

## 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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- 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**

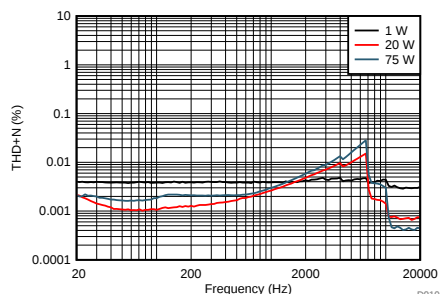
| Mode Pins |    | Input Mode | Output Configuration | Description                                 |
|-----------|----|------------|----------------------|---------------------------------------------|
| M2        | M1 |            |                      |                                            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

### 2.1 BTL Mode (Two-Speaker Output)

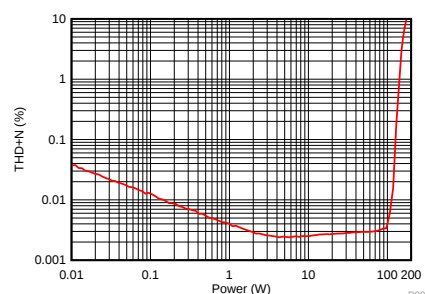
This mode is the same as described in [Section 1](#).

#### 2.1.1 Performance Data (BTL Mode)

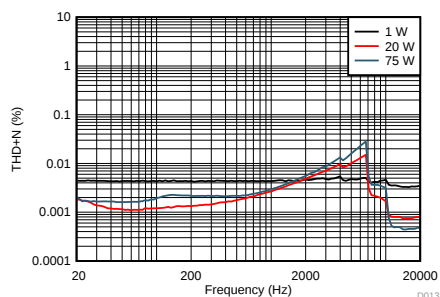
All measurements are taken at an audio frequency = 1 kHz, PVDD\_X = 36 V, RL = 4 Ω, fS = 600 kHz, ROC = 22 kΩ, Output filter: L = 7 μH, C = 0.68 μF, with AES17 + AUX-0025 measurement filters.



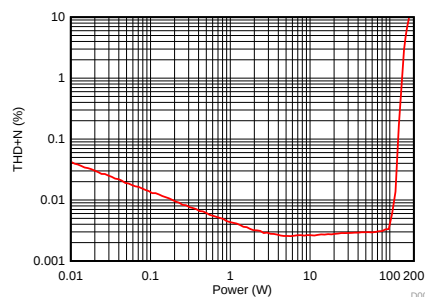
**Figure 4. AIB Input: THD+N vs Frequency**



**Figure 5. AIB Input: THD+N vs Power**



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



**Figure 7. Molex Input: THD+N vs Power**

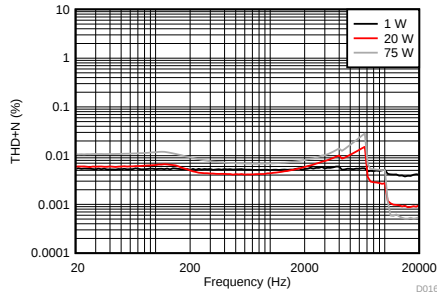


Figure 8. RCA Input: THD+N vs Frequency

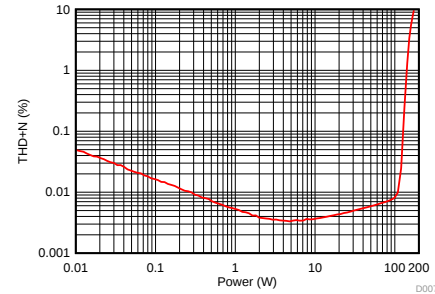


Figure 9. RCA Input: THD+N vs Power

## 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 <sup>(1)</sup>  |
|--------|---------|-------------------------|
| 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                 |

<sup>(1)</sup> 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.

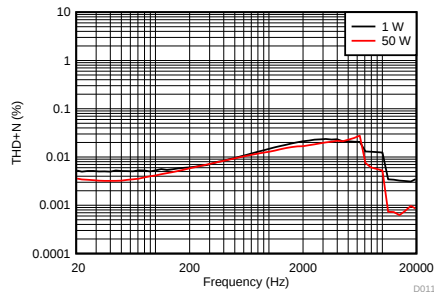


Figure 10. AIB Input: THD+N vs Frequency

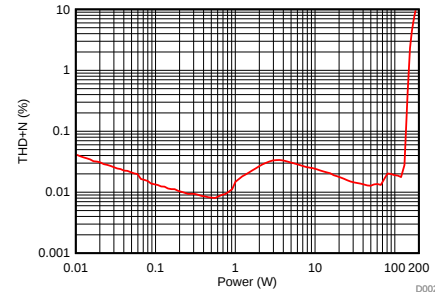


Figure 11. AIB Input: THD+N vs Power

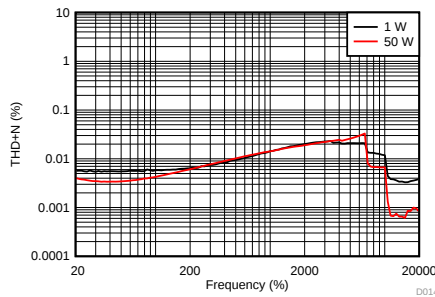


Figure 12. Molex Input: THD+N vs Frequency

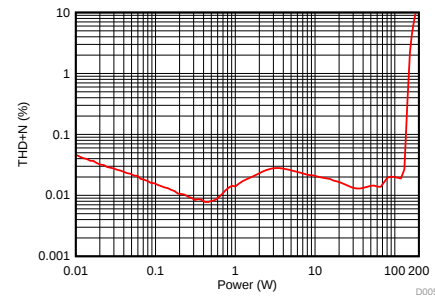


Figure 13. Molex Input: THD+N vs Power

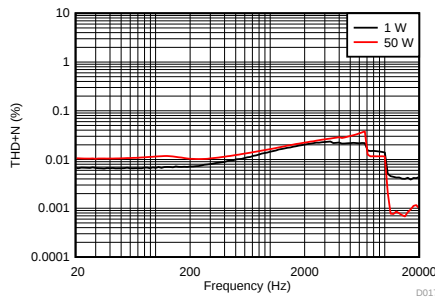


Figure 14. RCA Input: THD+N vs Frequency

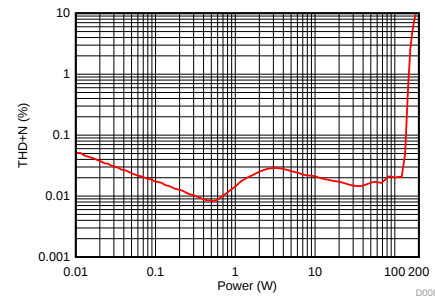


Figure 15. RCA Input: THD+N vs Power

## 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  $\mu$ F 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  $\Omega$ , fS = 600 kHz, ROC = 22 k $\Omega$ , Output filter: L = 7  $\mu$ H, C = 0.68  $\mu$ F, with AES17 + AUX-0025 measurement filters.

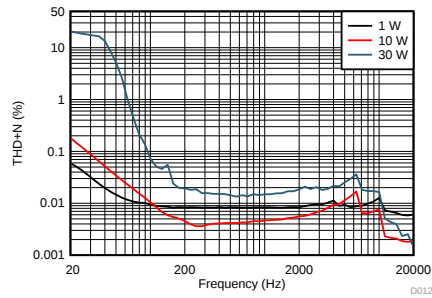


Figure 16. AIB Input: THD+N vs Frequency

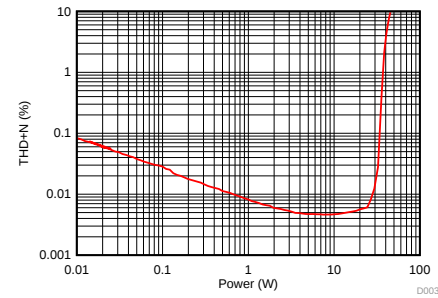


Figure 17. AIB Input: THD+N vs Power

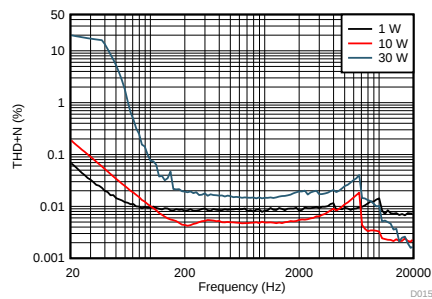


Figure 18. Molex Input: THD+N vs Frequency

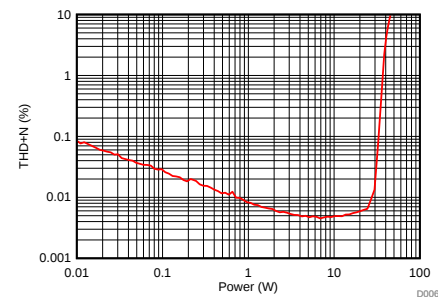


Figure 19. Molex Input: THD+N vs Power

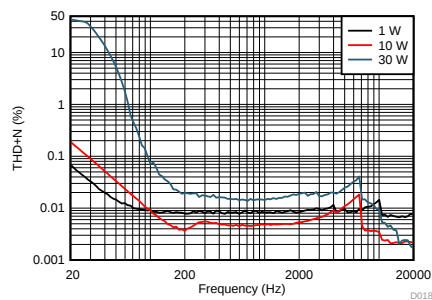


Figure 20. RCA Input: THD+N vs Frequency

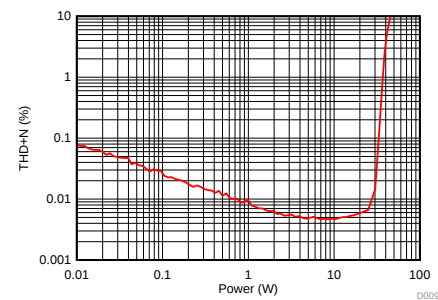


Figure 21. RCA Input THD+N vs Power

## 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 | 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 k $\Omega$   | 3 to 4            |
| MASTER MODE 500 kHz | 500 kHz             | 20 k $\Omega$   | 5 to 6            |
| MASTER MODE 450 kHz | 450 kHz             | 30 k $\Omega$   | 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/O`s 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 k $\Omega$  to 30 k $\Omega$ . For Latched OC operations, the resistance must be a value of 47 k $\Omega$  to 64 k $\Omega$ . By default, the resistor R13 is 22 k $\Omega$ . [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 k $\Omega$         | CB3C            | 16.3 A       |
| 24 k $\Omega$         | CB3C            | 15.1 A       |
| 27 k $\Omega$         | CB3C            | 13.5 A       |
| 30 k $\Omega$         | CB3C            | 12.3 A       |
| 47 k $\Omega$         | Latched OC      | 16.3 A       |
| 51 k $\Omega$         | Latched OC      | 15.1 A       |
| 56 k $\Omega$         | Latched OC      | 13.5 A       |
| 64 k $\Omega$         | 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 <sup>2</sup> S bus (digital in EVM)         | I                         |
| 12      | NC           |                                                                                            |                           |
| 13      | Analog IN_B  | Analog audio input B (analog in EVM), bit clock I <sup>2</sup> S 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 <sup>2</sup> S 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 <sup>2</sup> S 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](#)).

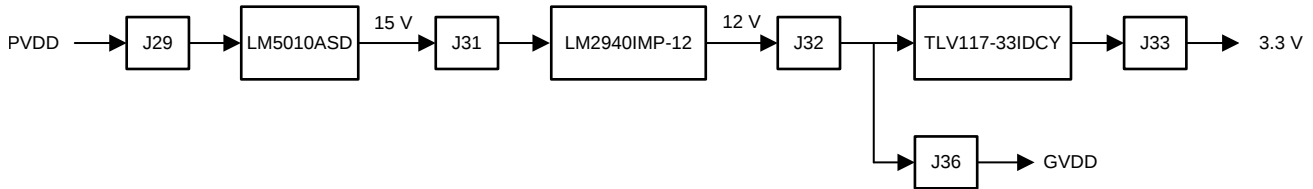


Figure 22. EVM Power Tree

### 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](#):

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

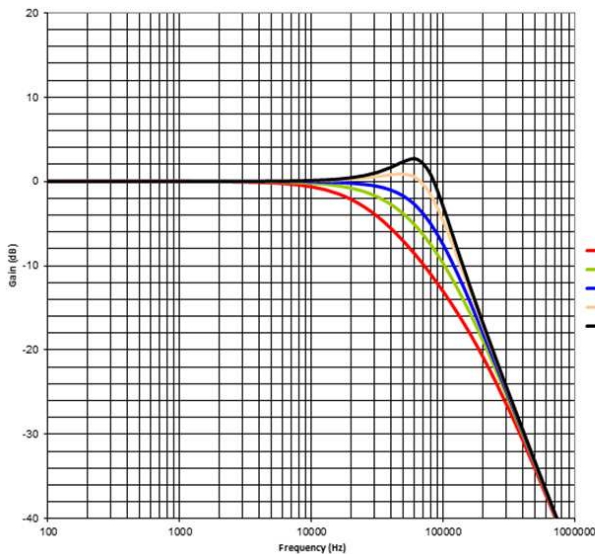


Figure 23. BTL LC Frequency Response

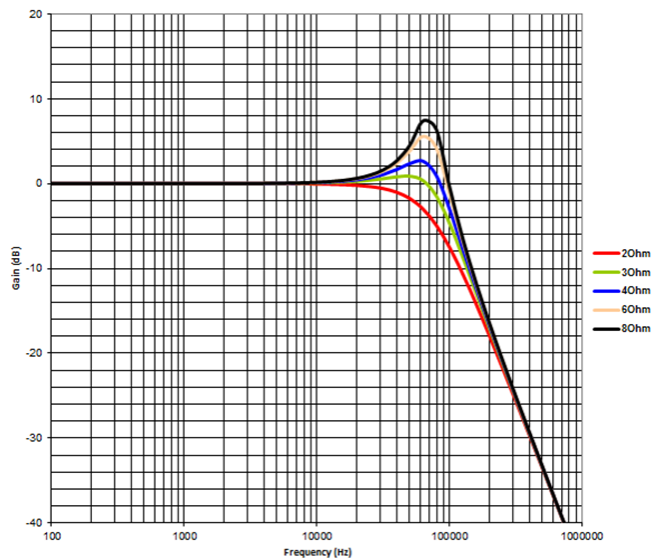


Figure 24. SE LC Frequency Response

### 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.

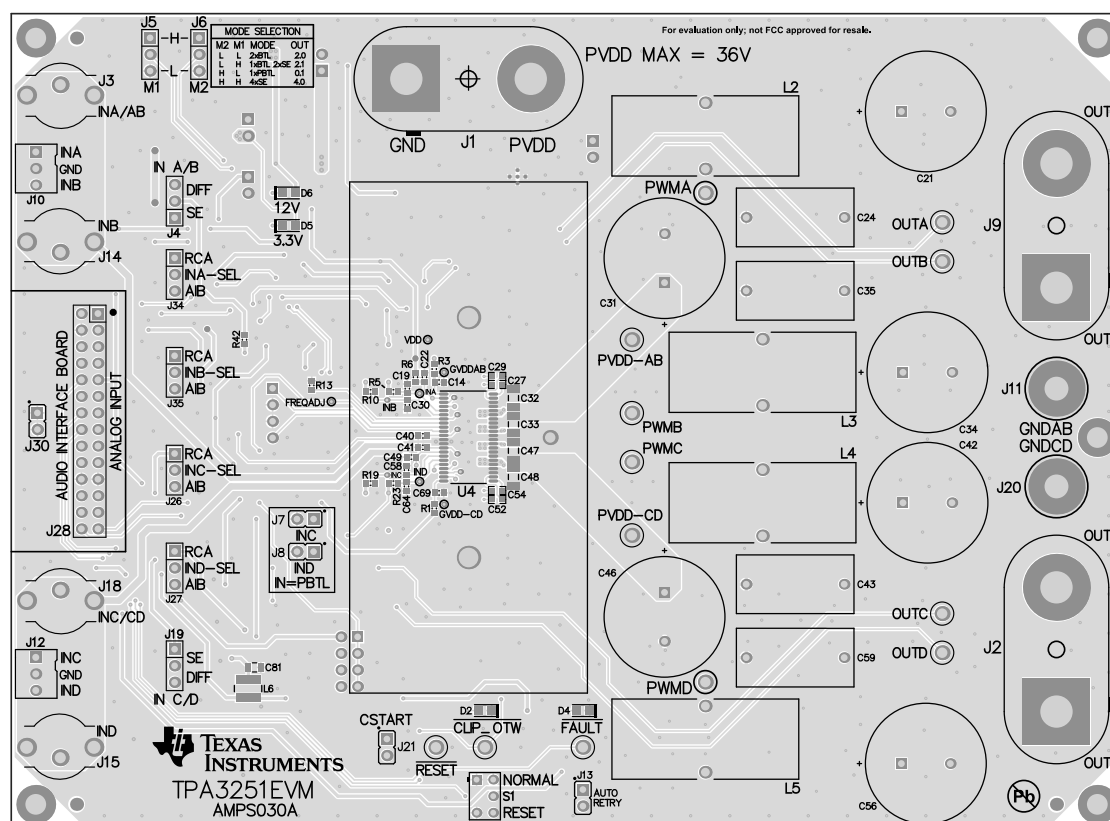
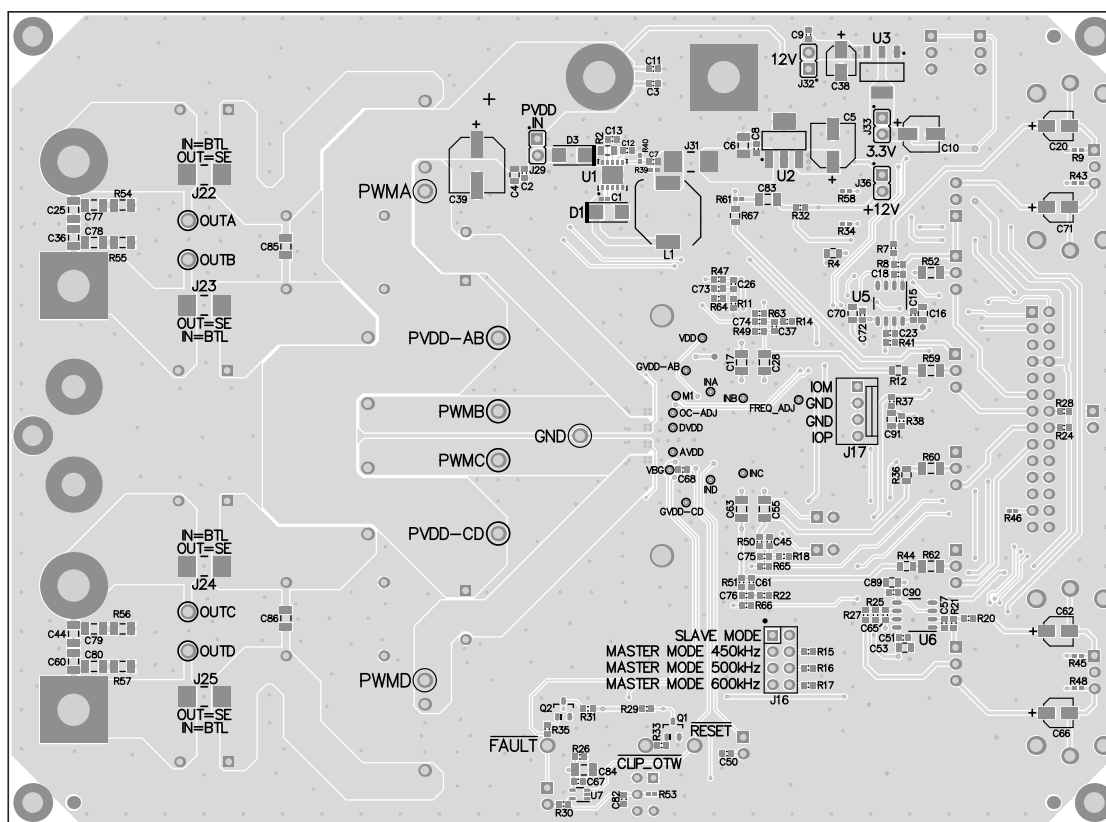


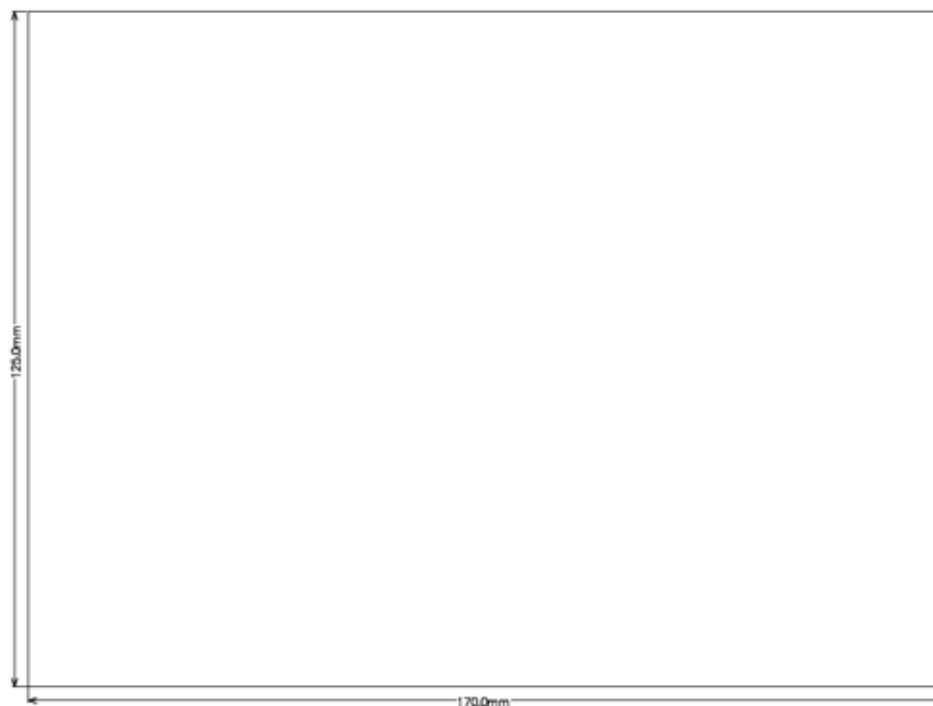
Figure 25. TPA3251 EVM Top Composite Assembly



**Figure 26. TPA3251 EVM Bottom Composite Assembly**

## 4.2 TPA3251EVM Board Layouts

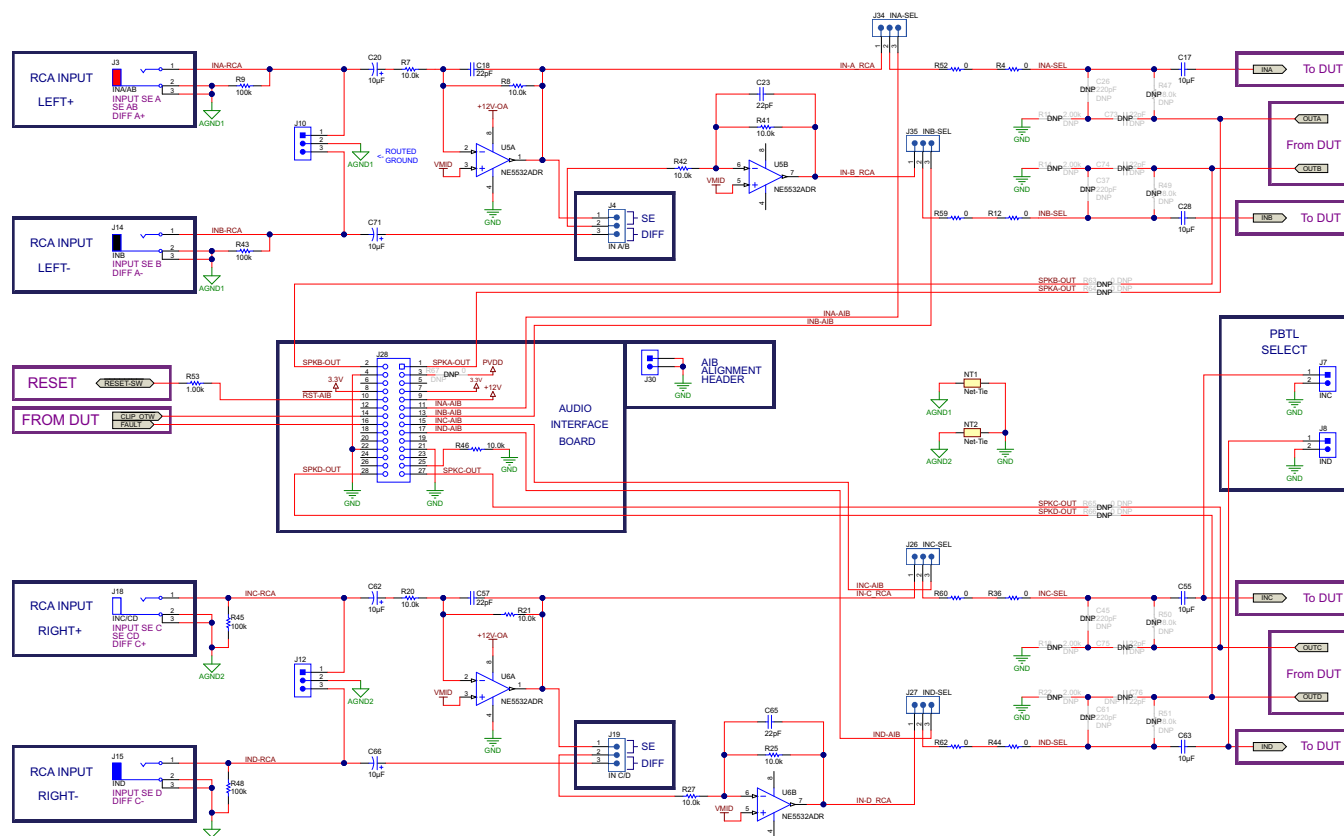
Figure 27 shows the EVM board dimensions.



**Figure 27. TPA3251EVM Board Dimensions**

### 4.3 TPA3251 EVM Schematics

Figure 28 through Figure 30 illustrate the TPA3251EVM schematics.



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**Figure 28. TPA3251EVM Schematic 1**

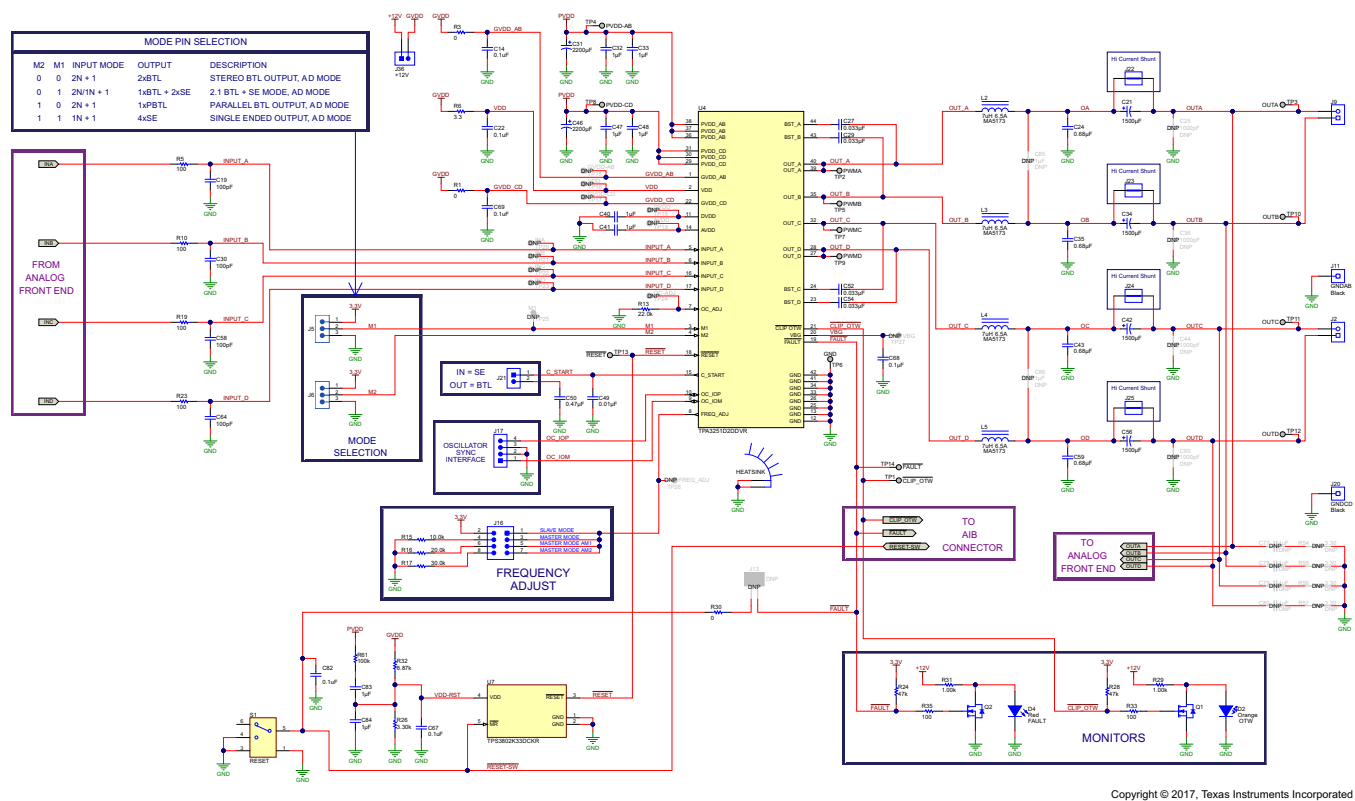


Figure 29. TPA3251EVM Schematic 2

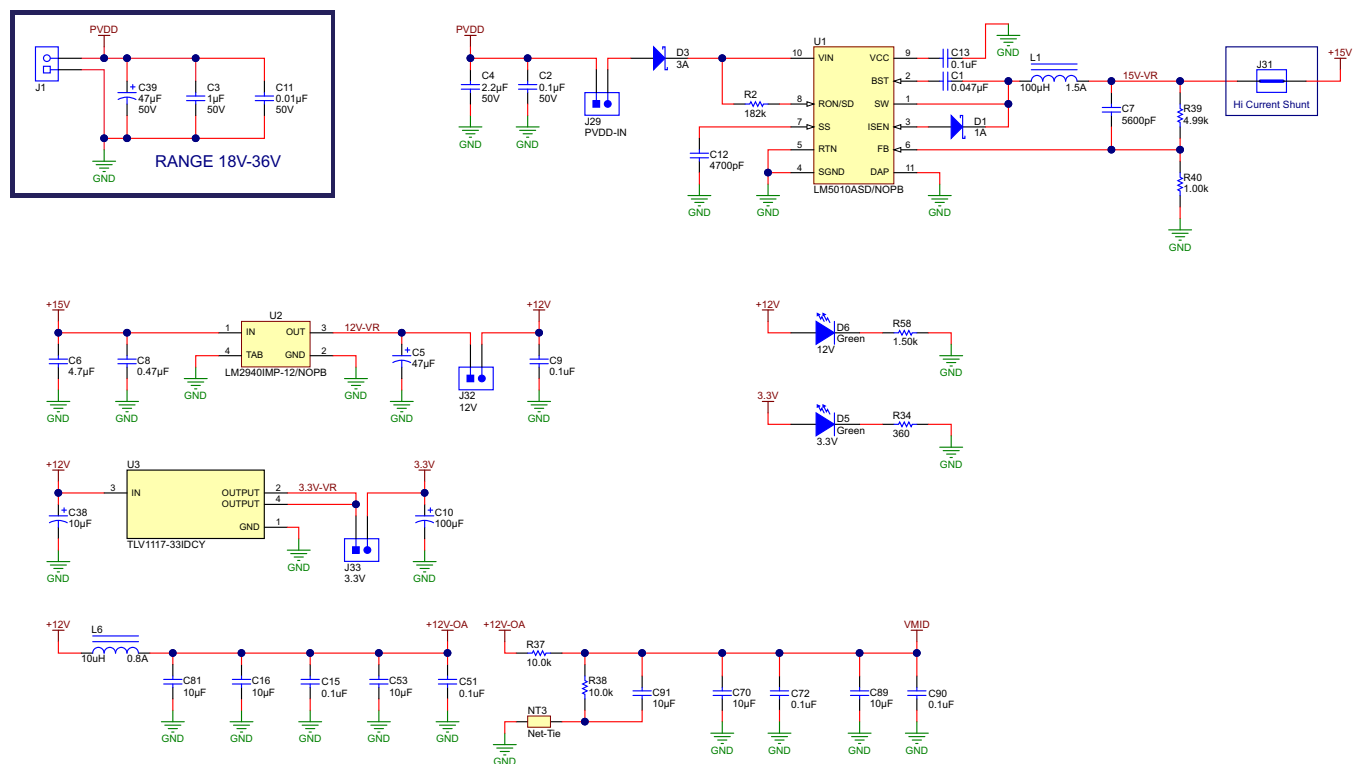


Figure 30. TPA3251EVM Schematic 3

## 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 $\mu$ F, 25 V, +/- 10%, X7R, 0402                   | 0402                            | GRM155R71E473KA88 D  | MuRata                      |
| C2, C9, C13, C15, C51, C68, C72, C90 | 8        | 0.1uF   | CAP, CERM, 0.1 $\mu$ F, 50 V, +/- 10%, X7R, 0603                     | 0603                            | C0603C104K5RACTU     | Kemet                       |
| C3                                   | 1        | 1uF     | CAP, CERM, 1 $\mu$ F, 50 V, +/- 10%, X7R, 0603                       | 0603                            | UMK107AB7105KA-T     | Taiyo Yuden                 |
| C4                                   | 1        | 2.2uF   | CAP, CERM, 2.2 $\mu$ F, 50 V, +/- 10%, X7R, 0805                     | 0805                            | C2012X7R1H225K125A C | TDK                         |
| C5                                   | 1        | 47uF    | CAP, AL, 47 $\mu$ F, 16 V, +/- 20%, 0.36 ohm, SMD                    | SMT Radial D                    | EEE-FK1C470P         | Panasonic                   |
| C6                                   | 1        | 4.7uF   | CAP, CERM, 4.7 $\mu$ F, 25 V, +/- 10%, X7R, 1206                     | 1206                            | GRM31CR71E475KA88 L  | MuRata                      |
| C7                                   | 1        | 5600pF  | CAP, CERM, 5600 pF, 50 V, +/- 10%, X7R, 0603                         | 0603                            | GRM188R71H562KA01 D  | MuRata                      |
| C8, C50                              | 2        | 0.47uF  | CAP, CERM, 0.47 $\mu$ F, 25 V, +/- 10%, X7R, 0603                    | 0603                            | GRM188R71E474KA12 D  | MuRata                      |
| C10                                  | 1        | 100uF   | CAP, AL, 100 $\mu$ F, 6.3 V, +/- 20%, 0.7 ohm, SMD                   | SMT Radial C                    | EEE-FK0J101UR        | Panasonic                   |
| C11                                  | 1        | 0.01uF  | CAP, CERM, 0.01 $\mu$ F, 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 $\mu$ F, 16 V, +/- 10%, X5R, 0805                      | 0805                            | EMK212BJ106KG-T      | Taiyo Yuden                 |
| C17, C28, C55, C63                   | 4        | 10uF    | CAP, CERM, 10 $\mu$ F, 16 V, +/- 10%, X7R, 1206                      | 1206                            | GRM31CR71C106KAC 7L  | MuRata                      |
| C18, C23, C57, C65                   | 4        | 22pF    | CAP, CERM, 22 pF, 50 V, +/- 5%, C0G/NP0, 0603                        | 0603                            | GRM1885C1H220JA01 D  | MuRata                      |
| C19, C30, C58, C64                   | 4        | 100pF   | CAP, CERM, 100 pF, 50 V, +/- 5%, C0G/NP0, 0603                       | 0603                            | GRM1885C1H101JA01 D  | MuRata                      |
| C20, C38, C62, C66, C71              | 5        | 10uF    | CAP, AL, 10 $\mu$ F, 16 V, +/- 20%, 1.35 ohm, SMD                    | SMT Radial B                    | EEE-FK1C100R         | Panasonic                   |
| C21, C34, C42, C56                   | 4        | 1500uF  | CAP, AL, 1500 $\mu$ F, 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 $\mu$ F, 250 V, +/- 5%, TH                           | 18x9x17.5mm                     | B32652A3684J         | EPCOS Inc                   |
| C27, C29, C52, C54                   | 4        | 0.033uF | CAP, CERM, 0.033 $\mu$ F, 50 V, +/- 10%, X7R, 0603                   | 0603                            | GRM188R71H333KA61 D  | MuRata                      |
| C31, C46                             | 2        | 2200uF  | CAP, AL, 2200 $\mu$ F, 50 V, +/- 20%, 0.023 ohm, TH                  | Dia 18mm                        | EEU-FC1H222          | Panasonic                   |
| C32, C33, C47, C48, C83, C84         | 6        | 1uF     | CAP, CERM, 1 $\mu$ F, 50 V, +/- 10%, X7R, 1206                       | 1206                            | GRM31MR71H105KA88 L  | MuRata                      |
| C39                                  | 1        | 47uF    | CAP, AL, 47 $\mu$ F, 50 V, +/- 20%, 0.68 ohm, SMD                    | SMT Radial E                    | EEE-FK1H470P         | Panasonic                   |
| C40, C41                             | 2        | 1uF     | CAP, CERM, 1 $\mu$ F, 16 V, +/- 10%, X7R, 0603                       | 0603                            | GRM188R71C105KA12 D  | MuRata                      |
| C49                                  | 1        | 0.01uF  | CAP, CERM, 0.01 $\mu$ F, 50 V, +/- 10%, X7R, 0603                    | 0603                            | GRM188R71H103KA01 D  | 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-TI0P-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 $\mu$ H, 1.5 A, 0.165 ohm, SMD | SMD                                          | 7447714101       | Würth Elektronik            |
| L2, L3, L4, L5                                                                                    | 4        | 7uH   | Inductor, Toroid, Powdered Iron, 7 $\mu$ H, 6.5 A, 0.0215 ohm, TH         | 28.6x12.3mm                                  | MA5173-AE        | Coilcraft                   |
| L6                                                                                                | 1        | 10uH  | Inductor, Wirewound, 10 $\mu$ H, 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                                         | CRCW0402100KFKEA | 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 uF, 50 V, +/- 10%, X7R, 1206                                                                    | 1206                                         | GRM31MR71H105KA88L | MuRata                      |
| C85, C86                                                                  | 0        | 1uF    | CAP, CERM, 1 uF, 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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