Dual 2.0W/CH Stereo Audio Amplifier include Headphone Function with Active-high shutdown mode

FEATURES

- 2.5V~5.5V Power supply.
- Thermal shutdown Protection.
- Low current shutdown mode
- Low noise during turn-on and turn-off transitions.
- Support “Click and pop” suppression circuitry
- Stereo headphone amplifier mode.
- Shutdown pin high active.
- Lead free and green package available. (RoHS Compliant)
- Space Saving Package
  -- TSSOP 14 pin Packaging .

APPLICATION

- Portable and desktop computers
- Multimedia Monitors
- Portable Audio System

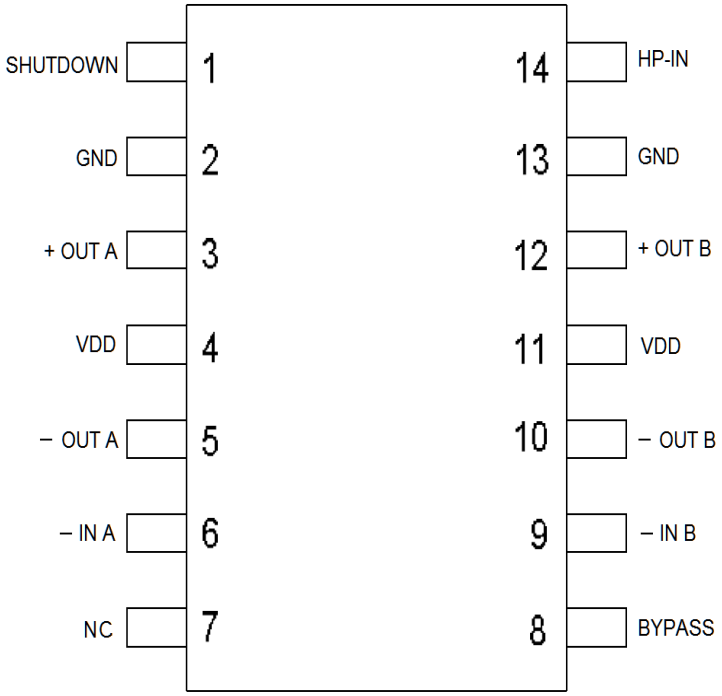
GENERAL DESCRIPTION

The LY8663 is a dual stereo audio power amplifier. It is capable of driving 4Ω speaker load at a continuous average output of 2.0W / 10% distortion (THD+N) from at 5.5V power supply. The LY8663 primarily designed for high quality output power from application in other portable communication device and portable and desktop computers device. The LY8663 audio amplifier features low power consumption in shutdown mode. It is achieved by driving the shutdown pin with logic high. And the LY8663 has an internal thermal shutdown protection feature.

To simplify audio system design and the LY8663 audio amplifier supports dual Bridge-Tied Load (BTL) speaker amplifier and stereo Single-End (SE) headphone. It is ideally suited for other low voltage applications or portable electronic devices where minimal power consumption is a primary requirement.

PIN CONFIGURATION

LY8663 TSSOP14 Pin Configuration (Top View)



PIN DESCRIPTION

SYMBOL	Pin No. TSSOP	DESCRIPTION
SHUTDOWN	1	Shutdown control.(when high level is active the pin)
GND	2/13	Ground
+OUTA	3	Positive BTL output of A channel.
V_{DD}	4/11	Power Supply
-OUTA	5	Negative BTL output of A channel.
-INA	6	Negative Input of A channel.
BYPASS	8	Bypass Pin
-INB	9	Positive Input of B channel.
-OUTB	10	Negative BTL output of B channel.
+OUTB	12	Positive BTL output of B channel.
HP-IN	14	Mode Control, Hold low for BTL mode, Hold high for SE mode. (If None headphone function must connect to GND)
NC	7	Not connection

TYPICAL APPLICATION CIRCUIT

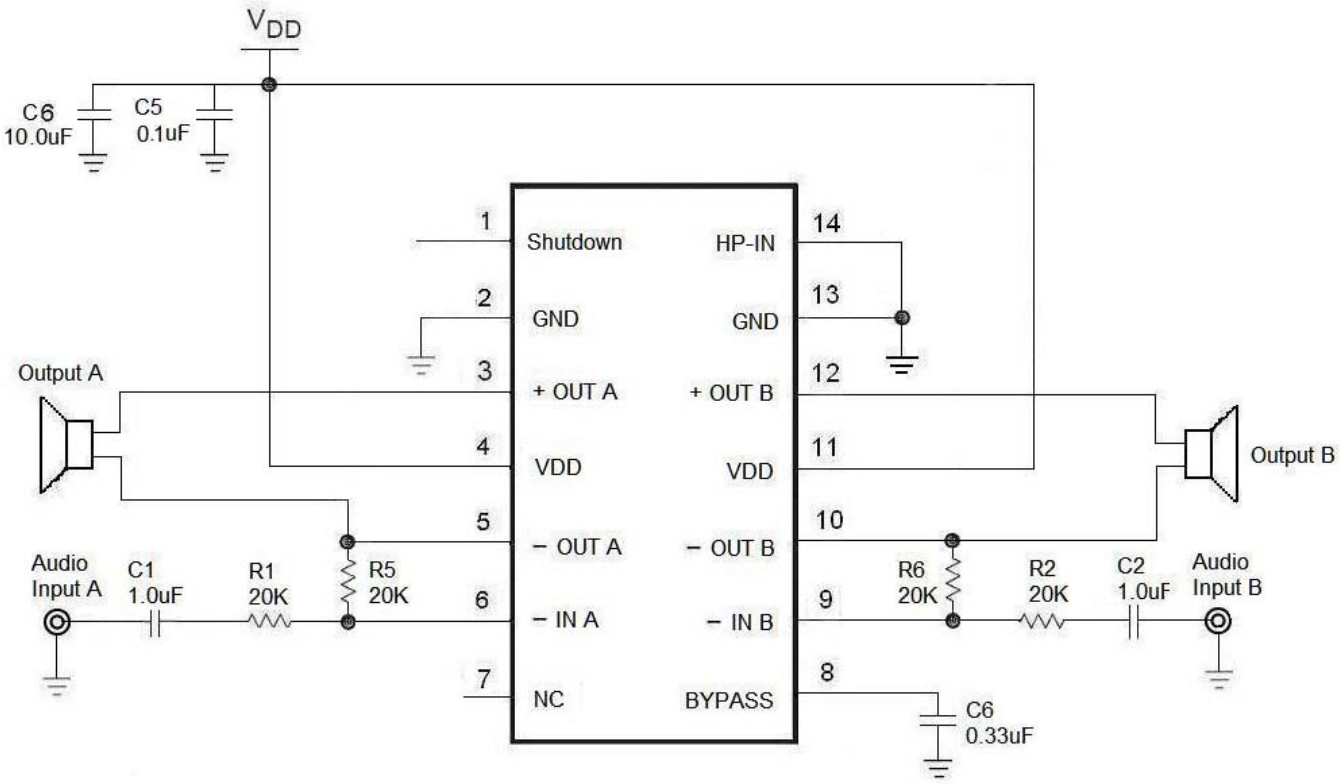


Figure 1. Without Headphone Typical Application Circuit

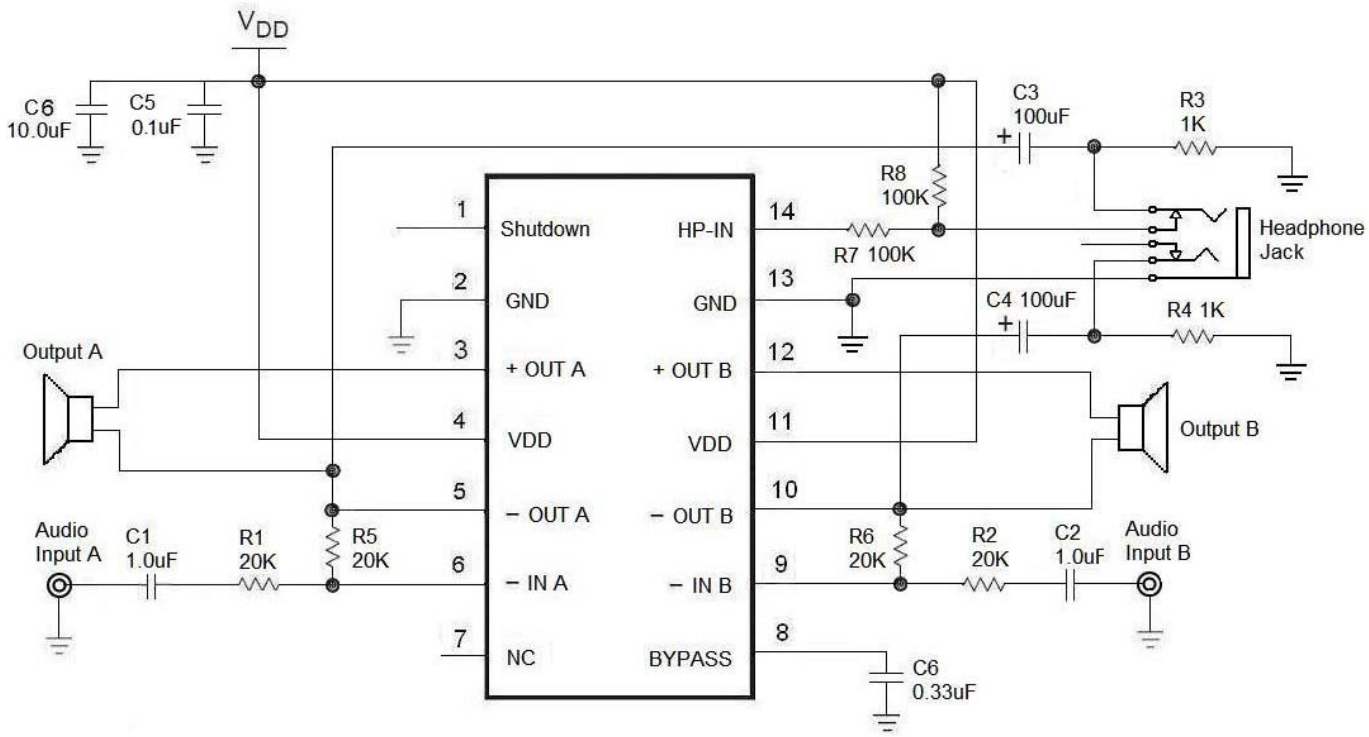


Figure 2. With Headphone Typical Application Circuit

ABSOLUTE MAXIMUN RATINGS*

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	6.0	V
Operating Temperature	T_A	-40 to 85 (I grade)	℃
Input Voltage	V_I	-0.3V to V_{DD} +0.3V	V
Storage Temperature	T_{STG}	-65 to +150	℃
Power Dissipation	P_D	Internally Limited	W
ESD Susceptibility	V_{ESD}	2000	V
Junction Temperature	T_{JMAX}	150	℃
Soldering Information	Vapor Phase (60 sec.)	215	℃
	Infrared (15 sec.)	220	

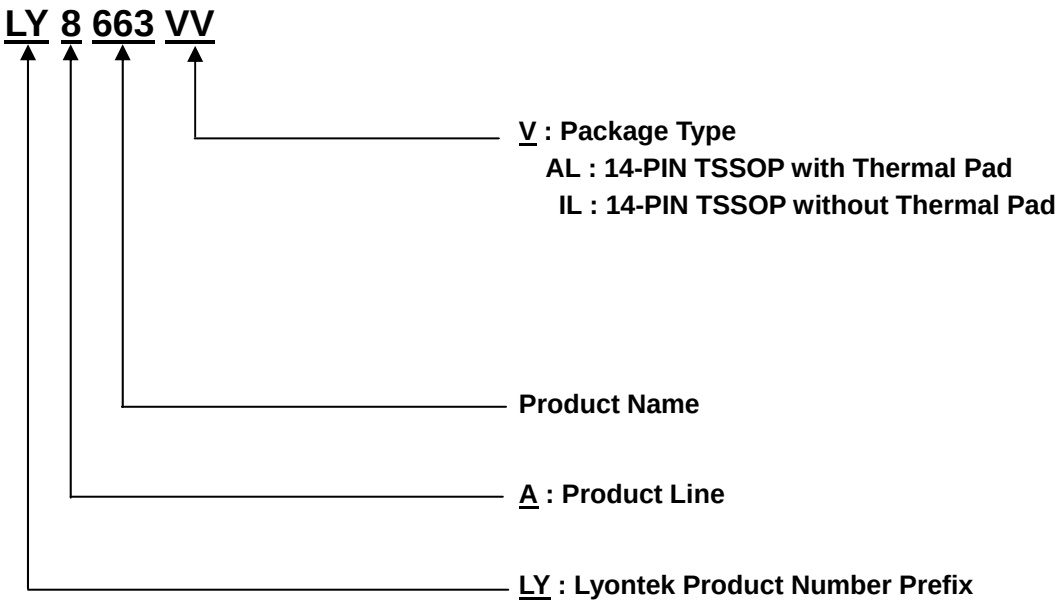
DC ELECTRICAL CHARACTERISTICS (V_{DD}=5.0V, T_A=25℃)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Power Supply Current	I_{DD}	V_{IN} = 0V,8Ω Load (BTL)	-	12.0	21.5	mA
Shutdown Current	I_{SD}	$V_{SHUTDOWN}$ = 0V HP sense= GND	-	0.1	2.0	μA
Shutdown, Headphone Sense High Input Voltage	V_{SDIH}		1.4	-	-	V
Shutdown, Headphone Sense Low Input Voltage	V_{SDIL}		-	-	0.4	V
Wake-up time	T_{WU}	Bypass cap.=1.0uF	-	172	-	ms
Output Offset Voltage	V_{OS}		-	7.0	50.0	mV
Output Power	Po	THD+N = 1%, f = 1 kHz, R_L=8Ω	-	1.0	-	W
		THD+N = 10%, f = 1 kHz R_L=8Ω	-	1.3	-	
		THD+N = 10%, f = 1 kHz R_L=8Ω (at 5.5V)	-	1.5	-	
		THD+N = 1%, f = 1 kHz R_L=4Ω	-	1.5	-	
		THD+N = 10%, f = 1 kHz R_L=4Ω	-	1.8	-	
		THD+N = 10%, f = 1 kHz R_L=4Ω (at 5.5V)	-	2.1	-	
		THD+N = 0.1%, f = 1 kHz, R_L=32Ω (SE Mode)	-	90	-	mW
		THD+N = 0.1%, f = 1 kHz, R_L=16Ω (SE Mode)	-	165	-	
Total Harmonic Distortion+ Noise	THD+N	Po = 0.66 W; f = 1kHz, V_{DD}=5.0V; R_L=8Ω	-	0.11	-	%
Power Supply Rejection Ratio	PSRR	Vripple = 200mV sine p-p Input terminated with 10Ω to GND	-	62 (f = 217Hz) 66 (f = 1kHz)	-	dB
Output voltage noise	Vn	f = 20 Hz to 20 kHz, A-weighting	-	37.5	-	uV
		f = 20 Hz to 20 kHz, A-weighting (SE mode)	-	15	-	
Thermal Shutdown Temperature	T_{SD}		150	170	190	℃
Shut Down Time	T_{SDT}	8 Ω load	-	1.0	-	ms

DC ELECTRICAL CHARACTERISTICS (V_{DD}=3.6V, T_A=25℃)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Power Supply Current	I_{DD}	V_{IN} = 0V, I_O = 0A, 8Ω Load (BTL)	-	10.0	16.5	mA
Shutdown Current	I_{SD}	$V_{SHUTDOWN}$ = 0V HP sense= GND	-	0.1	2.0	μA
Shutdown, Headphone Sense High Input Voltage	V_{SDIH}		1.4	-	-	V
Shutdown, Headphone Sense Low Input Voltage	V_{SDIL}		-	-	0.4	V
Wake-up time	T_{WU}	Bypass cap.=1.0uF	-	82	-	ms
Output Offset Voltage	V_{OS}		-	7.0	50	mV
Output Power	Po	THD+N = 1%, f = 1 kHz, R_L=8Ω	-	0.5	-	W
		THD+N = 10%, f = 1 kHz R_L=8Ω	-	0.65	-	
		THD+N = 1%, f = 1 kHz R_L=4Ω	-	0.65	-	
		THD+N = 10%, f = 1 kHz R_L=4Ω	-	0.8	-	
		THD+N = 0.1%, f = 1 kHz, R_L=32Ω (SE Mode)	-	45	-	mW
		THD+N = 0.1%, f = 1 kHz, R_L=16Ω (SE Mode)	-	83	-	
Total Harmonic Distortion+ Noise	THD+N	Po = 0.35 W; f = 1kHz, V_{DD}=3.6V; R_L=8Ω	-	0.12	-	%
Power Supply Rejection Ratio	PSRR	Vripple = 200mV sine p-p Input terminated with 10Ω to GND	-	56 (f = 217Hz) 62 (f = 1kHz)	-	dB
Output voltage noise	Vn	f = 20 Hz to 20 kHz, A-weighting	-	37.5	-	uV
		f = 20 Hz to 20 kHz, A-weighting (SE mode)	-	15	-	
Thermal Shutdown Temperature	T_{SD}		150	170	190	℃
Shut Down Time	T_{SDT}	8 Ω load	-	1.0	-	ms

ORDERING INFORMATION



TYPICAL PERFORMANCE CHARACTERISTICS

Figure 3
Total Harmonic Distortion + Noise vs Output Power

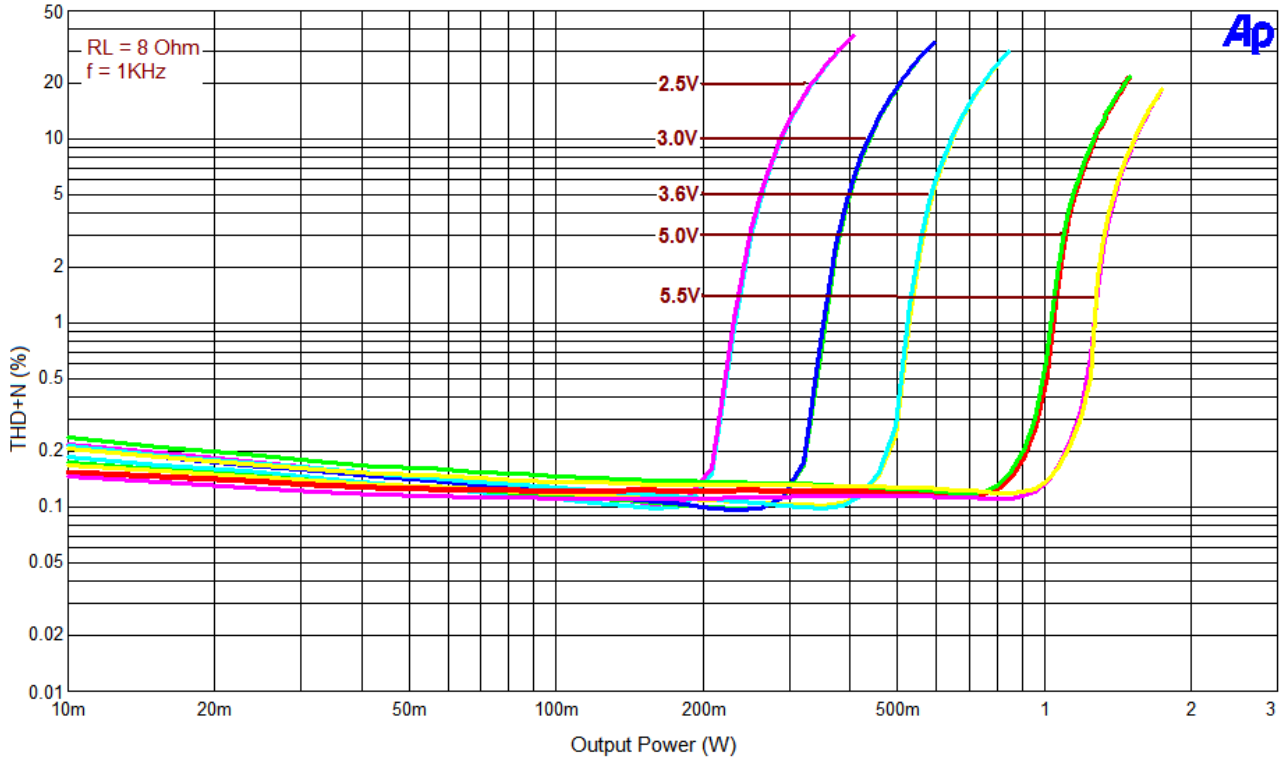
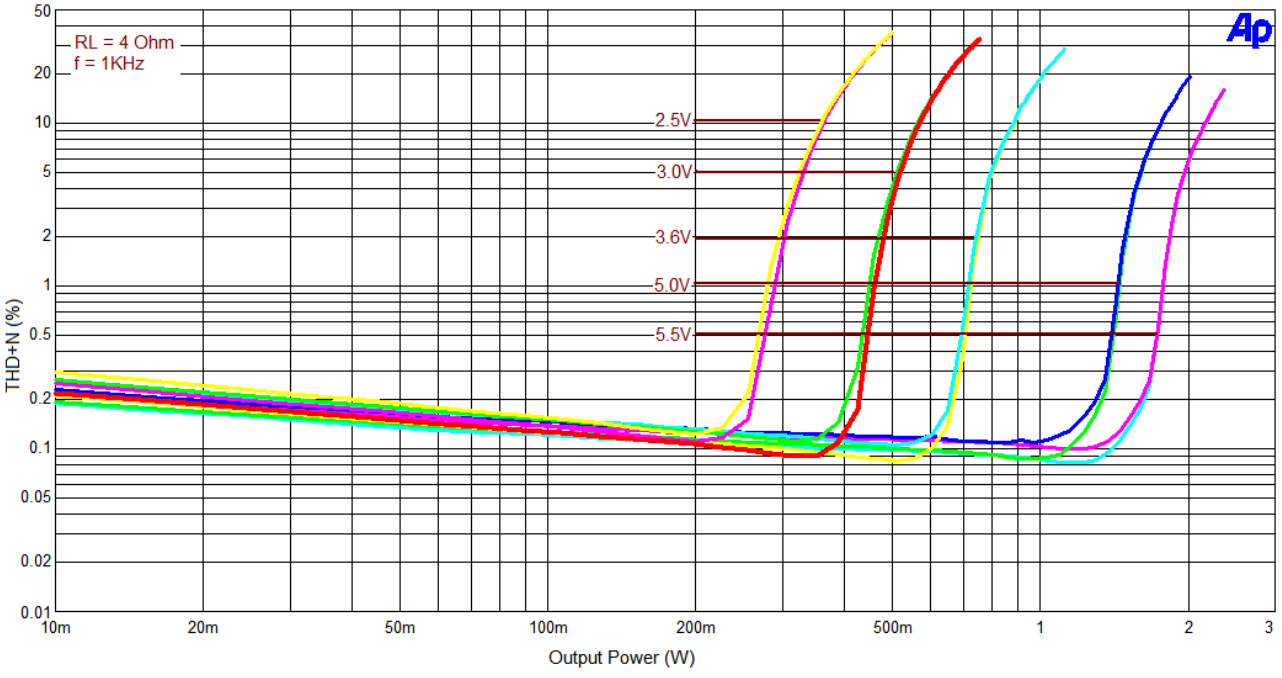


Figure 4
Total Harmonic Distortion + Noise vs Output Power



APPLICATION INFORMATION

POWER SUPPLY BYPASSING

As with any power amplifier, proper supply bypassing is critical for low noise performance and high power supply rejection. Applications that employ a 5V regulator typically use a 10 µF in parallel with a 0.1 µF filter capacitor to stabilize the regulator's output, reduce noise on the supply line, and improve the supply's transient response. However, their presence does not eliminate the need for a local 1.0 µF tantalum bypass capacitance connected between the LY8663's supply pins and ground. Do not substitute a ceramic capacitor for the tantalum. Doing so may cause oscillation. Keep the length of leads and traces that connect capacitors between the LY8663's power supply pin and ground as short as possible.

MICRO-POWER SHUTDOWN

The voltage applied to the SHUTDOWN pin controls the LY8663's shutdown function. Activate micro-power shutdown by applying VDD to the SHUTDOWN pin. When active, the LY8663's micro-power shutdown feature turns off the amplifier's bias circuitry, reducing the supply current. The low 0.1 µA typical shutdown current is achieved by applying a voltage that is as near as VDD as possible to the SHUTDOWN pin. A voltage that is less than VDD may increase the shutdown current.

Table 1 shows the logic signal levels that activate and deactivate micro-power shutdown and headphone amplifier operation.

There are a few ways to control the micro-power shutdown. These include using a single-pole, single-throw switch, a microprocessor or a microcontroller. When using a switch, connect an external 20k resistor between the SHUTDOWN pin and VDD. Connect the switch between the SHUTDOWN pin and GND. Select normal amplifier operation by closing the switch. Opening the switch sets the SHUTDOWN pin to VDD through the 20k resistor, which activates the micro-power shutdown. The switch and resistor guarantee that the SHUTDOWN pin will not float. This prevents unwanted state changes. In a system with a microprocessor or a microcontroller, use a digital output to apply the control voltage to the SHUTDOWN pin. Driving the SHUTDOWN pin with active circuitry eliminates the pull up resistor.

TABLE 1. Logic Level Truth Table

Shutdown Pin	HP-IN Pin	Operational Output Mode
Logic Low	Low (HP not Plugged in)	BTL
Logic Low	High (HP Plugged in)	Single-Ended
Logic High	High or Low Don't care	Micro-Power Shutdown

HP-IN FUNCTIONS

Applying a voltage between 4V and VDD level to the LY8663's HP-IN headphone control pin turns off Amp. A (+out) and Amp. B (+out) muting a bridged-connected load. Quiescent current consumption is reduced when the IC is in this single-ended mode.

Figure 3 shows the implementation of the LY8663's headphone control function. With no headphones connected to the headphone jack, the R3,R8 voltage divider sets the voltage applied to the HP-IN pin (pin 20) at approximately 50mV. This 50mV enables Amp A (+out) and Amp B (+out) placing the LY8663 in bridged mode operation.

While the LY8663 operates in bridged mode, the DC potential across the load is essentially 0V. The HP-IN threshold is set at 4V. Therefore, even in an ideal situation, the output swing cannot cause a false single -ended trigger. Connecting headphones to the headphone jack disconnects the headphone jack contact pin from −OUTA and allows R8 to pull the HP-IN pin up to VDD.

This enables the headphone function, turns off Amp A (+out) and Amp B (+out) and mutes the bridged speaker. The amplifier then drives the headphones, whose impedance is in parallel with resistors R3 and R4. These resistors have negligible effect on the LY8663's output drive capability since the typical impedance of headphones is 32Ω.

Figure 3 also shows the suggested headphone jack electrical connections. The jack is designed to mate with a three wire plug. The plug's tip and ring should each carry one of the two stereo output signals, whereas the

sleeve should carry the ground return. The headphone jack with one control pin contact is sufficient to drive the HP-IN pin when connecting headphones.

As outlined above driving the Speaker (BTL) and Headphone (SE) loads simultaneously using LY8663 is simple and easy. However this configuration will only work if the HP Logic pin is used to control the BTL/SE operation and HP-IN pin is connected to GND(Figure 4).

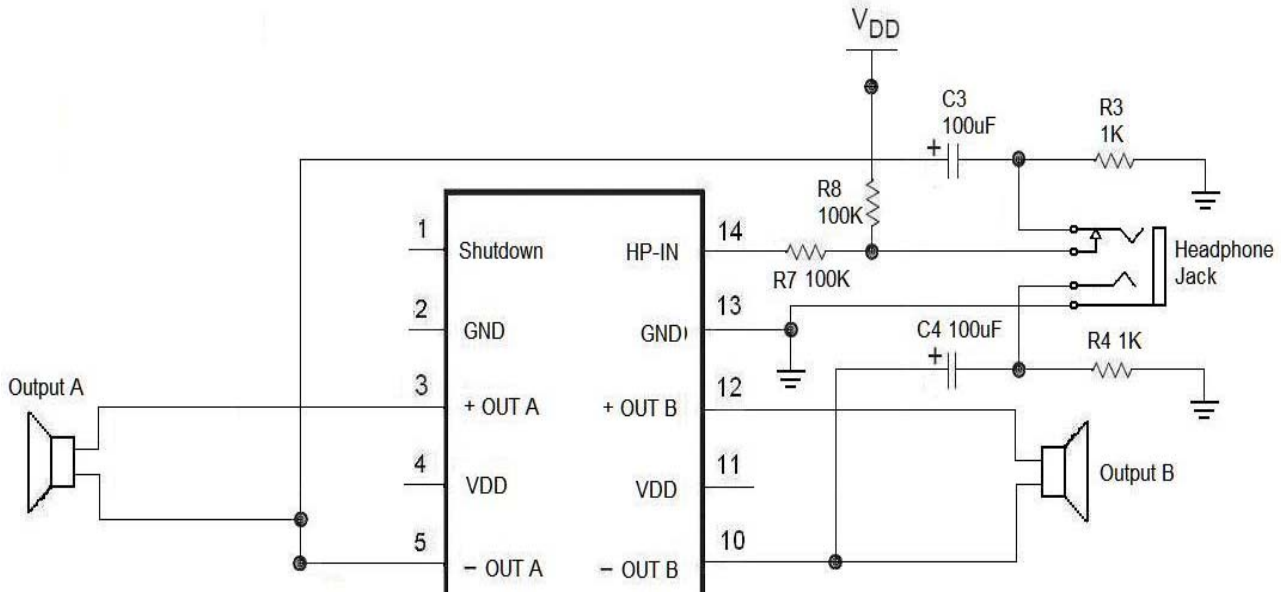


FIGURE 3. With Headphone Circuit

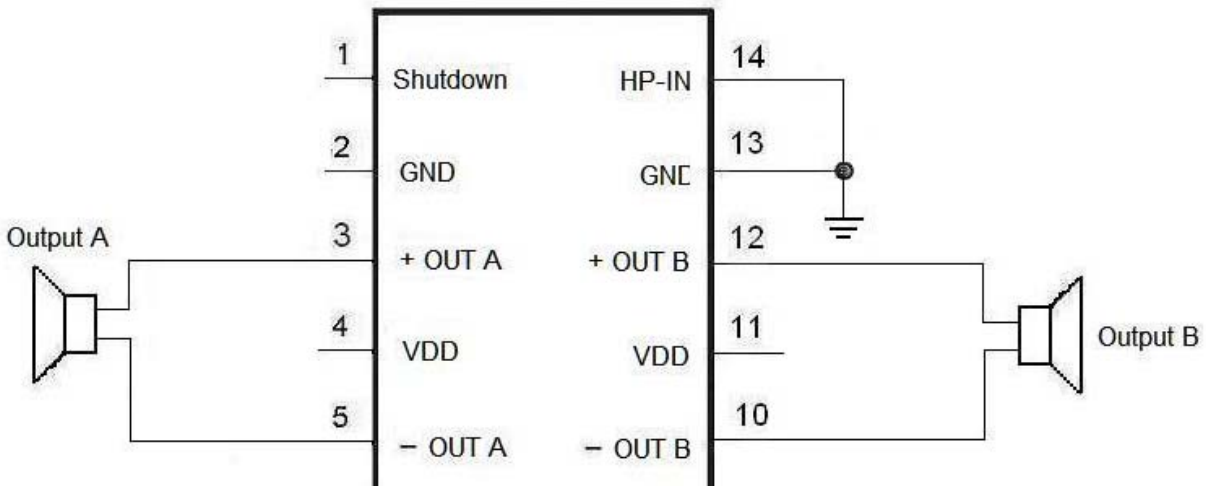


FIGURE 4. Without Headphone Circuit

Bypass Capacitor Value Selection

Besides minimizing the input capacitor size, careful consideration should be paid to value of C6, the capacitor connected to the BYPASS pin. Since C6 determines how fast the LY8663 settles to quiescent operation, its value is critical when minimizing turn-on pops. The slower the LY8663's outputs ramp to their quiescent DC voltage (nominally 1/2 VDD), the smaller the turn-on pop. Choosing C6 equal to 1.0 µF along with a small value of C1,C2 (in the range of 0.1 µF to 0.39 µF), produces a click-less and pop-less shutdown function. As discussed above, choosing C1,C2 no larger than necessary for the desired bandwith helps minimize clicks and pops.

OPTIMIZING CLICK AND POP REDUCTION PERFORMANCE

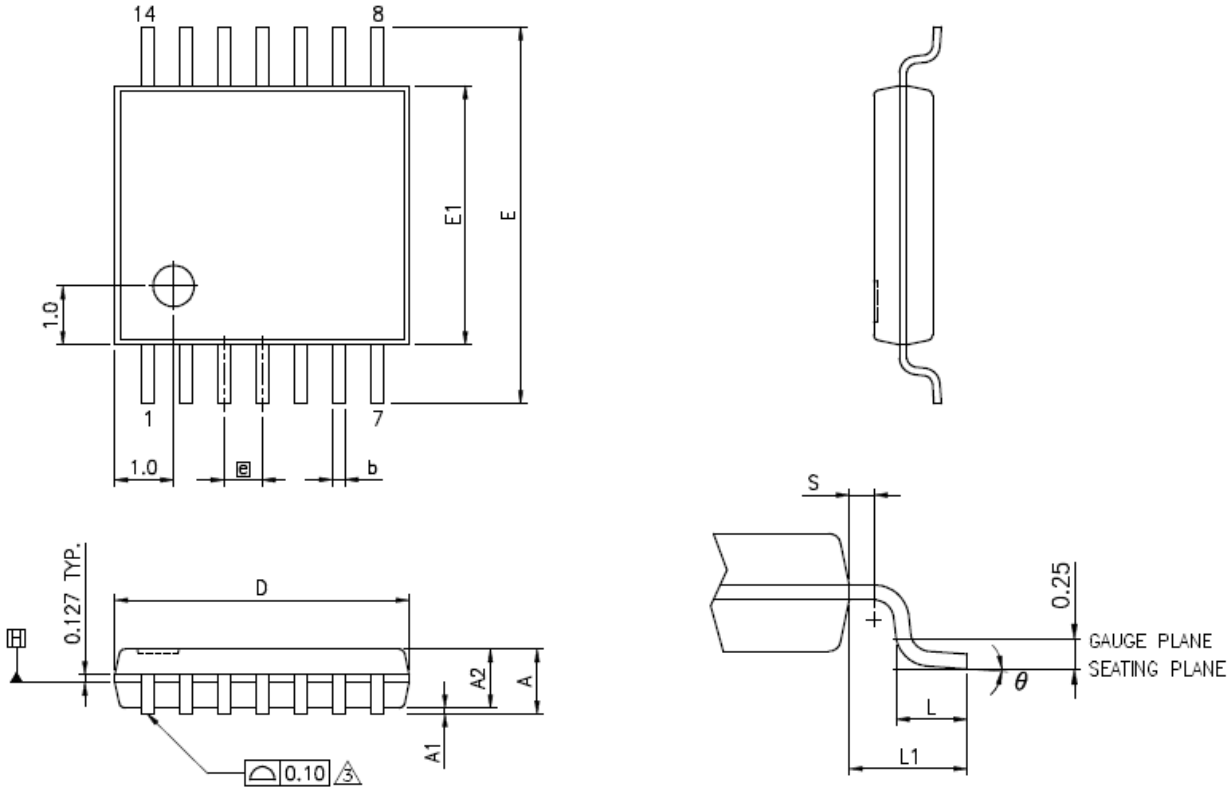
The LY8663 contains circuitry that minimizes turn-on and shutdown transients or "clicks and pop". For this discussion, turn-on refers to either applying the power supply voltage or when the shutdown mode is deactivated. When the part is turned on, an internal current source changes the voltage of the BYPASS pin in a controlled, linear manner. Ideally, the input and outputs track the voltage applied to the BYPASS pin. The gain of the internal amplifiers remains unity until the voltage on the bypass pin reaches 1/2 VDD. As soon as the voltage on the bypass pin is stable, the device becomes fully operational. Although the BYPASS pin current cannot be modified, changing the size of C6 alters the device's turn-on time and the magnitude of "clicks and pops". Increasing the value of C6 reduces the magnitude of turn-on pops. However, this presents a tradeoff: as the size of C6 increases, the turn-on time increases. There is a linear relationship between the size of C6 and the turn-on time. Here are some typical turn-on times for various values of C6:
In order eliminate "clicks and pops", all capacitors must be discharged before turn-on. Rapidly switching VDD on and off may not allow the capacitors to fully discharge, which may cause "clicks and pops". In a single -ended configuration, the output is coupled to the load by C3,C4. This capacitor usually has a high value. C3,C4 discharges through internal 20kΩ resistors. Depending on the size of C3,C4, the discharge time constant can be relatively large. To reduce transients in single-ended mode, an external 1kΩ - 5kΩ resistor can be placed in parallel with the internal 20kΩ resistor. The tradeoff for using this resistor is increased quiescent current.

TABLE 2. C_6 and T_{ON} Truth Table

C_6	T_{ON} (Typ.) at 5.0V
1.0uF	172 ms
0.47uF	76 ms
0.33uF	60 ms
0.22uF	50 ms
0.1uF	36 ms

PACKAGE OUTLINE DIMENSION

14-Pin TSSOP Package Outline Dimension



VARIATIONS (ALL DIMENSIONS SHOWN IN MM)

SYMBOLS		MIN.	NOM.	MAX.
A		–	–	1.20
A1	STANDARD	0.05	–	0.15
	THERMALLY ENHANCED	0.00	–	0.15
A2		0.80	1.00	1.05
b		0.19	–	0.30
D		4.90	5.00	5.10
E1		4.30	4.40	4.50
E		6.40 BSC		
e		0.65 BSC		
L1		1.00 REF		
L		0.50	0.60	0.75
S		0.20	–	–
θ		0°	–	8°