SM7512

3W STEREO AUDIO POWER AMPLIFIER WITH ADVANCED DC VOLUME CONTROL

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3W STEREO AUDIO POWER AMPLIFIER WITH ADVANCED DC VOLUME CONTROL

GENERAL DESCRIPTION

The SM7512 is a stereo audio power amplifier that drives 3 W/channel of continuous RMS power into a 3-Ω load. Advanced dc volume control minimizes external components and allows BTL (speaker) volume control and SE (headphone) volume control. Notebook and pocket PCs benefit from the integrated feature set that minimizes external components without sacrificing functionality.

To simplify design, the speaker volume level is adjusted by applying a dc voltage to the VOLUME terminal.

FEATURES

* Advanced DC Volume Control With 2-dB Steps

  From -40 dB to 20 dB

  - Maximum Volume Setting for SE Mode

  - Adjustable SE Volume control

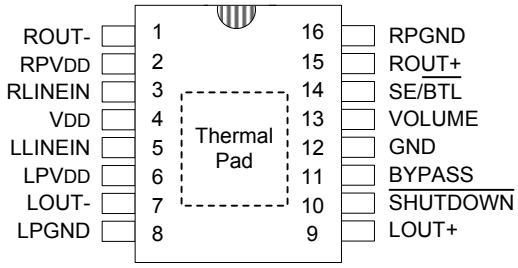
    Referenced to BTL Volume Control

* 3 W Into 3-Ω Speakers

APPLICATIONS

* Notebook PC
* LCD Monitors
* Portable DVD Player
* Digital photo frame

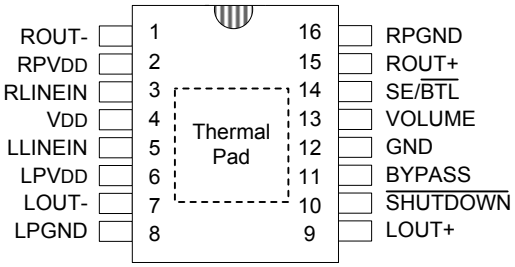
PIN ASSIGNMENTS (TOP VIEW)



SM7512 16PIN

3W STEREO AUDIO POWER AMPLIFIER WITH ADVANCED DC VOLUME CONTROL

PIN ASSIGNMENTS



SM7512 16PIN

PIN DESCRIPTIONS

No.	Pin Name	I / O	Function
1	ROUT-	O	Right channel negative audio output
2	RPVDD	-	Supply voltage terminal for power stage
3	RLINEIN	I	Right channel line input
4	VDD	-	Supply voltage terminal
5	LLINEIN	I	Left channel line input
6	LPVDD	-	Supply voltage terminal for power stage
7	LOUT-	O	Left channel negative audio output
8	LPGND	-	Power ground
9	LOUT+	O	Left chanel positive audio output
10	$\overline{\text{SHUTDOWN}}$	I	Places the amplifier in shutdown mode if a TTL logic low is placed on this terminal
11	BYPASS	I	Tap to voltage divider for internal midsupply bias generator used for analog reference
12	GND	-	Analog power supply ground
13	VOLUME	I	Terminal for dc volume control.DC voltage range is 0 to VDD
14	SE/$\overline{\text{BTL}}$	I	Output MUX control. When this terminal is high,SE outputs are selected. When this terminal is low, BTL outputs are selected
15	ROUT+	O	Right channel positive audio output
16	RPGND	-	Power ground

MAXIMUM RATINGS (Ta = 40~85°C)

Characteristic	Symbol	Rating	Unit
Supply Voltage, V_{DD}, PV_{DD}	V_{SS}	-0.3 ~ 6	V
Input Voltage	V_I	- 0.3 ~ V_{DD} +0.3	V
Operating free-air temperature range	T_A	- 40 ~ 85	-
Operaing junction temperature range	T_J	- 40 ~ 150	°C
Storage temperatuer range	T_{stg}	- 65 ~ 150	°C
Continous total power dissipation	-	See Dissipation Rating Table	°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	-	260	°C

DISSIPATION RATING TABLE

PACKAGE	T_A≤25°C Power Rating	Derating Factor Above T_A=25°C	T_A=70°C Power Rating	T_A=85°C Power Rating
SOP /SSOP	2.7mW	21.8 mW/°C	1.7W	1.4W

RECOMMENDED OPERATING CONDITION

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage, V_{DD}, PV_{DD}	V_{SS}	--	4.0	-	5.5	V
High-level input voltage	V_{IH}	SE/$\overline{BTL}$	0.8 V_{DD}	-	-	V
	V_{IH}	$\overline{SHUTDOWN}$	2.0	-	-	
Low-level input voltage	V_{IL}	SE/$\overline{BTL}$	-	-	0.3 V_{DD}	V
	V_{IL}	$\overline{SHUTDOWN}$	-	-	0.6	
Operating free-air temperature	T_A	--	-40	-	85	°C

ELECTRICAL CHARACTERISTICS (V_{DD} =PV_{DD} = 5.5V, Ta = 25°C unless otherwise noted)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Output offset voltage (measured differentially)	$\lvert V_{OO} \rvert$	V_{DD}=5.5V,Gain=20dB, SE/$\overline{BTL}$=0V	-	-	60	mV
Power supply rejection ratio	PSRR	V_{DD}=PV_{DD}=4.0V to 5.5V	-42	-70	-	dB
High-level input current (SE/$\overline{BTL}$,$\overline{SHUTDOWN}$,VOLUME)	$\lvert I_{IH} \rvert$	V_{DD}=PV_{DD}=5.5V, V_I=V_{DD}=PV_{DD}	-	-	1	uA
Low-level input current(SE/$\overline{BTL}$,$\overline{SHUTDOWN}$,VOLUME)	$\lvert I_{IL} \rvert$	V_{DD}=PV_{DD}=5.5V , V_I=0V	-	-	1	uA
Supply current, no load	I_{DD}	V_{DD}=PV_{DD}=5.5V,SE/$\overline{BTL}$=0V, $\overline{SHUTDOWN}$=2V	5.5	8.0	10	mA
		V_{DD}=PV_{DD}=5.5V,SE/$\overline{BTL}$=5.5V, $\overline{SHUTDOWN}$=2V	3.0	5.0	6.0	
Supply current,max power into a 3Ω load	I_{DD}	V_{DD}=5V=PV_{DD},SE/$\overline{BTL}$=0V, $\overline{SHUTDOWN}$=2V,R_L=3Ω, P_O=2W,Stereo	-	1.5	-	A_{RMS}
Supply current,shutdown mode	$I_{DD(SD)}$	$\overline{SHUTDOWN}$=0.0V	-	1	20	uA

OPERATING CHARACTERISTICS
(V_{DD} =PV_{DD} = 5V, R_L = 3Ω, Gain = 6dB, Ta = 25°C unless otherwise noted)

Characteristic	Symbol	Condition		Min.	Typ.	Max.	Unit
Output Power (1)	P_O	f = 1KHz, R_L =4Ω, BTL Mode , Gain =20 dB	THD+N=1%	-	1.9	-	W
			THD+N=10%	-	2.3	-	
		f = 1KHz, R_L =8Ω, BTL Mode , Gain =20 dB	THD+N=1%	-	1.4	-	
			THD+N=10%	-	1.7	-	
		V_{DD}=5.5V, f = 1KHz, THD+N =10%		-	3	-	
Total harmonic distortion+noise	THD+N	P_O =1W, R_L=8Ω, f=20Hz to 20kHz		-	< 0.6	-	%
High-level output voltage	V_{OH}	R_L=8Ω, Measured between output and V_{DD}		-	-	600	mV
Low-level output voltage	V_{OL}	R_L=8Ω, Measured between output and GND		-	-	400	mV
Bypass voltage(Nominally V_{DD}/2)(2)	$V_{(BYPASS)}$	Measured at pin 11, No load, V_{DD}=5.5V		2.65	2.75	2.85	V
Noise output voltage		f= 20 Hz to 20 kHz, Gain=0 dB, $C_{(BYP)}$= 1.0 uF	BTL	-	85	-	μV_{RMS}

(1) Output power is measured at the output terminals of the IC.

(2) At 4V < V_{DD} < 5.5V the DC bypass voltage is approximately V_{DD}/2

FUNCTIONAL BLOCK DIAGRAM

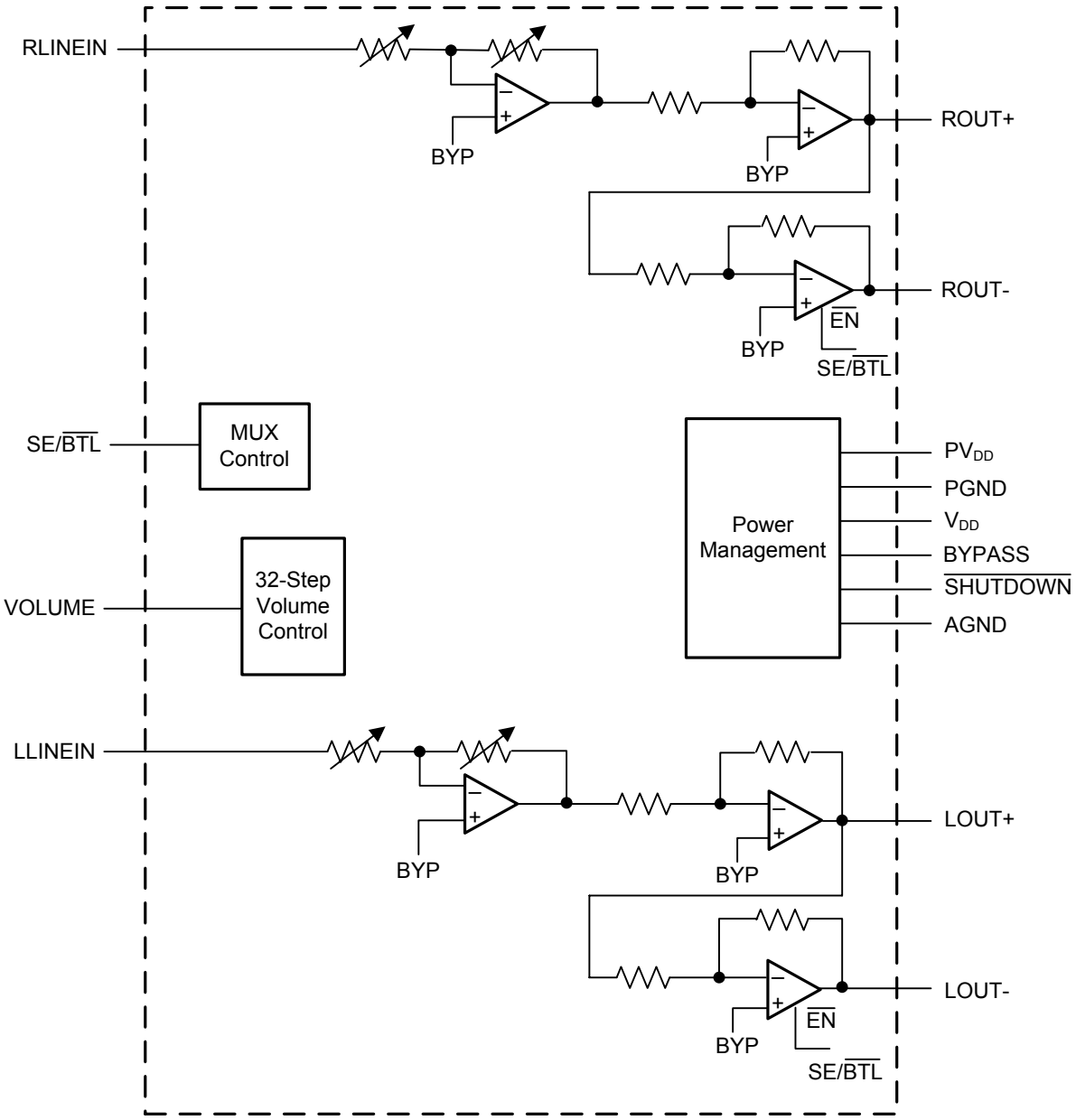


Table 1. DC Volume Control (BTL Mode, V_{DD}=5V)

VOLUME		GAIN OF AMPLIFIER (Typ.)
FROM (V)	TO (V)	
0.00	0.23	-85
0.31	0.34	-40
0.42	0.46	-38
0.54	0.56	-36
0.65	0.67	-34
0.76	0.79	-32
0.87	0.90	-30
0.98	1.01	-28
1.10	1.12	-26
1.21	1.24	-24
1.32	1.35	-22
1.43	1.46	-20
1.54	1.57	-18
1.66	1.68	-16
1.77	1.79	-14
1.88	1.91	-12
1.99	2.02	-10
2.10	2.13	-8
2.21	2.24	-6
2.33	2.35	-4
2.44	2.47	-2
2.55	2.57	0
2.67	2.70	2
2.77	2.80	4
2.89	2.92	6
3.00	3.03	8
3.11	3.14	10
3.22	3.26	12
3.33	3.37	14
3.44	3.48	16
3.55	3.60	18
3.67	5.00	20

APPLICATION INFORMATION

The figure is schematic diagrams of typical notebook computer application circuits.

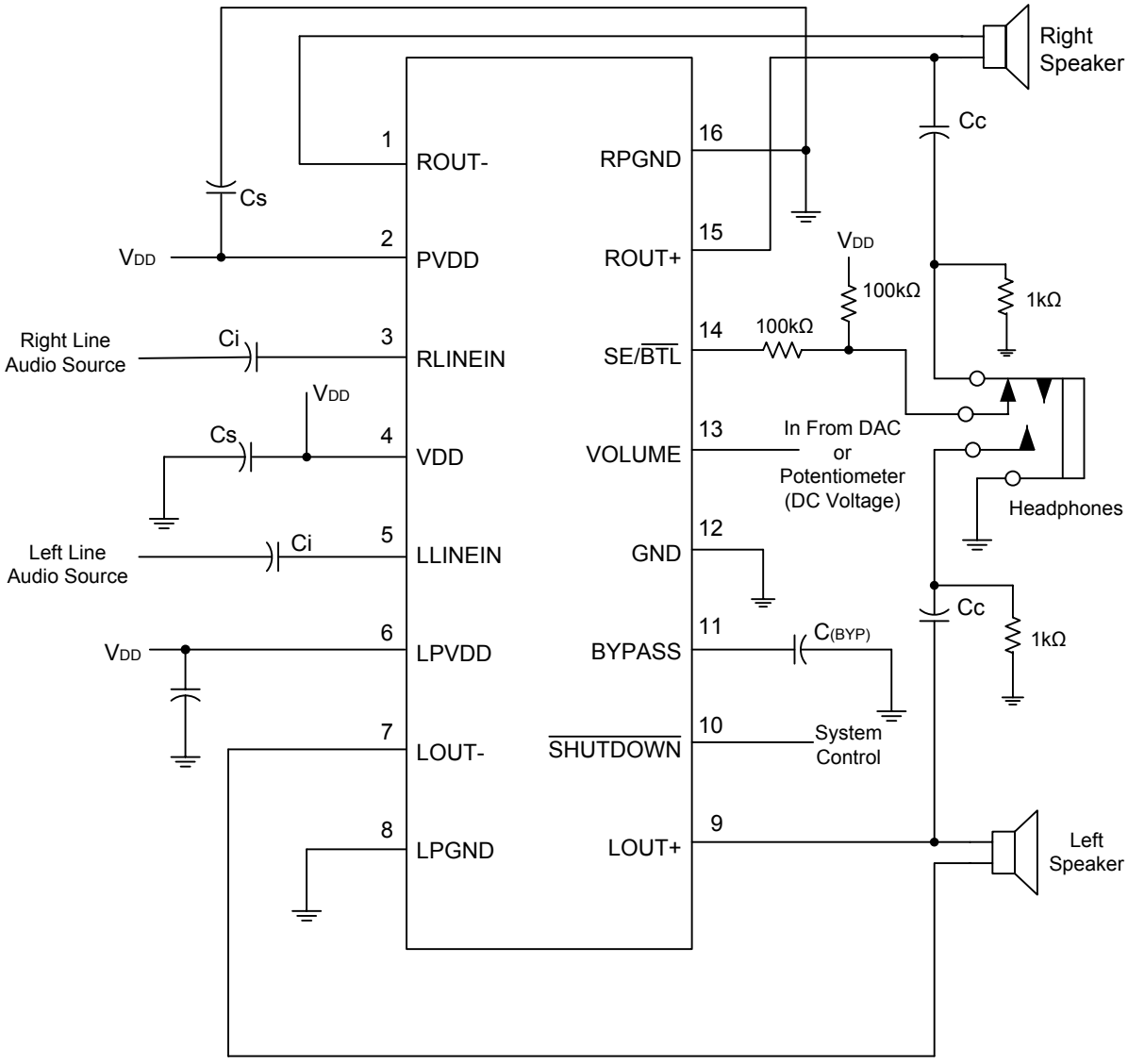


Figure 1. SM7512 Application Circuit Using Single-Ended Inputs and Input MUX

SE/$\overline{\text{BTL}}$ OPERATION

The ability of the SM7512 to easily switch between BTL and SE modes is one of its most important cost saving features. This feature eliminates the requirement for an additional headphone amplifier in applications where internal stereo speakers are driven in BTL mode but external headphone or speakers must be accommodated. Internal to the SM7512, two separate amplifiers drive OUT+ and OUT-. The SE/$\overline{\text{BTL}}$ input controls the operation of the follower amplifier that drives LOUT- and ROUT-. When SE/$\overline{\text{BTL}}$ is held low, the amplifier is on and the SM7512 is in the BTL mode. When SE/$\overline{\text{BTL}}$ is held high, the OUT- amplifiers are in a high output impedance state, which configures the SM7512 as an SE driver from LOUT+ and ROUT+. I_{DD} is reduced by approximately one-third in SE mode. Control of the SE/$\overline{\text{BTL}}$ input can be from a logic-level CMOS source or, more typically, from a resistor divider network as shown in Figure 2. The trip level for the SE/$\overline{\text{BTL}}$ input can be found in the *recommended operating condition* table.

APPLICATION INFORMATION (continued)

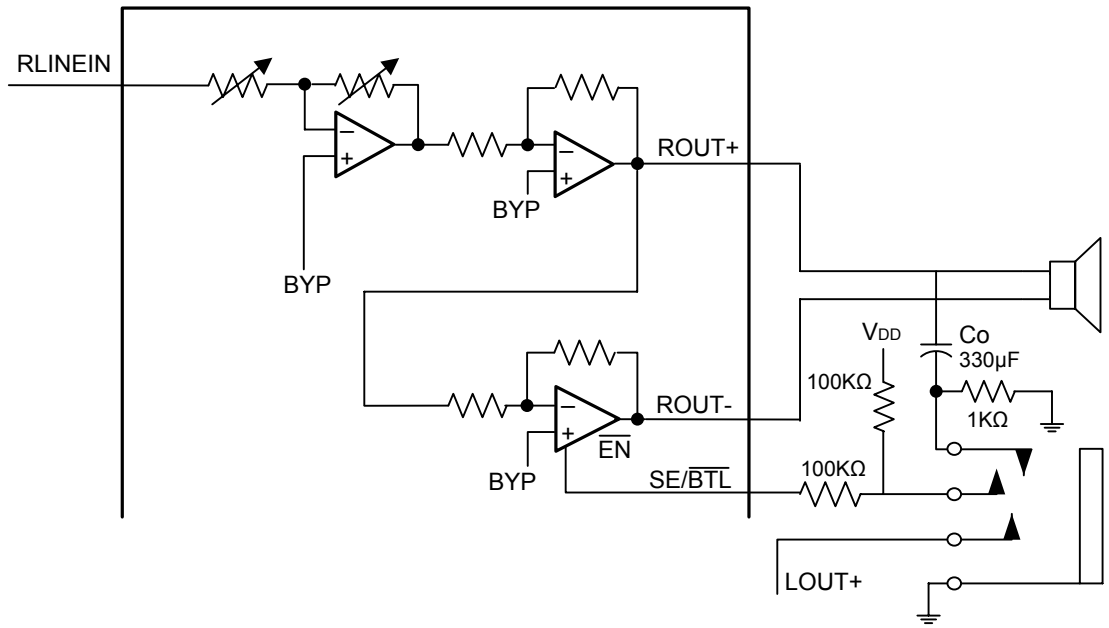


Figure 2. SM7512 Resistor Divider Network Circuit

Using a 1/8-in. (3,5mm) stereo headphone jack, the control switch is closed when no plug is inserted. When closed the 100KΩ/1KΩ divider pulls the SE/$\overline{\text{BTL}}$ input low. When a plug is inserted, the 1KΩ resistor is disconnected and SE/$\overline{\text{BTL}}$ input is pulled high. When the input goes high, the OUT- amplifier is shut down causing the speaker to mute (open-circuits the speaker). The OUT+ amplifier then drives through the output capacitor (C_O) into the headphone jack.

SHUTDOWN MODES

The SM7512 employs a shutdown mode of operation designed to reduce supply current (I_{DD}) to the absolute minimum level during periods of nonuse for battery-power conservation. The $\overline{SHUTDOWN}$ input terminal should be held high during normal operation when the amplifier is in use. Pulling $\overline{SHUTDOWN}$ low causes the outputs to mute and the amplifier to enter a low-current state, I_{DD}= 20μA. $\overline{SHUTDOWN}$ should never be left unconnected because amplifier operation would be unpredictable.

VOLUME OPERATION

The VOLUME controls the BTL volume when driving speakers and the SE volume when driving headphones. The pin is controlled with a dc voltage, which should not exceed V_{DD}.

When driving speakers in BTL mode, the VOLUME pin is the only pin that controls the gain. Table 1 shows the gain for the BTL mode. The voltage listed in the table are for V_{DD}=5V. For a different V_{DD}, the values in the table scale linearly. If V_{DD}=4V, multiply all the voltages in the table by 4V/5V or 0.8.

Some audio systems require that the gain be limited in the single-ended mode to a level that is comfortable for headphone listening. Most volume control devices only have one terminal for setting the gain. For example, if the speaker gain is 20 dB, the gain in the headphone channel is fixed at 14 dB.

Table 1 show a range of voltages for each gain step. There is a gap in the voltage between each gain step. This gap represents the hysteresis about each trip point in the internal comparator. The hysteresis ensures that the gain control is monotonic and does not oscillate from one gain step to another. If a potentiometer is used to adjust the voltage on the control terminals, the gain increases as the potentiometer is turned in one direction and decreases as it is turned back the other direction. The trip point, where the gain actually changes, is different depending on whether the voltage is increased or decreased as a result of the hysteresis about each trip point. The gaps can also be thought of as indeterminate states where the gain could be in the next higher gain step or the lower gain step depending on the direction the voltage is changing. If using a DAC to control the volume, set the volume, set the voltage in the middle of each range to ensure that the desired gain is achieved.

TABLE OF GRAPHS

		FIGURE
THD+N Total harmonic distortion plus noise(BTL)	vs Frequency	3,4,5
	vs Output power	6,7,8
Closed loop response		9,10
Crosstalk	vs Frequency	11,12
PSRR Power supply ripple rejection(BTL)	vs Frequency	13

TOTAL HARMONIC DISTORTION + NOISE
VS.
FREQUENCY

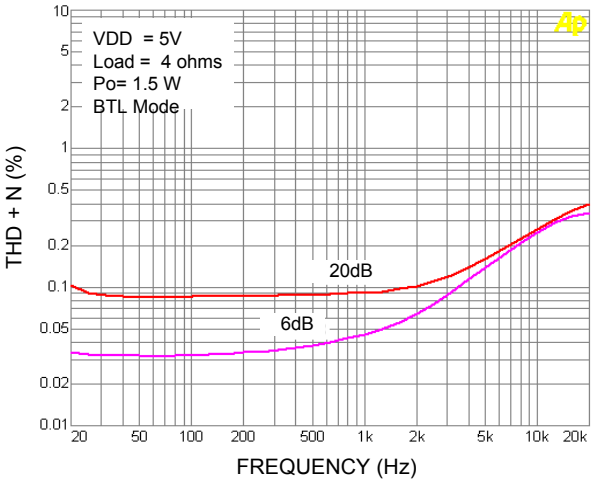


Figure 3

TOTAL HARMONIC DISTORTION + NOISE
VS.
FREQUENCY

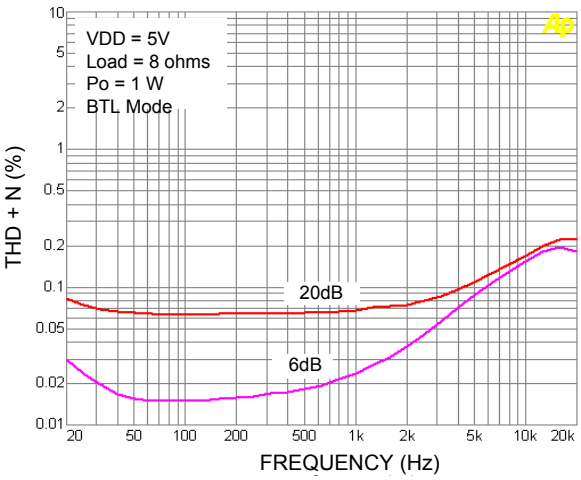


Figure 4

TOTAL HARMONIC DISTORTION + NOISE
VS.
OUTPUT POWER

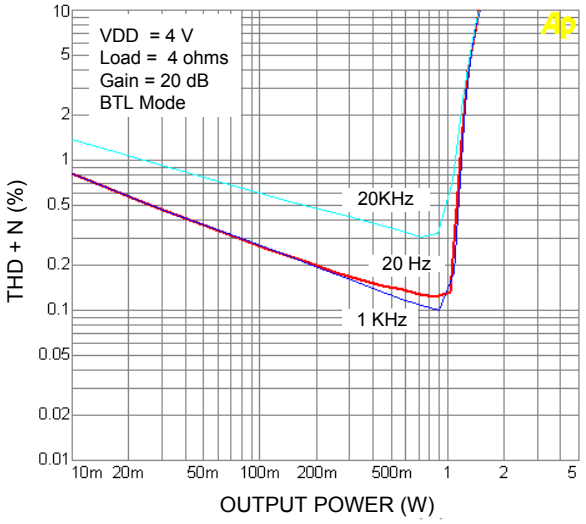


Figure 5

TOTAL HARMONIC DISTORTION + NOISE
VS.
OUTPUT POWER

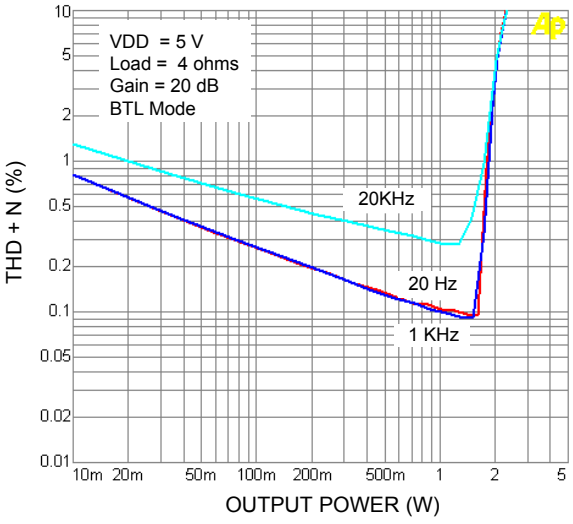


Figure 6

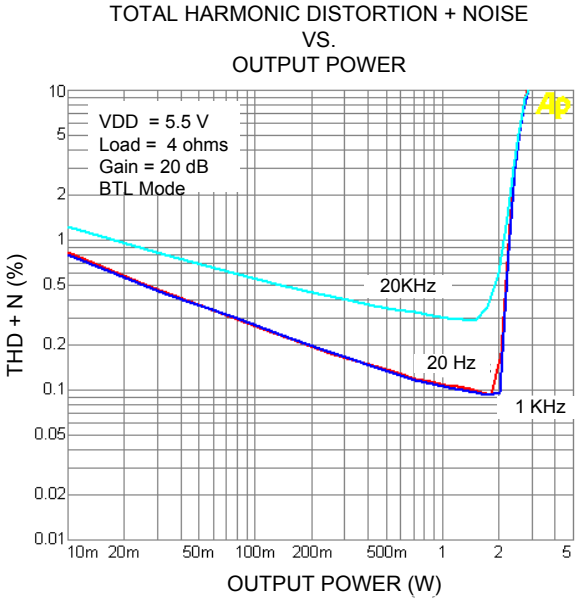


Figure 7

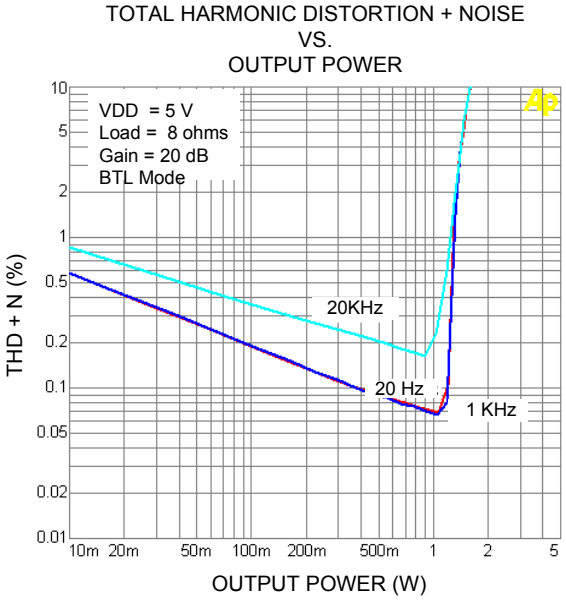


Figure 8

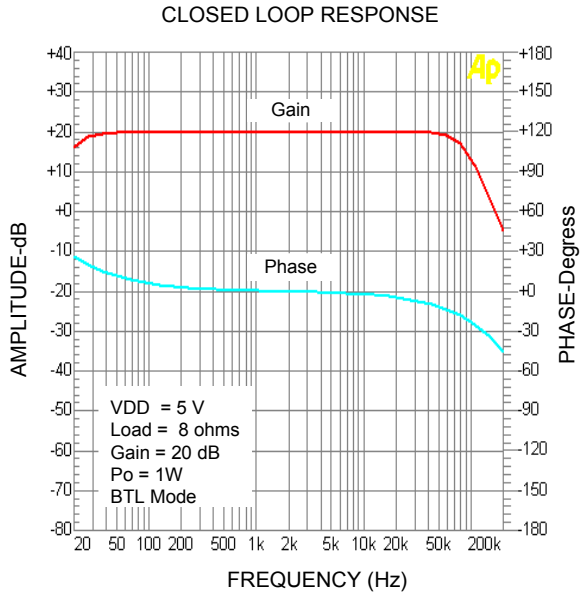


Figure 9

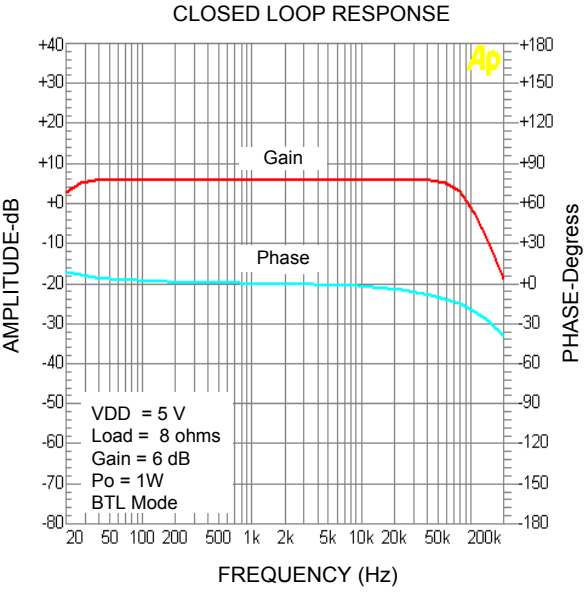


Figure 10

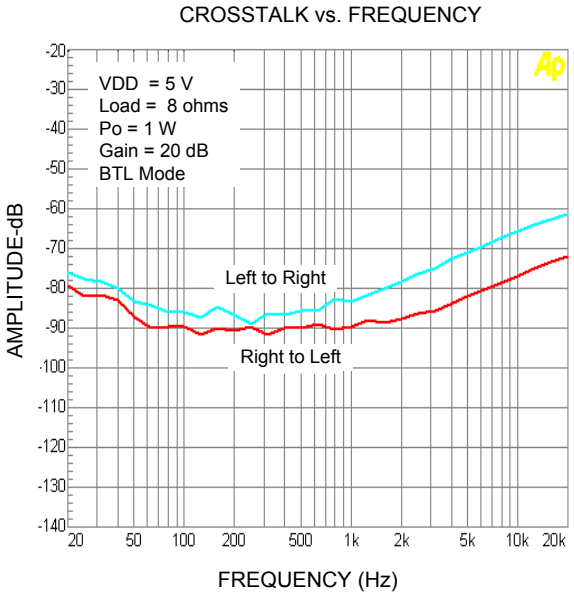


Figure 11

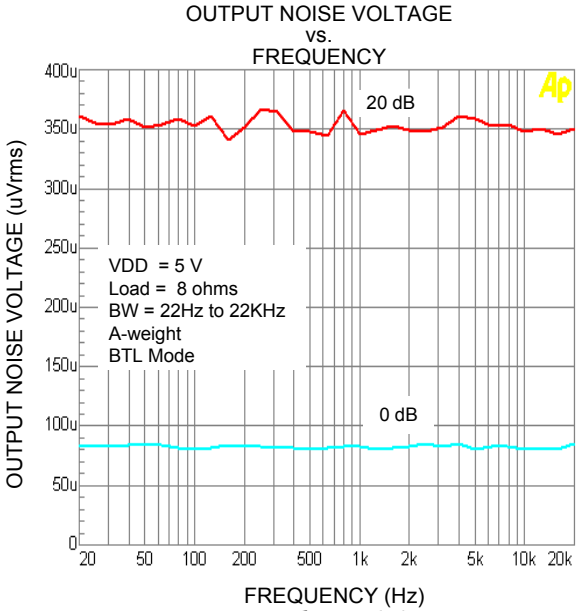
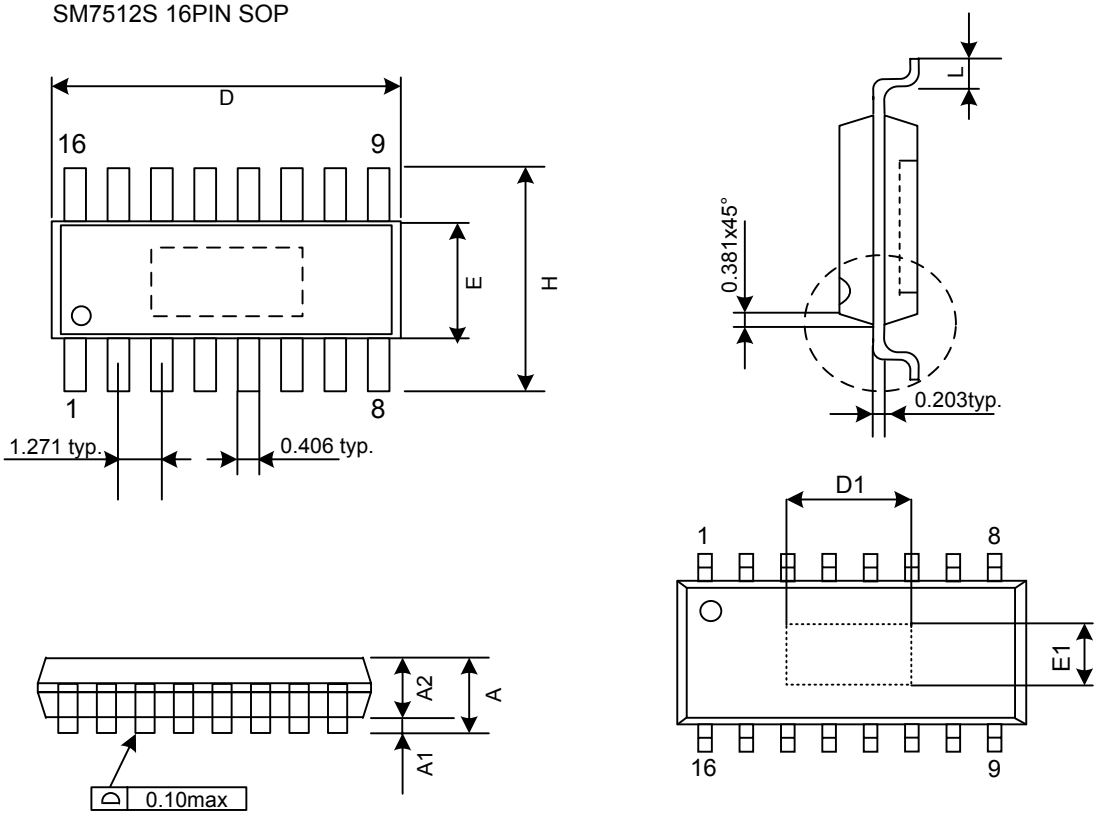


Figure 12

PACKAGE OUTLINE

Unit : mm

SM7512S 16PIN SOP



SYMBOLS	MIN.	NOM.
A	1.35	1.75
A1	0.05	0.15
D	9.81	10.02
E	3.81	4.0
H	5.80	6.20
L	0.41	1.27
θ°	0°	8°

THERMALLY ENHANCED DIMENSIONS

PAD SIZE	E1	D1
95 x 18E	2.19 REF	4.12 REF

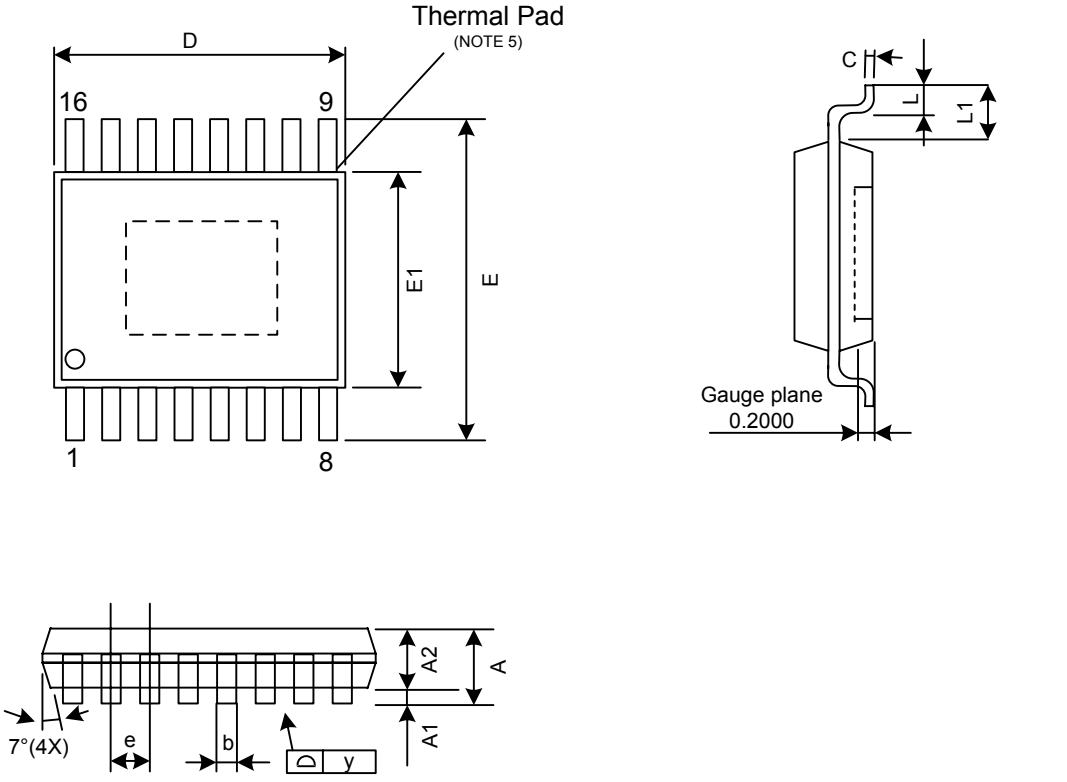
NOTES:

1. JEDEC OUTLINE：N/A
2. DIMENSIONS “ D” DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.MOLD FLASH PROTRUSIONS AND GATE BURRS SHALL NOT EXCEED 0.15mm PER SIDE.
3. DIMENSION “E” DOES NOT INCLUDE INTER-LEAD FLASH, OR PROTRUSIONS. INTER-LEAD FLASH AND PROTRUSIONS SHALL NOT EXCEED 0.25mm PER SIDE.

PACKAGE OUTLINE

SM7512F 16PIN SSOP

Unit : mm



SYMBOLS	MIN.	NOM.	MAX.
A	1.35	1.50	1.65
A1	0.00	—	0.10
A2	—	1.45	—
b	0.20	0.25	0.30
C	0.19	—	0.25
D	4.80	—	5.00
E	5.80	6.0	6.20
E1	3.80	3.9	4.00
e	—	0.64	—
L	0.40	—	1.27
y	—	—	0.10
θ	0°	—	8°
L1	0.95	1.05	1.15

NOTES:
1. PACKAGE BODY SIZE EXCLUDE MOLD FLASH PROTRUSION OR GATE BURRS.
2. TOLERANCE ± 0.1mm UNLESS OTHERWISE SPECIFIED
3. DIMENSION L IS MEASURED IN GAGE PLANE
4. CONTROLLING DIMENSION IS MILLIMETER. CONVERTED INCH DIMENSION ARE NOT NECESSARILY EXACT.
5. DIE PAD EXPOSURE SIZE IS ACCORDING TO LEAD FRAME DESIGN
6. FOLLOWED FROM JEDEC MO-137

Ordering Information

Package	Marking	Part Number (Tape and Reel)
SOP-16	SM7512S	SM7512S
SSOP-16	SM7512F	SM7512F

Lead Free Information

Package	Marking	Lead Free Part Number
SOP-16	SM7512SL	SM7512SL
SSOP-16	SM7512FL	SM7512FL

Green Information

Package	Marking	Green Part Number
SOP-16	SM7512SG	SM7512SG
SSOP-16	SM7512FG	SM7512FG