1 Watt Audio Power Amplifier

General Description

The LM4890isanaudiopoweramplifierprimarilydesigned for demanding applications in mobile phones and other portable communication device applications. It is capable of delivering 1 watt of continuous average power to an 8Ω BTL load with less than 1% distortion (THD+N) from a $5V_{DC}$ power supply.

Boomer audio power amplifiers were designed specifically to provide high quality output power with a minimal amount of externalcomponents.The LM4890doesnotrequireoutput coupling capacitors or bootstrap capacitors, and therefore is ideally suited for mobile phone and other low voltage applications where minimal power consumption is a primary requirement.

The LM4890featuresalow-powerconsumptionshutdown mode, which is achieved by driving the shutdown pin with logiclow.Additionally,the LM4890featuresaninternalthermal shutdown protection mechanism.

The LM4890containsadvancedpop&clickcircuitrywhich eliminates noises which would otherwise occur during turn-on and turn-off transitions.

The LM4890isunity-gainstableandcanbeconfiguredby external gain-setting resistors.

Key Specifications

- PSRR at 217Hz, V_{DD} = 5V (Fig. 1) 62dB(typ.)
- Power Output at 5.0V & 1% THD 1W(typ.)
- Power Output at 3.3V & 1% THD 400mW(typ.)
- Shutdown Current 0.1μA(typ.)

Features

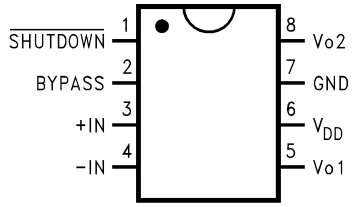
- Available in space-saving packages: micro SMD, MSOP, SOIC, and LLP
- Ultra low current shutdown mode
- BTL output can drive capacitive loads
- Improved pop & click circuitry eliminates noises during turn-on and turn-off transitions
- 2.2 - 5.5V operation
- No output coupling capacitors, snubber networks or bootstrap capacitors required
- Thermal shutdown protection
- Unity-gain stable
- External gain configuration capability

Applications

- Mobile Phones
- PDAs
- Portable electronic devices

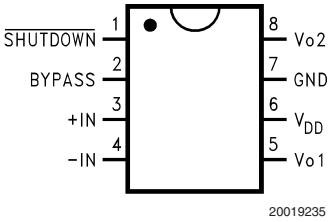
Connection Diagrams (Continued)

Mini Small Outline (MSOP) Package



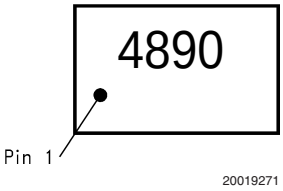
Top View
Order Number LM4890MM
See NS Package Number MUA08A

Small Outline (SO) Package



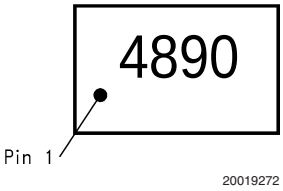
Top View
Order Number LM4890M
See NS Package Number M08A

MSOP Marking



Top View
G - Boomer Family
90 - LM4890MM

SO Marking



Top View
XY - Date Code
TT - Die Traceability
Bottom 2 lines - Part Number

Typical Application

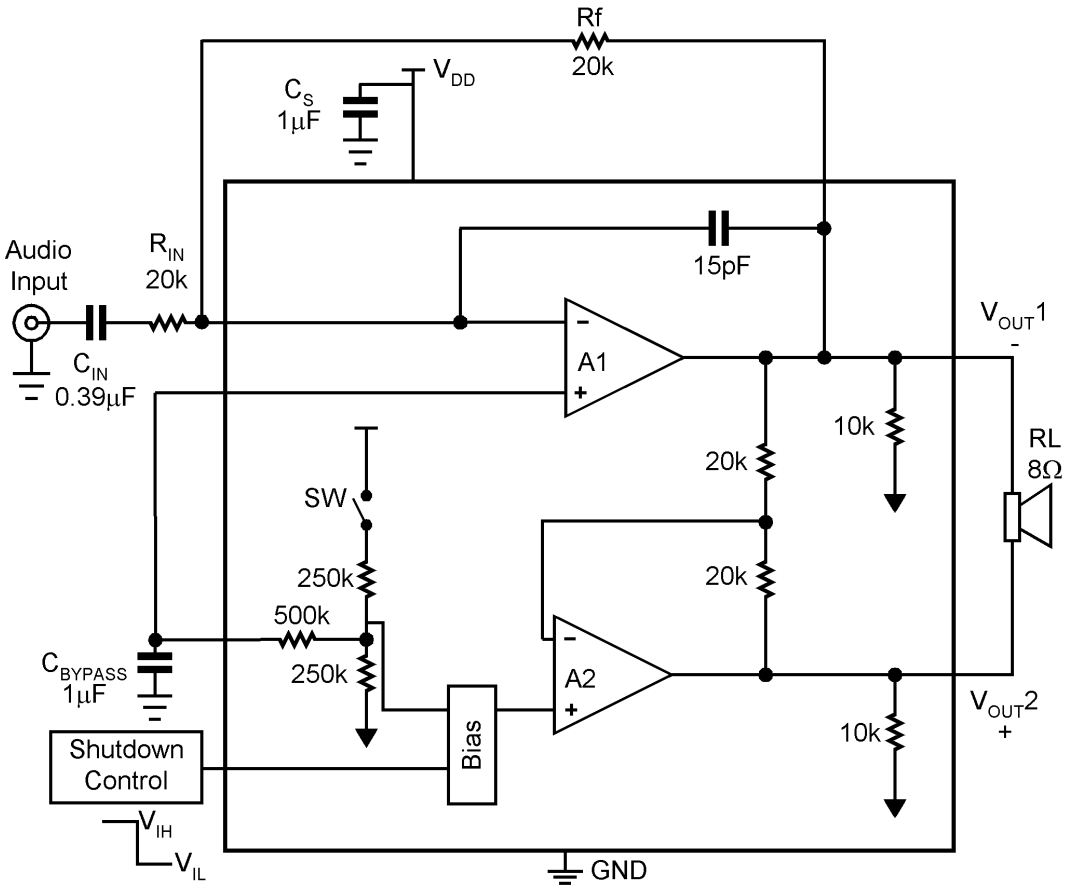


FIGURE 1. Typical Audio Amplifier Application Circuit

Absolute Maximum Ratings (Note 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Supply Voltage (Note 11)	6.0V
Storage Temperature	−65˚C to +150˚C
Input Voltage	−0.3V to V_{DD} +0.3V
Power Dissipation (Note 3)	Internally Limited
ESD Susceptibility (Note 4)	2000V
Junction Temperature	150˚C
Thermal Resistance	
θ_{JC} (SOP)	35˚C/W
θ_{JA} (SOP)	150˚C/W
θ_{JA} (8 Bump micro SMD, Note 12)	220˚C/W
θ_{JA} (9 Bump micro SMD, Note 12)	180˚C/W
θ_{JC} (MSOP)	56˚C/W
θ_{JA} (MSOP)	190˚C/W
θ_{JA} (LLP)	220˚C/W
Soldering Information	
See AN-1112 "microSMD Wafers Level Chip Scale Package."	
See AN-1187 "Leadless Leadframe Package (LLP)."	

Operating Ratings

Temperature Range	
$T_{MIN} \le T_A \le T_{MAX}$	$-40˚C \le T_A \le 85˚C$
Supply Voltage	$2.2V \le V_{DD} \le 5.5V$

Electrical Characteristics V_{DD} = 5V (Notes 1, 2, 8)

The following specifications apply for the circuit shown in Figure 1 unless otherwise specified. Limits apply for T_A = 25˚C.

Symbol	Parameter	Conditions	LM4890		Units (Limits)
			Typical (Note 6)	Limit (Notes 7, 9)	
I_{DD}	Quiescent Power Supply Current	V_{IN} = 0V, I_o = 0A, No Load	4	8	mA (max)
		V_{IN} = 0V, I_o = 0A, 8Ω Load	5	10	mA (max)
I_{SD}	Shutdown Current	$V_{SHUTDOWN}$ = 0V	0.1	2.0	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 Offset Voltage		7	50	mV (max)
$R_{OUT-GND}$	Resistor Output to GND (Note 10)		8.5	9.7	kΩ (max)
				7.0	kΩ (min)
P_o	Output Power (8Ω)	THD = 2% (max); f = 1 kHz	1.0	0.8	W
T_{WU}	Wake-up time		170	220	ms (max)
T_{SD}	Thermal Shutdown Temperature		170	150	˚C (min)
				190	˚C (max)
THD+N	Total Harmonic Distortion + Noise	P_o = 0.4 Wrms; f = 1kHz	0.1		%
PSRR	Power Supply Rejection Ratio (Note 14)	V_{ripple} = 200mV sine p-p Input Terminated with 10 ohms to ground	62 (f = 217Hz) 66 (f = 1kHz)	55	dB (min)
T_{SDT}	Shut Down Time	8 Ω load	1.0		ms (max)

Electrical Characteristics V_{DD} = 3V (Notes 1, 2, 8)

The following specifications apply for the circuit shown in Figure 1 unless otherwise specified. Limits apply for T_A = 25˚C.

Symbol	Parameter	Conditions	LM4890		Units (Limits)
			Typical (Note 6)	Limit (Notes 7, 9)	
I_{DD}	Quiescent Power Supply Current	V_{IN} = 0V, I_o = 0A, No Load	3.5	7	mA (max)
		V_{IN} = 0V, I_o = 0A, 8Ω Load	4.5	9	mA (max)
I_{SD}	Shutdown Current	$V_{SHUTDOWN}$ = 0V	0.1	2.0	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 Offset Voltage		7	50	mV (max)
$R_{OUT-GND}$	Resistor Output to Gnd (Note 10)		8.5	9.7	kΩ (max)
				7.0	kΩ (min)
T_{WU}	Wake-up time		120	180	ms (max)

Electrical Characteristics V_{DD} = 3V (Notes 1, 2, 8)

The following specifications apply for the circuit shown in Figure 1 unless otherwise specified. Limits apply for T_A = 25˚C. (Continued)

Symbol	Parameter	Conditions	LM4890		Units (Limits)
			Typical	Limit	
			(Note 6)	(Notes 7, 9)	
P_o	Output Power (8Ω)	THD = 1% (max); f = 1kHz	0.31	0.28	W
T_{SD}	Thermal Shutdown Temperature		170	150	˚C(min)
				190	˚C(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 terminated with 10 ohms to ground	56 (f = 217Hz) 62 (f = 1kHz)	45	dB(min)

Electrical Characteristics V_{DD} = 2.6V (Notes 1, 2, 8)

The following specifications apply for for the circuit shown in Figure 1 unless otherwise specified. Limits apply for T_A = 25˚C.

Symbol	Parameter	Conditions	LM4890		Units (Limits)
			Typical	Limit	
			(Note 6)	(Notes 7, 9)	
I_{DD}	Quiescent Power Supply Current	V_{IN} = 0V, I_o = 0A, No Load	2.6		mA (max)
I_{SD}	Shutdown Current	$V_{SHUTDOWN}$ = 0V	0.1		µA (max)
P_0	Output Power (8Ω) Output Power (4Ω)	THD = 1% (max); f = 1 kHz THD = 1% (max); f = 1 kHz	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 Terminated with 10 ohms to ground	44 (f = 217Hz) 44 (f = 1kHz)		dB

External Components Description (*Figure 1*)

Components		Functional Description
1.	R_{IN}	Inverting input resistance which sets the closed-loop gain in conjunction with R_f. This resistor also forms a high pass filter with C_{IN} at $f_C = 1/(2\pi R_{IN}C_{IN})$.
2.	C_{IN}	Input coupling capacitor which blocks the DC voltage at the amplifier's input terminals. Also creates a highpass filter with R_{IN} at $f_c = 1/(2\pi R_{IN}C_{IN})$. Refer to the section, **Proper Selection of External Components**, for an explanation of how to determine the value of C_{IN}.
3.	R_f	Feedback resistance which sets the closed-loop gain in conjunction with R_{IN}.
4.	C_S	Supply bypass capacitor which provides power supply filtering. Refer to the section, **Power Supply Bypassing**, for information concerning proper placement and selection of the supply bypass capacitor, C_{BYPASS}.
5.	C_{BYPASS}	Bypass pin capacitor which provides half-supply filtering. Refer to the section, **Proper Selection of External Components**, for information concerning proper placement and selection of C_{BYPASS}.

Application Information (Continued)

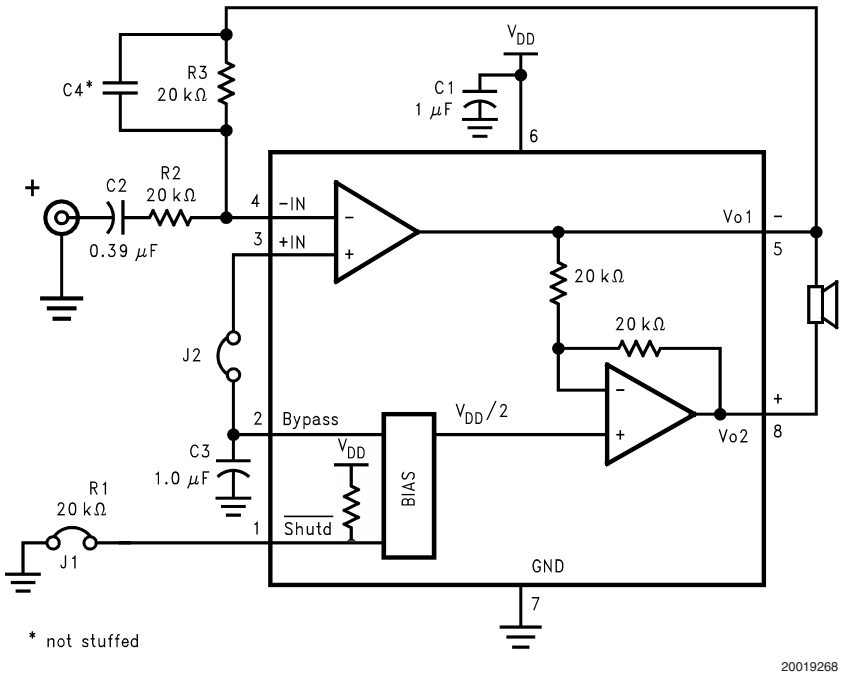
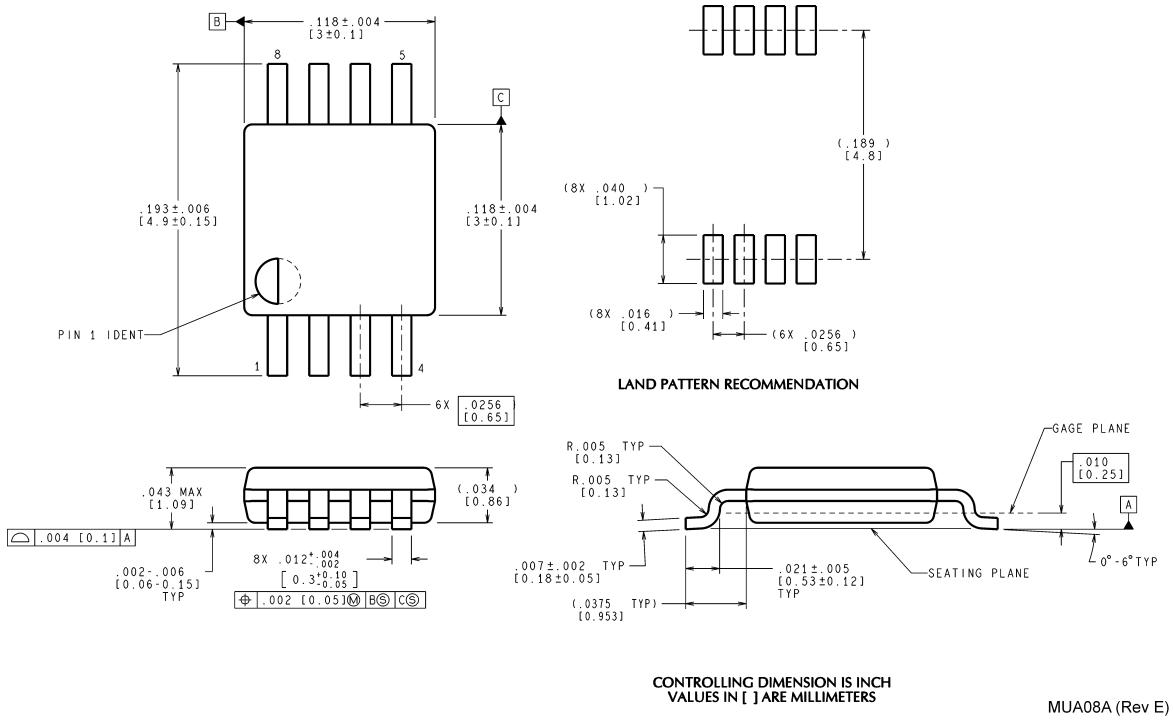


FIGURE 5. REFERENCE DESIGN BOARD and PCB LAYOUT GUIDELINES - MSOP & SO Boards

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



MSOP

