FUNCTIONAL DESCRIPTION

(1) IN terminal (Input Signal)

The input signals are PWM signals or PDM signals.

(2)  $OUT_P$  and  $OUT_N$  terminal (Output Signal)

The  $OUT_P$  and  $OUT_N$  generate PWM output signal. The NJU8789 drives a speaker by the BTL output, and  $OUT_P$  is a positive output and  $OUT_N$  is a negative output.

A switching regulator with a high response against a voltage fluctuation is the best selection for the  $V_{DDO}$ , which is the power supply for output drivers.

(3) Standby Control Function

By setting the STBYb terminal to "L", the **NJU8789** becomes standby condition. During standby condition,  $OUT_P$  and  $OUT_N$  are in Hi-Z.

The STBYb terminal must be connected to  $V_{DD}$  when not using the Standby Function.

## ■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	$V_{DD}$	-0.3 to +5.5	V
	$V_{DDO}$	-0.3 to +5.5	
Input Voltage	$V_{in}$	-0.3 to $V_{DD}+0.3$	V
Operating Temperature	Ta	-40 to +85	°C
Storage Temperature	Tstg	-40 to +125	°C
Power Dissipation	$P_D$	370*	mW
Thermal Resistance	$\theta_{ja}$	270	°C /W

\* : Mounted on two-layer board of based on the EIA/JEDEC STD.

Note 1) All voltage values are specified as  $V_{SS}=0V$ .

Note 2) If the LSI is used on condition beyond the absolute maximum rating, the LSI may be destroyed. Using LSI within electrical characteristics is strongly recommended for normal operation. Use beyond the electrical characteristics conditions will cause malfunction and poor reliability.

Note 3) De-coupling capacitors should be connected between  $V_{DD}-V_{SS}$  and  $V_{DDO}-V_{SS}$  due to the stabilized operation.

## ■ ELECTRICAL CHARACTERISTICS

DC Characteristics

(Ta=25°C,  $V_{DD}=2.2V$ ,  $V_{DDO}=3.5V$ ,  $V_{SS}=0V$ , unless otherwise noted)

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{DD}$ Supply Voltage	$V_{DD}$		1.8	2.2	4.5	V
$V_{DDO}$ Supply Voltage	$V_{DD}$		$V_{DD}$	3.5	4.5	V
Output Driver High side Resistance	$R_{ONH}$	$V_{OUT}=V_{DDO}-0.1V$	-	0.6	1.2	$\Omega$
Output Driver Low side Resistance	$R_{ONH}$	$V_{OUT}=0.1V$	-	0.6	1.2	$\Omega$
Operating Current at Standby	$I_{ST}$	$V_{DD}, IN=0V$ No-load operating	-	-	0.4	$\mu A$
	$I_{STO}$	$V_{DDO}, IN=0V$ No-load operating	-	-	0.4	$\mu A$
Operating Current at Operating (Mute signal input)	$I_{DD}$	$V_{DD}$ $f_{IN}=30kHz$ No-load operating	-	50	100	$\mu A$
	$I_{DDO}$	$V_{DDO}$ $f_{IN}=30kHz$ No-load operating	-	180	360	$\mu A$
Input Voltage	$V_{IH}$	IN,STBYb	$0.7V_{DD}$	-	$V_{DD}$	V
	$V_{IL}$	IN	0	-	$0.3V_{DD}$	V
STBYb		0	-	0.5		
Input Leakage Current	$I_{LK}$	IN,STBYb	-	-	$\pm 1$	$\mu A$

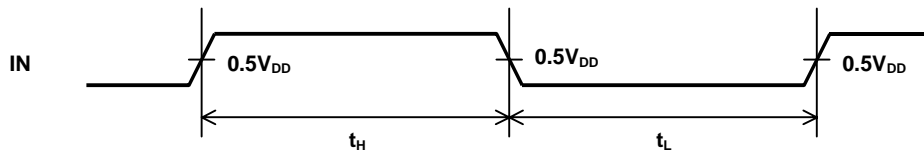
## AC Characteristics

( $T_a = 25\text{ }^\circ\text{C}$ ,  $V_{DD} = 2.2\text{ V}$ ,  $V_{DDO} = 3.5\text{ V}$ ,  $V_{SS} = 0.0\text{ V}$  unless otherwise noted)

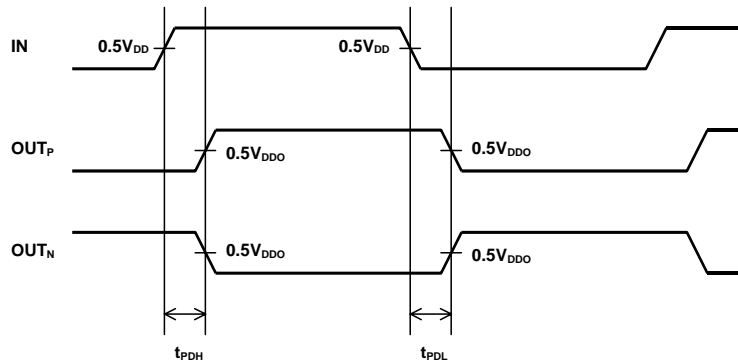
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Input Pulse Width "H"	$t_H$	IN	25	-	-	ns
Input Pulse Width "L"	$t_L$	IN	25	-	-	ns
Turn up Pulse Delay Time	$t_{PDH}$	IN-OUT <sub>P</sub> , IN-OUT <sub>N</sub> , $C_L = 10\text{ pF}$	-	25	-	ns
Turn down Pulse Delay Time	$t_{PDL}$	IN-OUT <sub>P</sub> , IN-OUT <sub>N</sub> , $C_L = 10\text{ pF}$	-	25	-	ns
Turn up Time	$t_{UP}$	IN, STBYb	-	-	50	ns
Turn down Time	$t_{DN}$	IN, STBYb	-	-	50	ns
Input Frequency	$f_{in}$	IN	20	-	2000	kHz

### ■ TIMING CHARACTERISTICS

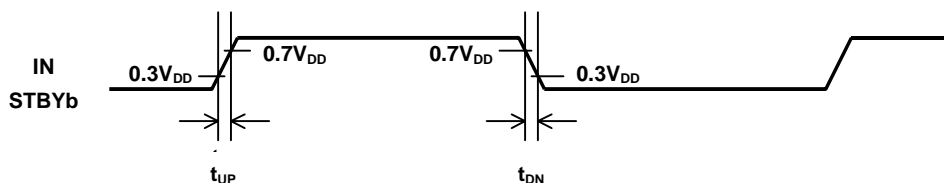
Input Pulse Width "H" and "L".



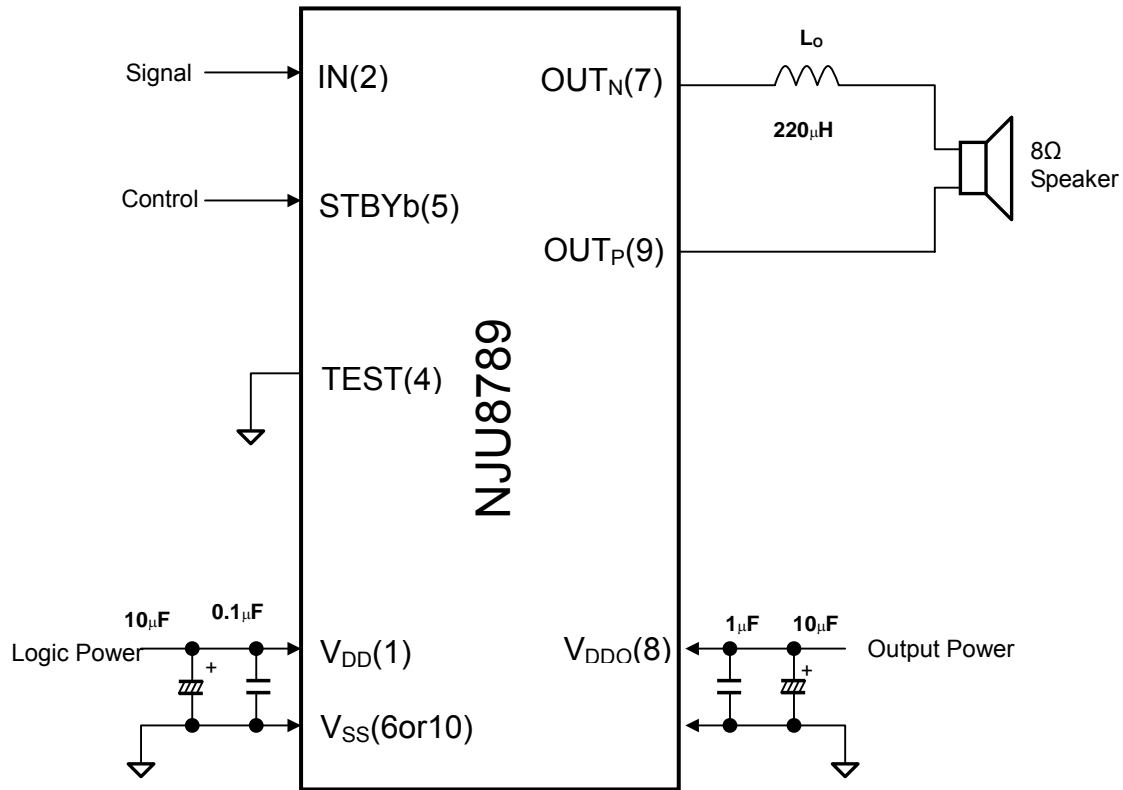
Pulse Delay Time



Output Control Signal Input



## ■ APPLICATION CIRCUIT



- Note 4) De-coupling capacitors must be connected between each power supply terminal and GND terminal.
- Note 5) The power supply for  $V_{DDO}$  requires fast driving response performance such as a switching regulator for T.H.D.
- Note 6) The above circuit shows only application example and does not guarantee the any electrical characteristics. Therefore, please consider and check the circuit carefully to fit your application.
- Note 7)  $V_{DD}$  and  $V_{DDO}$  must be applied with connecting to  $V_{SS}$  in  $STBYb$  must be connected to  $V_{SS}$ .
- Note 8)  $STBYb$  must be connected to  $V_{SS}$  when applying voltage to  $V_{DD}$  and  $V_{DDO}$ .
- Note 9) It is necessary to connect the Coil( $L_o$ ) to  $OUT_N$  or  $OUT_P$  terminal and Speaker for low power consumption of the NJU8789.
- Note 10)(1) to (10) indicates pin numbers.

[CAUTION]  
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