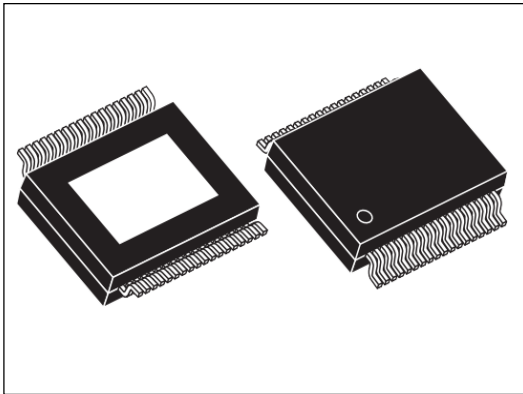


45 W + 45 W dual BTL class-D audio amplifier



Features

- Wide-range single-supply operation (7 - 26 V)
- Possible output configurations:
 - 2 x PBTL
 - 1 x Parallel BTL
- BTL output capabilities (VCC = 26 V):
 - 45 W + 45 W, 4 Ω, THD 1%, VCC 22V
 - 61 W + 61 W, 4 Ω, THD 1%, VCC 26V
 - 45 W + 45 W, 6 Ω, THD 1%, VCC 26V
 - 56 W + 56 W, 6 Ω, THD 10%, VCC 26V
 - 37 W + 37 W, 8 Ω, THD 1%, VCC 26V
 - 46 W + 46 W, 8 Ω, THD 10%, VCC 26V
- High efficiency
- Four selectable, fixed-gain settings of nominally 20.4 dB, 26.4 dB, 29.9 dB and 32.4dB
- Differential inputs minimize common-mode noise
- Standby, mute and play operating modes
- Short-circuit protection
- Output power limited by PLMIT function
- Detection of shorted output pins during startup
- Thermal overload protection

Description

The SMH7492PE is a dual BTL class-D audio amplifier with single power supply designed for home audio applications.

The device is housed in a 28-pin TSSOP package with exposed pad down and as a result of its high efficiency.

Applications

- Multimedia Speaker
- Aftermarket Automotive
- Sound Bar and Boombox

Table 1. Device summary

Order code	Operating temp. range	Package	Packaging
SMH7492PE	-40 to +85°C	TSSOP28	Tape and reel

Contents

1. DEVICE BLOCK DIAGRAM	5
2. PIN DESCRIPTION	6
2.1 PINOUT	6
2.2 PIN LIST	7
3. ABSOLUTE MAXIMUM RATINGS	8
4. THERMAL DATA	8
5. ELECTRICAL SPECIFICATIONS	9
5.1 STEREO BTL APPLICATION	10
5.2 PARALLEL BTL (MONO) APPLICATION	10
6. APPLICATIONS CIRCUIT	11
7. CHARACTERIZATION CURVES	13
7.1 STEREO CONFIGURATION.....	13
8. APPLICATIONS INFORMATION	15
8.1 MODE SELECTION	15
8.2 GAIN SETTING	16
8.3 INPUT RESISTANCE AND CAPACITANCE	16
8.4 INTERNAL AND EXTERNAL CLOCKS.....	17
8.5 MASTER MODE (INTERNAL CLOCK)	17
8.6 SLAVE MODE (EXTERNAL CLOCK)	17
8.7 OUTPUT LOW-PASS FILTER.....	18
8.8 DIAGNOSTIC OUTPUT.....	19
9. PROTECTION FUNCTIONS	20
10. PACKAGE MECHANICAL DATA	21
11. REVISION HISTORY	22
12. RESPONSIBILITY AND COPYRIGHT DECLARATION	23

45 W + 45 W dual BTL class-D audio amplifier

List of Figures

FIGURE 1. INTERNAL BLOCK DIAGRAM (SHOWING ONE CHANNEL ONLY)	5
FIGURE 2. PIN CONNECTIONS (TOP VIEW, PCB VIEW)	6
FIGURE 3. APPLICATIONS CIRCUIT FOR CLASS-D AMPLIFIER(BTL)	11
FIGURE 4. APPLICATIONS CIRCUIT FOR CLASS-D AMPLIFIER(PBTL).....	11
FIGURE 5. APPLICATIONS CIRCUIT FOR CLASS-D AMPLIFIER(BTL+PBTL).....	12
FIGURE 6. EFFICIENCY VS OUTPUT POWER.....	13
FIGURE 7. EFFICIENCY VS OUTPUT POWER.....	13
FIGURE 8. EFFICIENCY VS OUTPUT POWER.....	13
FIGURE 9. THD VS POUT	13
FIGURE 10. THD VS POUT	14
FIGURE 11. THD VS POUT	14
FIGURE 12. THD VS FREQUENCY	14
FIGURE 13. CROSSTALK ($V_s = 26\text{ V}$)	14
FIGURE 14. FFT (0 dB) ($V_s = 26\text{ V}$).....	14
FIGURE 15. FFT (-60 dB) ($V_s = 26\text{ V}$).....	14
FIGURE 16. STANDBY AND MUTE CIRCUITS	15
FIGURE 17. TURN-ON/OFF SEQUENCE FOR MINIMIZING SPEAKER “POP”	15
FIGURE 18. DEVICE INPUT CIRCUIT AND FREQUENCY RESPONSE	16
FIGURE 19. MASTER AND SLAVE CONNECTION	17
FIGURE 20. TYPICAL LC FILTER FOR A $8\ \Omega$ SPEAKER.....	18
FIGURE 21. TYPICAL LC FILTER FOR A $4\ \Omega$ SPEAKER.....	18
FIGURE 22. BEHAVIOR OF PIN DIAG FOR VARIOUS PROTECTION CONDITIONS	19
FIGURE 23. TSSOP28 PACKAGE OUTLINE	21

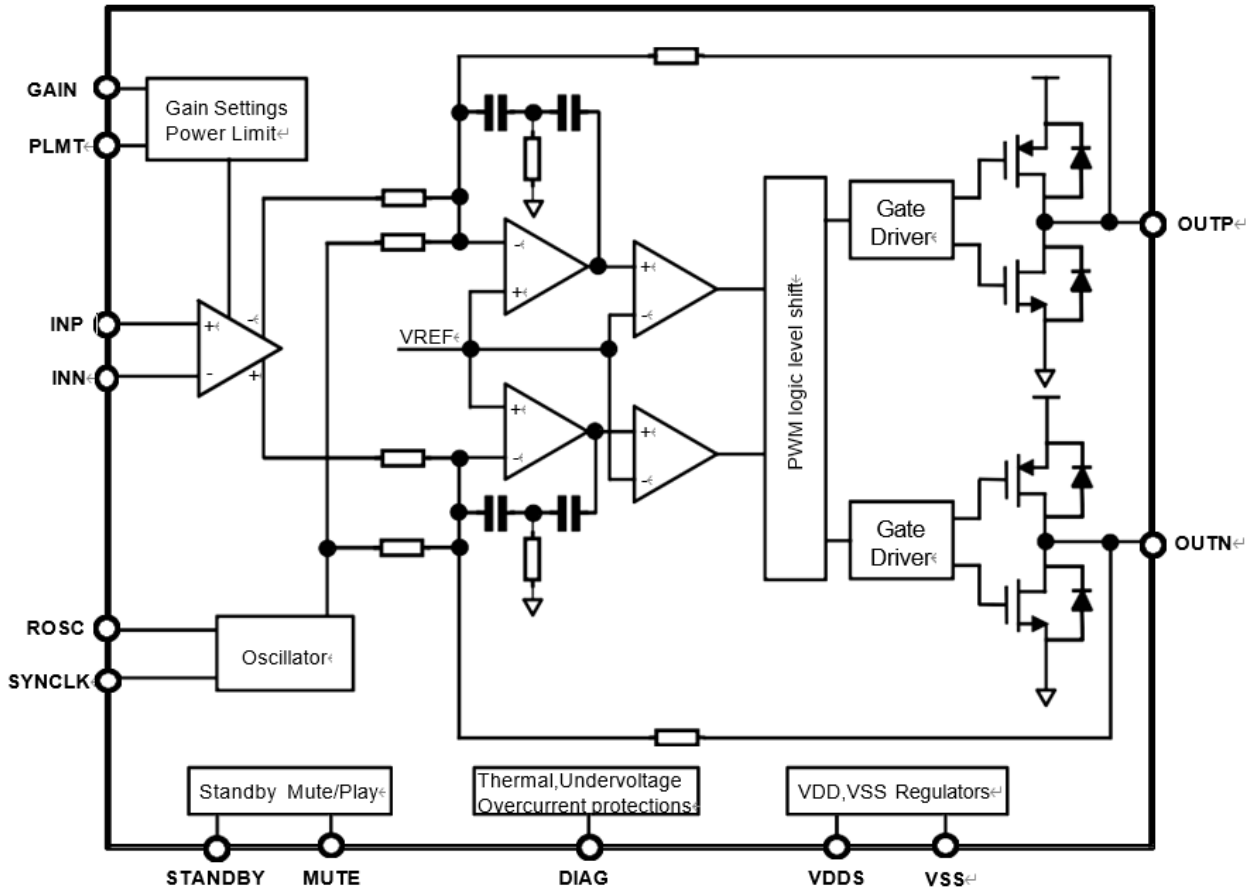
45 W + 45 W dual BTL class-D audio amplifier**List of Tables**

TABLE 1.DEVICE SUMMARY	1
TABLE 2.PIN DESCRIPTION LIST	7
TABLE 3.ABSOLUTE MAXIMUM RATINGS.....	8
TABLE 4.THERMAL DATA	8
TABLE 5.ELECTRICAL SPECIFICATIONS	9
TABLE 6.STEREO BTL APPLICATION	10
TABLE 7. STEREO BTL (MONO) APPLICATION	10
TABLE 8. MODE SETTINGS	15
TABLE 9.GAIN SETTINGS.....	16
TABLE 10.HOW TO SET UP SYNCLK.....	17
TABLE 11.DOCUMENT REVISION HISTORY	22

1. Device block diagram

Figure 1. Internal block diagram (showing one channel only) shows the block diagram of one of the two identical channels of the SMH7492PE.

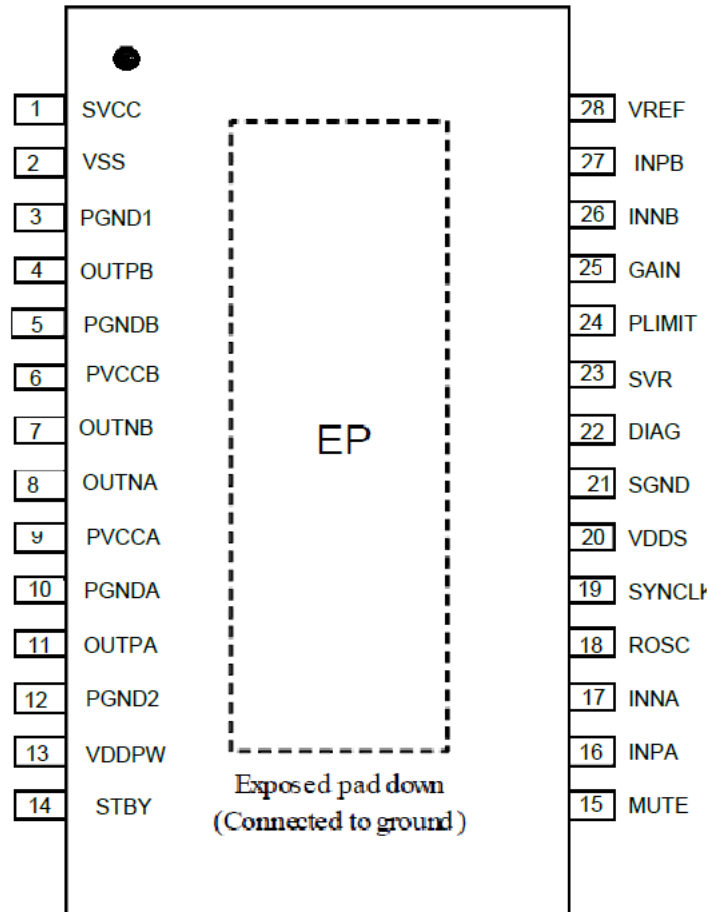
Figure 1. Internal block diagram (showing one channel only)



2. Pin description

2.1 Pinout

Figure 2.Pin connections (top view, PCB view)



45 W + 45 W dual BTL class-D audio amplifier
2.2 Pin list
Table 2.Pin description list

Pin Number	Name	Type	Description
1	SVCC	PWR	Signal power supply
2	VSS	O	3.3-V (nominal) regulator output referred to power supply
3	PGND	PWR	Power stage ground
4	OUTPB	O	Positive PWM for right channel
5	PGNDB	PWR	Power stage ground for right channel
6	PVCCB	PWR	Power supply for right channel
7	OUTNB	O	Negative PWM output for right channel
8	OUTNA	O	Negative PWM output for left channel
9	PVCCA	PWR	Power supply for left channel
10	PGNDA	PWR	Power stage ground for left channel
11	OUTPA	O	Positive PWM output for left channel
12	PGND	PWR	Power stage ground
13	VDDPW	O	3.3-V (nominal) regulator output referred to ground for power stage
14	STBY	I	Standby mode control
15	MUTE	I	Mute mode control
16	INPA	I	Positive differential input of left channel
17	INNA	I	Negative differential input of left channel
18	ROSC	O	Master oscillator frequency-setting pin
19	SYNCLK	I/O	Clock in/out for external oscillator
20	VDDS	O	3.3-V (nominal) regulator output referred to ground for signal blocks
21	SGND	PWR	Signal ground
22	DIAG	O	Open-drain diagnostic output
23	SVR	O	Supply voltage rejection
24	PLIMIT	I	Limit different maximum power
25	GAIN	I	Gain setting
26	INNB	I	Negative differential input of right channel
27	INPB	I	Positive differential input of right channel
28	VREF	O	Half VDDS (nominal) referred to ground

45 W + 45 W dual BTL class-D audio amplifier

3. Absolute maximum ratings

Table 3. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CCMAX}	DC supply voltage for pins PVCCA, PVCCB, SVCC	30	V
V_I	Voltage limits for input pins STANDBY, MUTE, INNA, INPA, INN B, INPB, GAIN	-0.3 to 5	V
T_{op}	Operating temperature	-40 to 85	°C
T_j	Junction temperature	-40 to 150	°C
T_{stg}	Storage temperature	-40 to 150	°C

4. Thermal data

Table 4. Thermal data

Symbol	Parameter	Min	Typ	Max	Unit
$R_{th\ j-case}$	Thermal resistance, junction to case	-	2	3	°C/W
$R_{th\ j-amb}$	Thermal resistance, junction to ambient	-	24 ⁽¹⁾	-	°C/W

45 W + 45 W dual BTL class-D audio amplifier

5. Electrical specifications

Unless otherwise stated, the results in Table 5: "Electrical specifications" below are given for the conditions: $V_{CC} = 26\text{ V}$, $R_L = 6\ \Omega$, $R_{OSC} = 39\text{ k}\Omega$, $f = 1\text{ kHz}$, $G_V = 20.4\text{ dB}$ and $T_{amb} = 25\text{ }^\circ\text{C}$.

Table 5. Electrical specifications

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
V_{CC}	Supply voltage for pins PVCCA, PVCCB, SVCC	-	7	-	26	V
I_q	Total quiescent current	Without LC, no load	-	40		mA
I_{qSTBY}	Quiescent current in standby	-	-	1	-	μA
V_{OS}	Output offset voltage	$V_i = 0$, $A_v = 20\text{ dB}$, no load		20		mV
I_{OCP}	Overcurrent protection threshold	$R_L = 0\ \Omega$	9	10	13	A
T_j	Junction temperature at thermal shutdown	-	140	150	160	$^\circ\text{C}$
R_i	Input resistance	Differential input		60	-	k Ω
R_{dsON}	Power transistor on-resistance	High side	-	0.35	-	Ω
		Low side	-	0.25	-	
G_V	Closed-loop gain	$GAIN4 < 0.25 * V_{dd}$		20.4	-	dB
		$0.25 * V_{dd} < GAIN3 < 0.5 * V_{dd}$	-	26.4	-	
		$0.5 * V_{dd} < GAIN2 < 0.75 * V_{dd}$	-	29.9	-	
		$GAIN1 > 0.75 * V_{dd}$	-	32.4	-	
ΔG_V	Gain matching	-	-	-	± 1	dB
CT	Crosstalk	$f = 1\text{ kHz}$	-	80	-	dB
PSRR	Power supply voltage rejection ratio		-	-	-	dB
T_r, T_f	Rise and fall times	PWM signal 50% duty cycle	-	24	40	ns
f_{sw}	Switching frequency	Internal oscillator with external $R_{osc} = 39\text{ k}\Omega$	-	420	-	kHz
f_{swR}	Output switching frequency range	With internal oscillator by changing R_{osc} ⁽¹⁾	420	-	550	kHz
V_{inH}	Digital input high (H)	-	2.0	-	-	V
V_{inL}	Digital input low (L)		-	-	0.8	
Function mode	Standby, Mute, Play	$STBY < 0.5\text{ V}$ Mute = 'X'	Standby			
		$STBY > 2.5\text{ V}$ Mute $< 0.8\text{ V}$	Mute			
		$STBY > 3\text{ V}$ Mute $> 2.5\text{ V}$	Play			
A_{MUTE}	Mute attenuation	$V_{MUTE} = 1\text{ V}$	60	80	-	dB

Notes: $f_{sw} = 10^6 / [(12 * R_{osc} + 110) * 4]\text{ kHz}$, $f_{sYNCLK} = 2 * f_{sw}$ (where R_{osc} is in k Ω and f_{sw} in kHz) with $R_{osc} = 39\text{ k}\Omega$.

45 W + 45 W dual BTL class-D audio amplifier
5.1 Stereo BTL application

All specifications are for $V_{CC} = 26\text{ V}$, $R_{osc} = 39\text{ k}\Omega$, $f = 1\text{ kHz}$, $T_{amb} = 25\text{ }^\circ\text{C}$, unless otherwise specified.

Table 6. Stereo BTL application

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
P_o	Output power	$R_L = 6\ \Omega$, THD = 10%	-	56	-	W
		$R_L = 6\ \Omega$, THD = 1%	-	45	-	
		$R_L = 4\ \Omega$, THD = 10%	-	79	-	
		$R_L = 4\ \Omega$, THD = 1%	-	61	-	
THD	Total harmonic distortion	$P_o = 1\text{ W}$, $f_{in} = 1\text{ kHz}$ $R_L = 6\ \Omega$	-	0.04	-	%
		$P_o = 1\text{ W}$, $f_{in} = 1\text{ kHz}$ $R_L = 4\ \Omega$	-	0.08	-	
VN	Total output noise	Inputs shorted and connected to GND, A curve, $G_v = 20.4\text{ dB}$	-	150	-	μV

5.2 Parallel BTL (mono) application

All specifications are for $V_{CC} = 22\text{ V}$, $R_{osc} = 33\text{ k}\Omega$, $f = 1\text{ kHz}$, $T_{amb} = 25\text{ }^\circ\text{C}$, INPB, INNB connected to VDDS, unless otherwise specified.

Table 7. Stereo BTL (mono) application

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
P_o	Output power	$R_L = 3\ \Omega$, THD = 10%	-	90	-	W
		$R_L = 3\ \Omega$, THD = 1%	-	71	-	
		$R_L = 3\ \Omega$, THD = 10% $V_{CC} = 18\text{ V}$	-	53	-	
		$R_L = 3\ \Omega$, THD = 1% $V_{CC} = 18\text{ V}$	-	41	-	
THD	Total harmonic distortion	$P_o = 1\text{ W}$, $f_{in} = 1\text{ kHz}$ $R_L = 3\ \Omega$	-	0.05	-	%
VN	Total output noise	Inputs shorted and connected to GND, A curve, $G_v = 20.4\text{ dB}$	-	150	-	μV

45 W + 45 W dual BTL class-D audio amplifier

6. Applications circuit

Figure 3. Applications circuit for class-D amplifier(BTL)

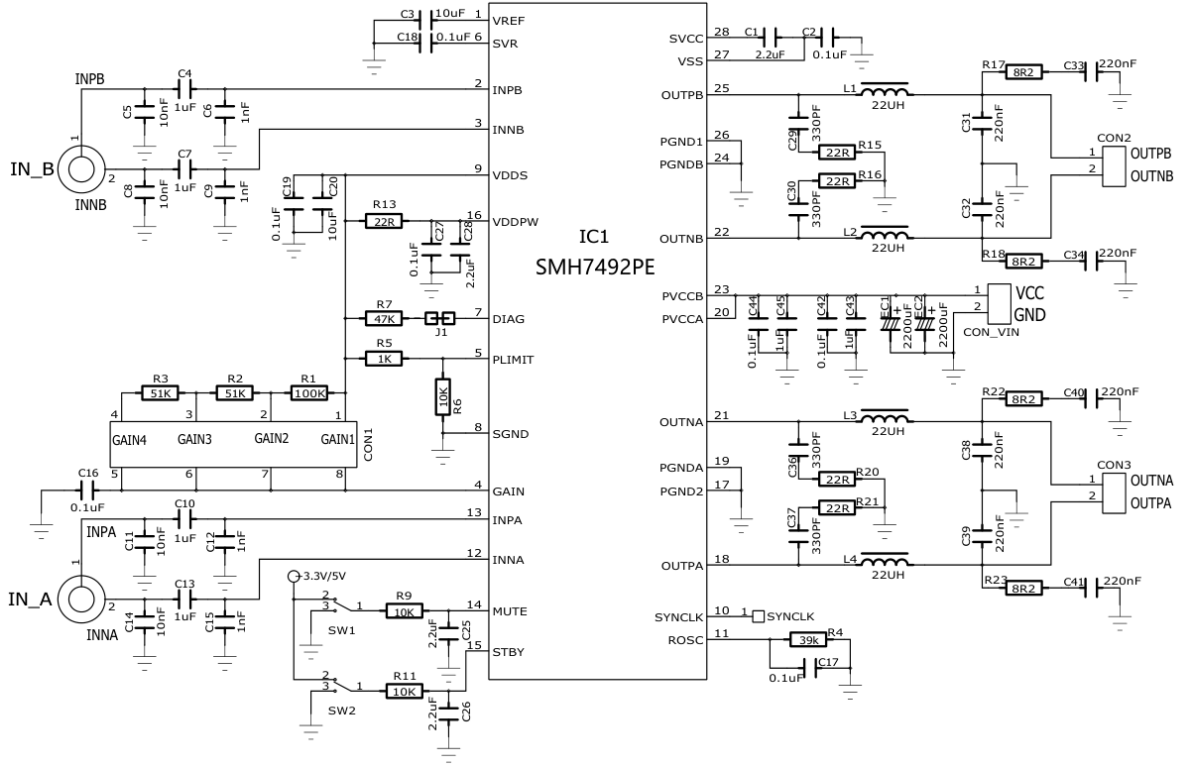
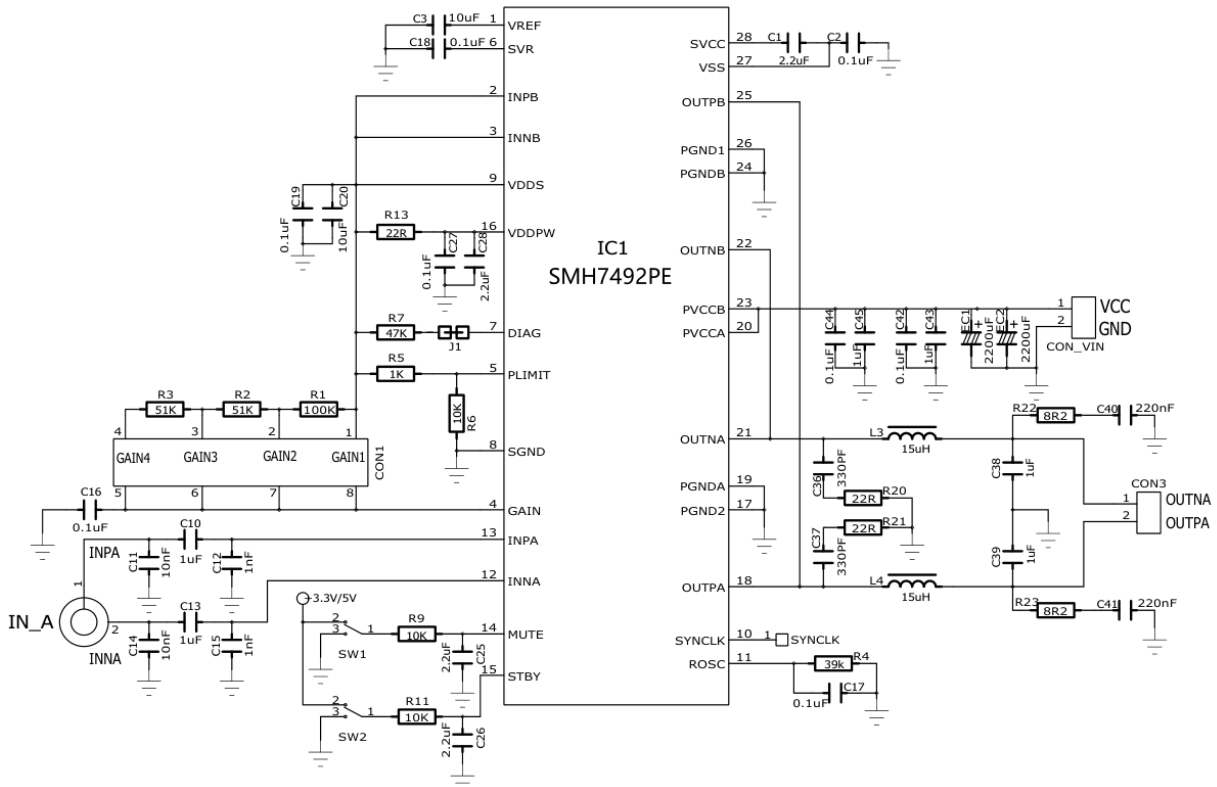
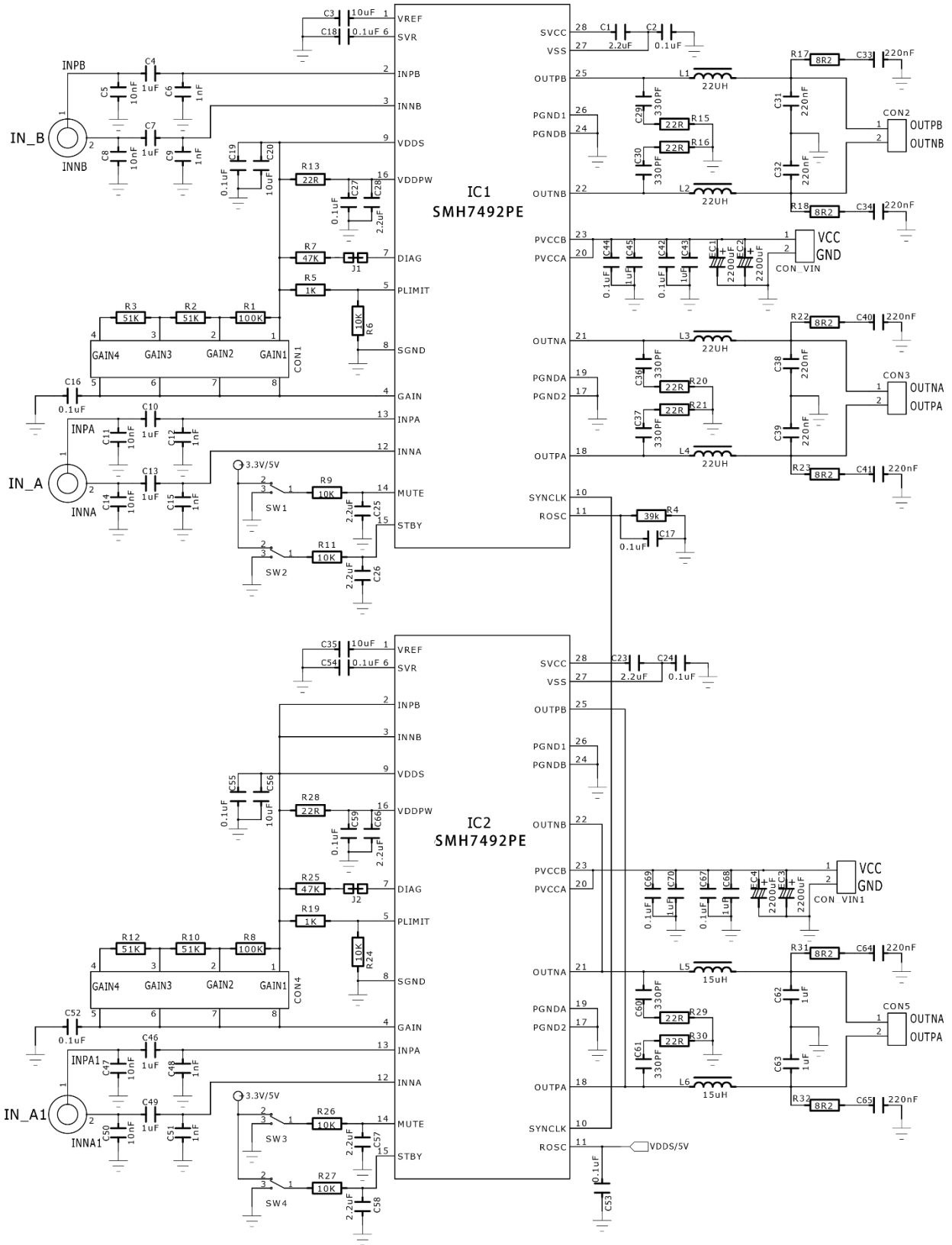


Figure 4. Applications circuit for class-D amplifier(PBTL)



45 W + 45 W dual BTL class-D audio amplifier

Figure 5. Applications circuit for class-D amplifier(BTL+PBTL)



45 W + 45 W dual BTL class-D audio amplifier

7. Characterization curves

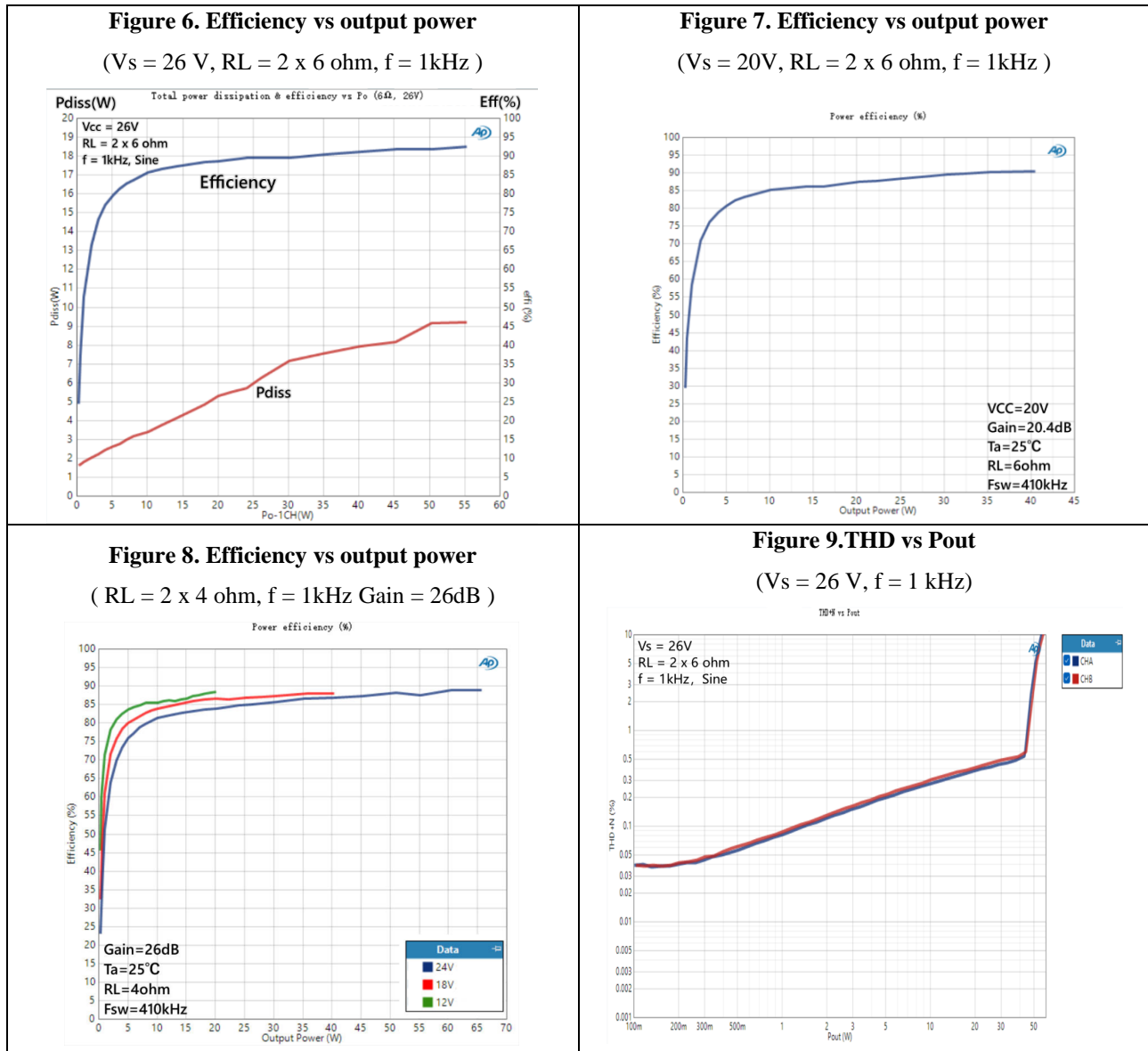
Unless otherwise stated, measurements were made under the following conditions: $V_{CC} = 26\text{ V}$, $R_L = 6\ \Omega$, $f = 1\text{ kHz}$, $G_v = 32.4\text{ dB}$, $R_{osc} = 39\text{ k}\Omega$, $T_{amb} = 25\text{ }^\circ\text{C}$.

Note: Maximum output power must be derated according to case temperature.

7.1 Stereo configuration

The following characterization curves were made using the SMH7492PE demonstration board (Figure 3: "Application circuit"). The characterization curves were made under the following test conditions:

$V_s = 7$ and 26 V , $R_L = 6\ \Omega$, $R_{osc} = 39\text{ k}\Omega$, $C_{osc} = 100\text{ nF}$, $\text{Gain} = 32.4\text{ dB}$ and $T_{amb} = 25^\circ\text{C}$ unless otherwise specified.



45 W + 45 W dual BTL class-D audio amplifier

Figure 10. THD vs Pout
(Vs = 26 V, f = 100 Hz)

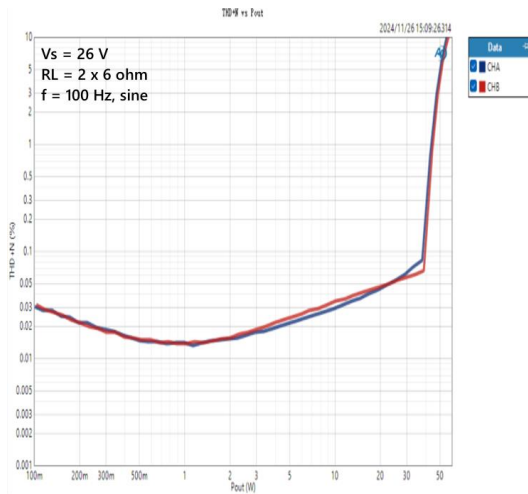


Figure 11. THD vs Pout
(Vs = 26 V, f = 6 kHz)

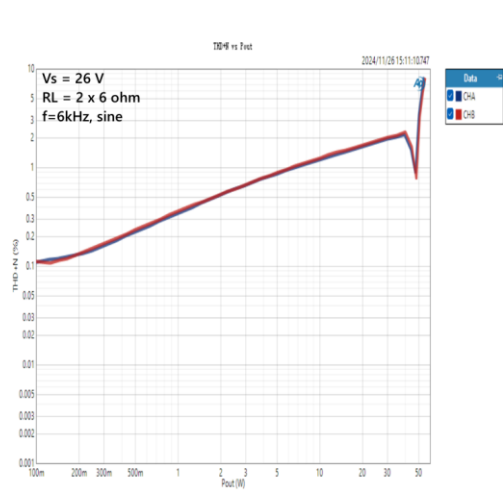


Figure 12. THD vs frequency
(Vs = 26 V, Po = 1 W)

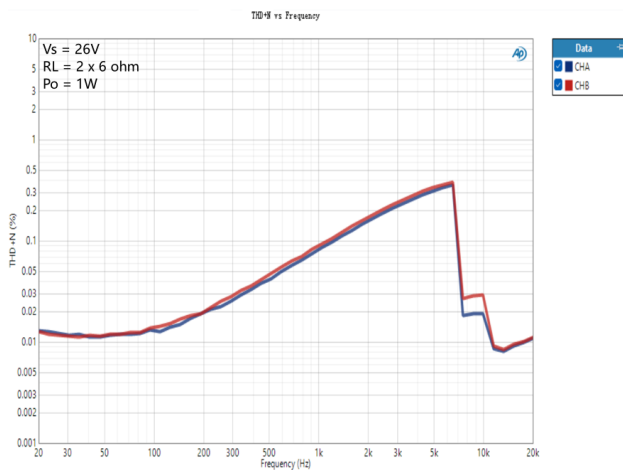


Figure 13. Crosstalk (Vs = 26 V)

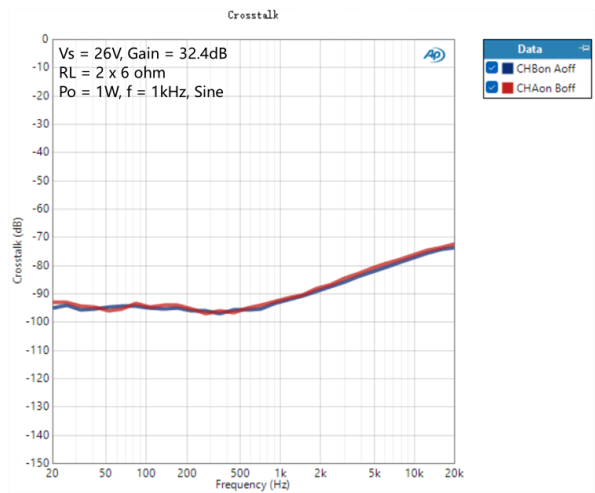


Figure 14. FFT (0 dB) (Vs = 26 V)

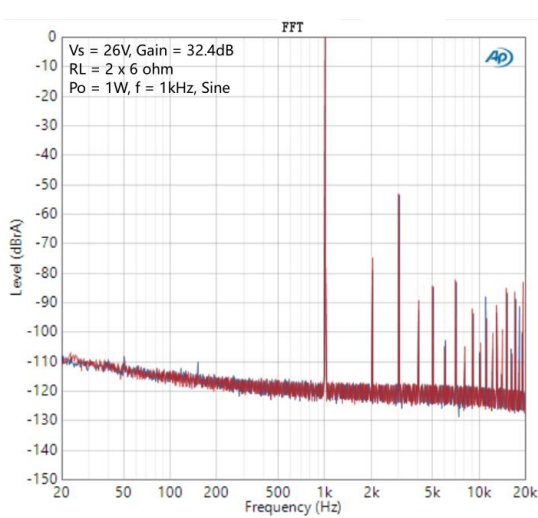
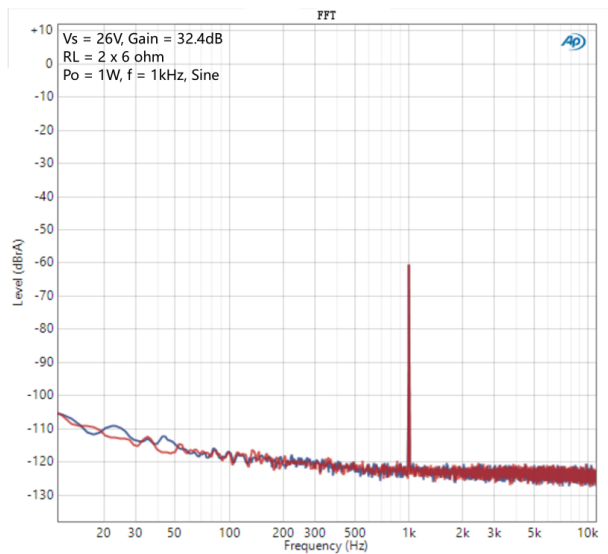


Figure 15. FFT (-60 dB) (Vs = 26 V)



8. Applications information

8.1 Mode selection

The three operating modes of the SMH7492PE are set by the two inputs STBY (pin 14) and MUTE (pin 15). Standby mode: all circuits are turned off, very low current consumption.

- Mute mode: inputs are connected to ground and the positive and negative PWM outputs are at 50% duty cycle.
- Play mode: the amplifiers are active.

The protection functions of the SMH7492PE are enabled by pulling down the voltages of the STBY and MUTE inputs shown in Figure 13. The input current of the corresponding pins must be limited to 200 μ A.

Table 8. Mode settings

Mode selection	STBY	MUTE
Standby	L ⁽¹⁾	X (don't care)
Mute	H ⁽¹⁾	L
Play	H	H

1. Drive levels defined in Table 5: Electrical specifications on page 6

Figure 16. Standby and mute circuits

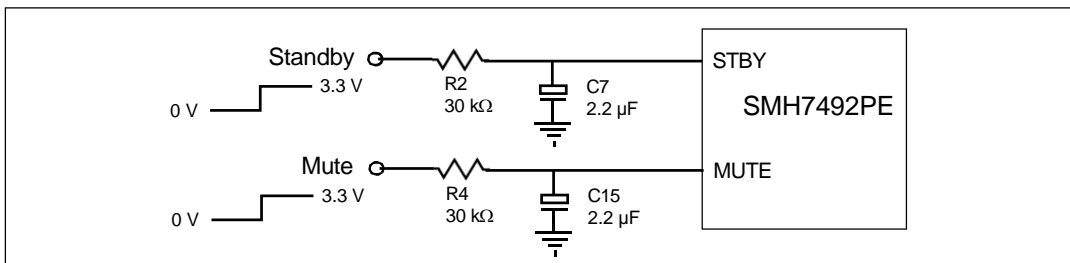
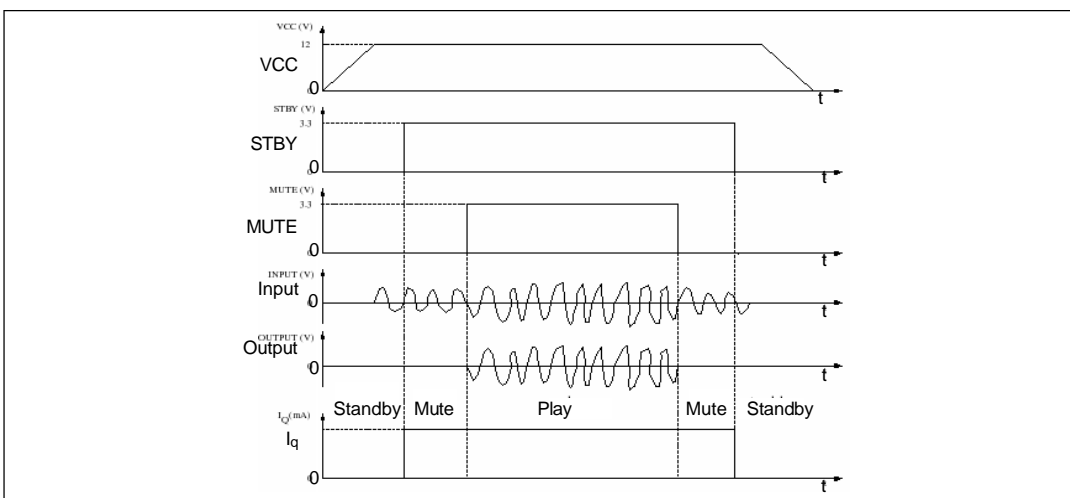


Figure 17. Turn-on/off sequence for minimizing speaker “pop”



8.2 Gain setting

The gain of the SMH7492PE is setting by changing the feedback resistors of the amplifier.

Table 9. Gain settings

GAIN	Nominal gain, G_v (dB)
1	32.4
2	29.9
3	26.4
4	20.4

8.3 Input resistance and capacitance

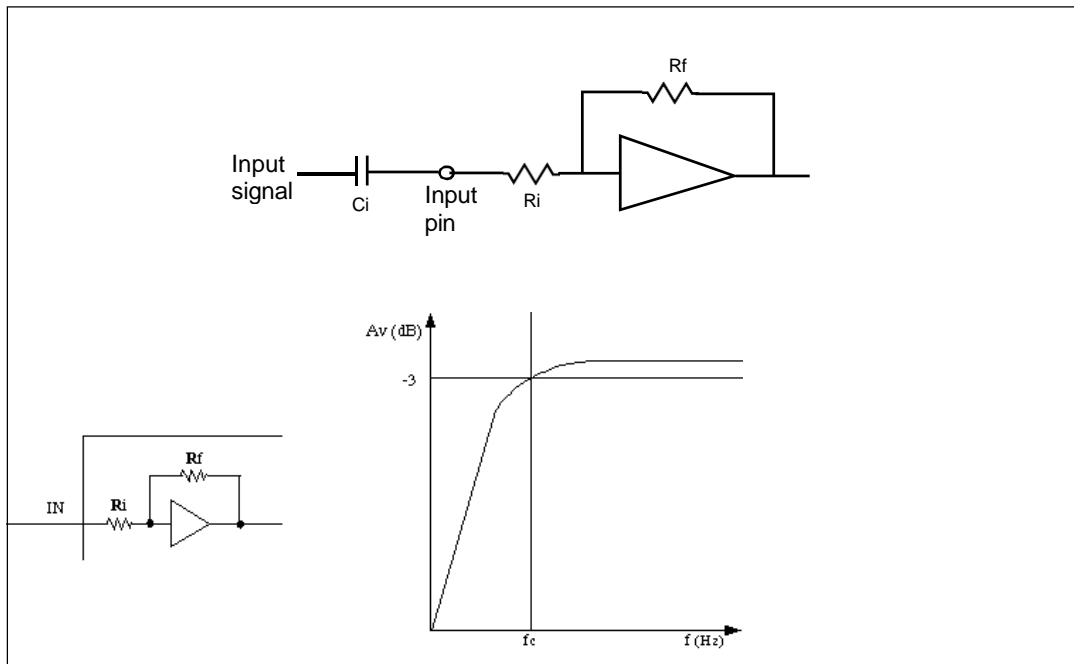
The input impedance is set by an internal resistor $R_i = 60 \text{ k}\Omega$ (typical). An input capacitor (C_i) is required to couple the AC input signal.

The equivalent circuit and frequency response of the input components are shown in

Figure 15. For $C_i = 470 \text{ nF}$ the high-pass filter cutoff frequency is below 20 Hz:

$$f_c = 1 / (2 * \pi * R_i * C_i)$$

Figure 18. Device input circuit and frequency response



45 W + 45 W dual BTL class-D audio amplifier

8.4 Internal and external clocks

The clock of the class-D amplifier can be generated internally or can be driven by an external source.

If two or more class-D amplifiers are used in the same system, it is recommended that all devices operate at the same clock frequency. This can be implemented by using one SMH7492PE as master clock, while the other devices are in slave mode (that is, externally clocked). The clock interconnect is via pin SYNCLK of each device. As explained below, SYNCLK is an output in master mode and an input in slave mode.

8.5 Master mode (internal clock)

Using the internal oscillator, the output switching frequency, f_{SW} , is controlled by the resistor, R_{osc} , connected to pin ROSC: $f_{SW} = 10^6 / ((16 * R_{OSC} + 182) * 4)$ kHz where R_{OSC} is in 39 k Ω .

In master mode, pin SYNCLK is used as a clock output pin, whose frequency is: $f_{SYNCLK} = 2 * f_{SW}$

For master mode to operate correctly then resistor R_{osc} must be less than 60 k Ω as given below in Table 9.

8.6 Slave mode (external clock)

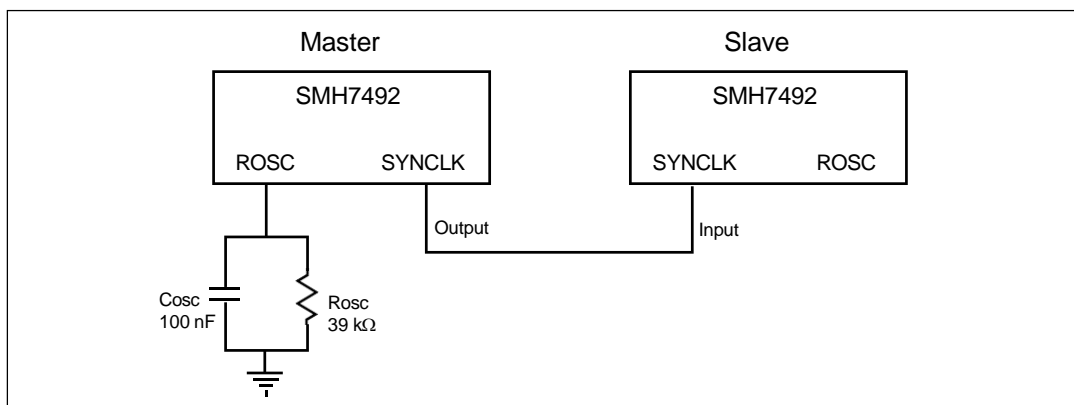
In order to accept an external clock input the pin ROSC must be left open, that is, floating. This forces pin SYNCLK to be internally configured as an input as given in Table 10.

The output switching frequency of the slave devices is: $f_{SW} = f_{SYNCLK} / 2$.

Table 10. How to set up SYNCLK

Mode	ROSC	SYNCLK
Master	$R_{OSC} < 60 \text{ k}\Omega$	Output
Slave	Floating (not connected)	Input

Figure 19. Master and slave connection



45 W + 45 W dual BTL class-D audio amplifier

8.7 Output low-pass filter

To avoid EMI problems, it may be necessary to use a low-pass filter before the speaker. The cutoff frequency should be larger than 22 kHz and much lower than the output switching frequency. It is necessary to choose the L-C component values depending on the loud speaker impedance. Some typical values, which give a cutoff frequency of 27 kHz, are shown in Figure 17 and Figure 18 below.

Figure 20. Typical LC filter for a 8Ω speaker

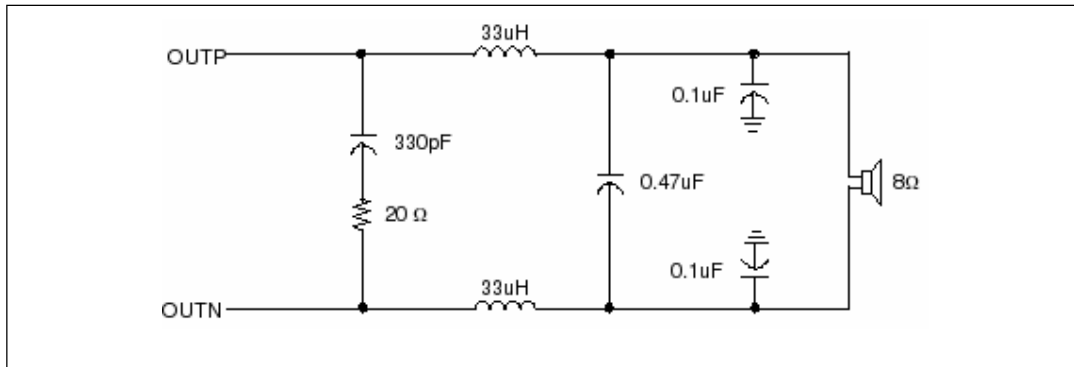
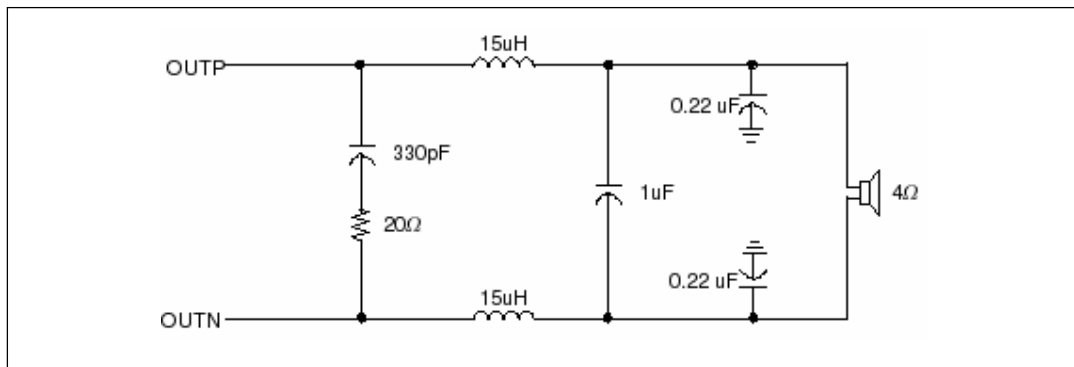


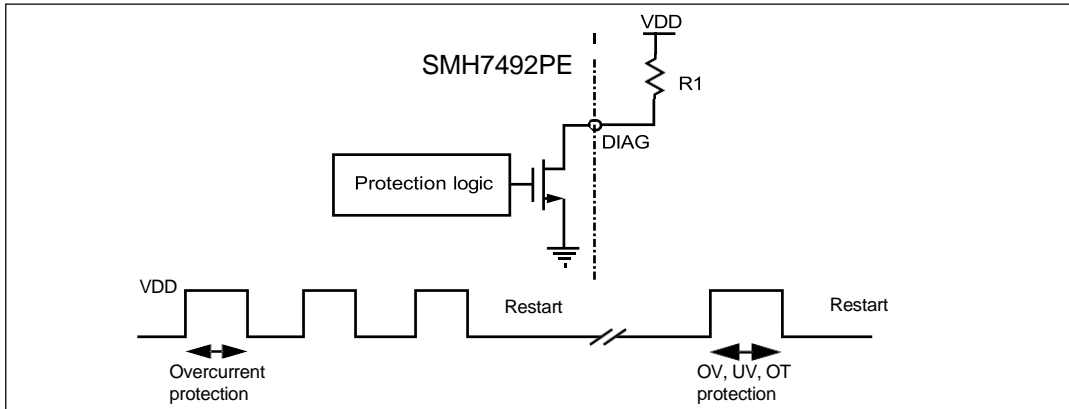
Figure 21. Typical LC filter for a 4Ω speaker



8.8 Diagnostic output

The output pin DIAG is an open-drain transistor. When the protection is activated it is in the high-impedance state. The pin can be connected to a power supply (<26 V) by a pull-up resistor whose value is limited by the maximum sinking current (200 μ A) of the pin.

Figure 22. Behavior of pin DIAG for various protection conditions



9. Protection functions

The SMH7492PE is fully protected against overvoltage, undervoltage, overcurrent and thermal overloads as explained here.

Overvoltage protection (OVP)

If the supply voltage exceeds the value for VOVP given in Table 5: Electrical specifications on page 8 the overvoltage protection is activated which forces the outputs to the

high-impedance state. When the supply voltage drops to below the threshold value the device restarts.

Undervoltage protection (UVP)

If the supply voltage drops below the value for VUVP given in Table 5: Electrical specifications on page 8 the undervoltage protection is activated which forces the outputs to the high-impedance state. When the supply voltage recovers the device restarts.

Overcurrent protection (OCP)

If the output current exceeds the value for IOCP given in Table 5: Electrical specifications on page 8 the overcurrent protection is activated which forces the outputs to the

high-impedance state. Periodically, the device attempts to restart. If the overcurrent condition is still present then the OCP remains active. The restart time, TOC, is determined by the R-C components connected to pin STBY.

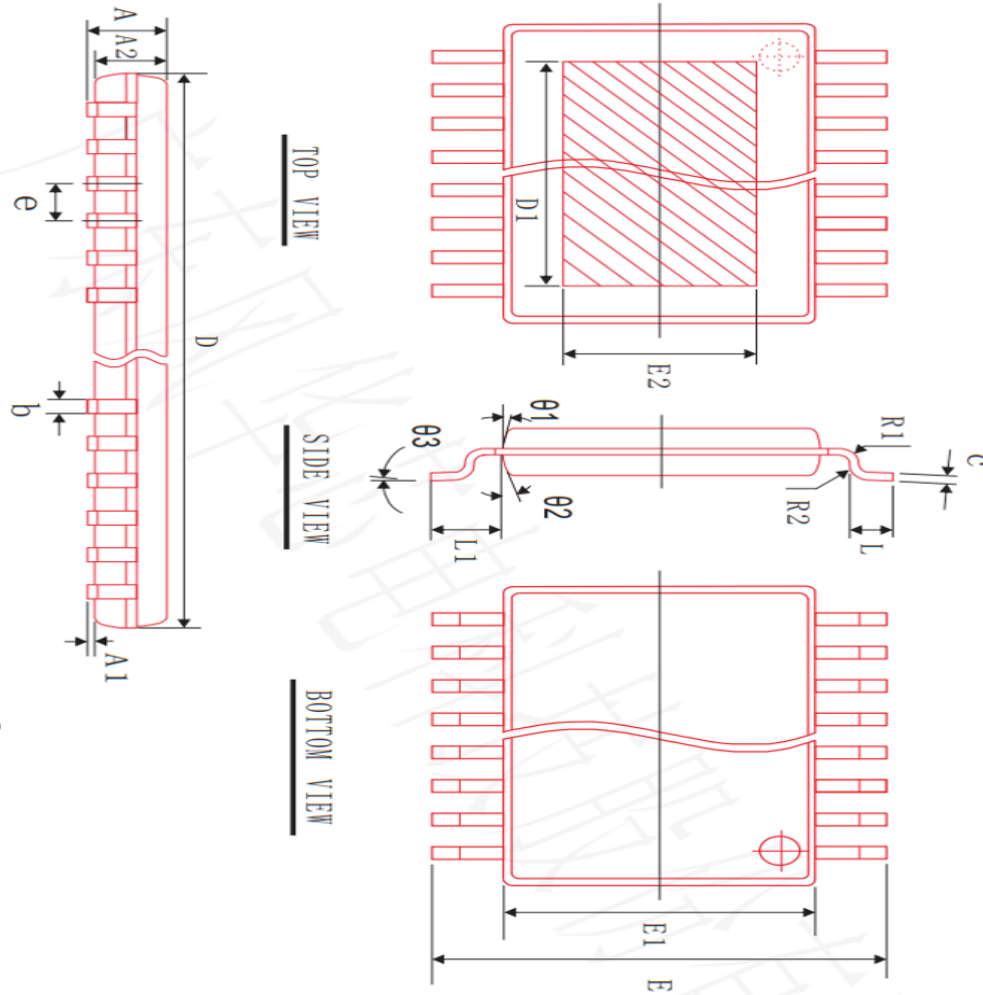
Thermal protection (OTP)

If the junction temperature, T_j , reaches 145 °C (nominally), the device goes to mute mode and the positive and negative PWM outputs are forced to 50% duty cycle. If the junction temperature reaches the value for T_j given in Table 5: Electrical specifications on page 8 the device shuts down and the output is forced to the high-impedance state. When the device cools sufficiently the device restarts.

10. Package mechanical data

The SMH7492PE comes in a 28-pin E-TSSOP28 package with exposed down.

Figure 23. TSSOP28 package outline



SYMBOL	MIN	NOM	MAX
A	--	--	1.20
A1	0.05	0.10	0.15
A2	0.80	0.875	1.05
C	0.09	0.145	0.20
b	0.19	0.255	0.30
L1	0.95	1.00	1.05
L	0.45	0.60	0.75
D1	5.80	5.90	6.00
E2	2.90	3.00	3.10
E	6.25	6.40	6.55
E1	4.30	4.40	4.50
D	9.60	9.70	9.80
Ø3	0	4	8
R1	0.15 TYP		
R2	0.15 TYP		
Ø1	0.12* TYP		
Ø2	0.12* TYP		
e	0.65 BSC		

COMMON DIMENSIONS
(UNITS OF MEASURE=mm)

11. Revision history

Table 11.Document revision history

Date	Revision	Changes
11-Dec-2024	1.0	Initial release.
11-Dec-2024	1.1	Update the Characterization curves
14-Dec-2024	1.2	Add the Parallel information
17-Dec-2024	1.3	Update the Application circuit and the Characterization curves
10-Jan-2025	1.4	Update the Pin list

12. Responsibility and Copyright Declaration

Shenzhen SMH Technology Co., Ltd. has the right to make corrections, modifications, enhancements, improvements or other changes to the products and services provided. Customers should obtain the latest relevant information and verify whether this information is complete and up-to-date before placing an order. All products are sold in accordance with the sales terms and conditions provided during order confirmation.

Shenzhen SMH Technology Co., Ltd. assumes no obligation for application assistance or customer product design. Customers are solely responsible for their use of Shenzhen SMH's products and applications. To minimize risks associated with customer products and applications, customers should provide sufficient design and operational safety verification.

The customer acknowledges and agrees that although any application related information or support may still be provided by SMH, they will be solely responsible for meeting all legal, regulatory, and safety requirements related to their products and the use of SMH products in their applications. The customer declares and agrees that they possess all necessary professional skills and knowledge to develop and implement safety measures, foresee the dangerous consequences of faults, monitor faults and their consequences, reduce the probability of faults that may cause personal injury, and take appropriate remedial measures. The customer will fully compensate for any losses caused to Shenzhen SMH and its agents due to the use of any Shenzhen SMH products in such critical applications.

For the product manuals or data sheets of Shenzhen SMH, copying is only allowed without any tampering with the content and with relevant authorization, conditions, restrictions, and statements. Shenzhen SMH assumes no responsibility or obligation for such tampered documents. Copying third-party information may require additional restrictions.

Shenzhen SMH will update the content of this document from time to time. The actual parameters of the product may vary due to different models or other matters. This document does not serve as any express or implied warranty or authorization

When reselling Shenzhen SMH products, if there is a discrepancy or false content between the description of the product parameters and the parameters indicated by Shenzhen SMH, all express or implied authorizations related to Shenzhen SMH products will be lost, and this is an improper and fraudulent business behavior. Shenzhen SMH assumes no responsibility or obligation for any such false statements.