TPA3251 Evaluation Module

This user's guide describes the characteristics, operation, and use of the TPA3251 evaluation module (EVM). A complete printed-circuit board (PCB) description, schematic diagram, and bill of materials are also included.

Figure 1. TPA3251 Evaluation Module

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Trademarks

PurePath is a trademark of Texas Instruments.
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1 Quick Start (BTL Mode)

This section describes the necessary hardware, connections, configuration, and steps to quick start the EVM into bridge-tied load (BTL) mode with stereo audio playing out of two speakers.

1.1 Required Hardware

The EVM requires the following hardware:

- TPA3251EVM (AMPS030-001) power supply 18-V to 36-V DC, 15 A
- Two 2-Ω to 8-Ω, 100-W speakers or resistor loads
- Four speaker or banana cables
- RCA input cables
- Analog output audio source

1.2 Connections and Board Configuration

Figure 2 and Figure 3 show both sides of the EVM board.

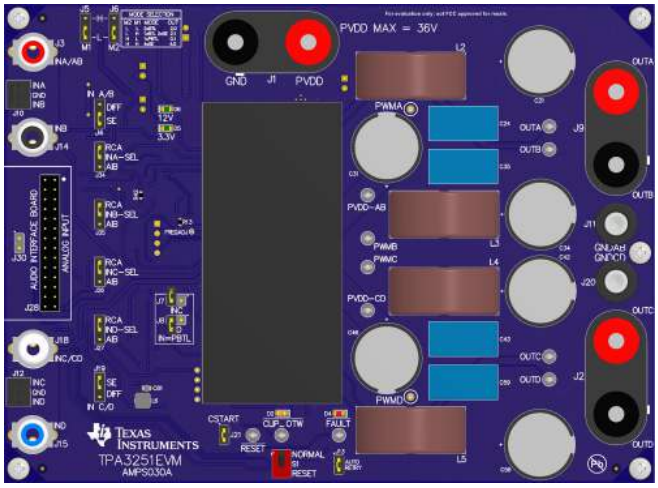

Figure 2. EVM Board (Top Side)

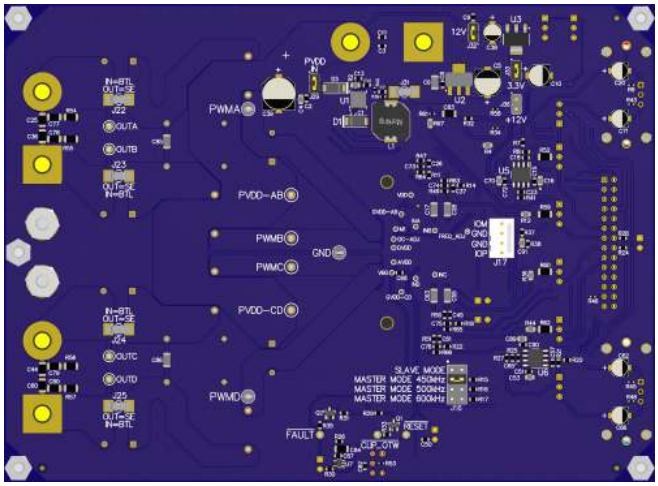

Figure 3. EVM Board (Bottom Side)

The steps for making the connections are as follows:

1. Set S1 to the *RESET* position.
2. Set the power supply to 36 V (18-V to 38-V range) and current to 10 A (5-A to 14-A range).
3. Connect the power supply to the TPA3251EVM positive terminal to PVDD *(J1-RED)* and negative terminal to GND *(J1-BLACK)*.
4. Connect the positive side of the *left* channel load to the TPA3251EVM *OUTA (J9-RED)* terminal.
5. Connect the negative side of the *left* channel load to the TPA3251EVM *OUTB (J9-BLACK)* terminal.
6. Connect the positive side of the *right* channel load to the TPA3251EVM *OUTC (J2-RED)* terminal.
7. Connect the negative side of the *right* channel load to the TPA3251EVM *OUTD (J2-BLACK)* terminal.
8. Be careful not to mix up PVDD, *OUTA,* and *OUTC* because the colors are the same *(RED)*.
9. Input configuration:
    a. Single-ended (SE) inputs: Set J4 and J19 to SE and set J26, J27, J34, and J35 to RCA.
        a. Connect the RCA male jack to the female RCA jack input A/AB *(J3-RED)*.
        b. Connect the RCA male jack to the female RCA jack input C/CD *(J18-WHITE)* .
    b. Differential inputs: Set J4 and J19 to DIFF and set J26, J27, J34, and J35 to RCA
        a. Connect the positive RCA male jack to the female RCA jack input A/AB *(J3-RED)* and connect the negative RCA male jack to the female RCA jack input B *(J14-BLACK)*.

b. Connect the positive RCA male jack to the female RCA jack input C/CD *(J18-RED)* and connect the negative RCA male jack to the female RCA jack input D *(J15-BLACK)*.

c. Analog-Input Board (AIB) input: Set J26, J27, J34, and J35 to AIB.

10. Power up the power supply after correctly making all the connections. The 3.3-V and 12-V LEDs *(GREEN)* then illuminate.
11. Set S1 to the *NORMAL* position.
12. The CLIP_OTW *(ORANGE)* and FAULT *(RED)* LEDs must be off if the audio source is off.

Table 1 lists the jumper configurations in BTL mode.

Table 1. Jumper Configurations (BTL Mode)

Jumper	Setting	Configuration for BTL
J29	IN	PVDD to 15-V BUCK
J32	IN	12-V LDO to 12-V TERM
J33	IN	3.3-V LDO to 3.3-V TERM
J36	IN	12-V LDO to GVDD
J16	3 to 4	MASTER MODE 600kHz
J22	IN	OUTA CAP SHUNT
J23	IN	OUTB CAP SHUNT
J24	IN	OUTC CAP SHUNT
J25	IN	OUTD CAP SHUNT
J5	2 to 3	M1-L
J6	2 to 3	M2-L
J7	OUT	PBTL SELECT INC
J8	OUT	PBTL SELECT IND
J4	1 to 2	INA/B SE INPUT
J19	1 to 2	INC/D SE INPUT
J26	1 to 2	INC-SEL RCA
J27	1 to 2	IND-SEL RCA
J34	1 to 2	INA-SEL RCA
J35	1 to 2	INB-SEL RCA
J21	OUT	C_START

2 Setup By Mode

The user can configure the TPA3251EVM for four different output operations. The 2.0 BTL configuration is the default set up of the TPA3251EVM as described in Section 1.2. The remaining three configurations are 2.1 BTL plus two SE outputs, 0.1 PBTL output, and 4.0 SE outputs.

Table 2. Mode Selection Pins

Mode Pins		Input Mode	Output Configuration	Description
M2	M1			
0	0	2N + 1	2 x BTL	Stereo BTL output configuration
0	1	2N-1N + 1	1 x BTL + 2 × SE	2.1 BTL + SE mode
1	0	2N + 1	1 × PBTL	Parallel BTL configuration; connect INPUT_C

2.1 BTL Mode (Two-Speaker Output)

This mode is the same as described in Section 1.

2.1.1 Performance Data (BTL Mode)

All measurements are taken at an audio frequency = 1 kHz, PVDD_X = 36 V, RL = 4 Ω, fS = 600 kHz, ROC = 22 kΩ, Output filter: L = 7 µH, C = 0.68 µF, with AES17 + AUX-0025 measurement filters.

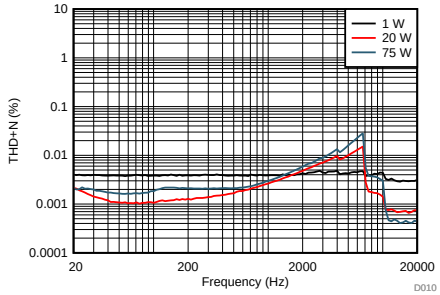

Figure 4. AIB Input: THD+N vs Frequency

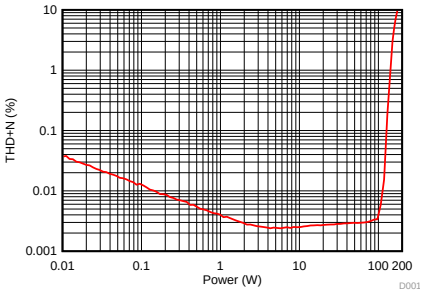

Figure 5. AIB Input: THD+N vs Power

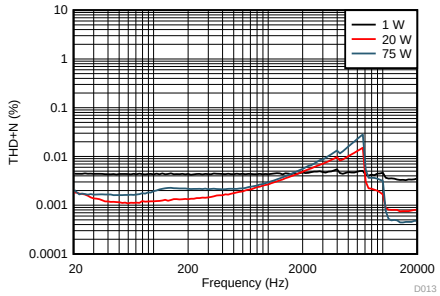

Figure 6. Molex™ Input: THD+N vs Frequency

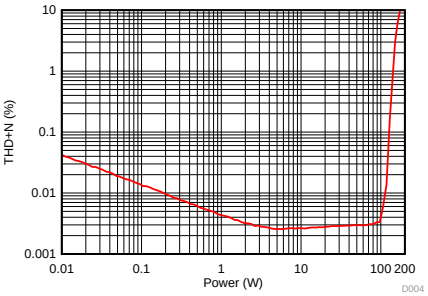

Figure 7. Molex Input: THD+N vs Power

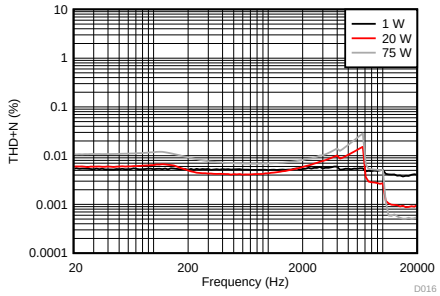

Figure 8. RCA Input: THD+N vs Frequency

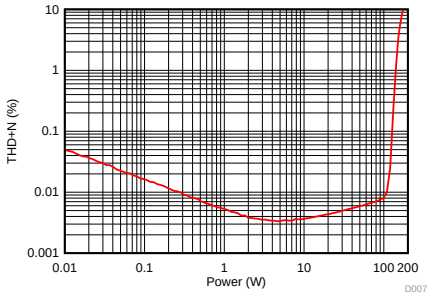

Figure 9. RCA Input: THD+N vs Power

2.2 BTL MODE (Three-Speaker Output)

OUTC and OUTD are the SE output channels and OUTA and OUTB are the BTL channels for 2.1 operations. OUTC and OUTD can only be in DIFF input mode.

1. Set J6 to L and J5 to H.
2. Remove jumpers J24 and J25.
3. Connect the positive side of the *left* channel load to *OUTC (*J2- *RED)* terminal and the negative side of the *left* channel load to the *GND* (J20) terminal.
4. Connect the positive side of the *right* channel load to *OUTD (*J2-*BLACK)* terminal and the negative side of the *right* channel load to the *GND* (J20) terminal.
5. Connect the positive terminal to *OUTA (*J9-*RED)* and the negative terminal to *OUTB (*J9-*BLACK)*.
6. Set the J19 jumper position to DIFF.
7. Input configuration:
   a. SE inputs: Connect the RCA male jack to the female RCA jack input A/AB *(*J3-*RED)* and set the *J4* jumper positions to SE. Set J26, J27, J34, and J35 to RCA.
   b. Differential inputs: Connect the positive RCA male jack to the female RCA jack input A/AB *(* J3-*RED)* and connect the negative RCA male jack to the female RCA jack input B *(*J14-*BLACK)* and set the J4 jumper positions to DIFF. Set J26, J27, J34, and J35 to RCA.
   c. AIB inputs: Set J26, J27, J34, and J35 to AIB.

Table 3. Jumper Configurations (2.1 BTL Mode)

Jumper	Setting	Comment
J29	IN	PVDD to 15-V BUCK
J32	IN	12-V LDO to 12-V TERM
J33	IN	3.3-V LDO to 3.3-V TERM
J36	IN	12-V LDO to GVDD
J16	3 to 4	MASTER MODE 600kHz
J22	IN	OUTA CAP SHUNT
J23	IN	OUTB CAP SHUNT
J24	OUT	OUTC CAP SHUNT
J25	OUT	OUTD CAP SHUNT
J5	1 to 2	M1 – H
J6	2 to 3	M2 – L
J7	OUT	PBTL SELECT INC

2.3 PBTL Mode (One-Speaker Output)

This mode uses all four half bridges for a mono output, allowing for the maximum power output from the device across one load.

2.3.1 Connections and Board Configuration

1. Set J6 to H and J5 to L.
2. Connect the positive side of the load to *OUTA (*J9-*RED)* and *OUTC (*J2-*RED)* terminals (OUTA and OUTC shorted).
3. Connect the negative side of the load to *OUTB (*J9-*BLACK)* and *OUTD (*J2-*BLACK)* terminals (OUTB and OUTD shorted).
4. Install PBTL jumpers J7 and J8 (pulls input C and input D to GND).
5. Input configuration:
   a. SE inputs: Connect the RCA male jack to the female RCA jack input A/AB *(*J3-*RED)* and set the J4 jumper positions to SE. Set J26, J27, J34, and J35 to RCA.
   b. Differential inputs: Connect the positive RCA male jack to the female RCA jack input A/AB *(*J3-*RED)* and connect the negative RCA male jack to the female RCA jack input B *(*J14-*BLACK)*. Set the *J4* jumper position to DIFF, and set J26, J27, J34, and J35 to RCA.
   c. AIB input: Set J26, J27, J34, and J35 to AIB.

Table 4. Jumper Configuration (PBTL Mode)

Jumper	Setting	Comment(1)
J29	IN	PVDD to 15-V BUCK
J32	IN	12-V LDO to 12-V TERM
J33	IN	3.3-V LDO to 3.3-V TERM
J36	IN	12-V LDO to GVDD
J16	3 to 4	MASTER MODE 600kHz
J22	IN	OUTA CAP SHUNT
J23	IN	OUTB CAP SHUNT
J24	IN	OUTC CAP SHUNT
J25	IN	OUTD CAP SHUNT
J5	2 to 3	M1 – L
J6	1 to 2	M2 – H
J7	IN	PBTL SELECT INC – GND
J8	IN	PBTL SELECT IND – GND
J4	1 to 2	INA/B SE INPUT
J19	1 to 2	INC/D SE INPUT
J26	1 to 2	INC-SEL RCA
J27	1 to 2	IND-SEL RCA
J34	1 to 2	INA-SEL RCA
J35	1 to 2	INB-SEL RCA
J21	OUT	C_START

(1) INA and INB are the inputs for PBTL, and INC and IND are grounded for PBTL operation.

2.3.2 Performance Data (PBTL Mode)

All measurements are taken at an audio frequency = 1 kHz, PVDD_X = 36 V, RL = 4 Ω, fS = 600 kHz, ROC = 22 kΩ, Output filter: L = 7μH, C = 0.68 μF, with AES17 + AUX-0025 measurement filters.

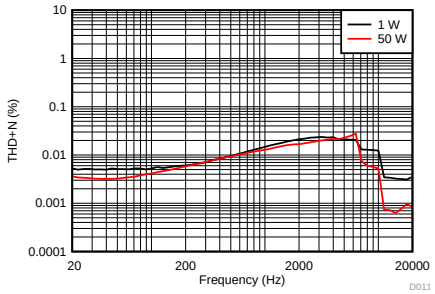

Figure 10. AIB Input: THD+N vs Frequency

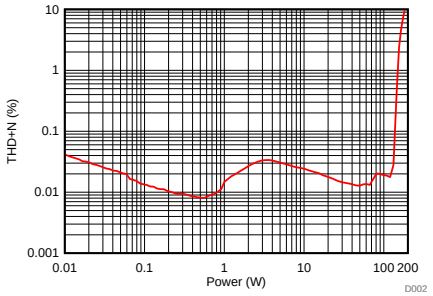

Figure 11. AIB Input: THD+N vs Power

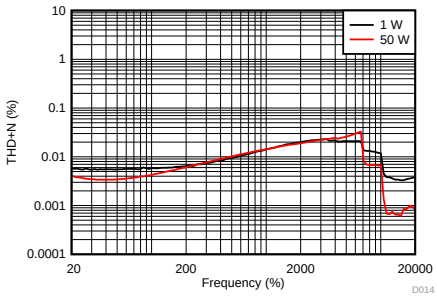

Figure 12. Molex Input: THD+N vs Frequency

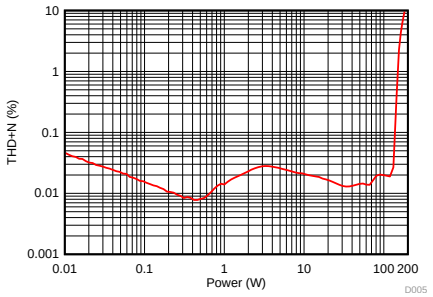

Figure 13. Molex Input: THD+N vs Power

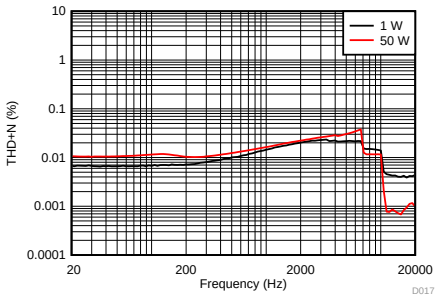

Figure 14. RCA Input: THD+N vs Frequency

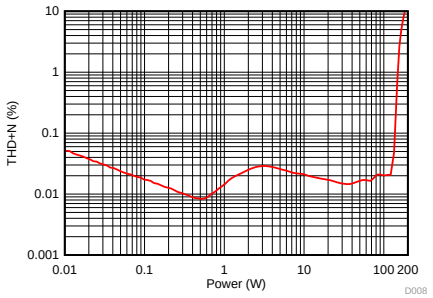

Figure 15. RCA Input: THD+N vs Power

2.4 SE Mode (Four-Speaker Output)

1. Set J6 to H and J5 to H.
2. Remove jumpers J22, J23, J24, and J25.
3. Connect the positive side of the load to the *OUTA (*J9-*RED)* terminal and the negative side of the load to the *GND* (J11) terminal.
4. Connect the positive side of the load to the *OUTB (*J9-*BLACK)* terminal and the negative side of the load to the *GND* (J11) terminal.
5. Connect the positive side of the load to the *OUTC (*J2-*RED)* terminal and the negative side of the load to the *GND* (J20) terminal.
6. Connect the positive side of the load to the *OUTD (*J2-*BLACK)* terminal and the negative side of the load to the *GND* (J20) terminal.
7. Set both J4 and J19 jumpers position to DIFF.
8. Input configuration:
   a. Differential inputs: Set J26, J27, J34, and J35 to RCA.
      i. Connect the male RCA jack to the female RCA jack input A/AB *(*J3-*RED)* for the *OUTA* speaker.

ii. Connect the male RCA jack to the female RCA jack input B *(*J14-*BLACK)* for the *OUTB* speaker.

iii. Connect the male RCA jack to the female RCA jack input C/CD *(*J18-*WHITE)* for the *OUTC* speaker.

iv. Connect the male RCA jack to the female RCA jack input D *(*J15-*BLUE)* for the *OUTD* speaker.

b. AIB input: Set J26, J27, J34, and J35 to AIB.

Table 5. Jumper Configuration (SE Mode)

Jumper	Setting	Comment
J29	IN	PVDD to 15-V BUCK
J32	IN	12-V LDO to 12-V TERM
J33	IN	3.3-V LDO to 3.3-V TERM
J36	IN	12-V LDO to GVDD
J16	3 to 4	MASTER MODE 600kHz
J22	OUT	OUTA CAP SHUNT
J23	OUT	OUTB CAP SHUNT
J24	OUT	OUTC CAP SHUNT
J25	OUT	OUTD CAP SHUNT
J5	1 to 2	M1 – H
J6	1 to 2	M2 – H
J7	OUT	PBTL SELECT INC
J8	OUT	PBTL SELECT IND
J4	2 to 3	INA/B DIFF INPUT
J19	2 to 3	INC/D DIFF INPUT
J26	1 to 2	INC-SEL RCA
J27	1 to 2	IND-SEL RCA
J34	1 to 2	INA-SEL RCA
J35	1 to 2	INB-SEL RCA
J21	IN	C_START

NOTE: The performance of the TPA3251EVM/TPA3251D2DDV is dependent on the power supply. Design the power supply with margins that can deliver the required power. Some low-frequency applications can require additional bulk capacitance. Replacing the bulk capacitors on the TPA3251EVM with 3300 µF or more capacitance can be necessary depending on the power supply used.

2.4.1 Performance Data (SE Mode)

All measurements are taken at audio frequency = 1 kHz, PVDD_X = 36 V, RL = 4 Ω, fS = 600 kHz, ROC = 22 kΩ, Output filter: L = 7 µH, C = 0.68 µF, with AES17 + AUX-0025 measurement filters.

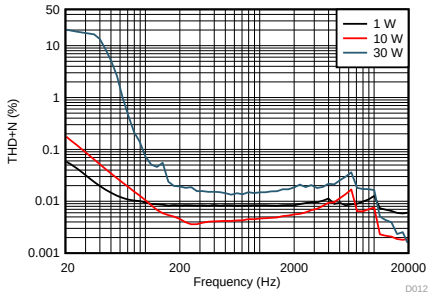

Figure 16. AIB Input: THD+N vs Frequency

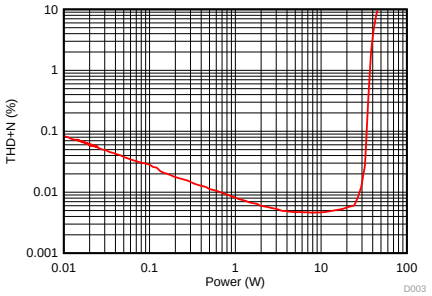

Figure 17. AIB Input: THD+N vs Power

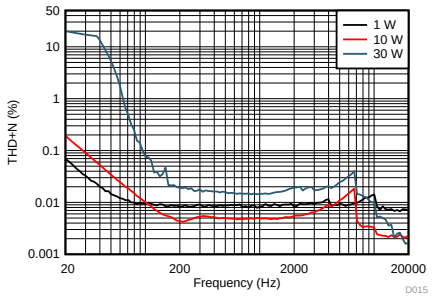

Figure 18. Molex Input: THD+N vs Frequency

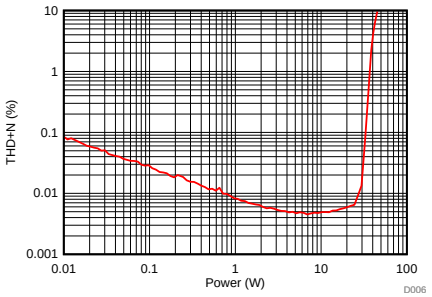

Figure 19. Molex Input: THD+N vs Power

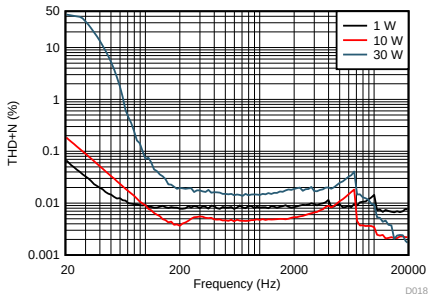

Figure 20. RCA Input: THD+N vs Frequency

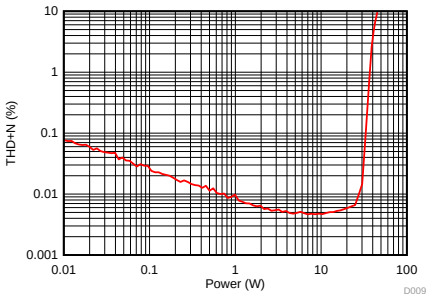

Figure 21. RCA Input THD+N vs Power

3 Hardware Configuration

3.1 Indicator Overview (OTW_CLIP and FAULT)

The TPA3251EVM is equipped with LED indicators that illuminate when the FAULT or CLIP_OTW pin (or both) goes low. See Table 6 and *TPA3251 175-W Stereo, 350-W Mono PurePath™ Ultra-HD Analog-Input Class-D Amplifier* for more details on which events trigger the pins to go low.

Table 6. Fault and Clip Overtemperature Status

FAULT	$\overline{\text{OTW\_CLIP}}$	Description
0	0	Overtemperature (OTE), overload (OLP), or undervoltage (UVP) junction temperature higher than 125°C (overtemperature warning)
0	0	OLP or UVP; junction temperature higher than 125°C (overtemperature warning)
0	1	OLP or UVP; junction temperature lower than 125°C
1	0	Junction temperature higher than 125°C (overtemperature warning)
1	1	Junction temperature lower than 125°C and no OLP or UVP faults (normal operation)

3.2 PWM Frequency Adjust

The TPA3251EVM offers a hardware-trimmed oscillator frequency by through the external control of the FREQ_ADJ pin. Use the frequency adjust to reduce interference problems while using a radio receiver tuned within the AM band and change the switching frequency from nominal values to lower values (see Table 7). Choose these values such that the nominal- and the lower-value switching frequencies together result in the fewest cases of interference throughout the AM band. Select the oscillator frequency based on the value of the FREQ_ADJ resistor connected to GND in master mode.

Table 7. Frequency Adjust Master Mode Selection

Mode	Switching Frequency	Resistor to GND	Pin Configuration
MASTER MODE 600 kHz	600 kHz	10 kΩ	3 to 4
MASTER MODE 500 kHz	500 kHz	20 kΩ	5 to 6
MASTER MODE 450 kHz	450 kHz	30 kΩ	7 to 8

For slave-mode operation, turn off the oscillator by pulling the FREQ_ADJ pin to 3.3 V. This action configures the OSC_I/O pins as inputs, which are to be slaved from an external differential clock. In a master and slave system, interchannel delay is automatically set up between the switching phases of the audio channels, which can be illustrated by no idle channels switching at the same time. This setup does not influence the audio output; rather, only the switch timing to minimize noise coupling between audio channels through the power supply. In turn, this process optimizes audio performance and results in better operating conditions for the power supply. The interchannel delay is setup for a slave device depending on the polarity of the OSC_I/O connection, such that slave mode 1 is selected by connecting OSC_I/O of the master device in phase with OSC_I/O of the slave device (+ to + and – to –), while slave mode 2 is selected by connecting the OSC_I/Os out of phase (+ to – and – to +).

3.3 TPA3251EVM Overcurrent Adjust

The TPA3251EVM offers the ability for the user to change the current limit by changing R13 as well as having two different protection modes, Cycle by Cycle Current Control (CB3C) and Latching Shutdown (Latched OC). For CB3C operations, the resistance must be a value of 22 kΩ to 30 kΩ. For Latched OC operations, the resistance must be a value of 47 kΩ to 64 kΩ. By default, the resistor R13 is 22 kΩ. Table 8 shows a few resistance values and their corresponding OC threshold and OC protection mode.

Table 8. Overcurrent Protection Selection

OC_ADJ Resistor Value	Protection Mode	OC Threshold
22 kΩ	CB3C	16.3 A
24 kΩ	CB3C	15.1 A
27 kΩ	CB3C	13.5 A
30 kΩ	CB3C	12.3 A
47 kΩ	Latched OC	16.3 A
51 kΩ	Latched OC	15.1 A
56 kΩ	Latched OC	13.5 A
64 kΩ	Latched OC	12.3 A

3.4 TPA3251EVM Single-Ended and Differential Inputs

The TPA3251EVM supports both differential and SE inputs. For SE inputs, set either the J4 or J19 jumper (or both) to the SE position so that the TPA3251EVM uses the NE5532 operational amplifier (op amp) to convert the SE input signal to differential to properly drive the differential inputs of the TPA3251 device. Use input RCA jack J3 to provide INA and INB inputs. Use RCA jack J18 to provide INC and IND inputs with SE inputs. For differential input operation, set either the J4 or J19 jumpers (or both) to the DIFF position. The TPA3251EVM uses the NE5532 to buffer the differential input signal to the differential inputs of the TPA3251 device. Use input RCA jack J3 to provide INA, RCA jack J14 to provide INB, RCA jack J18 to provide INC, and RCA jack J15 to provide IND with differential inputs.

NOTE: The SE input settings on the TPA3251EVM must only be used for channels with output configuration BTL or PBTL, *not* SE. For SE output configuration, the user must set either jumper J4 or J19 (or both) for that channel to the DIFF position so that the input signal INx is mapped directly to OUTx.

3.5 Input Connectors

The TPA3251EVM supports three different input connectors. J3, J14, J15, and J18 are RCA connectors; J10 and J12 are Molex connectors; and J28 is the AIB connector with J30 being the AIB alignment connection. Table 9 shows the AIB pinout in detail.

Table 9. AIB Connector (J28) Pinout

Pin No.	Function	Description	Audio EVM Input or Output
1	Amp Out A	Speaker-level output from audio class-D EVM (SE or one side of BTL)	O
2	Amp Out B	Speaker-level output from audio class-D EVM (SE or one side of BTL)	O
3	PVDD	PVDD voltage supply from audio Class-D EVM (variable voltage depending on Class-D EVM use)	O
4	GND	Ground reference between audio plug-in module and audio class-D EVM	
5	NC		
6	NC		
7	3.3 V	3.3-V supply from EVM; used for powering audio plug-in module	O
8	3.3 V	3.3-V supply from EVM; used for powering audio plug-in module	O
9	12 V	12-V supply from EVM; used for powering audio plug-in module	O
10	EN and Reset	Assert enable and reset control for audio class-D EVM (active low)	I
11	Analog IN_A	Analog audio input A (analog in EVM), Master I^2S bus (digital in EVM)	I
12	NC		
13	Analog IN_B	Analog audio input B (analog in EVM), bit clock I^2S bus (digital in EVM)	I
14	CLIP_OTW	Clipping detection, overtemperature warning, or both from audio class-D EVM (active low)	O
15	Analog IN_C	Analog audio input C (analog in EVM), frame clock I^2S bus (digital in EVM)	I
16	FAULT	Fault detection from audio Class-D EVM (active low)	O
17	Analog IN_D	Analog audio Input D (analog in EVM), data in I^2S bus (digital in EVM)	I
18	NC		
19	NC		
20	NC		
21	GND	Ground reference between audio plug-in module and audio class-D EVM	
22	GND	Ground reference between audio plug-in module and audio class-D EVM	
23	NC		
24	NC		
25	NC		
26	NC		
27	Amp Out C	Speaker-level output from audio class-D EVM (SE or one side of BTL)	O
28	Amp Out D	Speaker-level output from audio class-D EVM (SE or one side of BTL)	O

3.6 EVM Power Tree

The EVM power section is self-contained with all the necessary onboard voltages generated from the main PVDD (J1) power input. The PVDD is reduced to 15 V and then used to generate the remaining required board voltages of 12 V, 5 V, and 3.3 V. Low-dropout linear regulators (LDOs) generate supplies going to the TPA3221 device itself to reduce the chance of extra added noise. LEDs are provided on the 5-V and 3.3-V supplies so that the user can verify that the EVM is powered (see Figure 22).

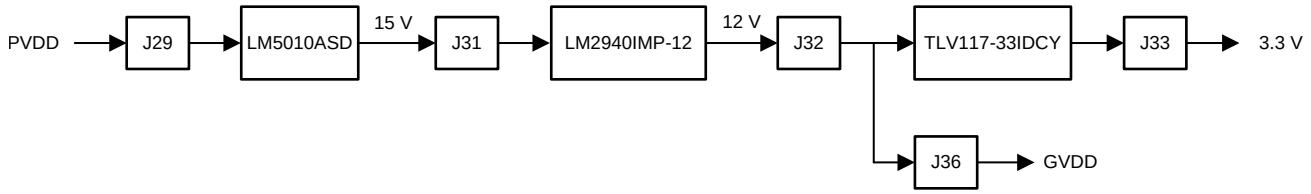

Figure 22. EVM Power Tree

3.7 LC Filter Overview

Included near the output of the TPA3251 device are four output LC filters. These output filters filter the pulse-width modulation (PWM) output, leaving only the audio content at high power, which is fed to the speakers. The board uses a CoilCraft™ 7-µH inductor and a 0.68-µF film capacitor to form this LC filter. Using the equations listed in *LC Filter Design Application Report* , the low-pass filter cutoff is calculated as follows in Equation 1:

$$F_{cut-off} = \frac{1}{2\pi\sqrt{L \times C}} = \frac{1}{2\pi\sqrt{7\ \mu H \times .68\ \mu F}} = 72.9\ kHz \quad (1)$$

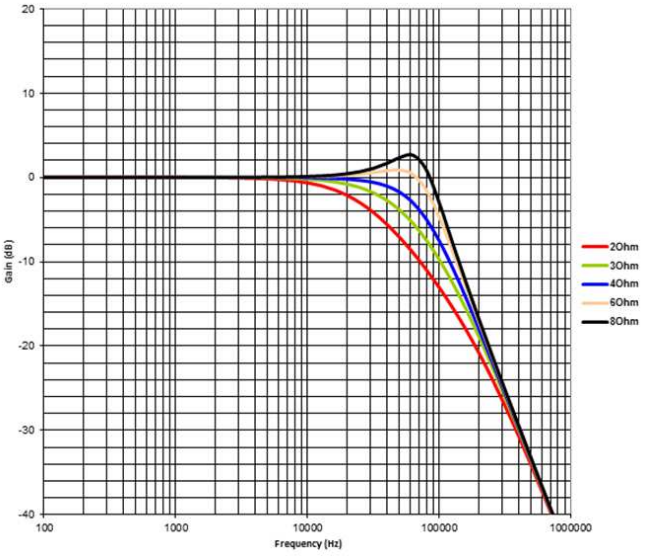

Figure 23. BTL LC Frequency Response

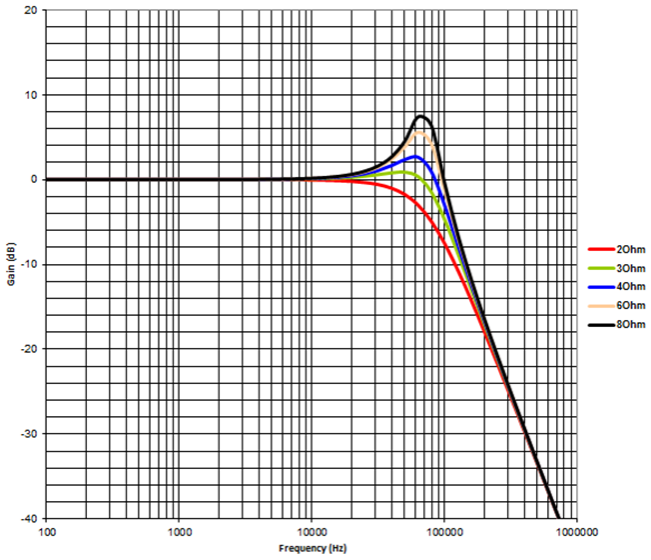

Figure 24. SE LC Frequency Response

3.8 Post-Filter Feedback (PFFB)

The TPA3251EVM has the footprints available to implement post filter feedback to improve the audio performance of the TPA3251 amplifier. For more details on benefits and implementation, see *TPA324x and TPA325x Post-Filter Feedback* .

3.9 Reset Circuit

The TPA3251EVM includes RESET supervision so that the TPA3251 device remains in reset until all the power rails are up and stable. The RESET supervisor also ensures that the device is put into reset if one of the power rails experiences a brownout. This circuit combined with the RESET switch (S1) help ensure that the TPA3251 can be placed in reset easily as needed or automatically if there is a power supply issue.

3.10 Op Amp versus Direct Drive

The op amps are used to change a single-ended input into a differential input. By default, the gain of the op amps are set for unity gain; however, this can be modified to increase or decrease the gain through the op amps. One way to bypass the op amps for a more direct connection is using the AIB.

4 EVM Design Documents

This section contains the TPA3251EVM board layout, schematics, and bill of materials (BOM).

4.1 TPA3251EVM Board Layouts

Figure 25 and Figure 26 illustrate the EVM board layouts.

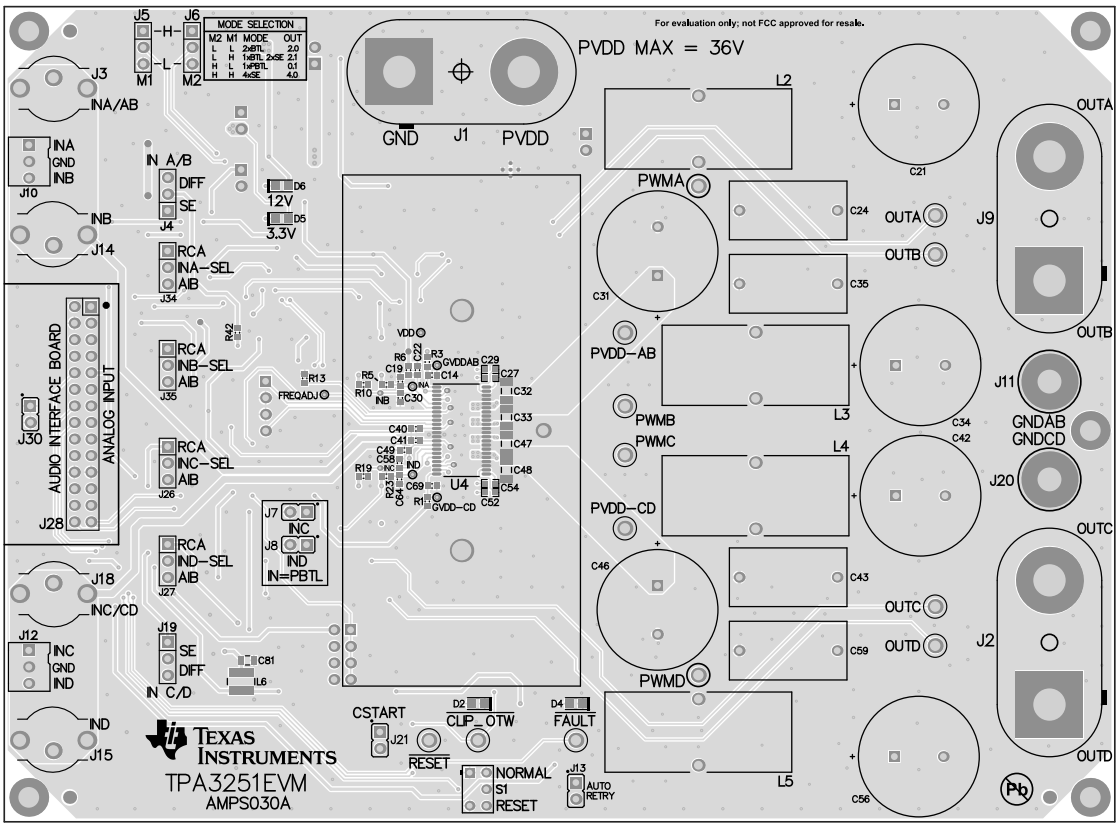

Figure 25. TPA3251 EVM Top Composite Assembly

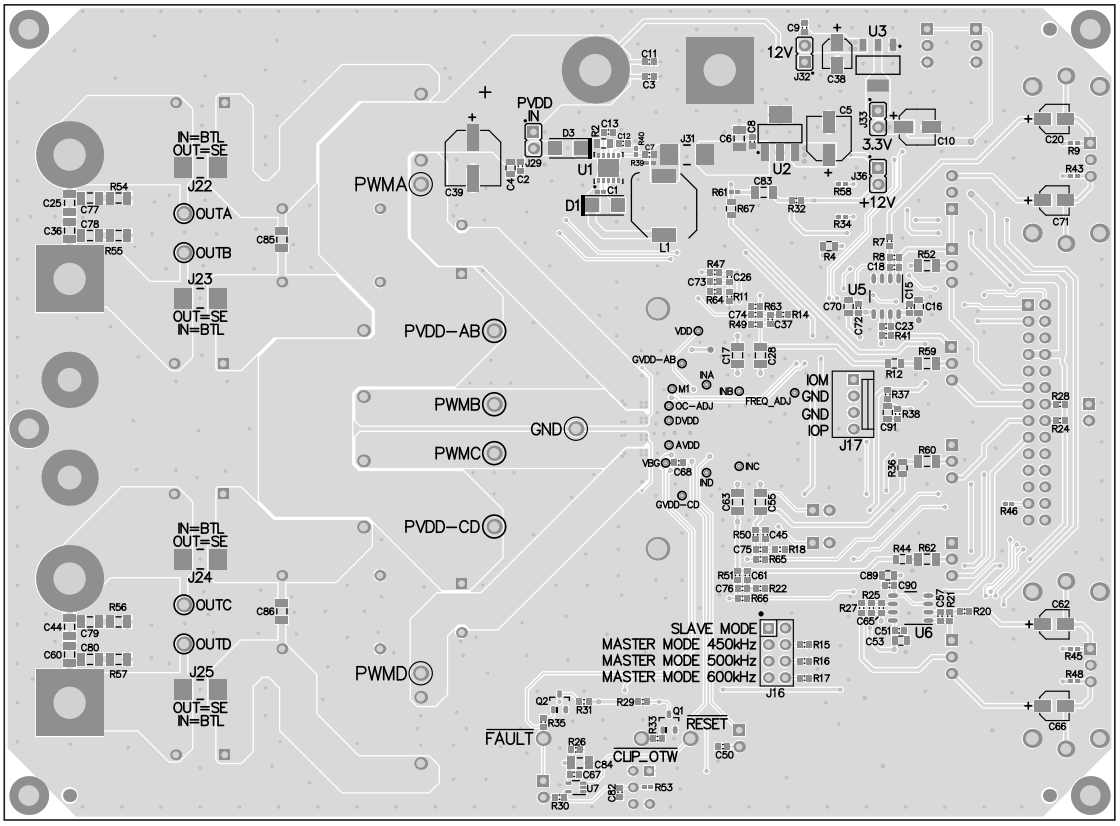

Figure 26. TPA3251 EVM Bottom Composite Assembly

4.2 TPA3251EVM Board Layouts

Figure 27 shows the EVM board dimensions.

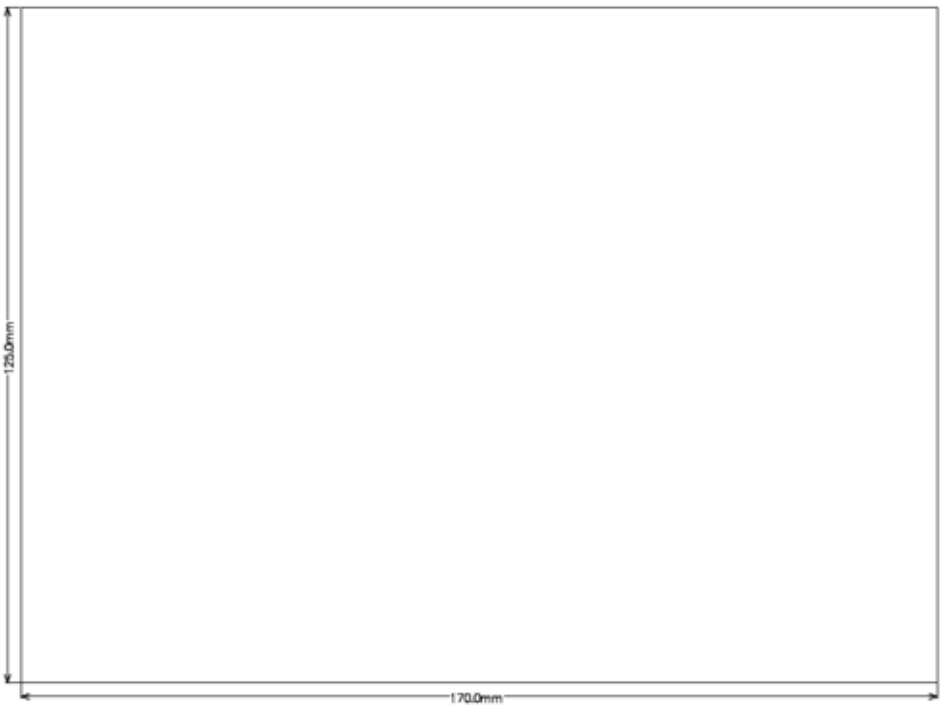

Figure 27. TPA3251EVM Board Dimensions

4.3 TPA3251 EVM Schematics

Figure 28 through Figure 30 illustrate the TPA3251EVM schematics.

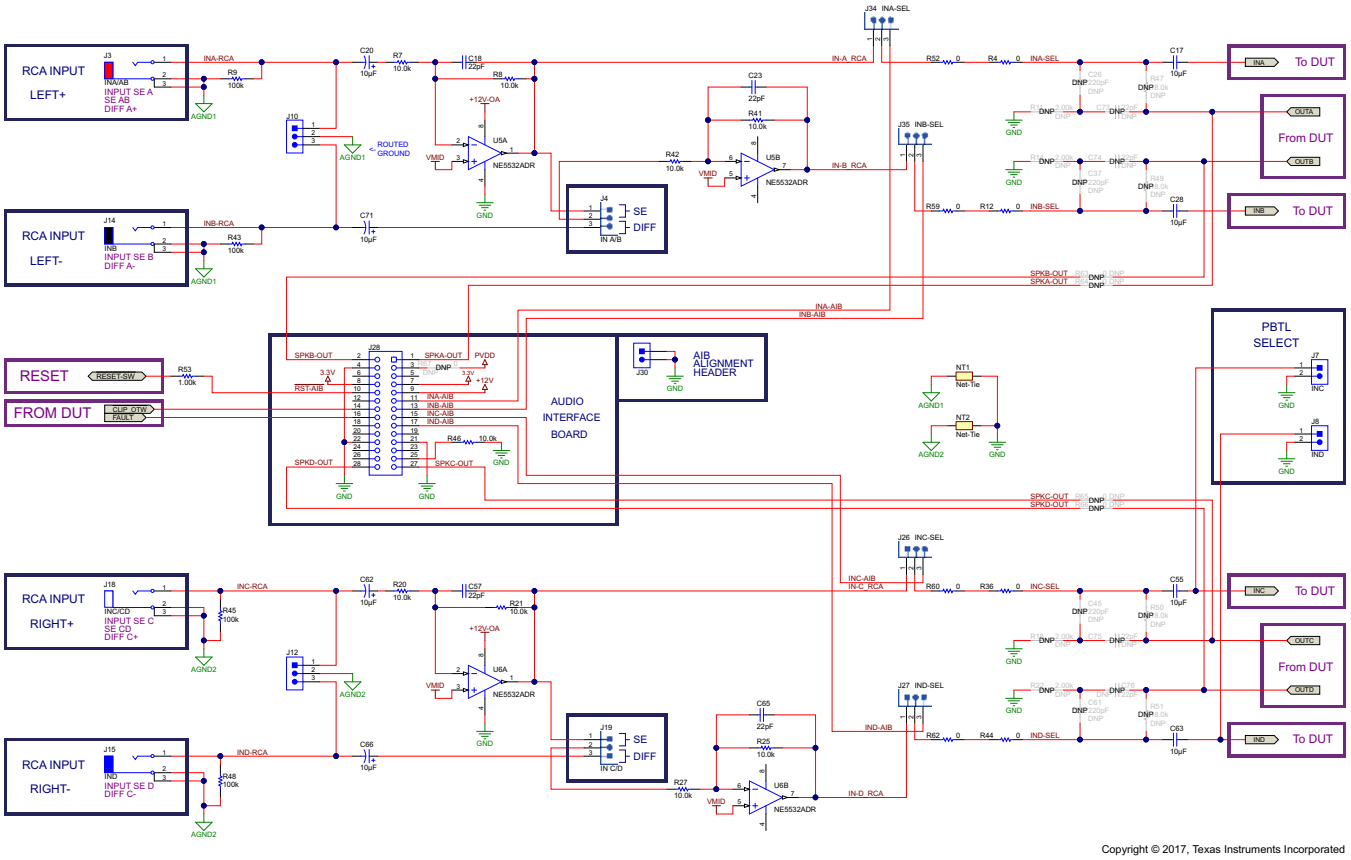

Figure 28. TPA3251EVM Schematic 1

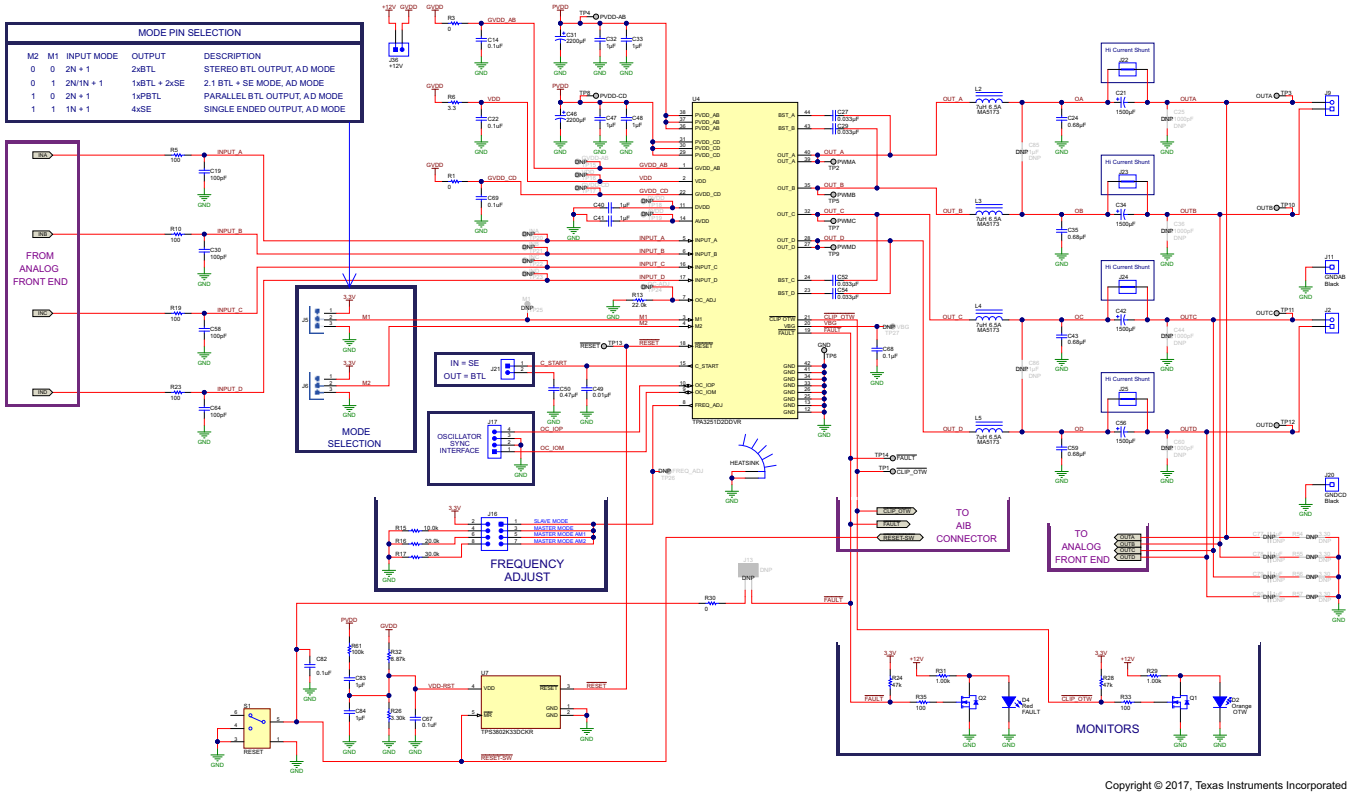

Figure 29. TPA3251EVM Schematic 2

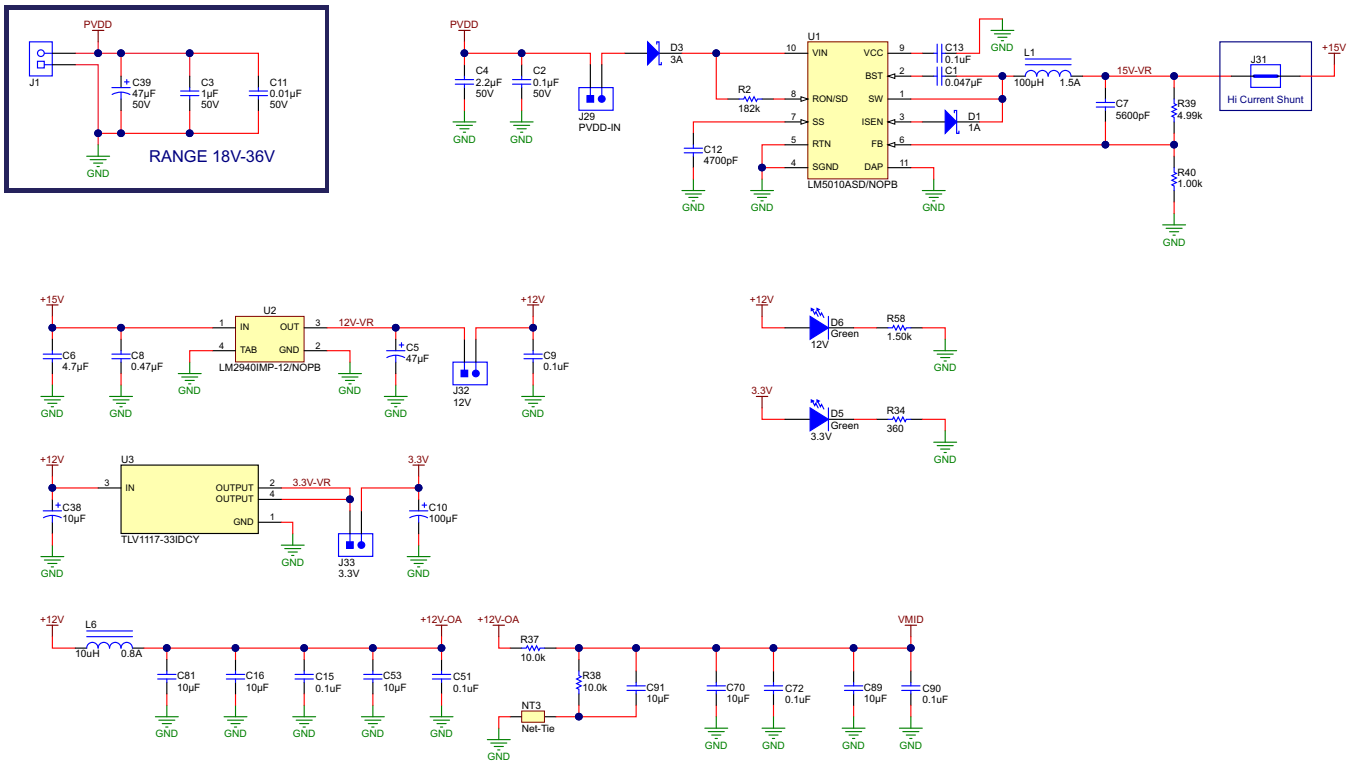

Figure 30. TPA3251EVM Schematic 3

4.4 TPA3251EVM Bill of Materials

Table 10 lists the TPA3251EVM BOM.

Table 10. TPA3251EVM Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
!PCB1	1		Printed Circuit Board		AMPS030	Any
C1	1	0.047uF	CAP, CERM, 0.047 µF, 25 V, +/- 10%, X7R, 0402	0402	GRM155R71E473KA88D	MuRata
C2, C9, C13, C15, C51, C68, C72, C90	8	0.1uF	CAP, CERM, 0.1 µF, 50 V, +/- 10%, X7R, 0603	0603	C0603C104K5RACTU	Kemet
C3	1	1uF	CAP, CERM, 1 µF, 50 V, +/- 10%, X7R, 0603	0603	UMK107AB7105KA-T	Taiyo Yuden
C4	1	2.2uF	CAP, CERM, 2.2 µF, 50 V, +/- 10%, X7R, 0805	0805	C2012X7R1H225K125AC	TDK
C5	1	47uF	CAP, AL, 47 µF, 16 V, +/- 20%, 0.36 ohm, SMD	SMT Radial D	EEE-FK1C470P	Panasonic
C6	1	4.7uF	CAP, CERM, 4.7 µF, 25 V, +/- 10%, X7R, 1206	1206	GRM31CR71E475KA88L	MuRata
C7	1	5600pF	CAP, CERM, 5600 pF, 50 V, +/- 10%, X7R, 0603	0603	GRM188R71H562KA01D	MuRata
C8, C50	2	0.47uF	CAP, CERM, 0.47 µF, 25 V, +/- 10%, X7R, 0603	0603	GRM188R71E474KA12D	MuRata
C10	1	100uF	CAP, AL, 100 µF, 6.3 V, +/- 20%, 0.7 ohm, SMD	SMT Radial C	EEE-FK0J101UR	Panasonic
C11	1	0.01uF	CAP, CERM, 0.01 µF, 50 V, +/- 10%, X7R, 0603	0603	C0603C103K5RACTU	Kemet
C12	1	4700pF	CAP, CERM, 4700 pF, 50 V, +/- 10%, X7R, 0603	0603	C0603X472K5RACTU	Kemet
C14, C22, C67, C69, C82	5	0.1uF	CAP, CERM, 0.1uF, 50V, +/-10%, X7R, 0603	0603	C0603C104K5RACTU	Kemet
C16, C53, C70, C81, C89, C91	6	10uF	CAP, CERM, 10 µF, 16 V, +/- 10%, X5R, 0805	0805	EMK212BJ106KG-T	Taiyo Yuden
C17, C28, C55, C63	4	10uF	CAP, CERM, 10 µF, 16 V, +/- 10%, X7R, 1206	1206	GRM31CR71C106KAC7L	MuRata
C18, C23, C57, C65	4	22pF	CAP, CERM, 22 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C1H220JA01D	MuRata
C19, C30, C58, C64	4	100pF	CAP, CERM, 100 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C1H101JA01D	MuRata
C20, C38, C62, C66, C71	5	10uF	CAP, AL, 10 µF, 16 V, +/- 20%, 1.35 ohm, SMD	SMT Radial B	EEE-FK1C100R	Panasonic
C21, C34, C42, C56	4	1500uF	CAP, AL, 1500 µF, 63 V, +/- 20%, 0.03 ohm, AEC-Q200 Grade 2, TH	Dia 18mm	EEU-FC1J152	Panasonic
C24, C35, C43, C59	4	0.68uF	CAP, Film, 0.68 µF, 250 V, +/- 5%, TH	18x9x17.5mm	B32652A3684J	EPCOS Inc
C27, C29, C52, C54	4	0.033uF	CAP, CERM, 0.033 µF, 50 V, +/- 10%, X7R, 0603	0603	GRM188R71H333KA61D	MuRata
C31, C46	2	2200uF	CAP, AL, 2200 µF, 50 V, +/- 20%, 0.023 ohm, TH	Dia 18mm	EEU-FC1H222	Panasonic
C32, C33, C47, C48, C83, C84	6	1uF	CAP, CERM, 1 µF, 50 V, +/- 10%, X7R, 1206	1206	GRM31MR71H105KA88L	MuRata
C39	1	47uF	CAP, AL, 47 µF, 50 V, +/- 20%, 0.68 ohm, SMD	SMT Radial E	EEE-FK1H470P	Panasonic
C40, C41	2	1uF	CAP, CERM, 1 µF, 16 V, +/- 10%, X7R, 0603	0603	GRM188R71C105KA12D	MuRata
C49	1	0.01uF	CAP, CERM, 0.01 µF, 50 V, +/- 10%, X7R, 0603	0603	GRM188R71H103KA01D	MuRata
D1	1	100V	Diode, Schottky, 100 V, 1 A, SMA	SMA	B1100-13-F	Diodes Inc.
D2	1	Orange	LED, Orange, SMD	LED_0805	LTST-C170KFKT	Lite-On
D3	1	100V	Diode, Schottky, 100 V, 3 A, SMA	SMA	SK310A-TP	Micro Commercial Components
D4	1	Red	LED, Red, SMD	Red 0805 LED	LTST-C170KRKT	Lite-On
D5, D6	2	Green	LED, Green, SMD	LED_0805	LTST-C171GKT	Lite-On
H1, H2, H3, H4, H5	5		MACHINE SCREW PAN PHILLIPS 4-40	Machine Screw, 4-40, 1/4 inch	PMSSS 440 0025 PH	B&F Fastener Supply
H6, H7	2		MACHINE SCREW PAN PHILLIPS M3	M3 Screw	RM3X8MM 2701	APM HEXSEAL
H8, H9, H10, H11, H12	5		HEX STANDOFF 4-40 ALUMINUM 3/4"	HEX STANDOFF 4-40 ALUMINUM 3/4"	2204	Keystone
HEATSINK	1		Heat Sink, Vertical	Heatsink	ATS-TI1OP-519-C1-R3	Advanced Thermal Solutions

Table 10. TPA3251EVM Bill of Materials (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
J1, J2, J9	3		Dual Binding Posts with Base, 2x1, TH	Dual Binding Posts with Base, 2x1, TH	6883	Pomona Electronics
J3	1		RCA Jack, Vertical, Red, TH	RCA JACK, RED	RCJ-022	CUI Inc.
J4, J19, J26, J27, J34, J35	6		Header, 100mil, 3x1, Gold, TH	PBC03SAAN	PBC03SAAN	Sullins Connector Solutions
J5, J6	2	1x3	Header, 100mil, 3x1, Gold, TH	PBC03SAAN	PBC03SAAN	Sullins Connector Solutions
J7, J8, J21, J29, J30, J32, J33, J36	8		Header, 100mil, 2x1, Gold, TH	Sullins 100mil, 1x2, 230 mil above insulator	PBC02SAAN	Sullins Connector Solutions
J10, J12	2		Header, 2.54 mm, 3x1, TH	Header, 2.54mm, 3x1, TH	22-11-2032	Molex
J11, J20	2		Binding Post, BLACK, TH	11.4x27.2mm	7007	Keystone
J14	1		RCA Jack, Vertical, Black, TH	RCA Jack, Vertical, Black, TH	RCJ-021	CUI Inc.
J15	1		RCA Jack, Vertical, Blue, TH	RCA Jack, Vertical, Blue, TH	RCJ-025	CUI Inc.
J16	1		Header, 100mil, 4x2, Tin, TH	Header, 4x2, 100mil, Tin	PEC04DAAN	Sullins Connector Solutions
J17	1		Header (friction lock), 100mil, 4x1, Gold, TH	Header 4x1 keyed	0022112042	Molex
J18	1		RCA Jack, Vertical, White, TH	RCA JACK, WHITE	RCJ-023	CUI Inc.
J22, J23, J24, J25, J31	5		JUMPER TIN SMD	6.85x0.97x2.51 mm	S1911-46R	Harwin
J28	1		Receptacle, 100mil, 14x2, Gold, TH	14x2 Receptacle	SSW-114-01-G-D	Samtec
L1	1	100uH	Inductor, Shielded Drum Core, Ferrite, 100 µH, 1.5 A, 0.165 ohm, SMD	SMD	7447714101	Wurth Elektronik
L2, L3, L4, L5	4	7uH	Inductor, Toroid, Powdered Iron, 7 µH, 6.5 A, 0.0215 ohm, TH	28.6x12.3mm	MA5173-AE	Coilcraft
L6	1	10uH	Inductor, Wirewound, 10 µH, 0.8 A, 0.204 ohm, SMD	2-Pin SMD, Body 4 x 4 mm, Height 1.2 mm	NRS4012T100MDGJV	Taiyo Yuden
Q1, Q2	2	60V	MOSFET, N-CH, 60 V, 0.17 A, SOT-23	SOT-23	2N7002-7-F	Diodes Inc.
R1, R3, R30	3	0	RES, 0, 5%, 0.1 W, 0603	0603	CRCW06030000Z0EA	Vishay-Dale
R2	1	182k	RES, 182 k, 1%, 0.125 W, 0805	0805	ERJ-6ENF1823V	Panasonic
R4, R12, R36, R44	4	0	RES, 0, 5%, 0.125 W, 0805	0805	ERJ-6GEY0R00V	Panasonic
R5, R10, R19, R23, R33, R35	6	100	RES, 100, 1%, 0.1 W, 0603	0603	CRCW0603100RFKEA	Vishay-Dale
R6	1	3.3	RES, 3.3, 5%, 0.1 W, 0603	0603	CRCW06033R30JNEA	Vishay-Dale
R7, R8, R20, R21, R25, R27, R37, R38, R41, R42	10	10.0k	RES, 10.0 k, 0.1%, 0.1 W, 0603	0603	RT0603BRD0710KL	Yageo America
R9, R43, R45, R48, R61	5	100k	RES, 100 k, 1%, 0.063 W, 0402	0402	CRCW0402100KFKED	Vishay-Dale
R13	1	22.0k	RES, 22.0 k, 1%, 0.1 W, 0603	0603	RC0603FR-0722KL	Yageo America
R15	1	10.0k	RES, 10.0 k, 1%, 0.1 W, 0603	0603	CRCW060310K0FKEA	Vishay-Dale
R16	1	20.0k	RES, 20.0 k, 1%, 0.1 W, 0603	0603	RC0603FR-0720KL	Yageo America
R17	1	30.0k	RES, 30.0 k, 1%, 0.1 W, 0603	0603	RC0603FR-0730KL	Yageo America
R24, R28	2	47k	RES, 47 k, 5%, 0.1 W, 0603	0603	RC0603JR-0747KL	Yageo America
R26	1	3.30k	RES, 3.30 k, 1%, 0.1 W, 0603	0603	RC0603FR-073K3L	Yageo America
R29, R31	2	1.00k	RES, 1.00 k, 1%, 0.1 W, 0603	0603	CRCW06031K00FKEA	Vishay-Dale
R32	1	8.87k	RES, 8.87 k, 1%, 0.1 W, 0603	0603	CRCW06038K87FKEA	Vishay-Dale
R34	1	360	RES, 360, 5%, 0.063 W, 0402	0402	CRCW0402360RJNED	Vishay-Dale
R39	1	4.99k	RES, 4.99 k, 1%, 0.063 W, 0402	0402	CRCW04024K99FKED	Vishay-Dale
R40	1	1.00k	RES, 1.00 k, 1%, 0.063 W, 0402	0402	CRCW04021K00FKED	Vishay-Dale
R46	1	10.0k	RES, 10.0 k, 1%, 0.063 W, 0402	0402	CRCW040210K0FKED	Vishay-Dale
R52, R59, R60, R62	4	0	RES, 0, 5%, 0.25 W, 1206	1206	CRCW12060000Z0EA	Vishay-Dale
R53	1	1.00k	RES, 1.00 k, 1%, 0.1 W, 0402	0402	ERJ-2RKF1001X	Panasonic
R58	1	1.50k	RES, 1.50 k, 1%, 0.063 W, 0402	0402	CRCW04021K50FKED	Vishay-Dale
S1	1		Switch, SPDT, On-On, 2 Pos, TH	Switch, 7x4.5mm	200USP1T1A1M2RE	E-Switch
SH1, SH2, SH3, SH4, SH5, SH6, SH7, SH8, SH9, SH10, SH11, SH12, SH13, SH14, SH15, SH16, SH17, SH18	18	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M

Table 10. TPA3251EVM Bill of Materials (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14	14	Grey	Test Point, Multipurpose, Grey, TH	Grey Multipurpose Testpoint	5128	Keystone
U1	1		High Voltage 1A Step Down Switching Regulator, 10-pin LLP, Pb-Free	SDC10A	LM5010ASD/NOPB	Texas Instruments
U2	1		1A Low Dropout Regulator, 4-pin SOT-223, Pb-Free	MP04A	LM2940IMP-12/NOPB	Texas Instruments
U3	1		FIXED LOW-DROPOUT VOLTAGE REGULATOR, DCY0004A	DCY0004A	TLV1117-33IDCY	Texas Instruments
U4	1		175W Stereo / 350W Mono PurePath(TM) Ultra-HD, Analog-In Class-D Amplifier, DDV0044D (TSSOP-44)	DDV0044D	TPA3251D2DDVR	Texas Instruments
U5, U6	2		Dual Low-Noise Operational Amplifier, 10 to 30 V, 0 to 70 degC, 8-pin SOIC (D0008A), Green (RoHS & no Sb/Br)	D0008A	NE5532ADR	Texas Instruments
U7	1		ULTRA-SMALL SUPPLY VOLTAGE SUPERVISORS, DCK0005A	DCK0005A	TPS3802K33DCKR	Texas Instruments
C25, C36, C44, C60	0	1000pF	CAP, CERM, 1000 pF, 50 V, +/- 5%, C0G/NP0, 1206	1206	GRM3195C1H102JA01D	MuRata
C26, C37, C45, C61	0	220pF	CAP, CERM, 220 pF, 50 V,+/- 5%, C0G/NP0, 0603	0603	GRM1885C1H221JA01D	MuRata
C73, C74, C75, C76	0	22pF	CAP, CERM, 22 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C1H220JA01D	MuRata
C77, C78, C79, C80	0	1uF	CAP, CERM, 1 µF, 50 V, +/- 10%, X7R, 1206	1206	GRM31MR71H105KA88L	MuRata
C85, C86	0	1uF	CAP, CERM, 1 µF, 100 V, +/- 10%, X7R, 1206	1206	GRM31CR72A105KA01L	MuRata
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A
J13	0		Header, 100mil, 2x1, Gold, TH	Sullins 100mil, 1x2, 230 mil above insulator	PBC02SAAN	Sullins Connector Solutions
R11, R14, R18, R22	0	2.00k	RES, 2.00 k, 1%, 0.1 W, 0603	0603	CRCW06032K00FKEA	Vishay-Dale
R47, R49, R50, R51	0	18.0k	RES, 18.0 k, 1%, 0.1 W, 0603	0603	RC0603FR-0718KL	Yageo America
R54, R55, R56, R57	0	3.30	RES, 3.30, 1%, 0.25 W, 1206	1206	ERJ-8RQF3R3V	Panasonic
R63, R64, R65, R66	0	0	RES, 0, 5%, 0.1 W, 0603	0603	CRCW06030000Z0EA	Vishay-Dale
R67	0	0	RES, 0, 5%, 0.125 W, 0805	0805	ERJ-6GEY0R00V	Panasonic

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