

TPA6130A2EVM

This user's guide describes the function, installation, and operation of the TPA6130A2EVM. Also included are the schematic diagrams, printed-circuit board (PCB) layouts, and the bill of materials (BOM).

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1 Introduction

1.1 Description

The TPA6130A2 is a stereo, capacitor-free headphone driver with I²C digital volume control. The TPA6130A2 has minimal quiescent current consumption, a flexible, 64-step, audio tapered volume control and channel independent enables and mutes.

1.2 TPA6130A2EVM Specifications

VDD	Supply voltage range	–0.3 V to 5.5 V
IDD	Supply current	0.5 A Maximum
PO	Continuous output power per channel, 16 Ω, VDD = 5 V, THD + N = 1%	138 mW
RL	Minimum load impedance	16 Ω

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2 Operation

The TPA6130A2EVM can be evaluated in a stand-alone mode or when connected to existing circuits with I²C controls.

2.1 Quick Start List for Stand-Alone Operation

A desktop or laptop with Microsoft® Windows® 7 installed is required in the stand-alone operation. Connect the EVM to a computer with a USB cable, not supplied with the EVM. A jumper allows the TPA6130A2 to receive power from either the USB or an external supply via banana plugs. The inputs accept standard RCA plugs. The output connection accepts standard 3.5-mm headphone plugs.

2.1.1 Software Installation Sequence

Install the TPA6130A2 EVM software with the following steps:

1. Download the software from the TPA6130A2 EVM webpage (<http://www.ti.com/tool/tpa6130a2evm>)
2. Unzip the files to a temporary folder.
3. Install TPA6130A2 software by executing setup.exe, located in *TPA6130A2 Interface\Volume*.

Accept license agreement and defaults, and complete the installation. Note: you can uninstall later with *Add/Remove Programs*. **It is unnecessary to repeat the steps in section 2.1.1, once the software is installed.**

2.1.2 Evaluation Module Preparations

Prepare the EVM with the following steps:

1. Install a shunt in jumper JP4; this sets the EEPROM in the EVM to the nonprogrammable mode.
2. Install shunts in jumpers JP5 and JP6. When single-ended audio inputs are used; this ties LINN and RINN to ground.
3. Install shunts in JP2 and JP3 as [Figure 1](#) illustrates. This sets the TPA6130A2 to accept I²C inputs from the EVM itself.

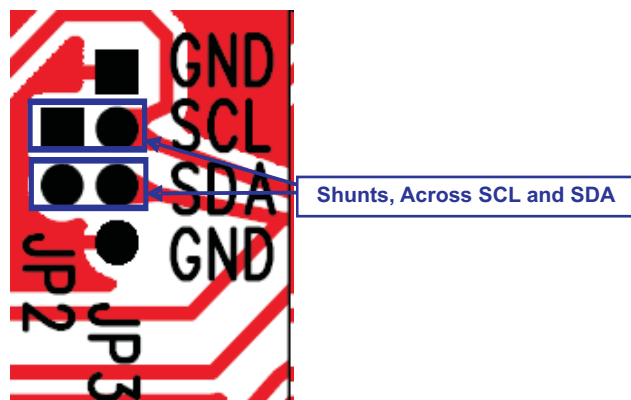


Figure 1. Place Shunts Horizontally Across SCL and SDA

4. TPA6130A2 can be powered either from the USB or with an external power supply.
 - (a) To power TPA6130A2 from the USB, place shunt in JP1 as shown in [Figure 2](#).



Figure 2. Shunts Across JP1 Powered From USB

(b) To power TPA6130A2 from external power sources, place a shunt in JP1 as Figure 3 illustrates.



Figure 3. Shunts Across JP1 Powered With an External Power Supply

Ensure that all external power sources are set to OFF.

Connect an external regulated power supply adjusted from 2.5 V–6 V to the module VDD (**J8**) and GND (**J7**) banana jacks, taking care to observe marked polarity.

5. Connect audio source to J4 and J3.
6. Connect headphones to J2.
7. If this is the first time you plug in a TPA6130A2EVM after installing the software, follow this set of Windows dialog, questions, and selections:
 - Can Windows connect to Windows Update to search for software?
No, not at this time → Click *Next*
 - What do you want the wizard to do?
Install from a list or specific location (Advanced) → Click *Next*
 - Search the best drivers in these locations
Un-check *Search removable media*
Check *Include this location in the search:* → Click *Browse*
Browse to the software install path (default: C:\Program Files\Texas Instruments Inc\TPA6130A2 Interface)
→ Click *OK*
→ Click *Next*
→ Click *Finish*
8. Proceed through installation. **It is not necessary to repeat steps 8 to 11, once the driver is installed.**

2.1.3 Computer Connection Issues

Use the following steps if there are connection issues after connecting the EVM USB to the host computer:

1. Download the USB firmware from the TPA6130A2 EVM webpage (<http://www.ti.com/tool/tpa6130a2evm>).
2. Unzip the *USBfirmware_V0304* folder and save to a known location.
3. Open *Device Manager* from the *Control Panel* and find the unrecognized hardware.
4. Right click on the device and open *Properties*.
5. Under the *Driver* tab click the *Update Driver* button.
6. Browse to the *USBfirmware_V0304* folder and open *dfu_driver*.
7. If the device is still unrecognized, disconnect the EVM from the computer, remove the JP4 jumper from the EVM board, and reconnect to the host computer.
8. In *Device Manager* under *Universal Serial Bus Controllers*, this component should now display as *DFUUSB*.
9. Navigate back to the *USBfirmware_V0304* folder and run *DFUTEST.exe*.
10. In the DFUTEST window, click on the *Program EVM* button.
11. The program now opens a browser that should be navigating within the *image* folder inside the *USBfirmware_V0304* folder.
12. Click on *DFUEE.bin* once.
13. A screen should open stating, “Set EEPROM’s I2C Address to 1010000b”. Now insert JP4 jumper and click *Ok*.
14. After a few seconds *Download Complete* should display. Click *Ok*.

15. Follow the on-screen instructions.
16. A new browser window should automatically open in the same *image* folder.
17. Open *USB-miniEVM0304_441KHZ.bin* to program standard 44.1 kHz USB.
18. The previously viewed on-screen windows and instructions should display.
19. After *Programming Complete* is displayed, the EVM should now be displayed as *USB Audio Device* in *Device Manager* under the sound devices drop-down menu.
20. Run the GUI.

2.1.4 Using the Software

1. Start the TPA6130A2 Interface by clicking the *Start* menu and clicking on the *TPA6130A2 Interface* icon.

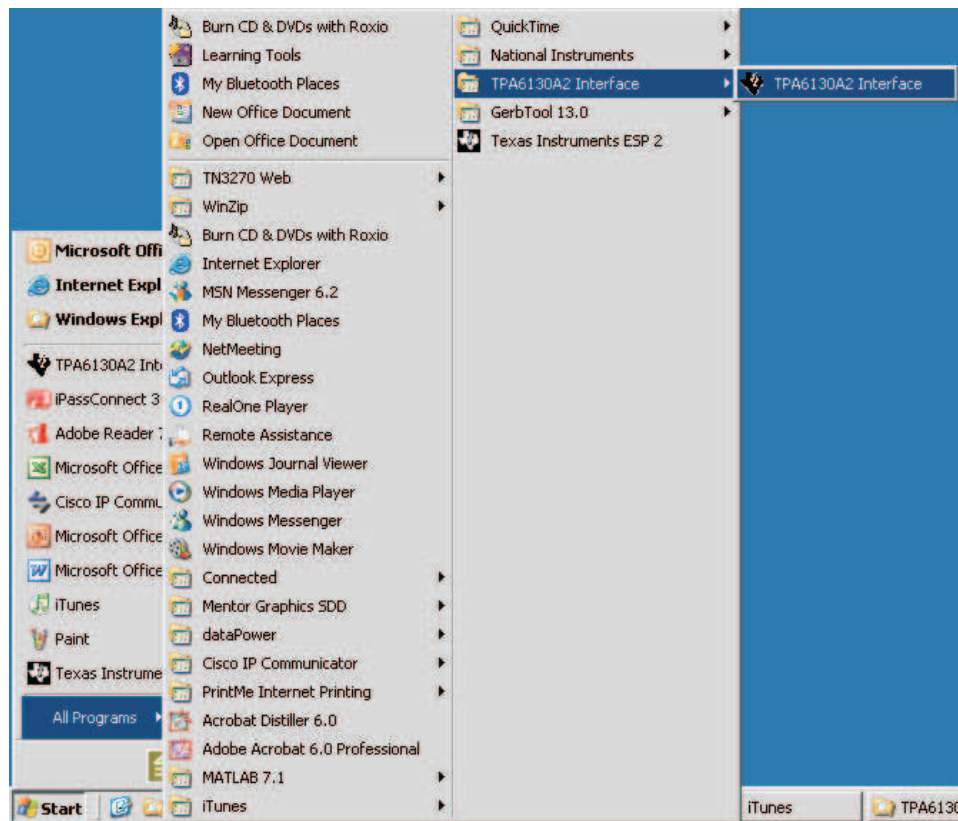


Figure 4. Starting the Software

- The TPA6130A2 software interface is as shown in Figure 5.

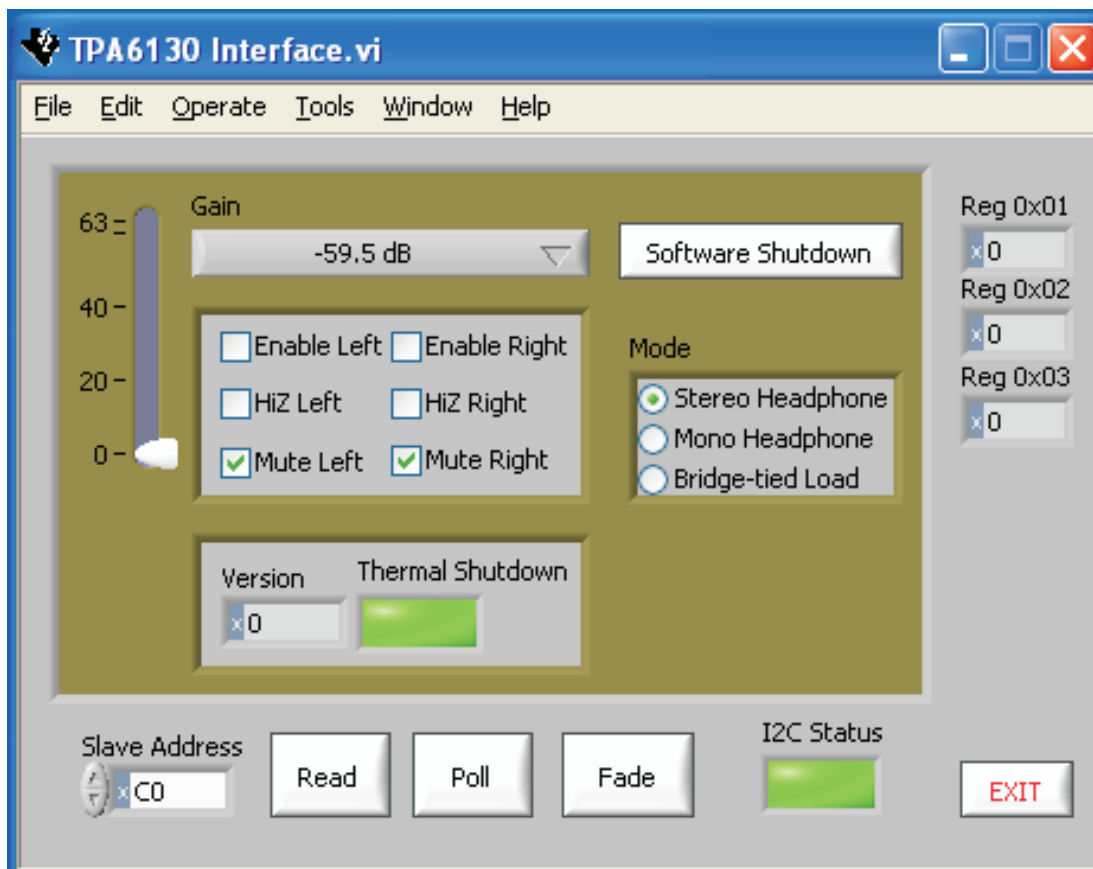


Figure 5. Software Interface

NOTE: The TPA6130A2 powers up with the amplifiers disabled, muted, and the gain set to the minimum. To hear an output, enable and unmute each channel, and set the gain to a higher level

- Follow these steps if the host PC running the TPA6130A2EVM GUI is also the music source.

When using Windows 7, if, after initially installing the software, the PC does not play music out of the headphone jack:

- Open the Control Panel.
 - Click on Sounds, Speech, and Audio Device Link under the Control Panel.
 - Click on Sounds and Audio Device Properties link.
 - Click on the Audio tab.
 - Verify that the Default device under sound playback is the audio driver of the PC HW, not the USBMODEVM TPA6130A2 GUI driver, otherwise the computer will try and send audio via USB, not the headphone output.
 - Change the driver in the menu to the PC Audio HW driver.
 - Click on OK.
- Uncheck and check *Enable Left* or *Enable Right* to place the corresponding channels in and out of SHUTDOWN.
 - Check and uncheck *Mute Left* or *Mute Right* to place the corresponding channels in and out of MUTE.
 - Click *Software Shutdown* to place the TPA6130A2 in and out of SHUTDOWN.

7. Select the correct mode of output under *Mode*.
8. Adjust the Volume or Gain of the TPA6130A2 by dragging the *Gain* bar or clicking on the *Gain* display and selecting from the drop-down menu.
9. *I2C Status* box reports the status of I²C communications. An error or failure has occurred if it turns red.
10. *Thermal* box reports the status of thermal failure. A thermal fault has occurred if it turns red.

2.2 Quick Start List When Connected to Existing Circuits With I²C Controls

The TPA6130A2EVM can be easily connected to existing circuits with I²C controls. Connections to the EVM module can be made using banana plugs for the power supply. The inputs accept standard RCA plugs. The output connection accepts standard 3.5-mm headphone plugs.

2.2.1 Evaluation Module Preparations

1. Install shunts in jumpers JP4, JP5, and JP6. Remove shunts in JP2 and JP3 and connect I²C controls to JP3 as shown in [Figure 6](#).

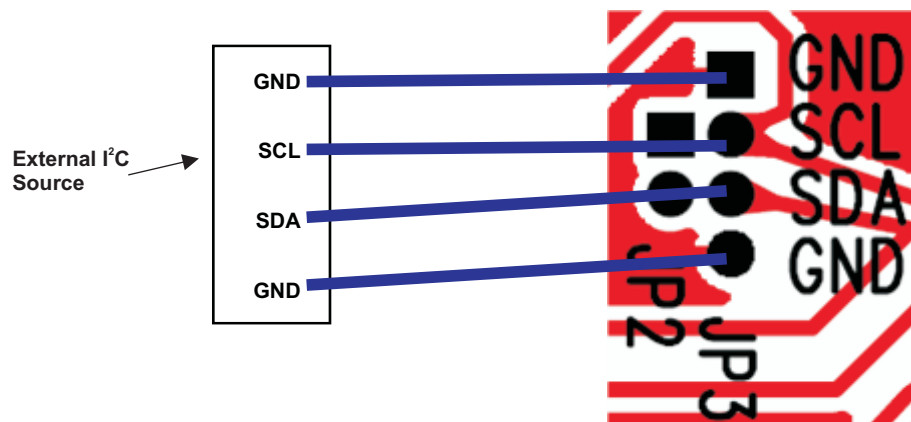


Figure 6. Connect I²C Controls to JP3

2. Power TPA6130A2 from external power sources; place a shunt in JP1 as shown in [Figure 7](#).



Figure 7. Shunts Across JP1 Powered With an External Power Supply

Ensure that all external power sources are set to OFF.

Connect an external regulated power supply adjusted from 2.5 V–6 V to the module VDD (**J8**) and GND (**J7**) banana jacks, taking care to observe marked polarity.

3. Connect audio source to J4 and J3.
4. Connect headphones to J2.
5. Set external power sources to ON. LED should illuminate.

3 TPA6130A2EVM Schematic

Figure 8 shows the TPA6130A2EVM schematic.

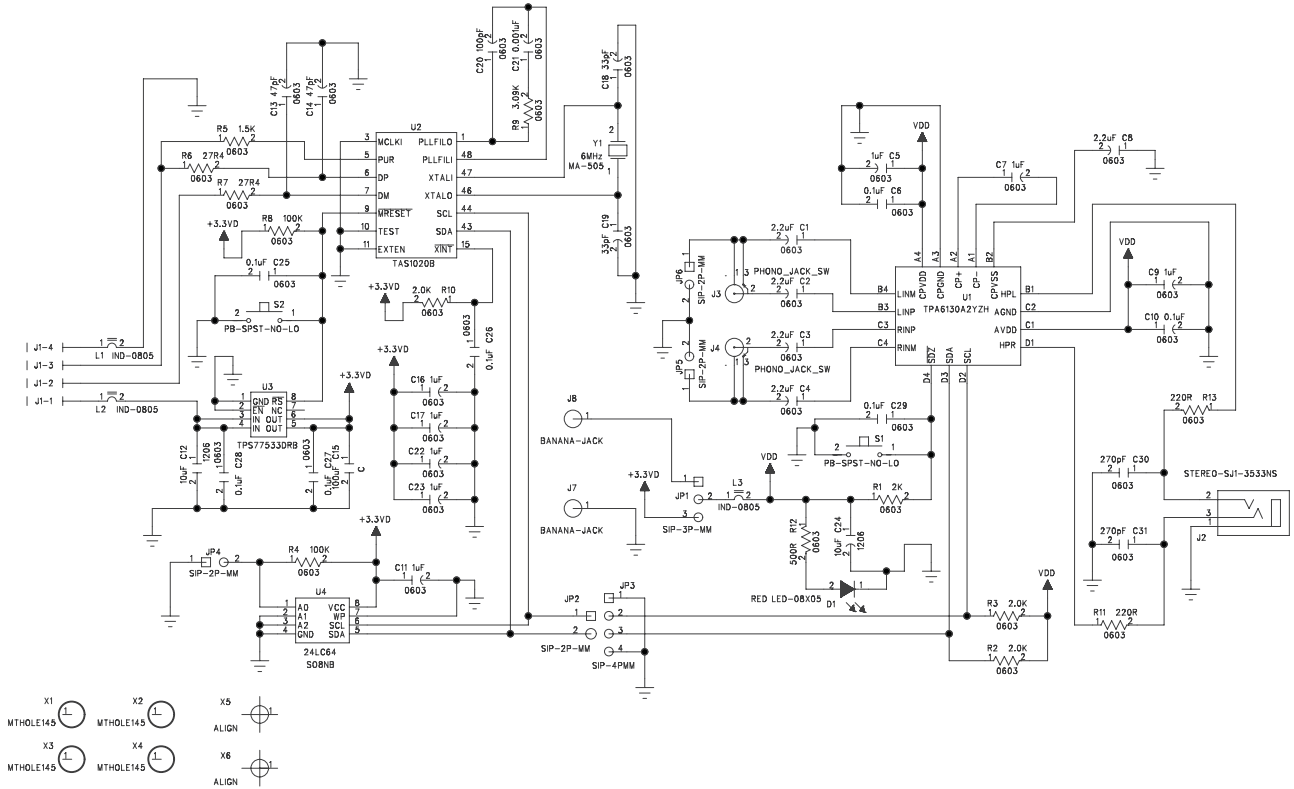


Figure 8. TPA6130A2EVM Schematic

4 TPA6130A2EVM PCB Layers

Figure 9 through Figure 12 illustrate the TPA6130A2EVM PCB layers.

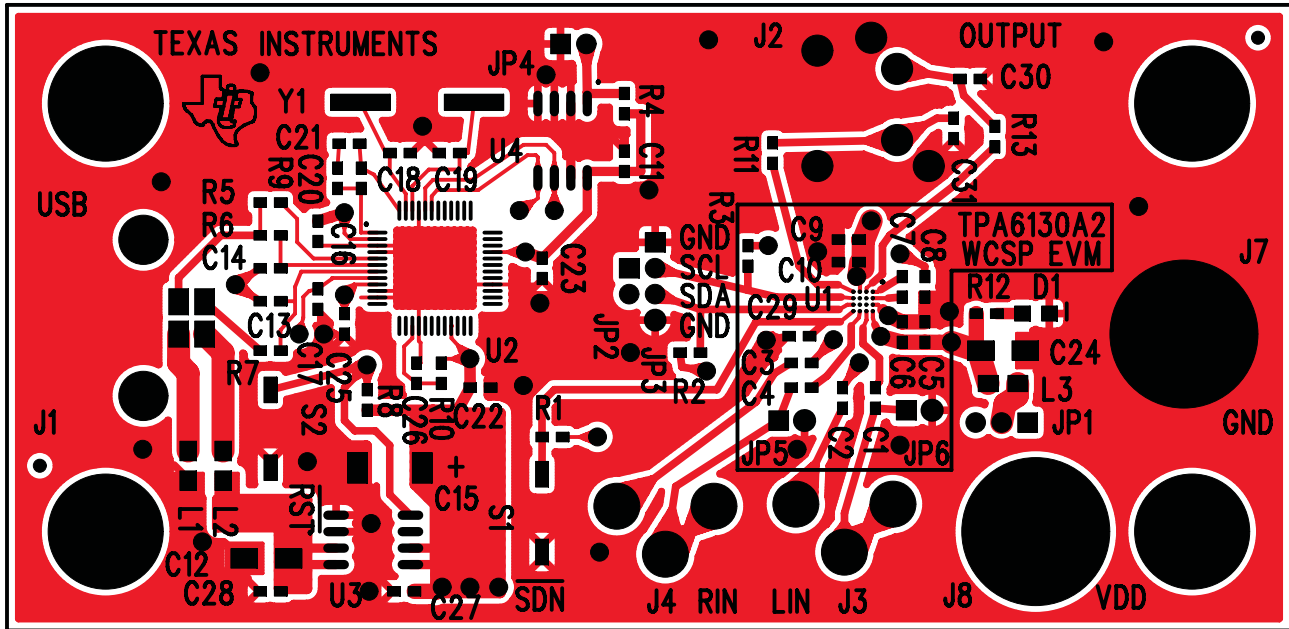


Figure 9. TPA6130A2EVM – Top Layer

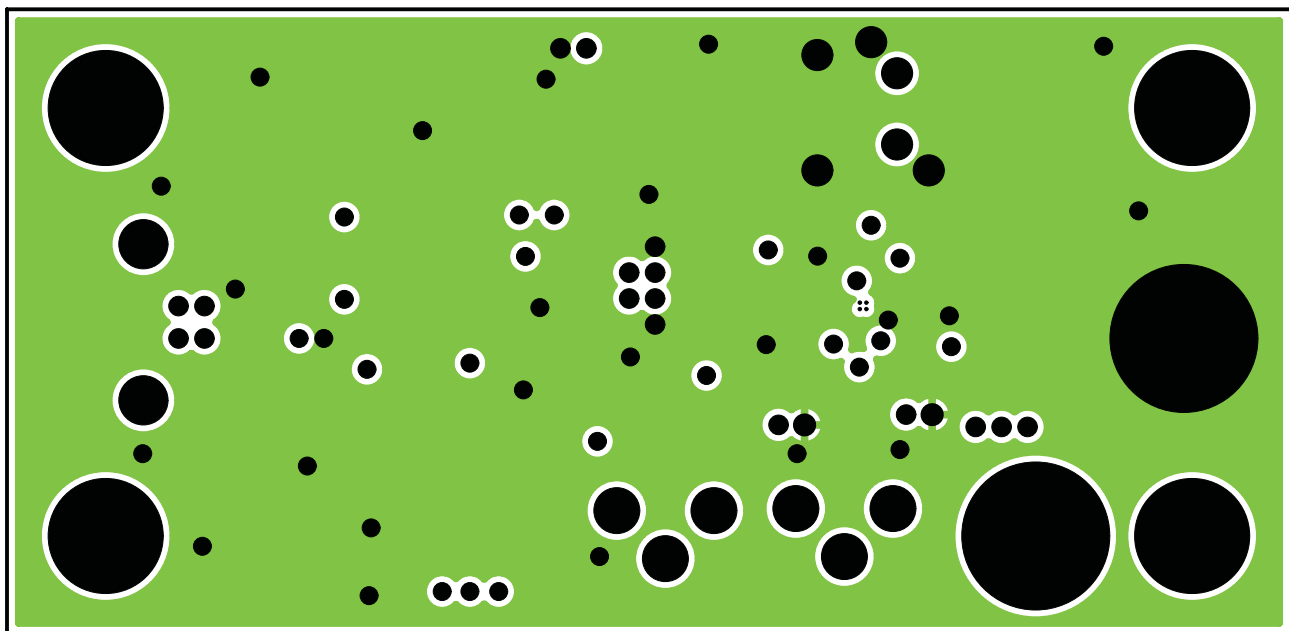


Figure 10. TPA6130A2EVM – Layer 2

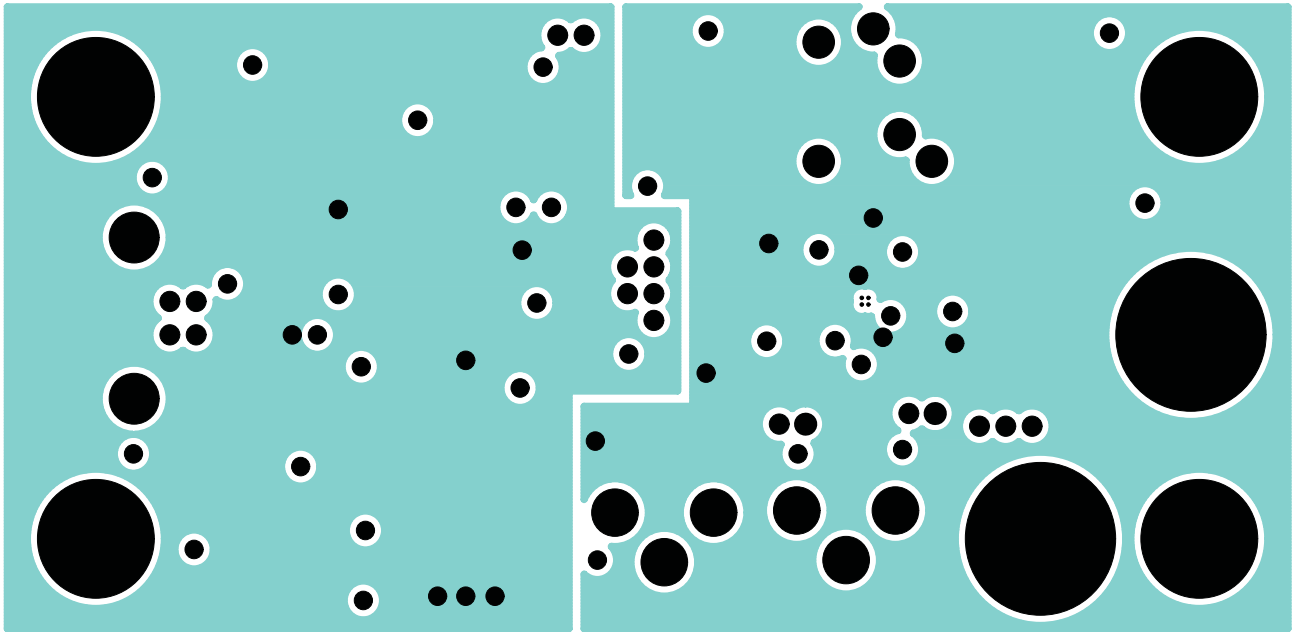


Figure 11. TPA6130A2EVM – Layer 3

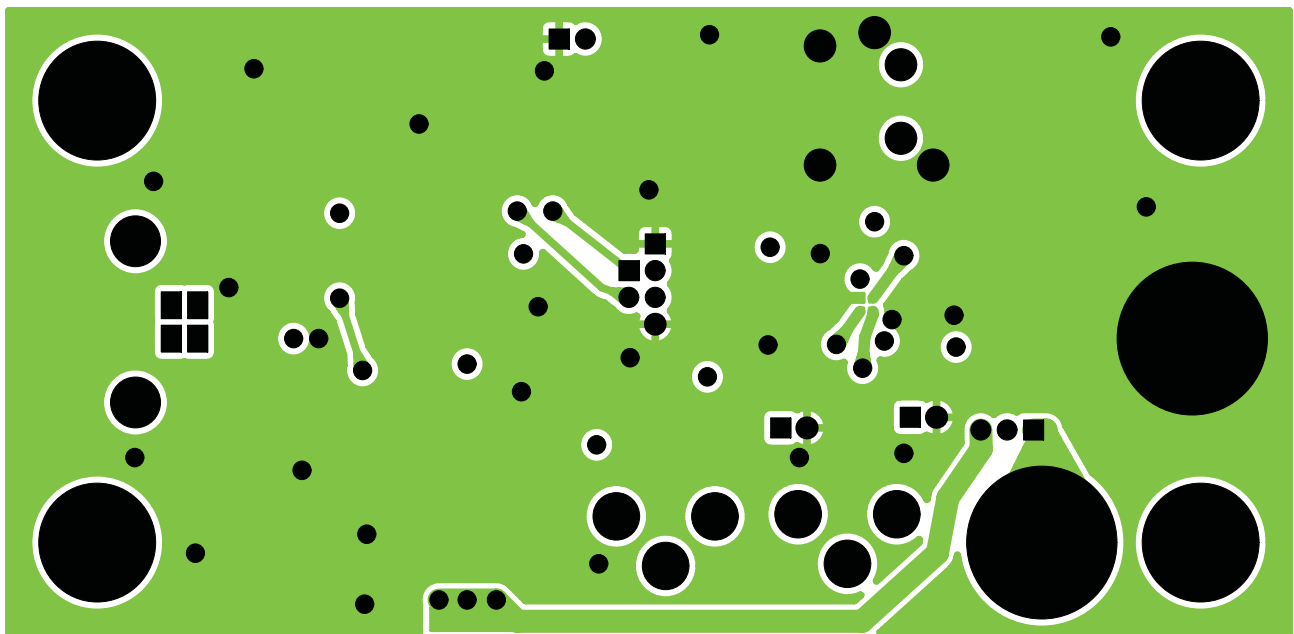


Figure 12. TPA6130A2EVM – Bottom Layer

5 TPA6130A2EVM Parts List

Table 1 lists the TPA6130A2EVM BOM.

Table 1. TPA6130A2EVM Parts List

Reference	Description	Size	Qty	MFR/ Part No.	Vendor No.
C1, C2, C3, C4, C8	Capacitor, ceramic, 2.2 μ F, \pm 10%, X5R, 10 V	0603	5	Kemet C0603C225K8PACTU	Digi-Key 399-4911-1-ND
C5, C7, C9, C11, C16, C17, C22, C23	Capacitor, ceramic, 1.0 μ F, \pm 10%, X5R, 10 V	0603	8	TDK C1608X5R1A105KT	Digi-Key 445-1321-2-ND
C6, C10, C25, C26, C27, C28, C29	Capacitor, ceramic, 0.1 μ F, \pm 10%, X7R, 50 V	0603	7	TDK C1608X7R1H104KT	Digi-Key 445-1314-2-ND
C13, C14	Capacitor, ceramic, 47pF 50V COG 5%	0603	2	TDK C1608C0G1H470J	Digi-Key 445-1277-2-ND
C12, C24	6.3V, 10 μ F, Ceramic Chip Capacitor, \pm 10%, X5R	1206	2	TDK C3216X5R0J106K	Digi-Key 445-1388-1-ND
C15	Tantalum Capacitor, 100 μ F, 10V, 10%, Low ESR, SMD	C	1	Kemet B45197A2107K309	DigiKey 495-1528-2-ND
C18, C19	50V, 33pF, Ceramic Chip Capacitor, \pm 5%, NPO	0603	2	TDK C1608C0G1H330J	DigiKey 445-1275-1-ND
C20	50V, 100pF, Ceramic Chip Capacitor, \pm 5%, NPO	0603	1	TDK C1608C0G1H101J	Digi-Key 445-1281-1-ND
C21	50V, 100pF, Ceramic Chip Capacitor, \pm 5%, NPO	0603	1	TDK C1608C0G1H102J	Digi-Key 445-1293-1-ND
C30, C31	Multilayer Varistor Not Installed	0603	DNP	Little Fuse V14MLA0603	Mouser 576-V14MLA0603H
R1, R2, R3, R10	Resistor, chip, 2.7 k Ω , 1/10W, 5%	0603	4	Panasonic ERJ-3GEYJ272V	Digi-Key P2.7KGCT-ND
R4, R8	Resistor, chip, 100 k Ω , 1/16W, 5%	0603	2	Panasonic ERJ-3GEYJ104V	Digi-Key P100KGCT-ND
R5	Resistor, chip, 1.5 k Ω , 1/10W, 5%	0603	1	Panasonic ERJ-3GEYJ152V	Digi-Key P1.5KGCT-ND
R6, R7	Resistor, chip, 27.4 Ω , 1/16W, 1%	0603	2	Panasonic ERJ-3EKF27R4V	Digi-Key P27.4HCT-ND
R9	Resistor, chip, 3.09 k Ω , 1/16W, 1%	0603	1	Panasonic ERJ-3EKF3091V	Digi-Key P3.09KHCT-ND
R11, R13	0-Ohm jumper, 1/10W, 5%	0603	2	Panasonic ERJ-3GEY0R00V	Digi-Key P0.0GCT-ND
R12	RES 110 Ω 1/10W 1% 0603 SMD	0603	1	Panasonic ERJ-3EKF1100V	Digi-Key P110HTR-ND
Y1	6MHz Crystal SMD		1	Epson MA-505 6.0000M-C0	Digi-Key SE2501CT-ND
S1, S2	Switch, momentary, SMD, low profile		2	Panasonic EVQ-PPBA25	Digi-Key P8086SCT-ND
L1, L2, L3	Inductor Bead	0805	3	Steward/HZ0805E601R-00 or Steward/HZ0805E601R-10	Digi-Key/240-1018-1-ND or Digi-Key/240-2399-1-ND
D1	Diode, LED, Green	0805	1	Lumex SML-LXT0805GW-TR	Digi-Key 67-1553-2
J1	USB Type B Slave Connector Thru-Hole		1	Mill-Max 897-30-004-90-000000	Digi-Key ED90003-ND
J2	Headphone Jack, shielded, 3.5mm		1	CUI SJ1-3533NS	Digi-Key CP1-3533NS-ND
J3, J4	Phono jack, PC mount, switched, red		2	Switchcraft PJRAN1X1U03	Newark 16C1860
J7, J8	Banana Jack w/knurled Thumbnut (nickel plate)		2	Johnson 111-2223-001	Digi-Key J587-ND
JP1	Header, 3 position, male	2mm	1	Norcomp 2163-36-01-P2	DigiKey 2163S-36
JP2, JP4–JP6	Header, 2 position, male	2mm	4	Norcomp 2163-36-01-P2	DigiKey 2163S-36
JP3	Header, 4 position, male	2mm	1	Norcomp 2163-36-01-P2	DigiKey 2163S-36

Table 1. TPA6130A2EVM Parts List (continued)

Reference	Description	Size	Qty	MFR/ Part No.	Vendor No.
JP1–JP6 (shunts)	SHUNT, 2mm	2mm	6	Specialty 2JM-G	
U1	Headphone amplifier with I ² C controls	WCSP	1	TI TPA6130A2	
U2	USB Streaming Controller		1	TI TAS1020BPFB	
U3	3.3V LDO Regulator with reset output		1	TI TPS77533DRB	
U4	64K 2-Wire Serial EEPROM I ² C		1	Microchip 24LC64I/SN	DigiKey 24LC64-I/SN-ND
	Standoffs, 5/8" length, 4-40 thread		4	Keystone 1808	(Newark) 89F1934
	Screws, 4-40, 0.375		4		(Digi-Key) H781-ND

Revision History

Changes from Original (October 2006) to A Revision
Page

- Changed *Quick Start List for Stand-Alone Operation* section to support Windows 7. 2
- Changed *Software Installation Sequence* section to support software download URL and instructions. 2
- Deleted items 9 and 10 from the *Evaluation Module Preparations* section. 2
- Added *Computer Connection Issues* section. 3
- Changed version on USBfirmware to V0304. 3
- Changed step 3 in the *Using the Software* section for Windows 7 support. 5
- Added information about the audio output in step 3e of the *Using the Software* section. 5

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

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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/lstds/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/lstds/ti_ja/general/eStore/notice_01.page

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

If User uses EVMs in 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.

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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/llds/ti_ja/general/eStore/notice_02.page

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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:*

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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.

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