

## **TPA3128D2 Evaluation Module**

This user's guide describes the operation of the TPA3128D2EVM. The document also provides design information such as schematic, BOM, and PCB layout.

### **Contents**

1	Hardware Overview.....	2
2	Operation .....	3
2.1	Electrostatic Discharge Warning.....	3
2.2	Unpacking the EVM .....	3
2.3	Power Supply Setup.....	3
2.4	Evaluation Module Preparations.....	3
2.5	Inputs and Outputs .....	4
2.6	Power Up .....	4
2.7	Recommended Settings .....	4
2.8	Separate PVCC/AVCC Supply Support .....	5
3	Board Layouts, Bill of Materials, and Schematic .....	6
3.1	TPA3128D2EVM Board Layouts .....	6
3.2	Bill of Materials .....	7
3.3	TPA3128D2EVM Schematic .....	9

### **List of Figures**

1	TPA3128D2EVM Board.....	2
2	TPA3128D2EVM Top Overlay .....	6
3	TPA3128D2EVM Bottom Overlay .....	6
4	TPA3128D2EVM Schematic .....	9

### **List of Tables**

1	TPA3128D2EVM Specification.....	2
2	Power Requirements .....	3
3	TPA3128D2EVM Setting 1 .....	4
4	TPA3128D2EVM Setting 2 .....	4
5	TPA3128D2EVM Setting 3 .....	5
6	TPA3128D2EVM Parts List.....	7

### **Trademarks**

All trademarks are the property of their respective owners.

## 1 Hardware Overview

The TPA3128D2 EVM customer evaluation module demonstrates the TPA3128D2 integrated circuit from Texas Instruments (TI). The TPA3128D2 is a 30-W (per channel), efficient stereo digital amplifier power stage for driving 2 bridge-tied speakers or a single parallel bridge-tied load. This document covers EVM specifications and design documentation.

Figure 1 illustrates the EVM board. Table 1 lists EVM specifications.

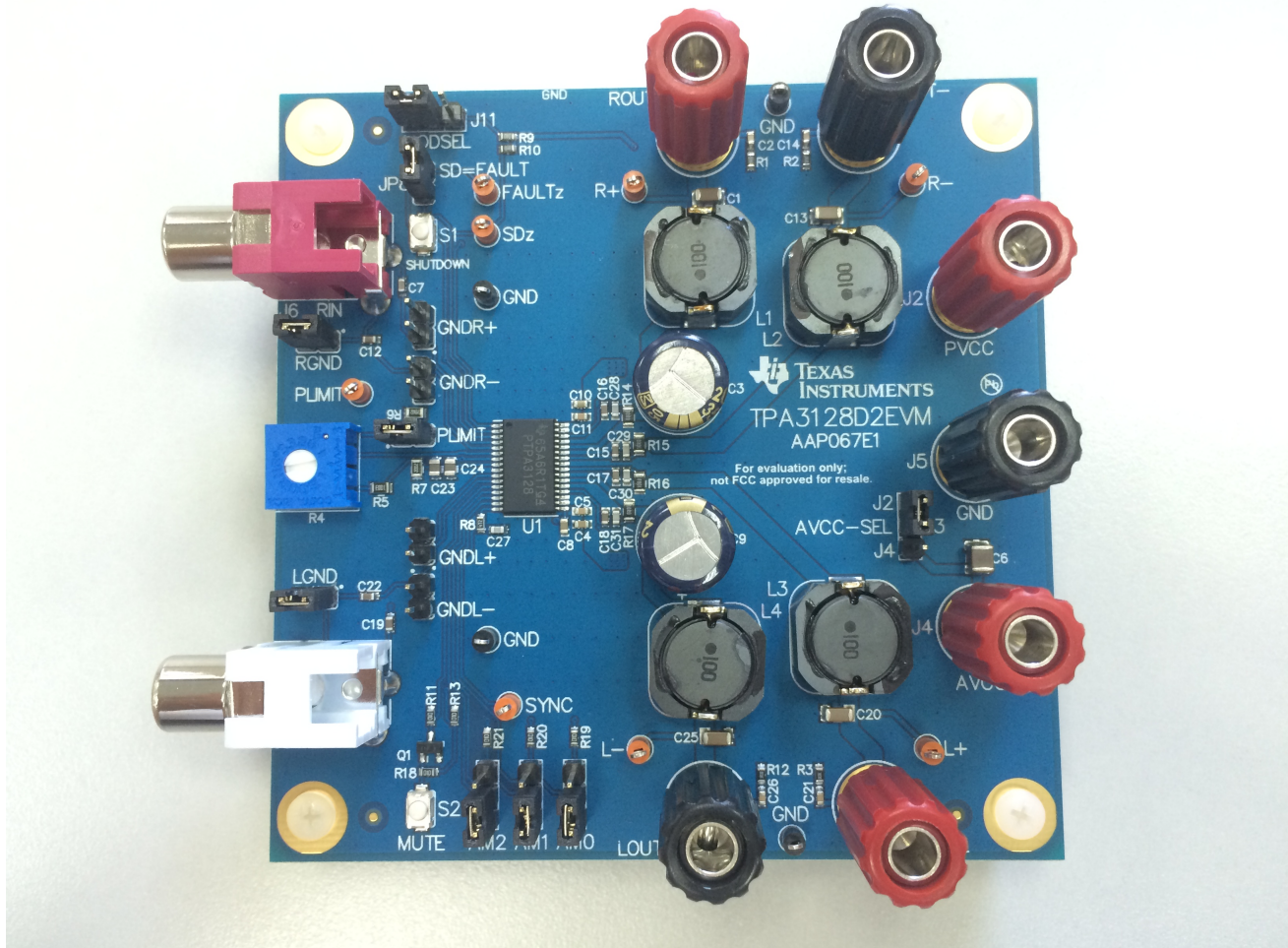


Figure 1. TPA3128D2EVM Board

Table 1. TPA3128D2EVM Specification

Key Parameters	Value
Power supply voltage	4.5 V to 26 V
Number of channels	2 bridge-tied load (BTL) Stereo
Load impedance	3.2 $\Omega$ to 8 $\Omega$
Output power BTL	30 W per channel
Output power PBTL	60 W

## 2 Operation

This section describes the TPA3128D2EVM board in regards to the power supply and system interfaces. Information regarding handling and unpacking, absolute operating conditions, and a description of the factory default switch and jumper configurations is provided.

The following is a step-by-step guide to configuring the TPA3128D2EVM for device evaluation:

### 2.1 Electrostatic Discharge Warning

Many of the components on the TPA3128D2EVM are susceptible to damage by electrostatic discharge

#### CAUTION

Failure to observe ESD handling procedures may result in damage to EVM components.

### 2.2 Unpacking the EVM

On opening the TPA3128D2EVM package, ensure that the following items are included:

1 piece TPA3128D2EVM board using one TPA3128D2 device

If the EVM board is missing, contact the Texas Instruments *Product Information Center* nearest you to inquire about a replacement.

### 2.3 Power Supply Setup

A single power supply or separate PVCC/AVCC is required to power up the EVM. Since most of the pins are PVCC compliant, the PVCC supply can also be used to power the analog supply (AVCC) and to pull up the logic pins for shutdown (SD) control, and fault detection (FAULT).

**Table 2. Power Requirements**

Description	Voltage Range	Current Requirement	Minimum Wire Size
PVCC/AVCC	4.5 to 26 V	8 A	24 AWG

#### CAUTION

Applying voltages above the limitations given in [Table 2](#) may cause permanent damage to your hardware.

### 2.4 Evaluation Module Preparations

Prepare the EVM using the following steps:

1. Ensure that the external power source is set to OFF.
2. Connect the external regulated power supply adjusted from 4.5 V to 26 V to the module PVCC and GND banana jacks taking care to observe marked polarity.

## 2.5 Inputs and Outputs

Make the following input and output connections:

1. Connect audio inputs, either differential or single-ended, to the LIN and RIN RCA phono plugs Stereo output operation. To enable the individual channel shutdown feature, tie RINP and RINN directly to GND (without capacitors) and OUTPL and OUTNL should be working normally in BTL configuration. For PBTL operation, apply a single input, differential or single-ended, to the RIN RCA phono plug and tie LINP and LINN directly to GND (without capacitors).
2. For a BTL configuration, connect a load across the outputs (OUTL+ and OUTL–) and (OUTR+ and OUTR–). For PBTL configuration, connect a single load from one of the left speaker jacks to one of the right speaker jacks, depending on how the filters are loaded.

## 2.6 Power Up

When powering up the EVM, use the following steps:

1. Verify the correct voltage and input polarity and turn the external power supplies ON. The EVM should begin operation.
2. Adjust the audio source for the correct volume.

## 2.7 Recommended Settings

This section contains the recommended settings for stereo, single-channel, and mono output.

[Table 3](#) lists the settings for a single-ended input with auto recovery, Plimit, and BTL (stereo output).

**Table 3. TPA3128D2EVM Setting 1**

Setting	Description
J6 (RIN)	R channel audio input
J9 (LIN)	L channel audio input
JP1 (GNDR+) and JP3 (GNDR–), Open	R channel on
JP4 (GNDL+) and JP6 (GNDL–), Open	L channel on
JP2 (RGND), Installed	Single-ended input (R channel)
JP5 (LGND), Installed	Single-ended input (L channel)
JP7, Installed	Set PLIMIT
R4	Change PLIMIT voltage value
JP8 ( $\overline{SD} = \text{FAULT}$ ), Installed	Auto-recovery mode
J11 (MODESEL = L)	Low idle-loss mode

[Table 4](#) lists the settings for a single-ended input with auto recovery, Plimit, and BTL (single-channel output).

**Table 4. TPA3128D2EVM Setting 2**

Setting	Description
J6 (RIN)	No audio input
J9 (LIN)	L channel audio input
JP1 (GNDR+) and JP3 (GNDR–), Installed	R channel off
JP4 (GNDL+) and JP6 (GNDL–), Open	L channel on
JP5 (LGND), Installed	Single-ended input (L channel)
JP7, Installed	Set PLIMIT
R4	Change PLIMIT voltage value
JP8 ( $\overline{SD} = \text{FAULT}$ ), Installed	Auto-recovery mode
J11 (MODESEL = L)	Low idle-loss mode

Table 5 lists the settings for a single-ended input with auto recovery, Plimit, and PBTL (mono output).

**Table 5. TPA3128D2EVM Setting 3**

Setting	Description
J6 (RIN)	R channel audio input
J9 (LIN)	No audio input
JP1 (GNDR+) and JP3 (GNDR-), Open	R channel on
JP4 (GNDL+) and JP6 (GNDL-), Installed	L channel off, PBTL mode
JP2, Installed	Single-ended input (R channel)
JP7, Installed	Set PLIMIT
R4	Change PLIMIT voltage value
JP8 ( $\overline{SD} = \text{FAULT}$ ), Installed	Auto-recovery mode
J11 (MODESEL = L)	Low idle-loss mode

## 2.8 Separate PVCC/AVCC Supply Support

By supplying a voltage of AVCC which is lower than PVCC (for example, PVCC = 24 V and AVCC = 12 V), the power dissipation on the internal LDO is reduced. This gives customers the flexibility to choose between extreme low-idle current mode (J3, 1 and 2 set to Short, with separate AVCC) and single power supply mode (J3, 2 and 3 set to Short, AVCC = PVCC).

### 3 Board Layouts, Bill of Materials, and Schematic

#### 3.1 TPA3128D2EVM Board Layouts

Figure 2 and Figure 3 illustrate the board layouts for the EVM.

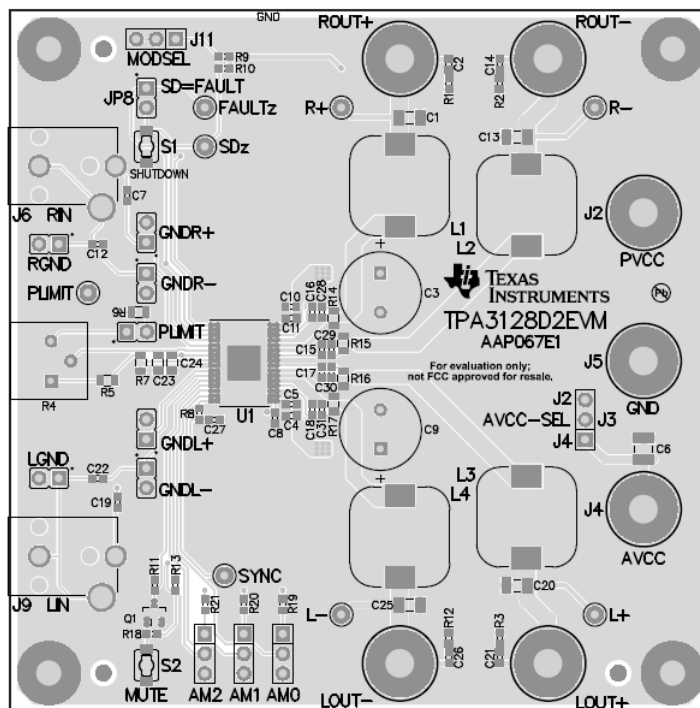


Figure 2. TPA3128D2EVM Top Overlay

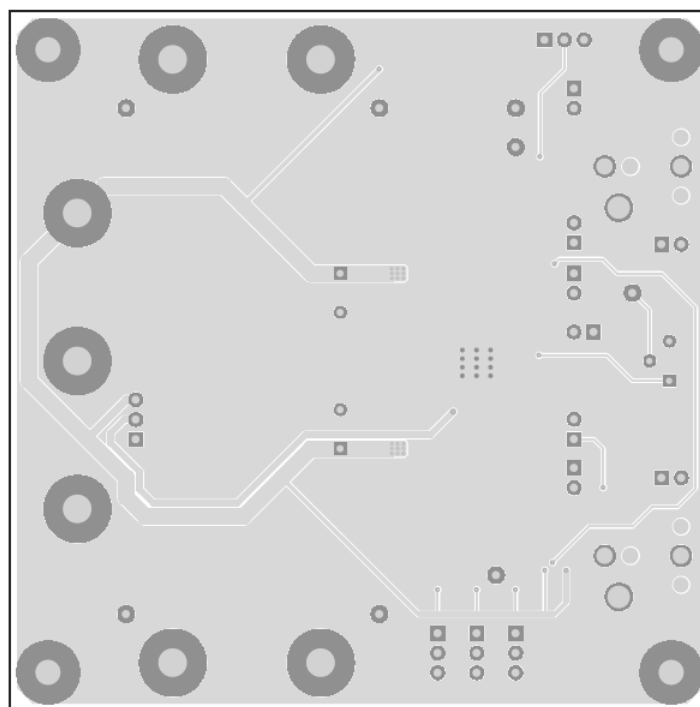


Figure 3. TPA3128D2EVM Bottom Overlay

## 3.2 Bill of Materials

Table 6 displays the BOM for this EVM.

**Table 6. TPA3128D2EVM Parts List**

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
!PCB1	1		Printed Circuit Board		AAP067	Any	-	-
C1, C13, C20, C25	4	0.68uF	CAP, CERM, 0.68 $\mu$ F, 50 V, +/- 10%, X7R, 1206	1206	GRM31MR71H684KA88L	Murata		
C2, C14, C21, C26	4	0.01uF	CAP, CERM, 0.01 $\mu$ F, 50 V, +/- 10%, X7R, 0603	0603	GRM188R71H103KA01D	Murata		
C3, C9	2	220uF	CAP, AL, 220 $\mu$ F, 35 V, +/- 20%, 0.09 ohm, TH	10x12.5mm	EEU-FC1V221	Panasonic		
C4, C10	2	0.1uF	CAP, CERM, 0.1 $\mu$ F, 50 V, +/- 10%, X7R, 0603	0603	GCM188R71H104KA57D	Murata		
C5, C11	2	1000pF	CAP, CERM, 1000 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C1H102JA01D	Murata		
C6	1	10uF	CAP, CERM, 10 $\mu$ F, 35 V, +/- 10%, X7R, 1210	1210	GRM32ER7YA106KA12L	Murata		
C7, C12, C19, C22	4	1uF	CAP, CERM, 1 $\mu$ F, 16 V, +/- 10%, X7R, 0603	0603	GRM188R71C105KA12D	Murata		
C8	1	1uF	CAP, CERM, 1 $\mu$ F, 30 V, +/- 10%, X7R, 0603	0603	C1608X7R1V105K080AC	TDK		
C15, C16, C17, C18	4	0.22uF	CAP, CERM, 0.22 $\mu$ F, 25 V, +/- 10%, X7R, 0603	0603	GRM188R71E224KA88D	Murata		
C23, C24	2	1uF	CAP, CERM, 1 $\mu$ F, 16 V, +/- 10%, X7R, 0805	0805	C0805C105K4RACTU	Kemet		
C27	1	47pF	CAP, CERM, 47 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C1H470JA01D	Murata		
C28, C29, C30, C31	4	330pF	CAP, CERM, 330 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C1H331JA01D	Murata		
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply		
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone	-	-
J1, J2, J4, J8	4		Binding Post, RED, TH	11.4x27.2mm	7006	Keystone		
J3, J11, J12, J13, J14	5		Header, 100mil, 3x1, Gold, TH	PBC03SAA N	PBC03SAAN	Sullins Connector Solutions		
J5, J7, J10	3		Binding Post, BLACK, TH	11.4x27.2mm	7007	Keystone		
J6	1		RCA Jack, Red, R/A, TH	PC Mount Phono Jack-Red, TH	971	Keystone		
J9	1		RCA Jack, White, R/A, TH	PC Mount Phono Jack-White, TH	970	Keystone		
JP1, JP2, JP3, JP4, JP5, JP6, JP7, JP8	8		Header, 100mil, 2x1, Gold, TH	Sullins 100mil, 1x2, 230 mil above insulator	PBC02SAAN	Sullins Connector Solutions		
L1, L2, L3, L4	4	10uH	Inductor, Ferrite, 10 $\mu$ H, 4.4 A, 23 ohm, SMD	12.8x12.8mm	#B953AS-100M=P3	Murata Toko		
Q1	1	40 V	Transistor, NPN, 40 V, 0.6 A, SOT-23	SOT-23	MMBT2222ALT1G	ON Semiconductor		
R1, R2, R3, R12	4	3.3	RES, 3.3, 5%, 0.1 W, 0603	0603	CRCW06033R30JNEA	Vishay-Dale		



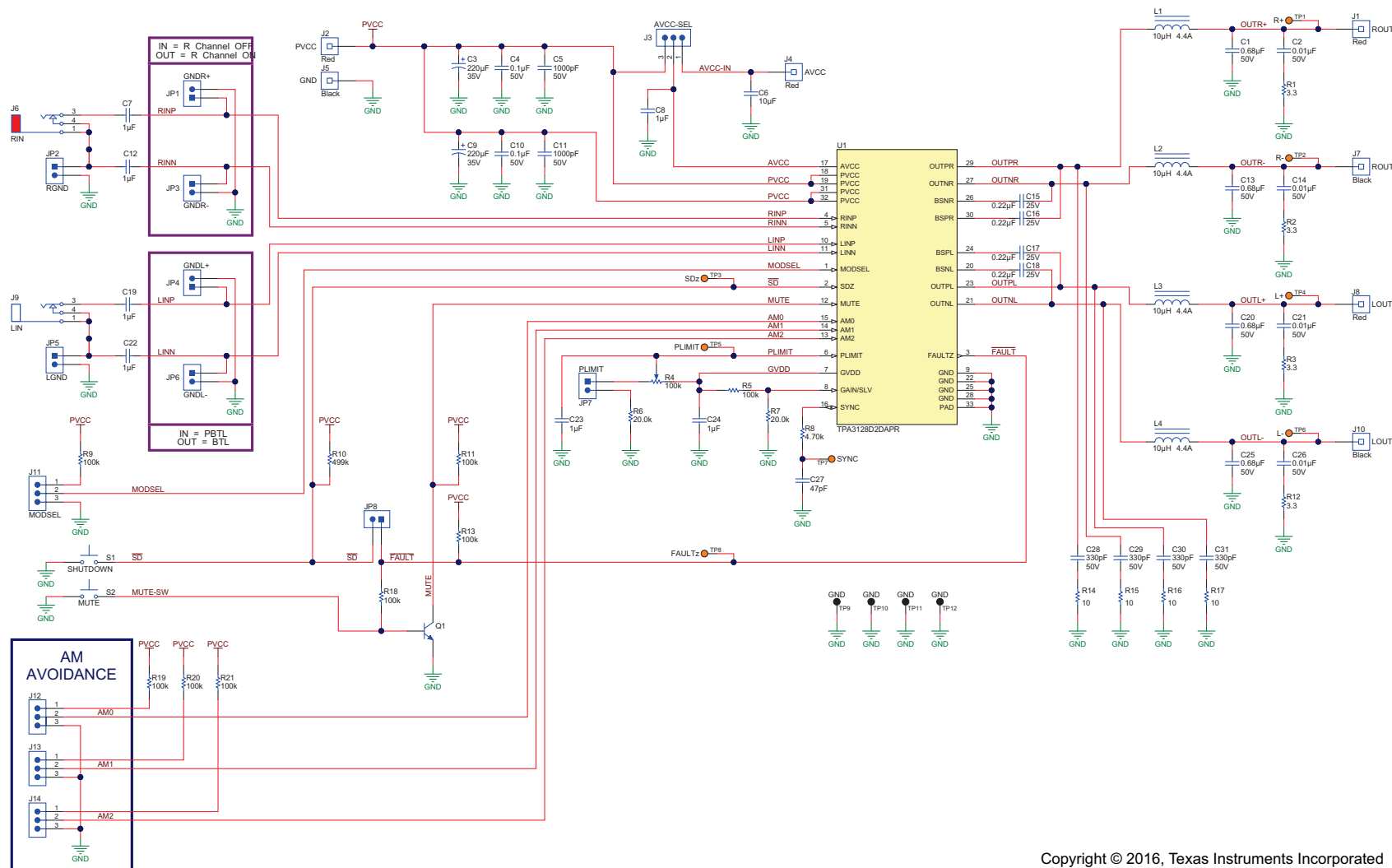
**Table 6. TPA3128D2EVM Parts List (continued)**

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
R4	1	100k	TRIMMER, 100k ohm, 0.5W, TH	375x190x37 5mil	3386P-1-104LF	Bourns		
R5	1	100k	RES, 100 k, 1%, 0.125 W, 0805	0805	CRCW0805100KFKEA	Vishay-Dale		
R6, R7	2	20.0k	RES, 20.0 k, 1%, 0.125 W, 0805	0805	CRCW080520K0FKEA	Vishay-Dale		
R8	1	4.70k	RES, 4.70 k, 0.1%, 0.1 W, 0603	0603	RG1608P-472-B-T5	Susumu Co Ltd		
R9, R11, R13, R18, R19, R20, R21	7	100k	RES, 100k ohm, 1%, 0.1W, 0603	0603	RC0603FR-07100KL	Yageo America		
R10	1	499k	RES, 499 k, 1%, 0.1 W, 0603	0603	RC0603FR-07499KL	Yageo America		
R14, R15, R16, R17	4	10	RES, 10, 5%, 0.125 W, 0805	0805	CRCW080510R0JNEA	Vishay-Dale		
S1, S2	2		Switch, Tactile, SPST-NO, 0.05A, 12V, SMT	Switch, 4.4x2x2.9 mm	TL1015AF160QG	E-Switch		
SH1, SH2, SH3, SH4, SH5, SH6, SH7, SH8, SH9	9	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M	SNT-100-BK-G	Samtec
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8	8	Orange	Test Point, Miniature, Orange, TH	Orange Miniature Testpoint	5003	Keystone		
TP9, TP10, TP11, TP12	4		Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone		
U1	1		TPA3128D2, DAP0032A	DAP0032A	TPA3128D2DAPR	Texas Instruments		Texas Instruments
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A		
Notes:			Unless otherwise noted in the Alternate Part Number and/or Alternate Manufacturer columns, all parts may be substituted with equivalents.					



### 3.3 TPA3128D2EVM Schematic

Figure 4 illustrates the schematics for the TPA3128D2EVM.



Copyright © 2016, Texas Instruments Incorporated

Figure 4. TPA3128D2EVM Schematic

## STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.

- 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms and conditions that accompany such Software
- 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

- 2 *Limited Warranty and Related Remedies/Disclaimers:*

- 2.1 These terms and conditions do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
- 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for any defects that are caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.
- 2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

- 3 *Regulatory Notices:*

- 3.1 *United States*

- 3.1.1 *Notice applicable to EVMs not FCC-Approved:*

This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

- 3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

### CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### FCC Interference Statement for Class A EVM devices

*NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.*

## FCC Interference Statement for Class B EVM devices

*NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:*

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

## 3.2 Canada

### 3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210

#### Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

#### Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

#### Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

#### Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

## 3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see [http://www.tij.co.jp/llds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/llds/ti_ja/general/eStore/notice_01.page) 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。  
[http://www.tij.co.jp/llds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/llds/ti_ja/general/eStore/notice_01.page)

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。日本テキサス・インスツルメンツ株式会社  
東京都新宿区西新宿 6 丁目 2 4 番 1 号  
西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see [http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_02.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page)  
電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。 [http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_02.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page)

#### 4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

#### 4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMS are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMS, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

- 6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY WRITTEN DESIGN MATERIALS PROVIDED WITH THE EVM (AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.
- 6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS AND CONDITIONS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT MADE, CONCEIVED OR ACQUIRED PRIOR TO OR AFTER DELIVERY OF THE EVM.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS AND CONDITIONS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

- 8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS AND CONDITIONS OR THE USE OF THE EVMS PROVIDED HEREUNDER, REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN ONE YEAR AFTER THE RELATED CAUSE OF ACTION HAS OCCURRED.
- 8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY WARRANTY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS AND CONDITIONS, OR ANY USE OF ANY TI EVM PROVIDED HEREUNDER, EXCEED THE TOTAL AMOUNT PAID TO TI FOR THE PARTICULAR UNITS SOLD UNDER THESE TERMS AND CONDITIONS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM AGAINST THE PARTICULAR UNITS SOLD TO USER UNDER THESE TERMS AND CONDITIONS SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2016, Texas Instruments Incorporated

## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you fully indemnify TI and its representatives against any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#), [TI's General Quality Guidelines](#), or other applicable terms available either on [ti.com](#) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products. Unless TI explicitly designates a product as custom or customer-specified, TI products are standard, catalog, general purpose devices.

TI objects to and rejects any additional or different terms you may propose.

Copyright © 2026, Texas Instruments Incorporated

Last updated 10/2025