

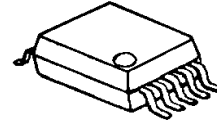
Monaural BTL Output Clock-less Switching Driver for Class D Amplifier

■ 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

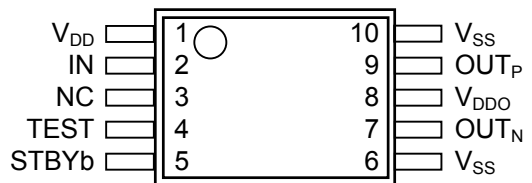


NJU8789V

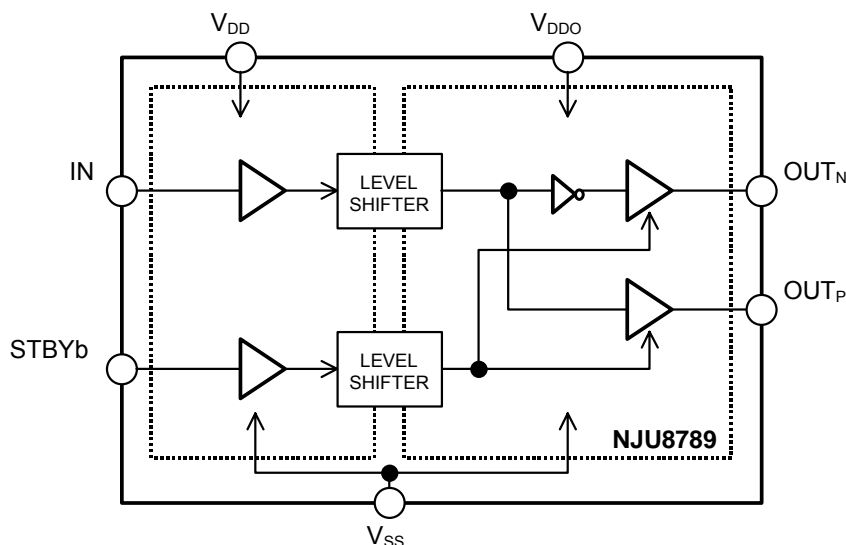
■ FEATURES

- 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

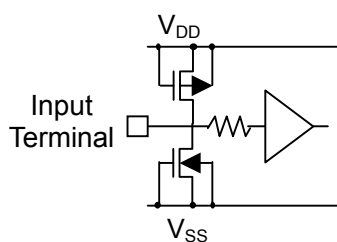


■ TERMINAL DESCRIPTION

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 _P	O	Positive output
7	OUT _N	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	θ_{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	Ω
Output Driver Low side Resistance	R_{ONH}	$V_{OUT}=0.1V$	-	0.6	1.2	Ω
Operating Current at Standby	I_{ST}	$V_{DD}, IN=0V$ No-load operating	-	-	0.4	μA
	I_{STO}	$V_{DDO}, IN=0V$ No-load operating	-	-	0.4	μA
Operating Current at Operating (Mute signal input)	I_{DD}	V_{DD} $f_{IN}=30kHz$ No-load operating	-	50	100	μA
	I_{DDO}	V_{DDO} $f_{IN}=30kHz$ No-load operating	-	180	360	μA
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	-	-	± 1	μA

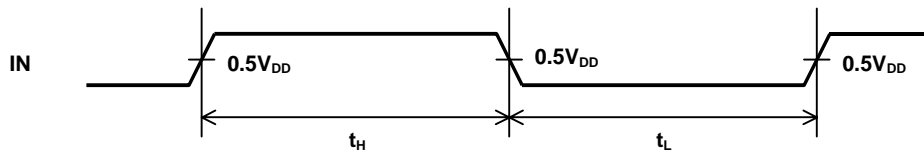
AC Characteristics

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

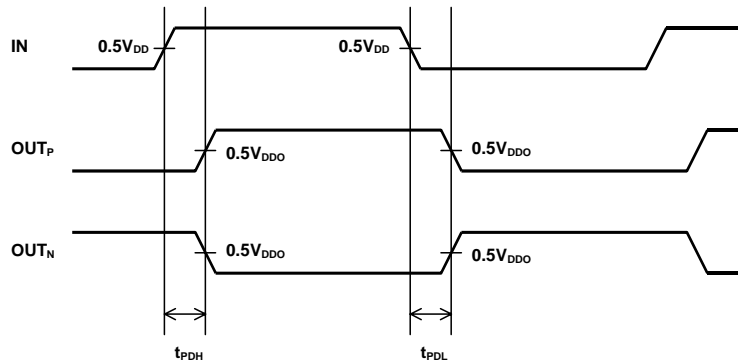
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Input Pulse Width "H"	t_H	IN	25	-	-	ns
Input Pulse Width "L"	t_L	IN	25	-	-	ns
Turn up Pulse Delay Time	t_{PDH}	IN-OUT _P , IN-OUT _N , $C_L = 10\text{ pF}$	-	25	-	ns
Turn down Pulse Delay Time	t_{PDL}	IN-OUT _P , IN-OUT _N , $C_L = 10\text{ pF}$	-	25	-	ns
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

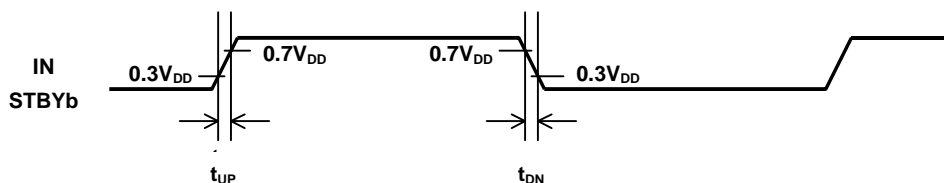
Input Pulse Width "H" and "L".



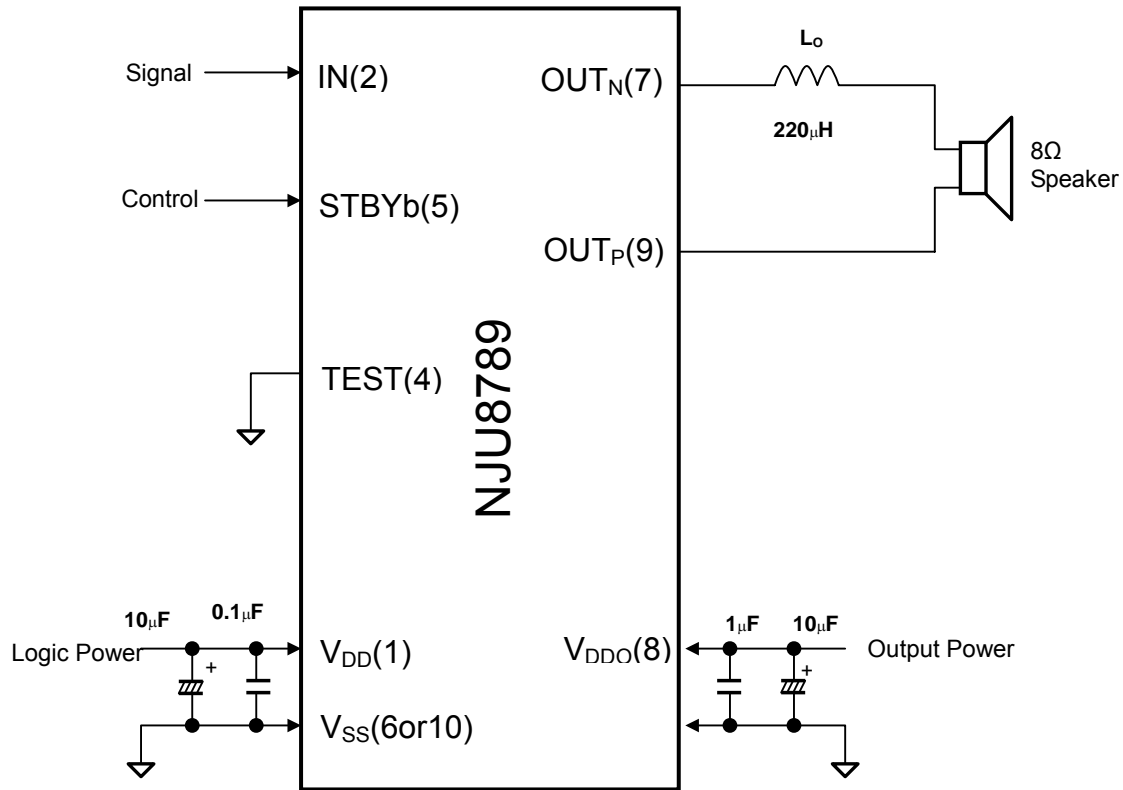
Pulse Delay Time



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]
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.