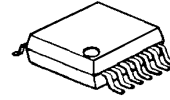


Analog Signal Input Monaural 1.5W Filterless Class D Power Amplifier

■ GENERAL DESCRIPTION

The **NJU8758** is an analog signal input monaural 1.5W filterless class D power amplifier. The **NJU8758** is capable of driving 0.6W at 3.3V or 1.5W at 5.0V into 8ohms without external LC low-pass filters. It includes an output-short protector. The **NJU8758** incorporates BTL amplifier, which eliminate AC coupling capacitors. The **NJU8758** features high power-efficiency by class-D operation, and is suited for security equipment, portable set with speaker, PC, etc.

■ PACKAGE OUTLINE

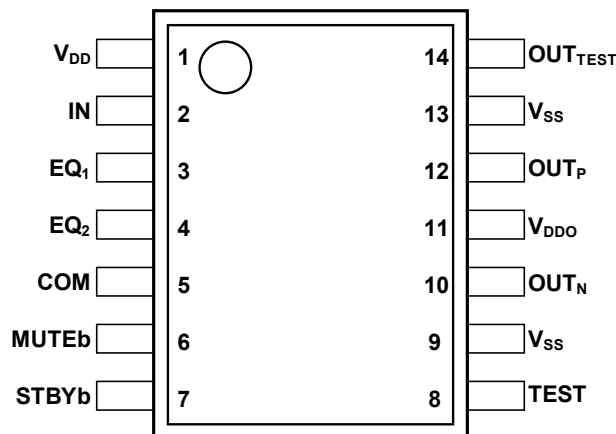


NJU8758V

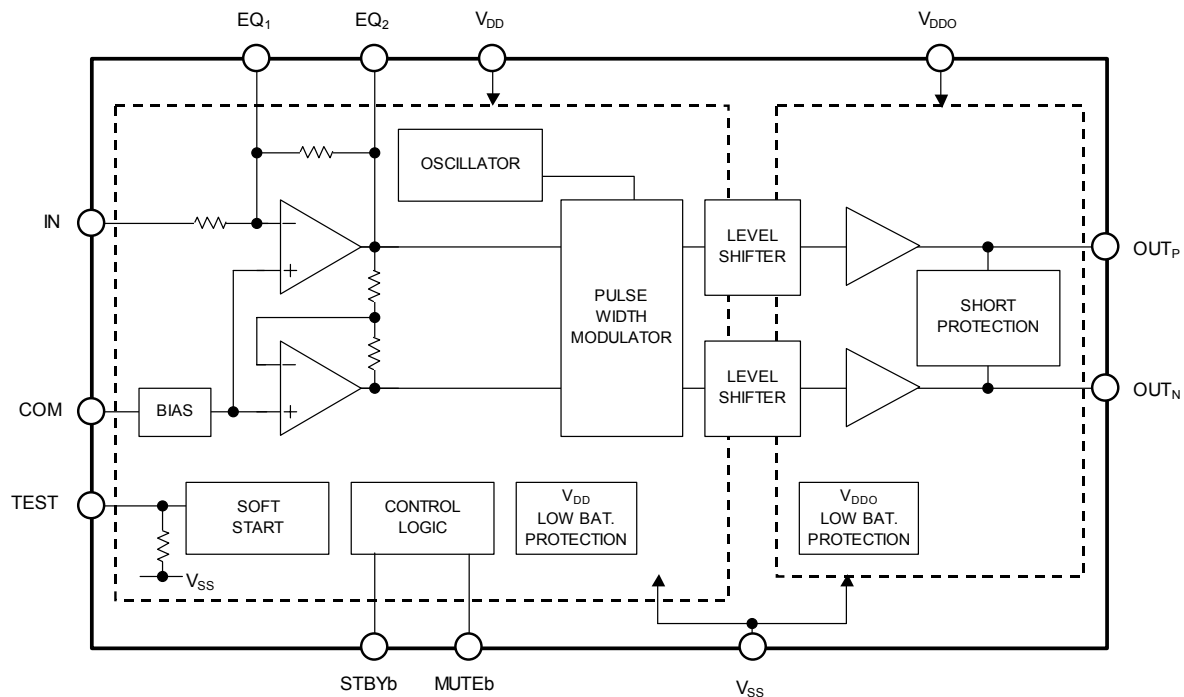
■ FEATURES

- Operating Voltage: 1.8 to 5.5V
- 1.5 W at 5V into 8ohms
- No output filters
- Standby(Hi-Z), Mute Control
- Built-in Pop noise reduction
- EQ for Active filter
- Built-in Low Voltage Detector
- Built-in Short Protector for each channel
- CMOS Technology
- Package Outline: SSOP14

■ PIN CONFIGURATION



■ BLOCK DIAGRAM



■ PIN DESCRIPTION

No	SYMBOL	I/O	FUNCTION
1	V _{DD}	-	Power supply : V _{DD} =3.3V (*1)
2	IN	I	Signal input
3	EQ ₁	I/O	for Active filter
4	EQ ₂	I/O	for Active filter
5	COM	-	Analog common
6	MUTEb	I	Mute control (*3) MUTEb=Low: MUTE Mode
7	STBYb	I	Standby control (*3) STBYb=MUTEb=Low: Standby Mode
8	TEST	I	TEST terminal for maker (*4)
9	V _{SS}	-	Power GND : V _{SS} =0V (*1)(*2)
10	OUT _N	O	Negative output
11	V _{DDO}	-	Output power supply : V _{DDO} =3.3V (*1)
12	OUT _P	O	Positive output
13	V _{SS}	-	Power GND : V _{SS} =0V (*1)(*2)
14	OUT _{TEST}	O	Short Detect output

*1) The relations of "V_{SS}= 0V" and "V_{DD}= V_{DDO}" must be maintained.

*2) The V_{SS} should be connected at a nearest point to the IC.

*3) The MUTEb and the STBYb must be connected to V_{DD}, when these terminals are not used.

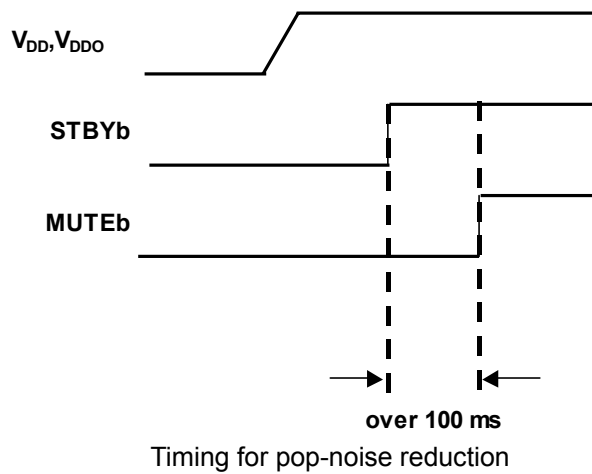
*4) The Test terminal must be connected to V_{SS}.

■

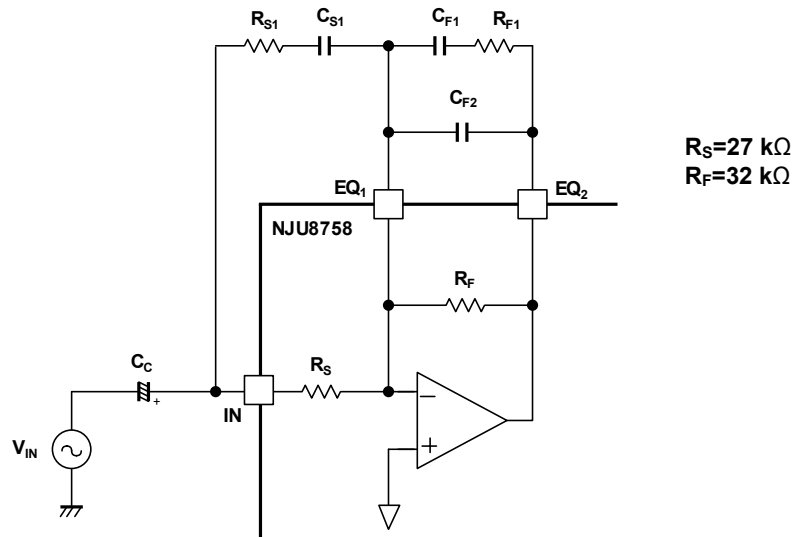
■ FUNCTIONAL DESCRIPTION

- (1) Signal Output (OUT_P, OUT_N)
The OUT_P and OUT_N generate PWM output signal.
- (2) Standby (STBYb)
By setting the STBYb and MUTEb terminal to “L”, the standby mode is enabled. In the standby mode, the entire functions of the NJU8758 enter a low-power state, and the output terminals(OUT_P and OUT_N) are in high impedance.
- (3) Mute (MUTEb)
By setting the MUTEb terminal to “L”, the Mute function is enabled, and the output terminals(OUT_P and OUT_N) output square wave(Duty: 50%).

The NJU8758 has a built-in circuit for the pop-noise reduction at power-on. However the control with the sequence can realize more effective the pop-noise reduction.



- (4) EQ for Active filter (IN, EQ1, EQ2)
 The NJU8758 has EQ1 and EQ2, which is for active filter.
 The band-pass filter is calculated as shown below.



Example: The band-pass filter

$$H(s) = \frac{1}{R_F + \left(\frac{1}{sC_{F1}} + R_{F1} \right) + sC_{F2}} \cdot \frac{1}{\frac{1}{sC_C} + \frac{1}{R_S + \frac{1}{\frac{1}{sC_{S1}} + R_{S1}}}}$$

$C_{F1} > 100 \text{ pF}$

- (5) Low Voltage Detector
 When the power supply voltage drops down to below $V_{DD}(\text{MIN})$, the internal circuit is halted, and the output terminals (OUT_P and OUT_N) become in high impedance.
- (6) Short Protection Circuit
 The short protector is enabled in response to following accidents.

- Short between OUT_P and OUT_N
- Short between OUT_P and V_{SS}
- Short between OUT_N and V_{SS}

When the Short Protector enable, the output terminals (OUT_P and OUT_N) become in high impedance, and OUT_{TEST} enable "H" ($H=V_{DD}$). By setting the STBYb terminal to "L", the **NJU8758** returns to normal operation.

- Note 1) The detectable current and the period for the protection depend on the power supply voltage and ambient temperature.
- Note 2) The short protector is not effective for a long term short-circuit but for an instantaneous accident. Continuous high-current may cause permanent damage to **NJU8758**.

■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

PARAMETER	SYMBOL	TERMINAL	RATING	UNIT
Supply Voltage	V _{DD}	V _{DD}	-0.3 to +7.0	V
	V _{D_{DDO}}	V _{D_{DDO}}	-0.3 to +7.0	V
Input Voltage	V _{in}	IN, STBYb, MUTEb	-0.3 to V _{DD} + 0.3	V
Operating Temperature	T _a		-40 to +85	°C
Storage Temperature	T _{stg}		-40 to +125	°C
Power Dissipation	P _{D_{MAX2}}	Mounted on two-layer board of based on the EIAJ, T _j = 125°C	450	mW
	P _{D_{MAX4}}	Mounted on four-layer board of based on the EIAJ, T _j = 125°C	570	mW
Thermal Resistance	θ _{ja2}	Mounted on two-layer board of based on the EIAJ, T _j = 125°C	223	°C / W
	θ _{ja4}	Mounted on four-layer board of based on the EIAJ, T _j = 125°C	176	°C / W

- Note 3) All voltage are relative to “V_{SS} = 0V” reference.
- Note 4) Mounted on two-layer/4-layer board of based on the EIA/JEDEC STD
- Note 5) The IC must be used inside of the “Absolute maximum ratings”. Otherwise, a stress may cause permanent damage to the LSI.
- Note 6) De-coupling capacitors for V_{DD}-V_{SS} and V_{D_{DDO}}-V_{SS} should be connected for stable operation.
- Note 7) The class-D amplifiers are more power efficient, and dissipate power less than general analog-amplifiers. In theory, the NJU8758 actualize quite high output-power such as 1.2W at =5V operation with 8ohms load, it looks as if the NJU8758 exceeds the absolute maximum rating of the power dissipation. However, in practice, the effective output-power of usual music sound is only about 1/10 of its maximum output power, thus it may never exceed the absolute maximum rating.

The maximum power dissipation in the system is calculated, as shown below.

$$P_{D_{MAX}} = \frac{T_{j_{MAX}} [^{\circ}C] - T_a [^{\circ}C]}{\theta_{ja} [^{\circ}C / W]}$$

Pdmax: Maximum Power Dissipation, Tjmax: Junction Temperature = 125°C
 Ta: Ambient Temperature, θja: Thermal Resistance of package (SSOP14) = 223°C/W

Power dissipation of the NJU8758 itself is calculated, as shown below.

$$P_D = \frac{125^{\circ}C - 50^{\circ}C}{223^{\circ}C / W} = 336.3mW$$

■ ELECTRICAL CHARACTERISTICS

(7) DC CHARACTERISTICS

($T_a=25^{\circ}\text{C}$, $V_{DD}=V_{DDO}=3.3\text{V}$, $V_{SS}=0\text{V}$, Input Signal=1kHz, Input Signal Level=200mVrms, Load Impedance=8 Ω)

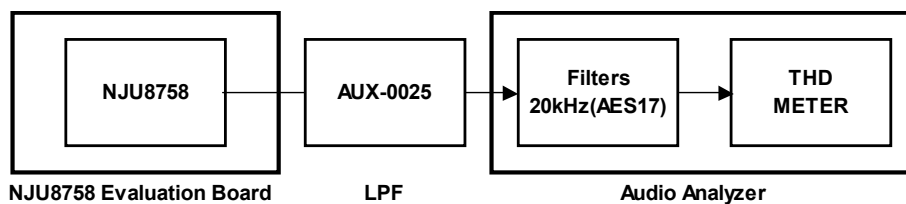
PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{DD}, V_{DDO} Supply Voltage	V_{DD}, V_{DDO}		1.8	3.3	5.5	V
Drain-Source On-state Resistance (High-side)	R_{ONH}	OUT_P, OUT_N $V_{OUTP,N} = V_{DDO} - 0.1\text{V}$	-	0.5	-	Ω
Drain-Source On-state Resistance (Low-side)	R_{ONL}	OUT_P, OUT_N $V_{OUTP,N} = 0.1\text{V}$	-	0.5	-	Ω
Input Impedance	R_{IN}	IN	-	27	-	k Ω
Operating Current (Standby)	I_{ST}	$V_{DD}, STBYb: "L",$ No Load	-	0.1	0.5	μA
	I_{STO}	$V_{DDO}, STBYb: "L",$ No Load	-	0.1	0.5	μA
Operating Current (No signal input)	I_{DD}	No Load	-	1.5	-	mA
	I_{DDO}		-	1.2	-	mA
Input Voltage	V_{IH}	STBYb, MUTEb	1.5	-	V_{DD}	V
	V_{IL}	STBYb, MUTEb	0	-	0.5	V
Input Leakage Current	I_{LK}	STBYb, MUTEb	-	-	± 1	μA
Frequency	f_{OSC}		-	320	-	kHz
Start up Time	T_{ON}	MUTEb: "L"	-	205	-	ms
Voltage Gain	A_v	No Load	-	22.9	-	dB

(8) AC CHARACTERISTICS

($T_a=25^\circ\text{C}$, $V_{DD}=V_{DDL}=V_{DDR}=3.3\text{V}$, Input Signal=1kHz, Input Signal Level=200mVrms, Load Impedance=8 Ω .)

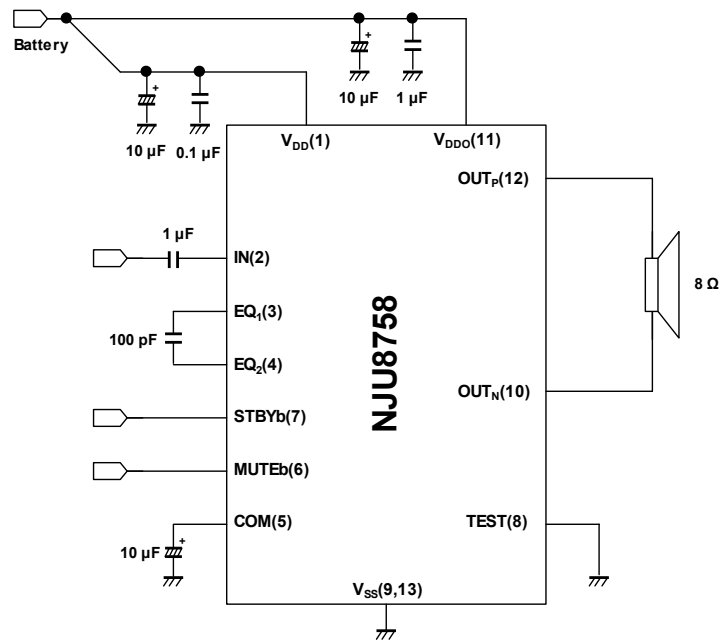
PARAMETER	CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Output Power Efficiency	E_{EFF}	THD+N=10 %	-	80	-	%
THD+N	THD+N	$P_O=200\text{ mW}$	-	0.05	-	%
Output Power	P_O	$V_{DD}=V_{DDO}=3.3\text{ V}$ THD+N=10 %	-	0.66	-	W
		$V_{DD}=V_{DDO}=5.0\text{ V}$ THD+N=10 %	-	1.5	-	W
S/N	S/N	A-weight $V_{DD}=V_{DDO}=5.0\text{ V}$	-	84	-	dB

Test system of the output THD



Output THD Test System

■ TYPICAL APPLICATION CIRCUIT



TYPICAL APPLICATION CIRCUIT

- Note 8) De-coupling capacitors must be connected between each power supply terminal and GND ($V_{DD}-V_{SS}$, $V_{DDO}-V_{SS}$).
- Note 9) V_{SS} should be connected at a nearest point to the IC on PCB.
- Note 10) IN, EQ1 and EQ2 should be not designed near OUTP and OUTN, which emit PWM noise.
- Note 11) The power supply for V_{DDO} requires fast driving response performance such as a switching regulator for better THD.
- Note 12) The above circuit shows only application example and does not guarantee the any electrical characteristics. Therefore, please test the circuit carefully to fit your application.
- Note 13) The transition time for MUTEb and STBYb signals must be less than 100µs. Otherwise, a malfunction may be occurred.
- Note 14) (1) – (12) indicates terminal number.

[CAUTION]
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