

TPA6140A2EVM

Contents

1	Introduction	1
2	Operation	2
3	TPA6140A2EVM Schematic	8
4	TPA6140A2EVM PCB Layouts for YFF Device	9
5	TPA6140A2EVM Parts List	11

List of Figures

1	YFF EVM—Place Shunts Horizontally Across SCL and SDA	3
2	Found New Hardware Wizard Advisory Screen	4
3	Starting the Software	5
4	Software Interface	6
5	Connect I ² C Controls to J1 (YFF EVM shown)	7
6	TPA6140A2EVM Schematic with YFF Device	8
7	TPA6140A2EVM –Top Layer for YFF Device	9
8	TPA6140A2EVM – Bottom Layer for YFF Device	10

List of Tables

1	TPA6140A2EVM Parts List	11
---	-------------------------------	----

1 Introduction

1.1 Description

The TPA6140A2 is a DirectPath™ Class-G stereo headphone amplifier with a built-in I²C volume control. Class-G technology maximizes battery life by adjusting the voltage supplies of the headphone amplifier based on audio signal level. DirectPath eliminates external DC-blocking capacitors. Availability in a 0.4 mm pitch WCSP package makes TPA6140A2 an ideal choice for both cellular handsets and PDAs.

The TPA6140A2 evaluation module (EVM) is a complete, stand-alone audio board. It contains the TPA6140A2 WCSP (YFF) Class-G stereo headphone amplifier.

All components and the EVM are Pb free.

1.2 TPA6140A2EVM Specifications

V _{DD}	Supply voltage range	–0.3 V to 6 V
I _{DD}	Supply current	2 A Maximum
P _o	Continuous output power per channel, 16 Ω, V _{dd} = 5.0 V, THD + N = 10%	25 mW
V _I	Audio Input Voltage	0.5 V to V _{DD} - 0.5 V
RL	Minimum load impedance	16 Ω

2 Operation

The TPA6140A2EVM 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 computer with Windows™ XP installed is required for the stand-alone operation. Install the software before connecting the EVM to a computer with a USB cable. The inputs accept standard RCA plugs and the outputs accept banana connectors.

2.1.1 Software Installation Sequence

1. Insert the CD provided.
2. Unzip the files to a temporary folder.
3. Install TPA6140A2 software by executing setup.exe located in *TPA6140A2 Interface\Volume*.

Accept license agreement and defaults, and complete the installation. Note: you can uninstall later with Add/Remove Programs.

Note: It is unnecessary to repeat the steps in [Section 2.1.1](#), once the software is installed.

2.1.2 Evaluation Module Preparations

1. Ensure that all external power sources are set to OFF.
2. Install shunt in jumper JP4
3. Install shunts in jumpers JP1 and JP2 when single-ended audio inputs are used; this ties INL+ and INR+ to ground.
4. Install shunts to connect J1-SCL to J3-SCL, and J1-SDA to J3-SDA as shown in [Figure 1](#). This sets the TPA6140A2 to accept I²C inputs from the EVM itself.

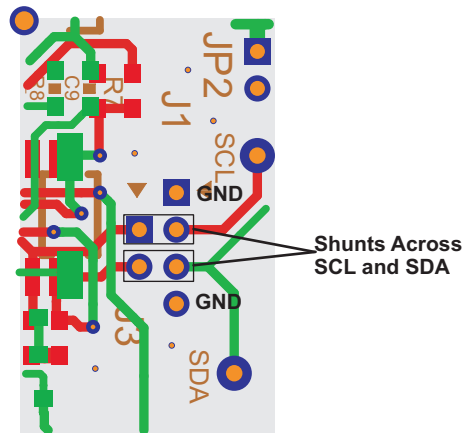


Figure 1. YFF EVM—Place Shunts Horizontally Across SCL and SDA

1. Powering the EVM:
 - The EVM can be powered via USB connection or by external power supply:
 - a. Via USB power: Install shunt for jumper USB+ if USB power is used.
 - b. External power supply: connect an external regulated power supply adjusted for 2.5 V–5.5 V to the module VDD and GND banana jacks, taking care to observe marked polarity. Make sure jumper USB+ is removed in this case.
 - Note:
 - i. USB interface may not be able to provide enough current. For best audio performance, use external power supply.
 - ii. Make sure only one power source is used. Connecting two power sources will cause damage to the device and the supply.
6. Connect audio source to RCA jacks INL and INR.
7. Connect headphone to the output headphone jack.
8. Plug in USB.
9. Turn on the power supply.
10. If this is the first time a TPA6140A2EVM is plugged in after installing the software, follow the Windows dialog ([Figure 2](#)), questions, and selections:
 - a. Select "Install from a list or specific location (Advanced)", then click next.
 - b. Browse to the folder where the TPA6140A2 interface is installed then click ok.
 - c. Windows will automatically install the driver.

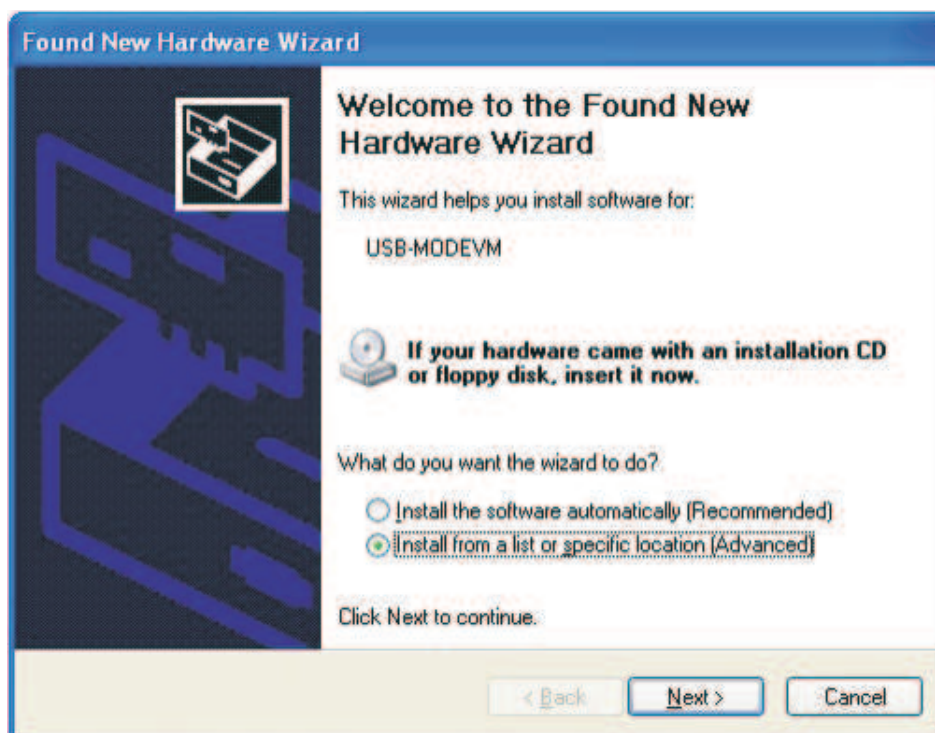


Figure 2. Found New Hardware Wizard Advisory Screen

Note: It is not necessary to repeat steps 10. a. to c., once the driver is installed.

2.1.3 Using the Software

1. Start the TPA6140A2 Interface by clicking the *Start* menu and clicking on the *TPA6140A2 Interface* icon. ⁽¹⁾

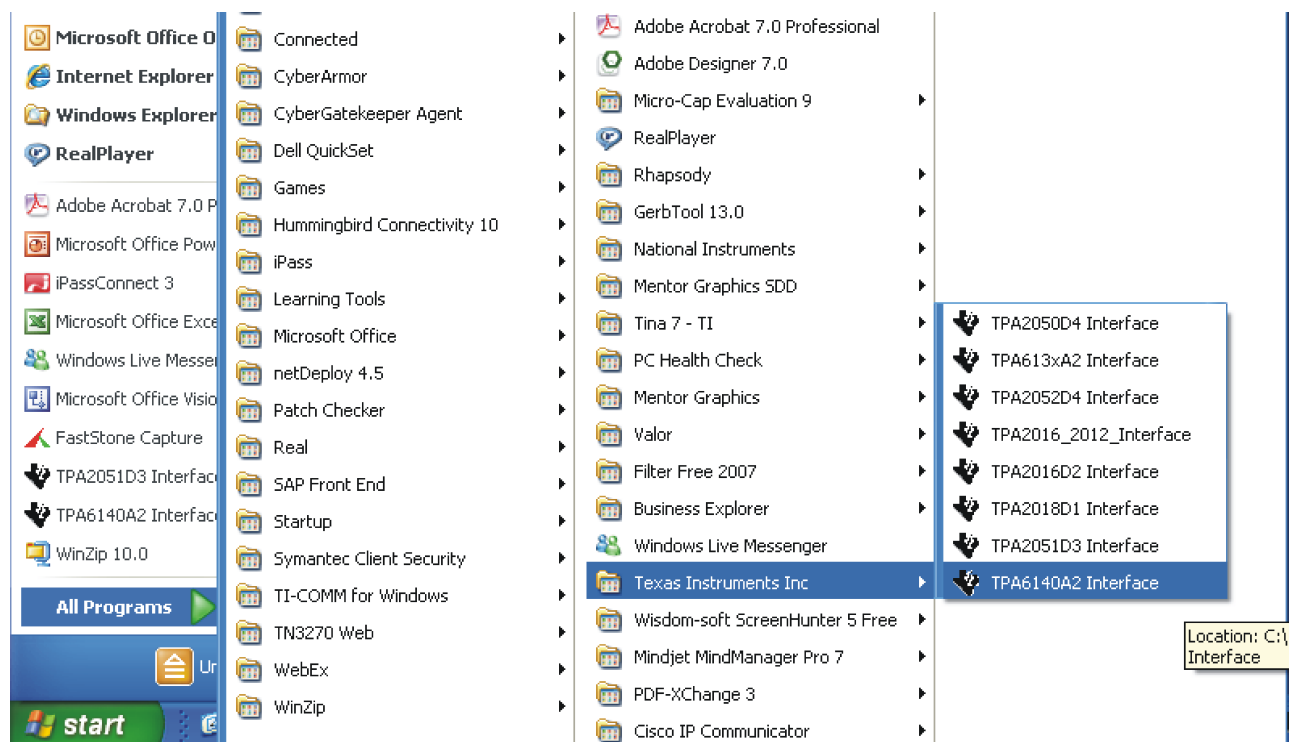


Figure 3. Starting the Software

- ⁽¹⁾ Computer screen images showing Windows XP interface are courtesy of Microsoft Corporation

- The TPA6140A2 software interface is as shown in [Figure 4](#).

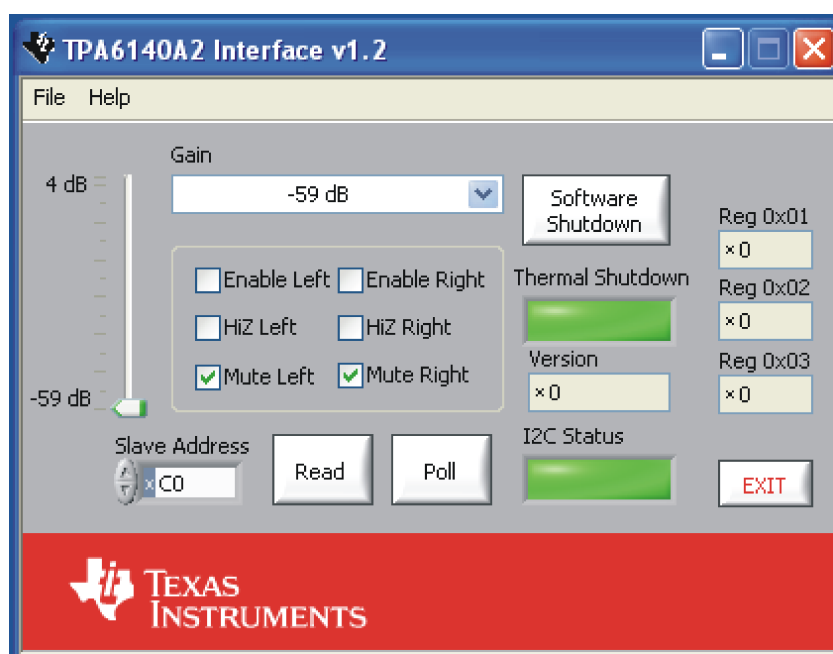


Figure 4. Software Interface

Note: The TPA6140A2 powers up with the amplifier in software shutdown. To hear an output, uncheck shutdown.

- Uncheck and check *Enable Left* or *Enable Right* to place the corresponding channels in and out of SHUTDOWN.
- Uncheck and check *Mute Left* or *Mute Right* to mute the corresponding channels.
- Click *Software Shutdown* to place the TPA6140A2 in and out of SOFTWARE SHUTDOWN.
- I2C Status* box reports the status of I²C communications. An error or failure has occurred if it turns red.
- To read the I²C status, click Read.
- Thermal Shutdown* box reports the status of thermal failure. A thermal fault has occurred if it turns red.
- The GUI has a built-in I²C programming interface. Follow the steps below to use the I²C programming function.
 - At the top left corner of the GUI, click *File* to access the I²C programming interface.
 - Save Script* can record the current register values. Select *Save Script* >> Click the folder icon to browse to the place where you want to save the script >> name the file in text format, then select OK to save.
 - Load Script* can load the previously saved script to program the entire register file. Select *Load Script* >> Click the folder icon to browse to the place where the script is located >> Select the file then click OK >> Click Load.
 - I2C interface* can program individual register value of TPA6140A2. Select *I2C Interface* >> I²C address is xC0, which is the address of TPA6140A2. Device address is from 1 to 7, which is the register address of TPA6140A2.

2.1.4 Shutdown Control

The TPA6140A2 EVM provides hardware shutdown control for the USB controller. Press and hold push button S1 to shutdown the USB controller. Release S1 to activate the USB controller.

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

The TPA6140A2EVM 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 and the outputs accept banana connectors.

2.2.1 Evaluation Module Preparations

1. Ensure that all external power sources are set to OFF.
2. Install shunts in jumpers JP4.
3. Remove shunts between J1 and J3 and connect I²C controls to J1 as shown in [Figure 5](#) (YFF EVM shown).

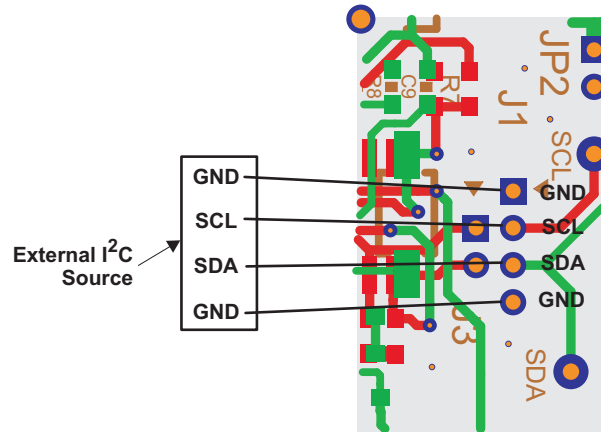


Figure 5. Connect I²C Controls to J1 (YFF EVM shown)

4. Install shunts in jumpers JP1 and JP2 when single-ended audio inputs are used; this ties INL– and INR– to ground.
5. Remove jumper USB+.
6. Connect an external regulated power supply adjusted for 2.5 V–5.5 V to the module VDD and GND banana jacks, taking care to observe marked polarity.
7. Connect audio source to RCA jack INL and INR.
8. Connect headphone to the output headphone jack.
9. Turn on power supply.

Figure 6. TPA6140A2EVM Schematic with YFF Device

4 TPA6140A2EVM PCB Layouts for YFF Device

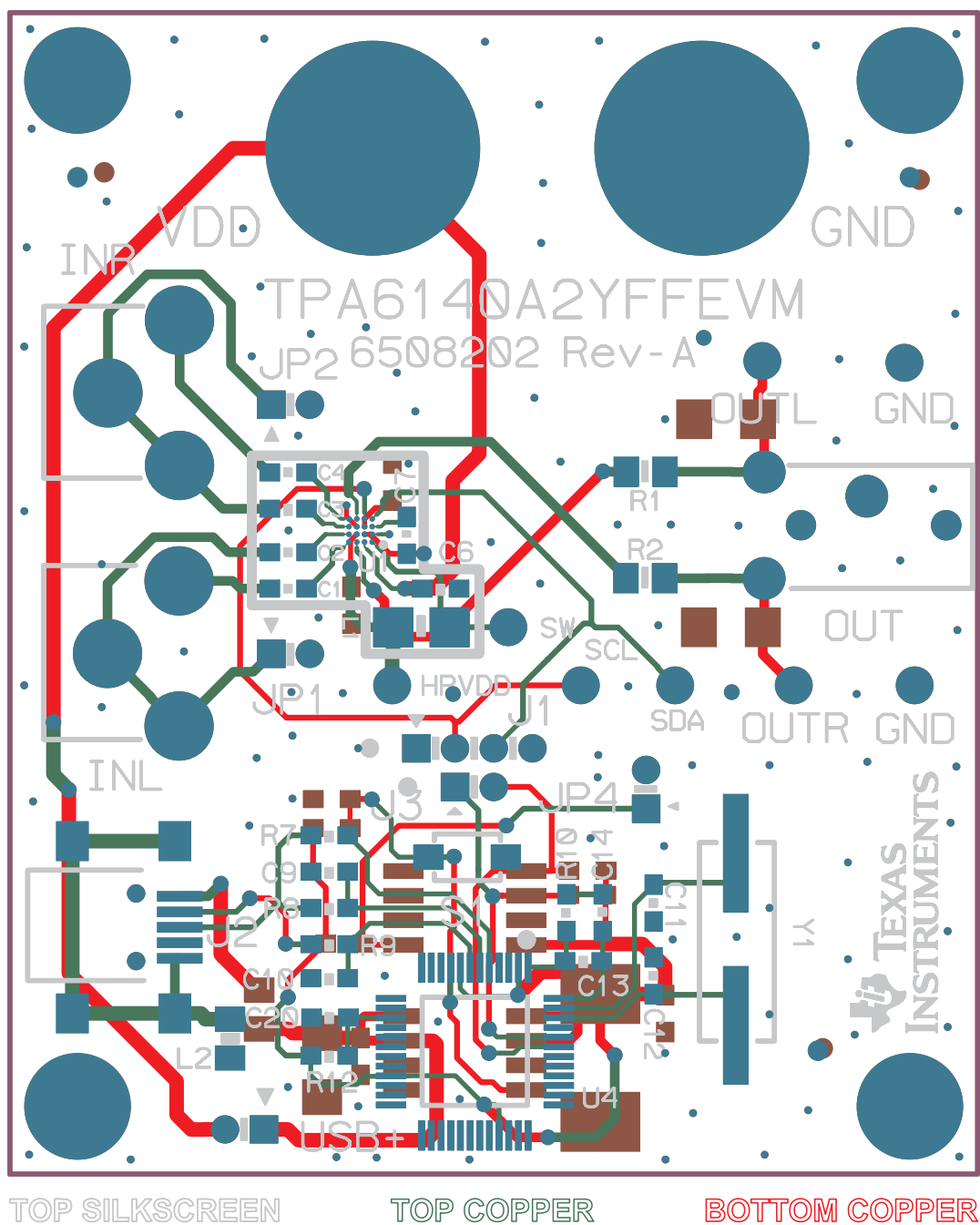


Figure 7. TPA6140A2EVM –Top Layer for YFF Device

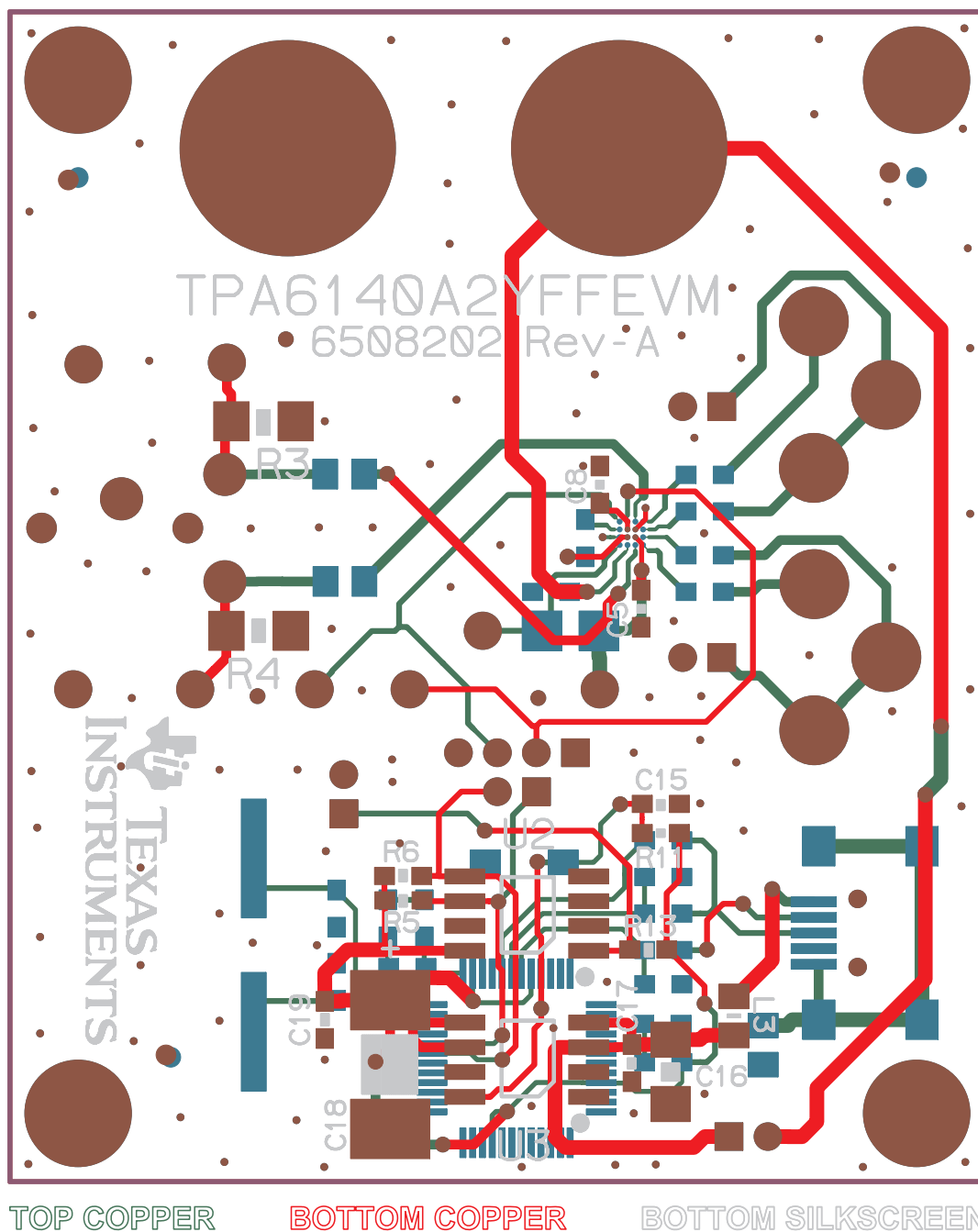


Figure 8. TPA6140A2EVM – Bottom Layer for YFF Device

5 TPA6140A2EVM Parts List

Table 1. TPA6140A2EVM Parts List

DESCRIPTION	REF	QTY	MFR	MFR PART NUMBER	VENDOR
Stereo Class-G Amplifier	U1	1	TEXAS INSTRUMENTS	TPA6140A2YFF	TEXAS INSTRUMENTS
USB Streaming Controller, TQFP48-PFB	U2	1	TEXA4S INSTRUMENTS	TAS1020BPFB	DIGI-KEY
FAST TRANSIENT RESPONSE LDO, SOP8-D	U3	1	TEXAS INSTRUMENTS	TPS77533D	DIGI-KEY
EEPROM, SERIAL 64K 2.5V SOIC-8	U4	1	MICROCHIP TECHNOLOGY	24LC64-I/SN	DIGI-KEY
CRYSTAL, 6.000MHz, HC49M ROHS	Y1	1	ECS	ECS-60-32-5PXDND-TR	DIGI-KEY
CAP 33 pF 50V 5% CERM 0603 NPO ROHS	C11, C12	2	PANASONIC	ECJ-1VC1H330J	DIGI-KEY
CAP 47 pF 50V 5% CERM 0603 NPO ROHS	C9, C10	2	PANASONIC	ECJ-1VC1H470J	DIGI-KEY
CAP 100 pF 50V 5% CERM 0603 NPO ROHS	C13	1	PANASONIC	ECJ-1VC1H101J	DIGI-KEY
CAP 1000 pF50V CERM 0603 COG ROHS	C14	1	TDK CORP.	C1608C0G1H102J	DIGI-KEY
CAP 0.1 uFD 50V CERM 0603 X7R ROHS	C15, C17, C19, C20	4	TDK CORP.	C1608X7R1H104K	DIGI-KEY
CAP 1.0 uFD 10V 10% CERM 0603 X5R ROHS	C7	1	PANASONIC	ECJ-1VB1A105K	DIGI-KEY
CAP 1.0 uFD 16V 10% CERM 0603 X5R ROHS	C1-C4, C6, C7	5	TDK CORP	C1608X5R1C105K	DIGI-KEY
CAP 2.2 uFD 10V CERM 0603 X7R	C5, C8	2	MURATA ELECTRONICS	GRM188R71A225KE15D	DIGI-KEY
CAP 10 uFD 6.3V 10% CERM 1206 X5R ROHS	C16	1	TDK CORP	C3216X5R0J106K	DIGI-KEY
CAP 100 uFD 10V 10% TANT SMD1206 ROHS	C18	1	AVX CORP	TPSB686K010R0600	DIGI-KEY
RES 27.4 Ω 1/16W 1% SMD 0603 ROHS	R8, R9	2	PANASONIC	ERJ-3EKF27R4V	DIGI-KEY
RES 1.50 k Ω 1/16W 1% SMD 0603 ROHS	R7	1	PANASONIC	ERJ-3EKF1501V	DIGI-KEY
RES 2.00 k Ω 1/16W 1% SMD 0603 ROHS	R5, R6, R12	3	PANASONIC	ERJ-3EKF2001V	DIGI-KEY
RES 3.09 k Ω 1/16W 1% SMD 0603 ROHS	R10	1	PANASONIC	ERJ-3EKF3091V	DIGI-KEY
RES 100K OHM 1/10W 5% SMD 0603 ROHS	R11, R13	2	PANASONIC	ERJ-3GEYJ104V	DIGI-KEY
RES 0.0 Ω 1/10W 5% SMD 0805	R1, R2	2	PANASONIC	ERJ-GEY0R00V	DIGI-KEY
Do not populate	R3, R4				
Inductor, 2.2 μ H, 800mA, SMD 0805	L1	1	TOKO	MDT2012-CH2RA	TOKO
FERRITE BEAD 600 Ω 2A SM0805 ROHS	L2, L3	2	TDK CORP	MPZ2012S601A	DIGI-KEY
HEADER 2 PIN, PCB 2.0 MM ROHS	J3, JP1-JP4	5	NORCOMP	26630201RP2	DIGI-KEY
HEADER 4 PIN, PCB 2.0MM ROHS	J1	1	NORCOMP	26630401RP2	DIGI-KEY
JACK, MINI-STEREO, PCB-RA, 3.5 mm ROHS	OUT	1	CUI STACK	SJ1-3535N	DIGI-KEY
JACK, RCA, PCB-RA, BLACK	INL	1	SWITCHCRAFT	PJRN1X1U01	NEWARK
JACK, RCA, PCB-RA, RED	INR	1	SWITCHCRAFT	PJRN1X1U03	NEWARK
JACK USB MINIB SMT-RA 5PIN ROHS	J2	1	HIROSE	UX60-MB-5ST	DIGI-KEY
PC Testpoint, Black	GND, GND	2	KEYSTONE ELECTRONICS	5001	DIGI-KEY
PC Testpoint, White	HPVDD, OUTL, OUTR, SCL, SDA, SW	6	KEYSTONE ELECTRONICS	5002	DIGI-KEY
Switch, Momentary SMT-Short, Black Tab, 240g	S1	1	PANASONIC	EVQ-PPDA25	DIGI-KEY
BINDING-POST,NONINS,THRU,ROHS	GND, VDD	2	EMERSON NPCS	J587	DIGI-KEY
SHUNT, BLACK AU FLASH 2 MM	JP1-JP4, J2-J4	6	NORCOMP INC.	800-002-SP2-001	DIGI-KEY
Hex Nut, 4-40, Zinc/Steel	HW1-HW4	4	BUILDING FASTENERS	HNZ440	DIGI-KEY
Standoff 4-40 Threaded M/F 0.50 in. ALUM-HEX	HW1-HW4	4	KEYSTONE ELECTRONICS	8401	DIGI-KEY

EVALUATION BOARD/KIT IMPORTANT NOTICE

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. **THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.**

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

TI currently deals with a variety of customers for products, and therefore our arrangement with the user **is not exclusive**.

TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.**

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please contact the TI application engineer or visit www.ti.com/esh.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used.

FCC Warning

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the supply voltage range of -0.3 V to 6 V and the input voltage range of -0.3 V to $V_{DD} + 0.3$.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 85°C . The EVM is designed to operate properly with certain components above 85°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2009, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
RF/IF and ZigBee® Solutions	www.ti.com/lprf

Applications

Audio	www.ti.com/audio
Automotive	www.ti.com/automotive
Broadband	www.ti.com/broadband
Digital Control	www.ti.com/digitalcontrol
Medical	www.ti.com/medical
Military	www.ti.com/military
Optical Networking	www.ti.com/opticalnetwork
Security	www.ti.com/security
Telephony	www.ti.com/telephony
Video & Imaging	www.ti.com/video
Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2009, Texas Instruments Incorporated