PRELIMINARY

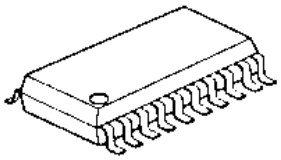
Analog Signal Input Stereo Class D Power Amplifier

■ GENERAL DESCRIPTION

The **NJU8755** is an analog signal input stereo class D power amplifier. The **NJU8755** includes Inversion operational amplifier input circuit, PWM modulators, an output-short protector and a low voltage detector. The **NJU8755** incorporates BTL amplifiers, which eliminate AC coupling capacitors, capable of driving up to 1.2W/channel with simple external LC low-pass filters.

Class-D operation achieves high power-efficiency, which achieves longer battery life for battery powered applications, thus the **NJU8755** is suited for portable audio, note-PC, etc.

■ PACKAGE OUTLINE

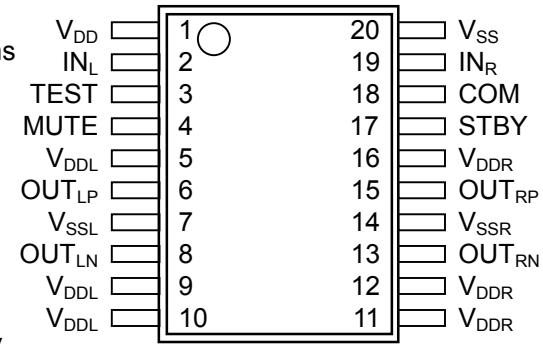


NJU8755V

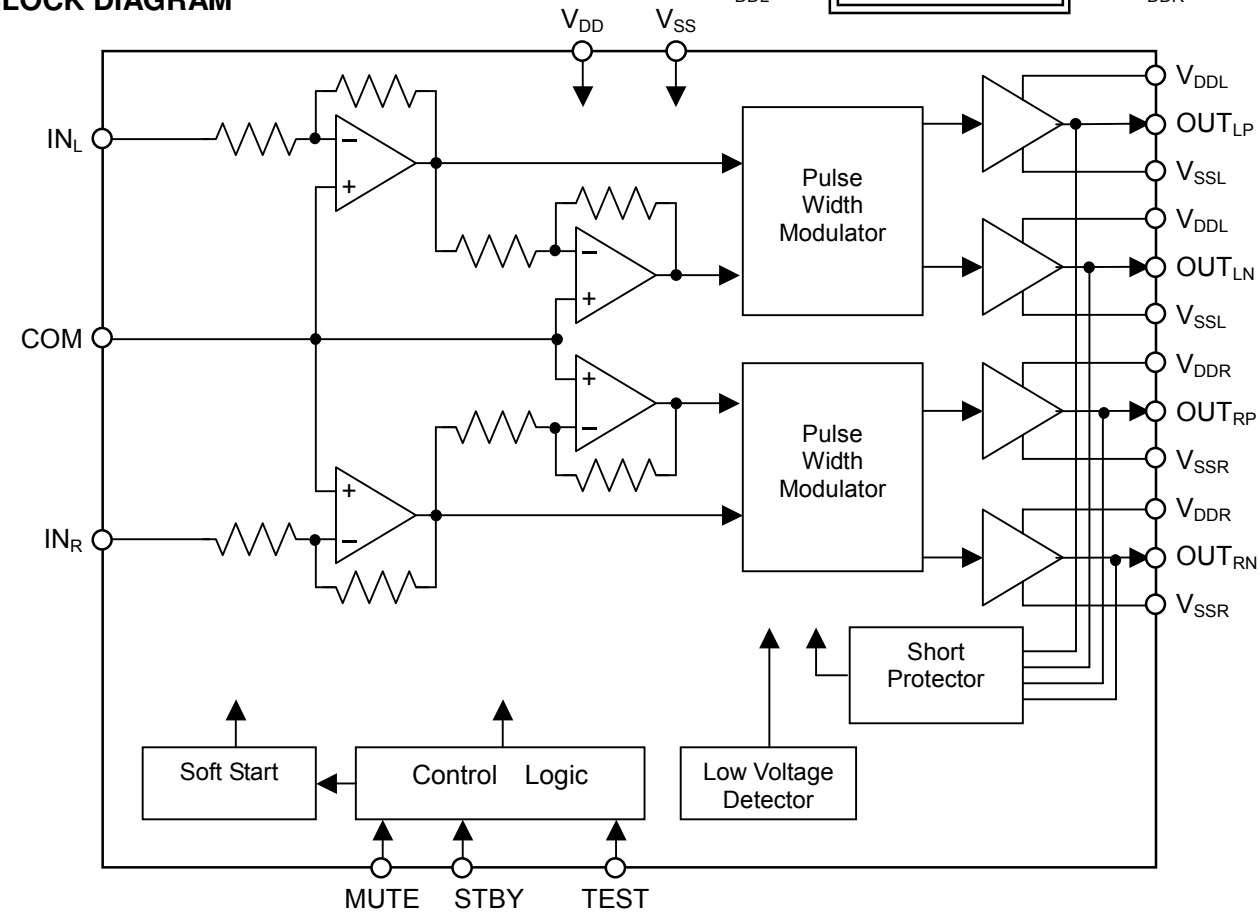
■ FEATURES

- 2-Channel Analog Signal Input
- 2-Channel BTL Outputs :1.2W/channel at 5V into 8Ohms
- Standby(Hi-Z), Mute Control
- Built-in Short Protector
- Built-in Low Voltage Detector
- Operating Voltage 2.7 ~ 5.25V
- CMOS Technology
- Package Outline SSOP20

■ PIN CONFIGURATION



■ BLOCK DIAGRAM



■ PIN DESCRIPTION

No.	SYMBOL	I/O	FUNCTION
1	V_{DD}	–	Power Supply : V_{DD}=5.0V
2	IN_L	I	L-channel signal input
3	TEST	I	Maker test This pin must be connected to GND.
4	MUTE	I	Mute control Low : Mute ON High : Mute OFF
5 9 10	V_{DDL}	–	L-channel Power Supply : V_{DDL}=5.0V
6	OUT_{LP}	O	L-channel positive output
7	V_{SSL}	–	L-channel Power GND
8	OUT_{LN}	O	L-channel negative output
11 12 16	V_{DDR}	–	R-channel Power Supply : V_{DDR}=5.0V
13	OUT_{RN}	O	R-channel negative output
14	V_{SSR}	–	R-channel Power GND : V_{SSR}=0V
15	OUT_{RP}	O	R-channel positive output
17	STBY	I	Standby control Low : Standby ON High : Standby OFF
18	COM	–	Analog common
19	IN_R	I	R-channel signal input
20	V_{SS}	–	Power GND : V_{SS}=0V

*The relations of "V_{SS}= V_{SSL}= V_{SSR}=0V" and "V_{DD}= V_{DDL}=V_{DDR}" must be maintained.
*Pin No.4(MUTE) and 17(STBY) must be connected to V_{DD}, when these pins are not used.

■ FUNCTIONAL DESCRIPTION

(1) Signal Output

The $OUT_{LP/LN}$ and $OUT_{RP/RN}$ generate respectively L-channel and R-channel PWM output signals, which will be converted to analog signal via external 2nd-order or higher LC filter. A switching regulator with a high response against a voltage fluctuation is the best selection for the V_{DDL} and V_{DDR}, which are the power supply for output drivers. To obtain better THD performance, the stabilization of the power is required.

(2) Standby

By setting the STBY pin to "L", the standby mode is enabled. In the standby mode, the entire functions of the **NJU8755** enter a low-power state, and the output pins($OUT_{LP/LN}$ and $OUT_{RP/RN}$) are high impedance.

(3) Mute

By setting the MUTE pin to "L", the Mute function is enabled. In the Mute mode, the output pins($OUT_{LP/LN}$ and $OUT_{RP/RN}$) output square wave(Duty: 50%).

(4) Low Voltage Detector

When the power supply voltage drops down to below V_{DD}(MIN), the internal oscillation is halted for prevention to generate unwanted frequency, and the output pins($OUT_{LP/LN}$ and $OUT_{RP/RN}$) become in high impedance.

(5) Short Circuit Protection

The short protector, which protects the **NJU8755** against high short-circuit current, turns off the output drivers of L-channel and R-channel independently. After about 5 seconds from the protection, the **NJU8755** returns to normal operation. The short protector functions at following accidents.

- Short between OUT_{LP} and OUT_{LN}
- Short between OUT_{LP} and V_{SSL}
- Short between OUT_{LN} and V_{SSL}
- Short between OUT_{RP} and OUT_{RN}
- Short between OUT_{RP} and V_{SSR}
- Short between OUT_{RN} and V_{SSR}

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 **NJU8755**.

■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	-0.3 ~ +5.5	V
	V_{DDL}	-0.3 ~ +5.5	V
	V_{DDR}	-0.3 ~ +5.5	V
Input Voltage	Vin	-0.3 ~ V_{DD}+0.3	V
Operating Temperature	Topr	-40 ~ +85	°C
Storage Temperature	Tstg	-40 ~ +125	°C
Power Dissipation	P_D	300 (SSOP20)	mW

Note 1) All voltage are relative to "V_{SS}= V_{SSL}= V_{SSR}=0V" reference.

Note 2) The LSI must be used inside of the "Absolute maximum ratings". Otherwise, a stress may cause permanent damage to the LSI.

Note 3) De-coupling capacitors for V_{DD}-$V_{SS,}$ V_{DDL}-V_{SSL} , and V_{DDR}-V_{SSR} should be connected for stable operation.

Note 4) Power Dissipation

The class-D amplifiers are more power efficiency, and dissipate power less than general analog-amplifiers. In theory, the **NJU8755** actualize quite high output-power such as 1.2W/channel at 5V operation with 8ohms load, and total power is supposed to be 2.4W. For this reason, it looks as if the **NJU8755** 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.

$Pdmax(W) = (Tjmax(°C) - Ta(°C)) / \theta ja$

Pdmax: Maximum Power Dissipation, Tjmax: Junction Temperature = 125°C
Ta: Ambient Temperature, θja: Thermal Resistance of package(SSOP20) = 333°C/W

Power dissipation of the **NJU8755** itself is calculated, as shown below.

$Pd(W) = P_O(W) \times R_O(\Omega) / R_L(\Omega) + Pd_{IC}(W)$

Pd: Power Dissipation, P_O: Output Power, $R_{O:}$ Internal Resistance(output driver)
R_L: Load Resistance, $Pd_{IC:}$ Power of internal circuit

■ ELECTRICAL CHARACTERISTICS

(Ta=25°C, V_{DD}= V_{DDL}= V_{DDR}=5.0V, V_{SS}=V_{SSL}=V_{SSR}=0V, Input Signal=1kHz, Input Signal Level=200mVrms, Frequency Band=20Hz~20kHz, Load Impedance=8Ω, 2nd-order 34kHz LC Filter(Q=0.85))

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	Note
V_{DD},V_{DDP},V_{DDN} Supply Voltage	V_{DD}		2.7	5.0	5.25	V	
Input Impedance	Z_{IN}	IN_L, IN_R pins	-	20	-	kΩ	
Voltage Gain	A_V		-	23	-	dB	
Output Power Efficiency	Eeff	Output THD=10%	80	-	-	%	
Output THD	THD	Po=0.6W	-	0.05	0.08	%	5
Output Power	Po	Output THD=10%	-	1.2	-	W/ch	
S/N	SN	A weight	-	80	-	dB	5
Dynamic Range	Drange	A weight	-	83	-	dB	5
Channel Separation	Echn	EIAJ(1kHz)	60	-	-	dB	
Output Level Difference Between L- and R- channels	CHD		-	-	3	dB	
Maximum Mute Attenuation	MAT		90	-	-	dB	
Operating Current (Standby)	I_{ST}		-	-	1	μA	
Operating Current (No signal input)	I_{DD}	No Filter No Load	-	7.5	10	mA	
Input Voltage	V_{IH}	MUTE, STBY pins	$0.7V_{DD}$	-	V_{DD}	V	
	V_{IL}	MUTE, STBY pins	0	-	$0.3V_{DD}$	V	
Input Leakage Current	I_{LK}	MUTE, STBY pins	-	-	±1.0	μA	

Note 5) Test system of the output THD, S/N and Dynamic Range
The output THD, S/N and dynamic range are tested in the system shown in Figure1, where a 2nd-order LC LPF and another filter incorporated in an audio analyzer are used.

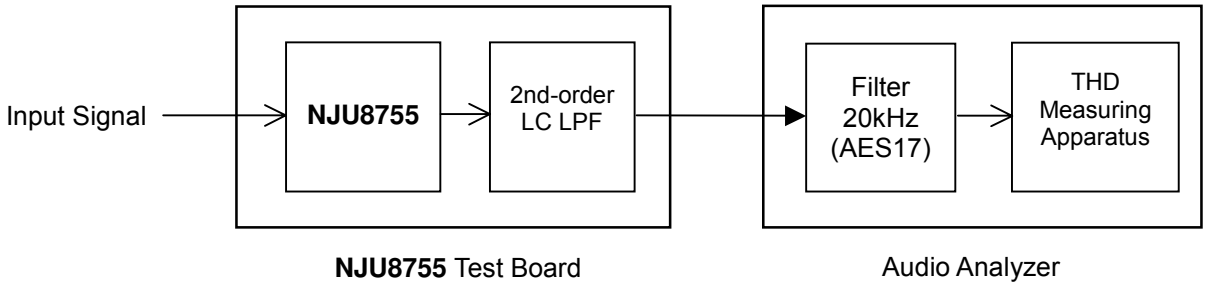


Figure 1. Output THD, S/N and Dynamic Range Test System

2nd-order LPF : fc=34kHz / Refer to “Typical Application Circuit”.
Filters : 22Hz HPF + 20kHz LPF(AES17)
(with the A-Weight filter for S/N and Dynamic-range tests)

■ TYPICAL APPLICATION CIRCUIT

•A918CY-220M is manufactured by TOKO, INC.
For detail information, please refer its technical papers.

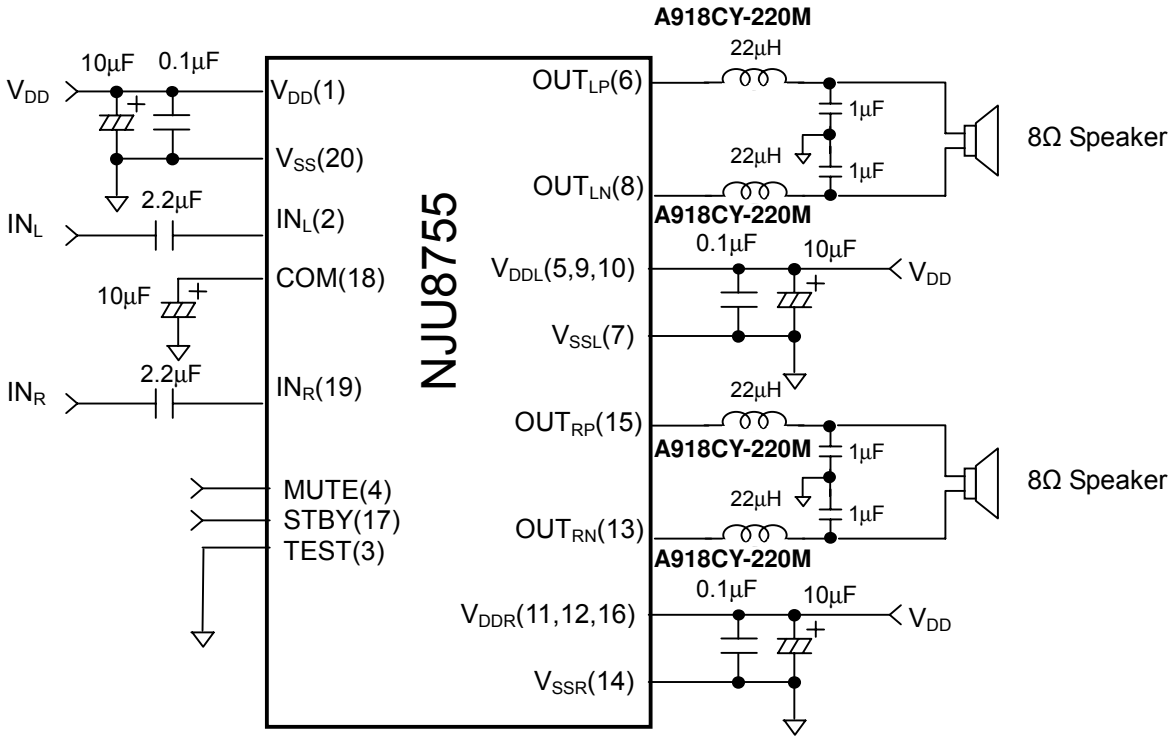


Figure 2. Application Circuit example

Note 6) De-coupling capacitors must be connected between each power supply pin and GND.
The capacity value should be adjusted on the application circuit and the operation temperature. It may malfunction if capacity value is small.

Note 7) The power supply for V_{DDL} and V_{DDR} require fast driving response performance such as a switching regulator for better THD.
THD performance becomes worse by ripple if the capacity of De-coupling capacitor is small.

Note 8) 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.
The cutoff frequency of the LC filter influences the quality of sound.
The Q factor of the LC filter must be less than "1". Otherwise, the operating current increase when the frequency of input signal is closed to the cutoff frequency.

Note 9) The transition time for MUTE and STBY signals must be less than 100μs. Otherwise, a malfunction may be occurred.

Note 10) (1) – (20) indicates pin number.