1W audio power amplifier

Description

- The LM4890S audio power amplifier is primarily designed for demanding applications in mobile phones and other portable communication devices. It is capable of delivering 0.5W of continuous average power into an 8Ω BTL load from a 5V DC power supply with less than 1% total harmonic distortion plus noise (THD+N).
- The Boomer audio power amplifier is designed specifically to provide high-quality output power with minimal external components. The LM4890S does not require output coupling capacitors or bootstrap capacitors, making it highly suitable for mobile phones and other low-voltage applications where minimal power consumption is a key requirement.
- The LM4890S features a low-power shutdown mode, which is activated by driving the shutdown pin low.
- The LM4890S incorporates advanced pop & click circuitry, eliminating transitions that would otherwise cause noise during power on and off.
- The LM4890S is unity-gain stable and can be configured for external gain setting resistors.

Physical map

Applications

- Mobile phone
- Personal computer
- Portable electronic device

Features

- This device features a space-saving package: micro-sized MSOP8.
- Ultra-low current shutdown mode.
- BTL output capable of driving capacitive loads.
- Enhanced pop & click circuitry eliminates noise during power transitions.
- Operating voltage range of 2.2 - 5.5V.
- No output coupling capacitors, buffer networks, or required bootstrap capacitors.
- 0.1uA current in shutdown mode.
- External gain configuration capability.

Specifications

- PSRR 62dB (typical) at 217Hz, V_{DD}=5V (Figure)
- Power output at 5.0V & 1% THD 1W (typical)
- Power output voltage at 3.3V & 1% THD 400m W (typical)
- Shutdown current 0.1μ A (typical)

Typical application

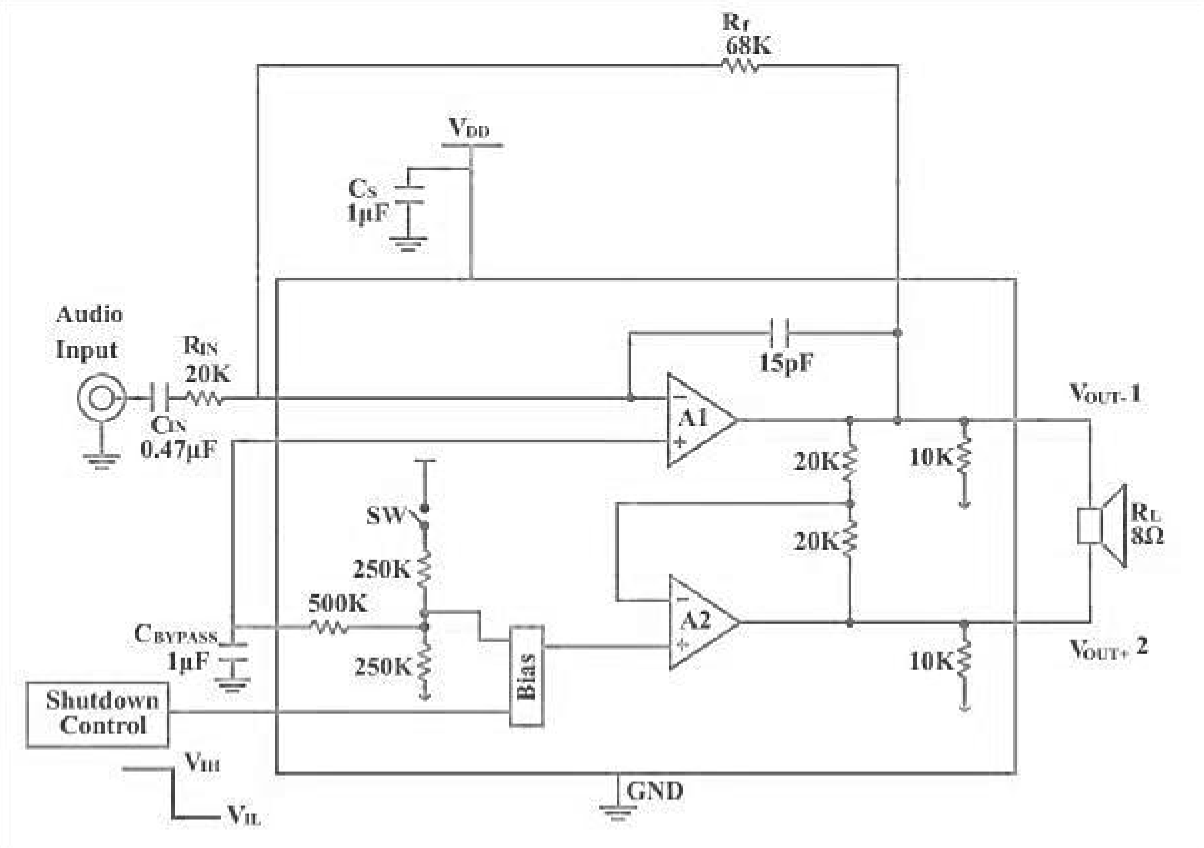


Fig.1 Lm4890S Typical Application Schematic

Absolute Maximum Ratings (Note 2)		Thermal Resistance	
supply voltage (note 11)	5.5V	θ_{JC} (SOP)	35℃/W
storage temperature	-65℃ to +150℃	θ_{JA} (SOP)	150℃/W
input voltage	-0.3V to V_{DD}+0.3V	θ_{JA} (8-Ball Micro SMD, Note 12)	220℃/W
power dissipation (3)	internal limitations	θ_{JA} (9-Ball Micro SMD,Note 12)	180℃/W
ESD susceptibility (4)	2000V	θ_{JC} (MSOP)	56℃/W
junction temperature	150℃	θ_{JA} (MSOP)	190℃/W
		θ_{JA} (LLP)	220℃/W
Operating Ratings			
temperature range			
$T_{MIN}≤T_A≤T_{MAX}$	-40℃≤T_A≤85℃		
voltage	2.2V≤V_{DD}≤5.5V		

Electrical characteristics V_{DD}=5V (Note 1, 2, 8)

The following specifications apply, unless otherwise noted, and the limits for the circuit shown in Figure.1 apply at T_A = 25°C.

Symbol	Parameter	Conditions	LM4890		Unit (Limited)
			Type (Note 6)	Limit (Note 7,9)	
I_{DD}	quiescent supply current	V_{IN}=0V,I_O=0A,No load	2.6	4	mA(max.)
		V_{IN}=0V,I_O=0A,8Ωload	3	5	mA(max.)
I_{SD}	shutdown current	$V_{SHUTDOWN}$=0V	0.1	0.5	μA(max.)
V_{SDIH}	shutdown voltage input high			1.2	V(min.)
V_{SDIL}	shutdown voltage input low			0.4	V(max.)
V_{OS}	output voltage setting		7	50	mV(max.)
$R_{OUT-GND}$	output to ground resistor(10)		8.5	9.7	KΩ(max.)
				7.0	KΩ(min.)
P_O	output power(8Ω)	THD=2%(max.)；F=1KHz	1.0	0.8	W
T_{WU}	wake-up time		170	220	ms(max.)
T_{SD}	thermal shutdown temperature		170	150	℃(min.)
				190	℃(max.)
THD+N	total harmonic distortion + noise	P_O=0.4Wrms;F=1KHz	0.1		%
PSRR	power supply rejection ratio (note 14)	V_{ripple}=200mV sine P-P input terminal connect 10Ω resistor to ground	62(f=217Hz) 66(f=1KHz)	55	dB(min.)
T_{SDT}	shutdown time	8Ω load	1.0		ms(max.)

Electrical characteristics V_{DD}=3V (Note 1, 2, 8)

The following specifications apply, unless otherwise noted, and the limits for the circuit shown in Figure.1 apply at T_A = 25°C.

Symbol	Parameter	Conditions	LM4890 Type (Note 6)	LM4890 Limit (Note 7,9)	Unit (Limited)
I_{DD}	quiescent supply current	V_{IN}=0V,I_O=0A,No load	3.5	7	mA(max.)
		V_{IN}=0V,I_O=0A,8Ωload	4.5	9	mA(max.)
I_{SD}	shutdown current	$V_{SHUTDOWN}$=0V	0.1	0.5	μA(max.)
V_{SDIH}	shutdown voltage input high			1.2	V(min.)
V_{SDIL}	shutdown voltage input low			0.4	V(max.)
V_{OS}	output voltage setting		7	50	mV(max.)
$R_{OUT-GND}$	output to ground resistor(10)		8.5	9.7	KΩ(max.)
				7.0	KΩ(min.)
P_O	output power(8Ω)	THD=1%(max.)；F=1KHz	0.31	0.28	W
T_{WU}	wake-up time		120	180	ms(max.)
T_{SD}	thermal shutdown temperature		170	150	℃(min.)
				190	℃(max.)
THD+N	total harmonic distortion + noise	P_O=0.15Wrms;F=1KHz	0.1		%
PSRR	power supply rejection ratio (note 14)	V_{ripple}=200mV sine P-P input terminal connect 10Ω resistor to ground	56(f=217Hz) 62(f=1KHz)	45	dB(min.)

Electrical characteristics V_{DD}=2.6V (Note 1, 2, 8)

The following specifications apply, unless otherwise noted, and the limits for the circuit shown in Figure.1 apply at T_A = 25°C.

Symbol	Parameter	Conditions	LM4890		Unit (Limited)
			Type (Note 6)	Limit (Note 7,9)	
I_{DD}	quiescent supply current	V_{IN}=0V,I_O=0A,No load	2.6		mA(max.)
I_{SD}	shutdown current	VSHUTDOWN=0V	0.1		μA(max.)
P_O	output power(8Ω) output power(4Ω)	THD=1%(max.)；F=1KHz THD=1%(max.)；F=1KHz	0.2 0.22		W W
THD+N	total harmonic distortion + noise	P_O=0.1Wrms;F=1KHz	0.08		%
PSRR	power supply rejection ratio (note 14)	V_{ripple}=200mV sine P-P input terminal connect 10Ω resistor to ground	44(f=217Hz) 44(f=1KHz)		dB

Note 1: All voltages are measured relative to this ground pin, unless otherwise specified.

Note 2: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings are conditions under which the device operates normally, but specific performance is not guaranteed. Electrical characteristics are specifications under test conditions of national DC and AC standards, which ensure specific performance limits, assuming the device is operating within its operating ratings. Specifications are not guaranteed without limiting parameters; however, typical values indicate good device performance.

Note 3: At high temperatures, the maximum power dissipation decreases, which is determined by T_{JMAX}, θ_{JA}, and the ambient temperature T_A. The maximum allowable power dissipation PDMAX is calculated using the formula $P_{DMAX} = (T_{JMAX} - T_A) / \theta_{JA}$, or it can be derived from the lower of the values provided in the Absolute Maximum Ratings. For the LM4890S, refer to the derating curve in the additional information section for details on power dissipation reduction.

Note 4: Human body model with 100pF discharge through a 1.5KΩ resistor.

Note 5: Machine model with discharge of 220pF-240pF, all pins.

Note 6: Standards are based on measurements taken at 25°C.

Note 7: Limits are guaranteed for national AOQL (Average Outgoing Quality Level).

Note 8: For micro SMD only, shutdown current measurements are taken under normal room temperature conditions; direct sunlight exposure increases this value.

Note 9: Minimum/maximum specifications in the datasheet are guaranteed by design, testing, or statistical analysis.

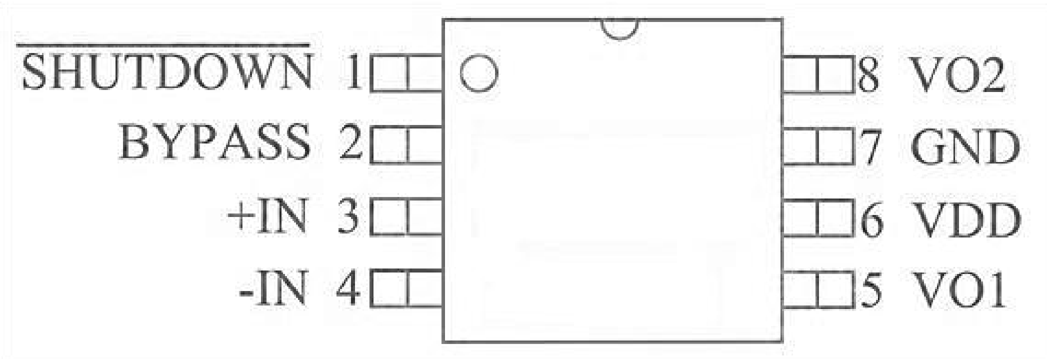
Note 10: Maximum dissipation power (P_{DMAX}) occurs in the device at output power levels significantly lower than full output power. P_{DMAX} can be obtained from Formula 1 displayed in application sections. It can also be derived from power dissipation graphs.

Note 11: PSRR is a system gain function. Specifications apply to the circuit shown in Figure 1 with A_V=2; higher system gains will reduce PSRR values proportionally to the gain increase. A 10-system gain represents a 14 dB gain increase. PSRR is reduced by 14 dB and applies to all operating voltages.

External components description

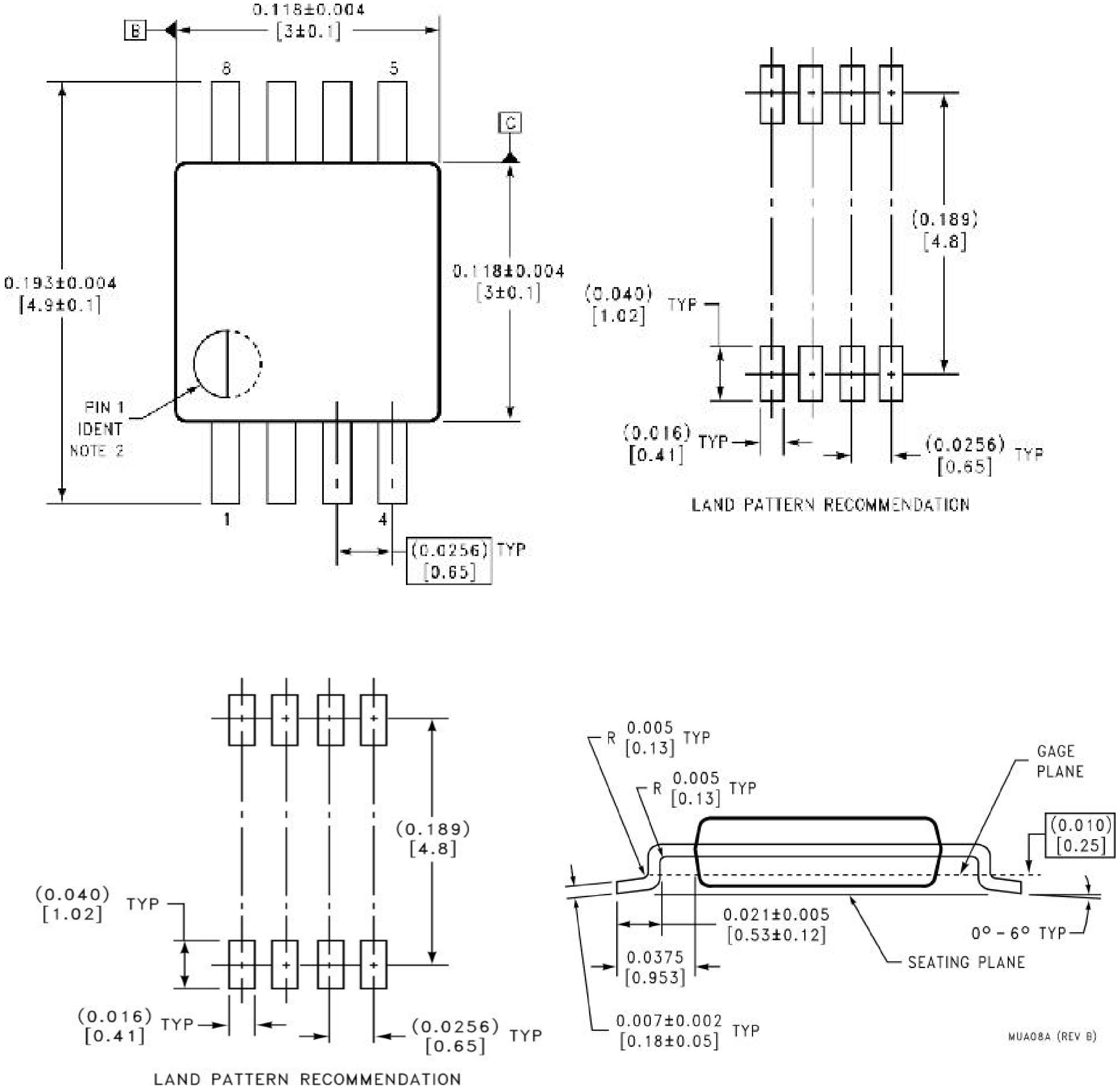
Components		Description
1	R_{IN}	The inverting input impedance affects the closed-loop gain of the R_F stage. This resistor also forms a high-pass filter with the input capacitance C_{IN}, where the cutoff frequency is given by $f_C = 1/(2\pi R_{IN} \cdot C_{IN})$.
2	C_{IN}	The input coupling capacitor blocks DC voltage at the amplifier's input and also forms a high-pass filter with R_{IN}, where the cutoff frequency is given by $f_C = 1/(2\pi R_{IN} \cdot C_{IN})$. Referencing this section, proper selection of external components involves determining the capacitance value.
3	R_f	The feedback resistor is set to determine the closed-loop gain (R).
4	C_S	The power supply bypass capacitor, C_{BYPASS}, is essential for providing power supply filtering. Please refer to the following section for guidance on the correct placement and selection criteria for CBYPASS to effectively filter the power supply.
5	C_{BYPASS}	The bypass pin capacitor, C_{BYPASS}, is crucial for providing half-supply filtering. Please refer to the following section for proper guidance on selecting external components and ensuring CBYPASS is correctly placed and chosen to effectively filter the half-supply.

Package pin diagram



Pin	Symbol	Description
1	SD (SHUTDOWN)	high-level chip operates normally; low-level chip stops functioning
2	BYP (BYPASS)	internal common-mode voltage bypass capacitor
3	+IN	analog input in-phase terminal
4	-IN	analog input out-of-phase terminal
5	V_{O-}	analog output terminal negative
6	V_{DD}	power supply input positive
7	GND	power supply input negative
8	V_{O+}	analog output positive

Package dimensions of MSOP8



Unless otherwise specified, all dimensions are in inches (millimeters)