TAS2560 Evaluation Module

This user's guide describes the characteristics, operation, and use of the TAS2560 Evaluation Module (EVM). The complete schematic diagrams, printed-circuit board layouts, and bill of materials (BOM) are included in this document.

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1 Description

The TAS2560 is an amplifier with an integrated 8.5V boost converter supporting Class-D, Class-G, and Class-H. The device supports up to 5.7W output while using a 4 Ohm driver and includes on-chip voltage and current sensing. Users can utilize this sensing to implement an advanced algorithm to provide real-time speaker protection against overheating and excessive excursion.

The TAS2560 EVM supports evaluation and development with the TAS2560 through the following interfaces:

1. USB interface
   (a) TAS2560 control through PurePath™ Console 3 GUI, USB-HID
   (b) USB-class Audio Device, compatible with Microsoft® Windows® 7
2. Digital audio AP/PSIA interface through 100-mil headers
3. TI Learning Board 2 for speaker characterization
4. SPI interface for TAS2560 control
5. I^2C interface for TAS2560 control

Table 1. Specifications

Amplifier power supply (V_{BAT})	+2.7 V to +5.5 V
EVM power supply	+5 V
I/O power supply (I/O_{VDD})	+1.62 V to +3.6 V
Output power	4 W
USB, USB class-audio	Micro-USB B

2 Software

The EVM requires PurePath™ Console 3 with the TAS2560 EVM App.

3 Mono Setup

- Install PurePath™ Console 3 and the TAS2560 App
- Connect a speaker to J8 on the EVM.
- Attach a +5-V, 2-A power supply to connector J29 (inner = +5 V, outer = GND).
- Connect the EVM to a Windows 7 PC with a micro USB cable (J23). It enumerates as a USB class-audio device (sound card).

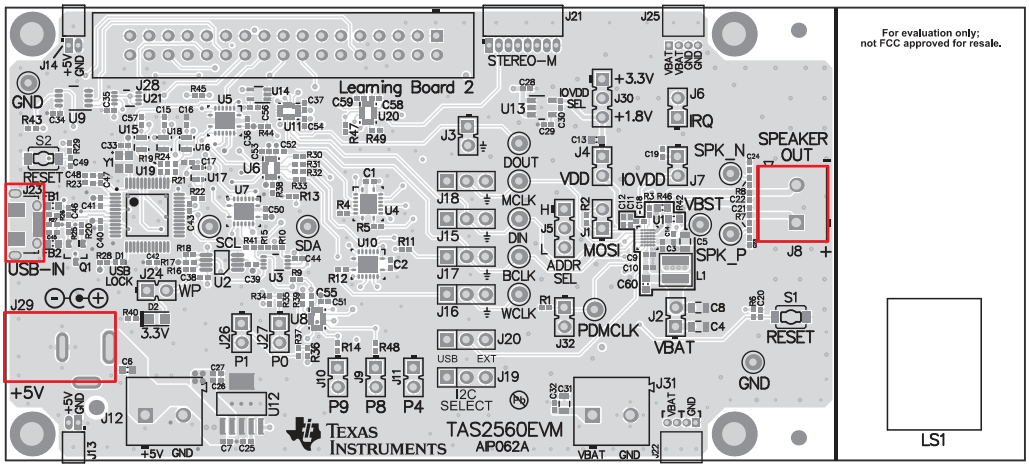

Figure 1. Sound Card

Default jumper settings:

J1: inserted
J2: inserted (V_{BAT} = from +5 V)
J3: removed (DATA from TAS2560 access header)
J4: inserted (or wire loop)
J5: inserted bottom (I2C address = 0x98 (0x4C 7-bit))
J6: inserted
J7: inserted (or wire loop)
J9: inserted (select USB audio)
J10: inserted (select USB audio)
J11: inserted
J15: inserted left (DIN = on-board)
J16: inserted left (WCLK = on-board)
J17: inserted left (BCLK = on-board)
J18: inserted left (MCLK = on-board)
J19: inserted left (SCL = on-board)
J20: inserted left (SDA = on-board))
J24: removed (EEPROM write protect = off)
J26: inserted (select USB audio)
J27: inserted (select USB audio)
J30: inserted bottom (I_{OVDD} = 1.8 V)
J32: removed

Verify that the EVM is the default playback device (open the Sound dialog from the Windows Control Panel):

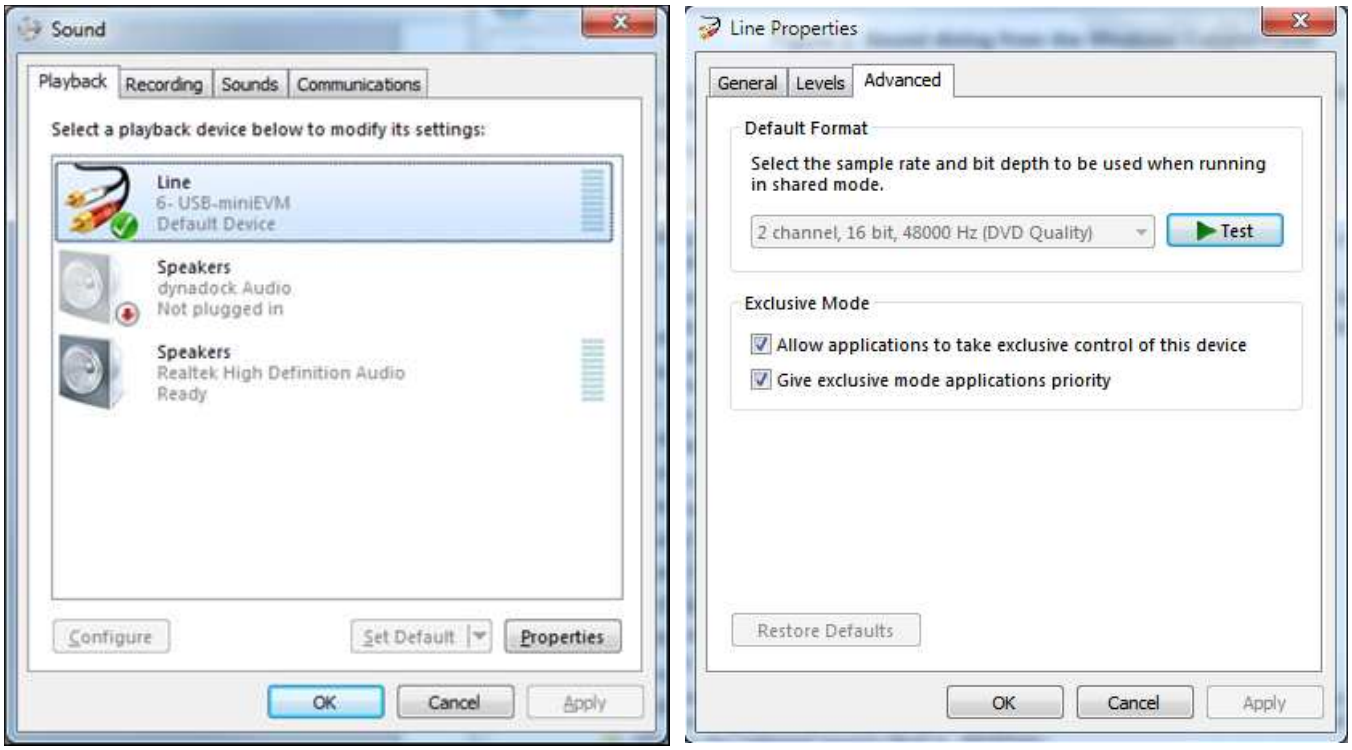

Figure 2. Sound dialog from the Windows Control Panel

The EVM firmware enumerates as a USB-miniEVM. It supports 48kHz sampling rate by default. Check if the sampling rate matches the Windows setting via Properties->Advanced.

This setting must match the EVM (2 channel, 16 bit, 48000 Hz)

4 Digital Audio Interfaces

The various digital audio interfaces on the TAS2560 EVM can be selected through hardware settings and software settings.

Several headers close to the TAS2560 allow access to the following digital audio signals:

- J3: Data Out (DOUT) from the TAS2560 (that is, current and voltage sense data)
- J15: Data In (DIN) to the TAS2560
- J16: Word Clock / Frame Sync (WCLK)
- J17: Bit Clock (BCLK)
- J18: Master Clock (MCLK) – optional if TAS2560 PLL is not used

J3 has two pins:

1. Digital data (that is, I and V sense data) from the TAS2560
2. Ground

J15, J16, J17 and J18 have three pins:

1. Digital audio interface signals from the EVM
2. Digital audio interface signals to the TAS2560
3. Ground

A jumper inserted in position 1-2 connects the TAS2560 to the digital audio signals from the board (e.g. USB or Learning Board 2). Replacing the jumper with a connector from an external source connects the TAS2560 to the external source (that is, AP/PSIA).

The selection between the two on-board digital audio sources (USB or Learning Board 2) is controlled by:

(a) Hardware: J26, J27:

(a) J26 = inserted, J27 = inserted selects USB

(b) J26 = inserted, J27 = removed selects Learning Board 2

(b) Software: The PPC3 GUI controls the digital audio routing during speaker characterization. This has priority over the hardware settings from point a.

4.1 Digital Audio Interface Selection

4.1.1 USB

The TAS2560 EVM contains a microcontroller (TAS1020b) that acts as a USB HID and USB class audio interface. To select USB, insert J26, J27, J9, J10 and insert J15, J16, J17, J18 in the 1-2 position.

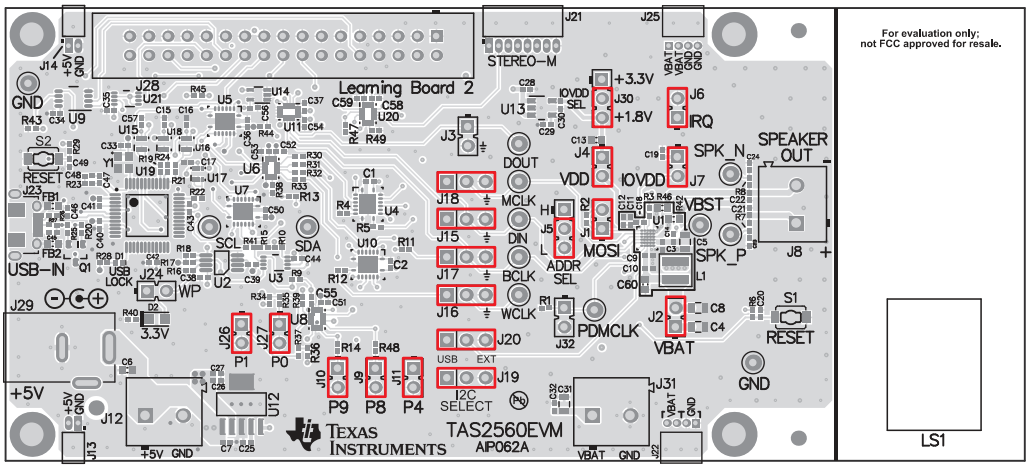

Figure 3. USB Interface

4.1.2 Direct (AP/PSIA)

Remove the jumpers from J15, J16, J17, J18 and connect the external digital audio source (that is, AP/PSIA) to pin 2 of each header. Pin 3 provides a ground connection.

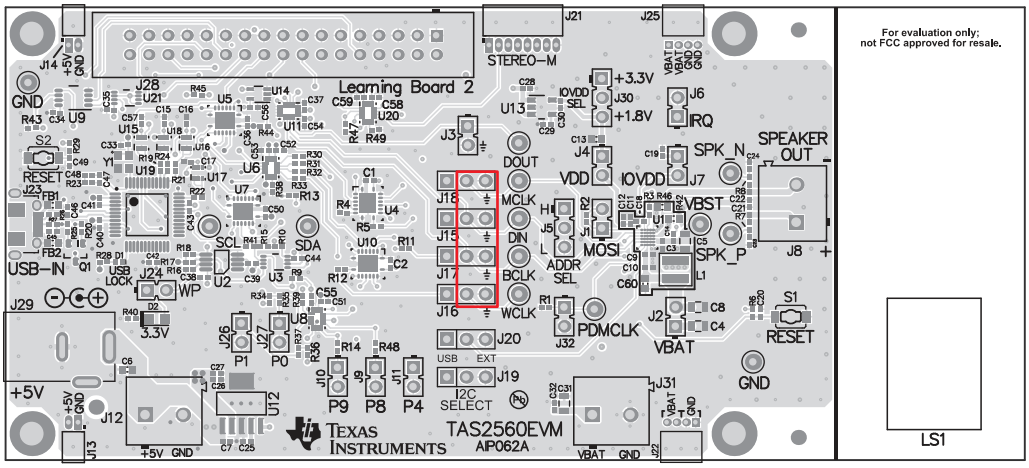

Figure 4. Direct (AP/PSIA)

5 PurePath™ Console 3 Software

The graphical user interface software, PurePath™ Console 3 with the TAS2560 App, controls the TAS2560 EVM.

NOTE: The TAS2560 must be configured using this software. It will not function without configuration.

6 Schematics, Layout and BOM

6.1 Schematic

Figure 5 through Figure 10 illustrate the EVM schematic diagrams.

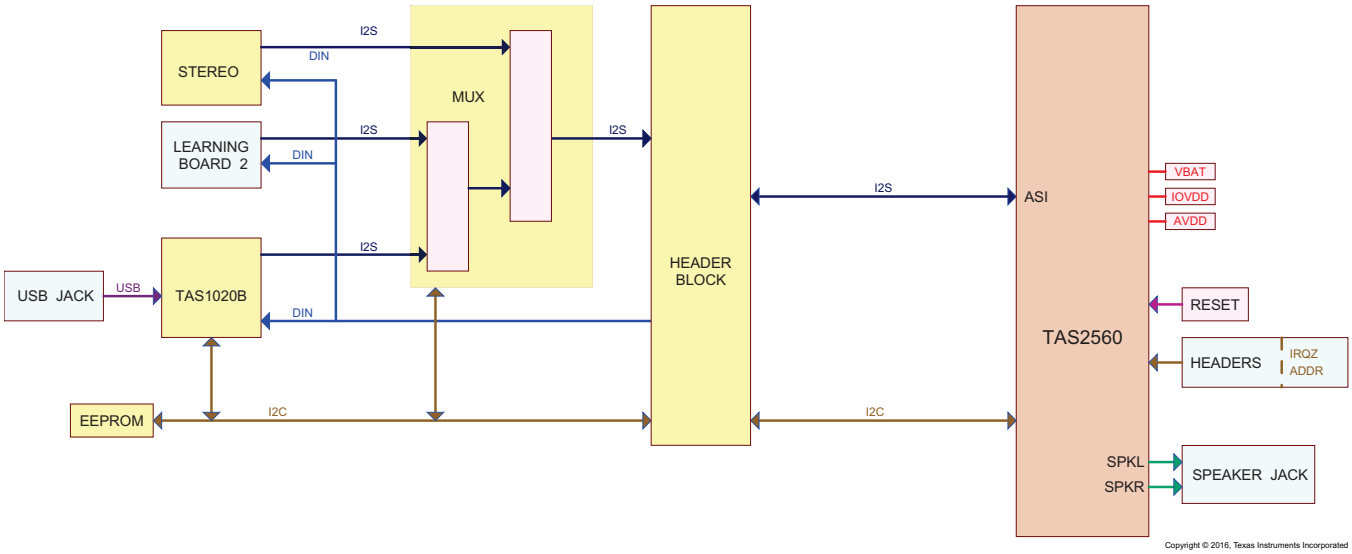

Figure 5. Schematic Page 1

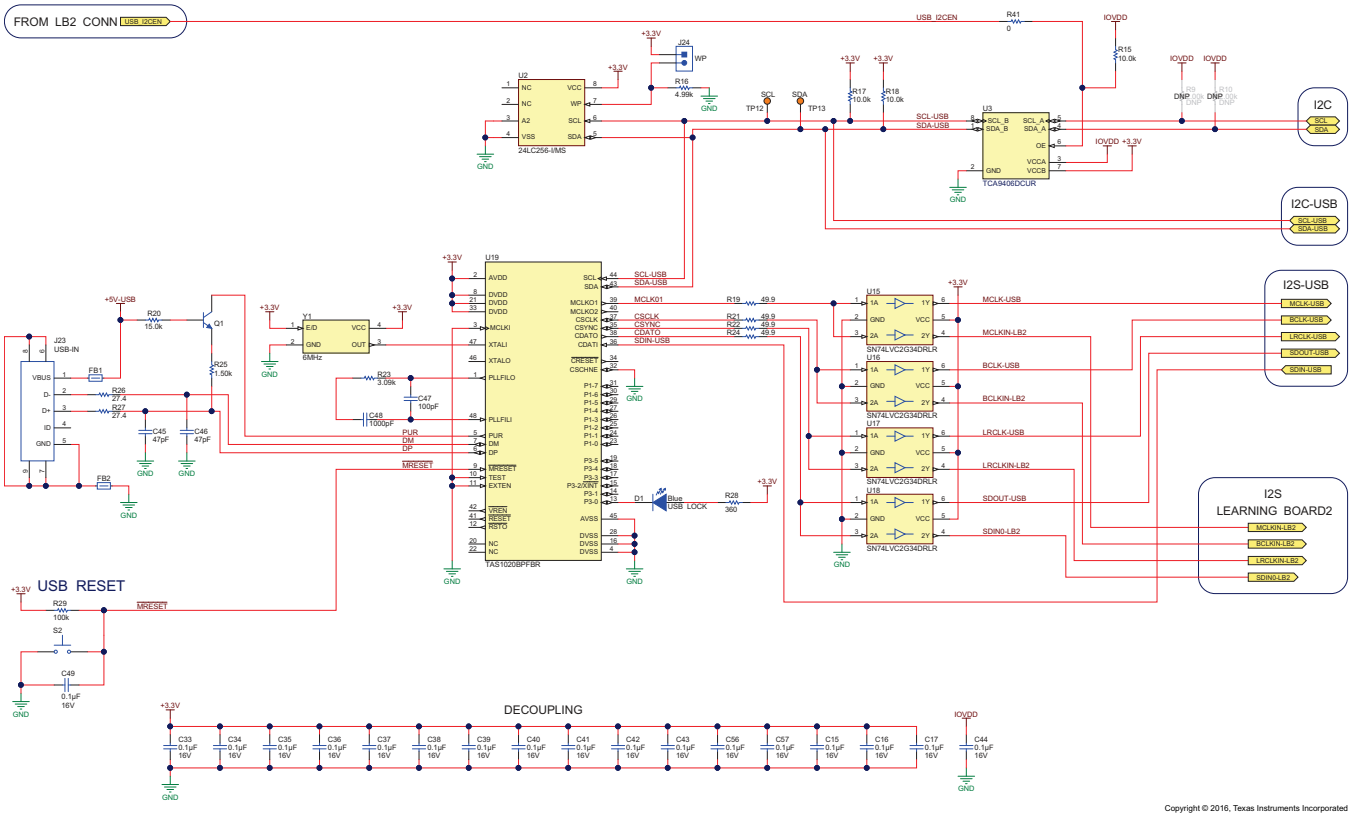

Figure 6. Schematic Page 2

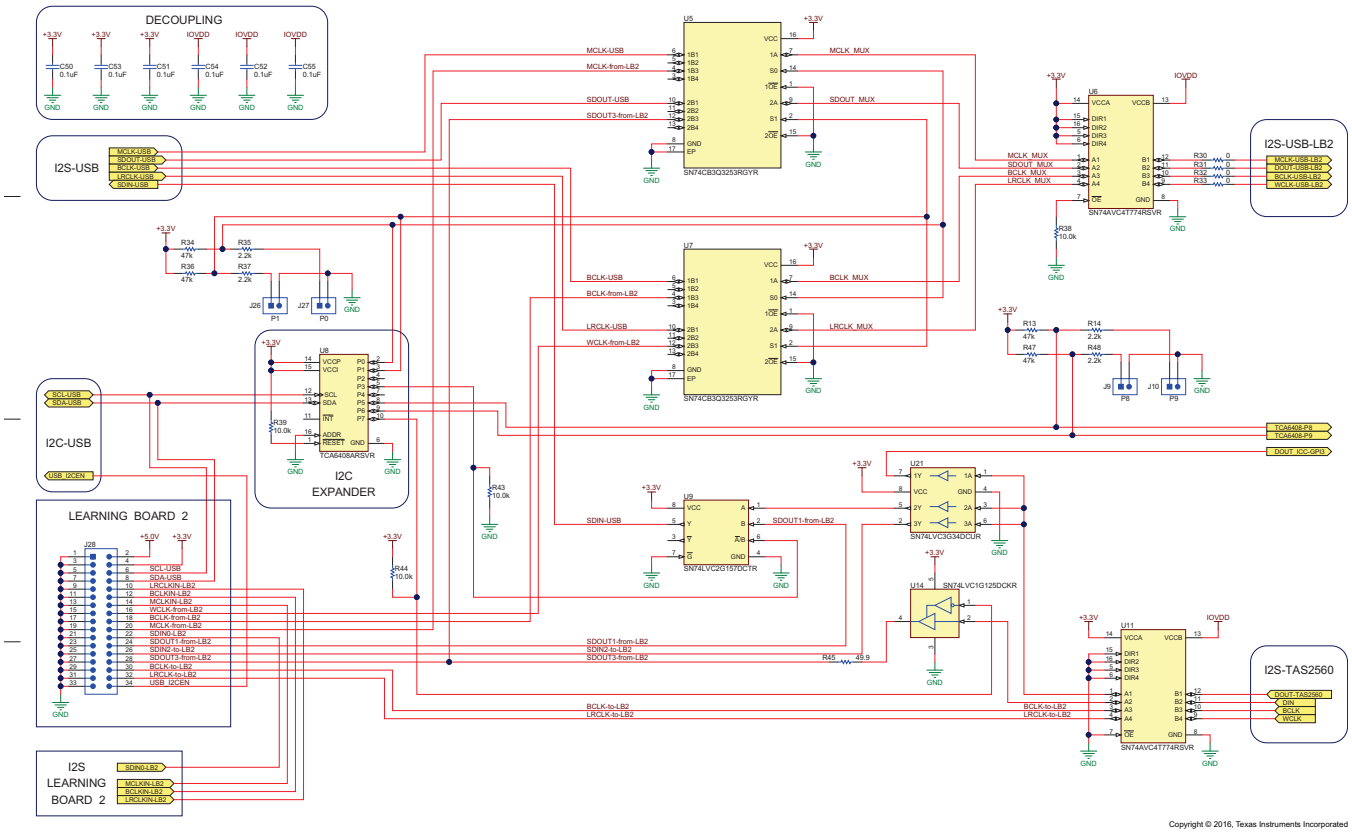

Figure 7. Schematic Page 3

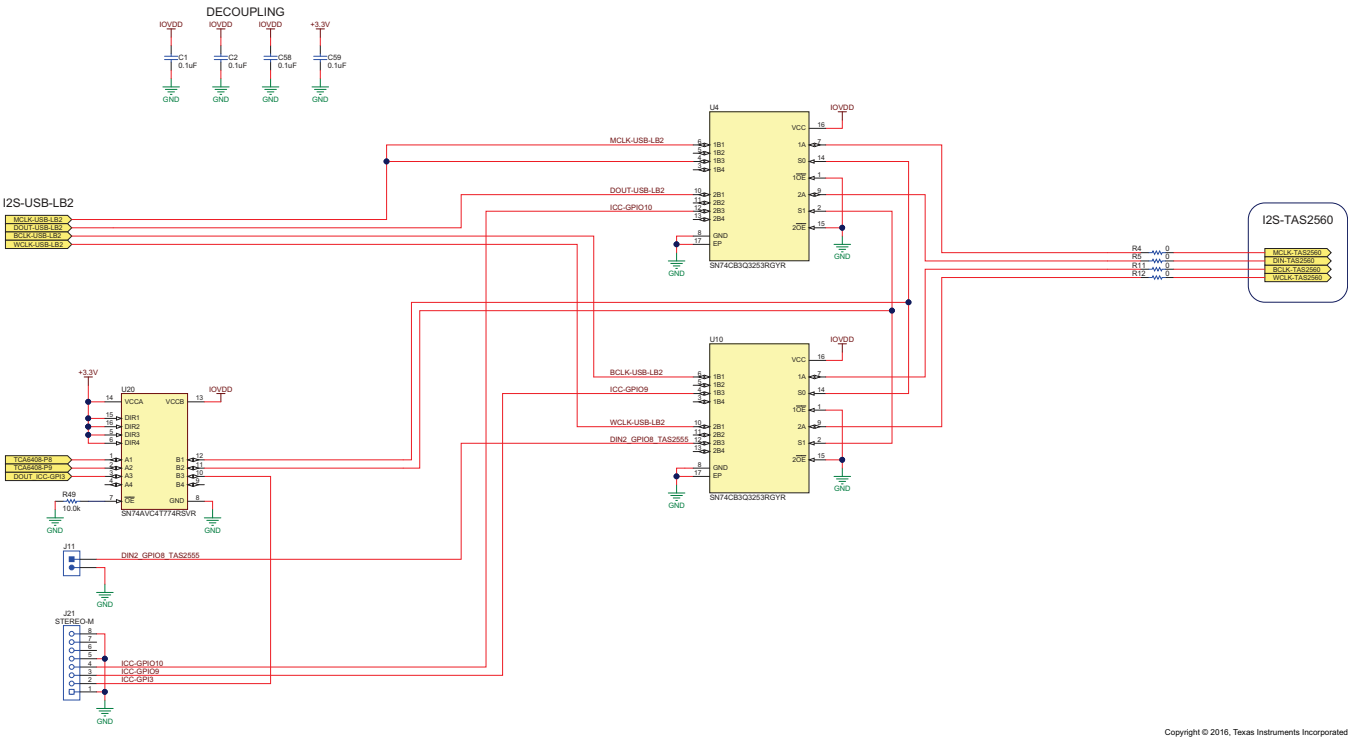

Figure 8. Schematic Page 4

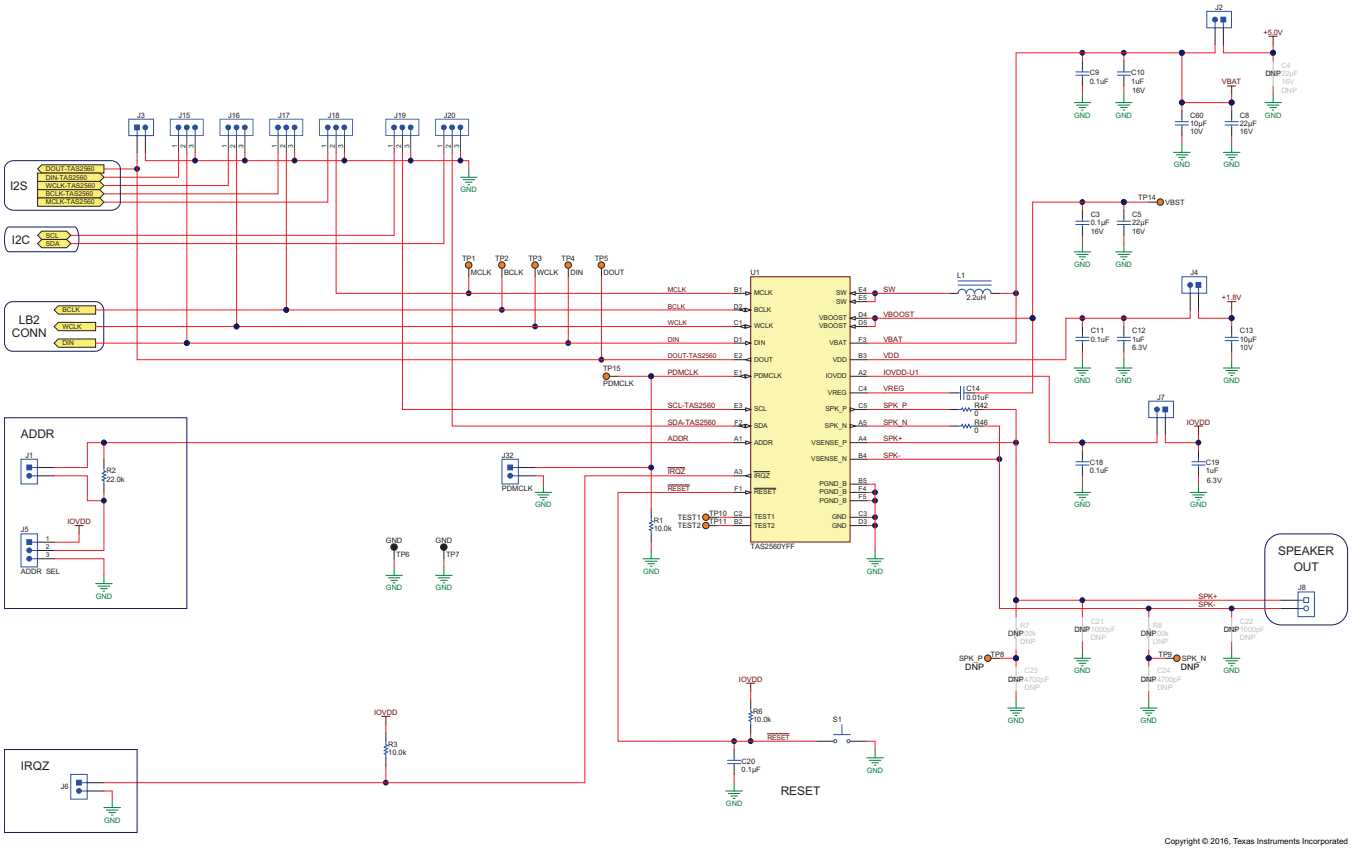

Figure 9. Schematic Page 5

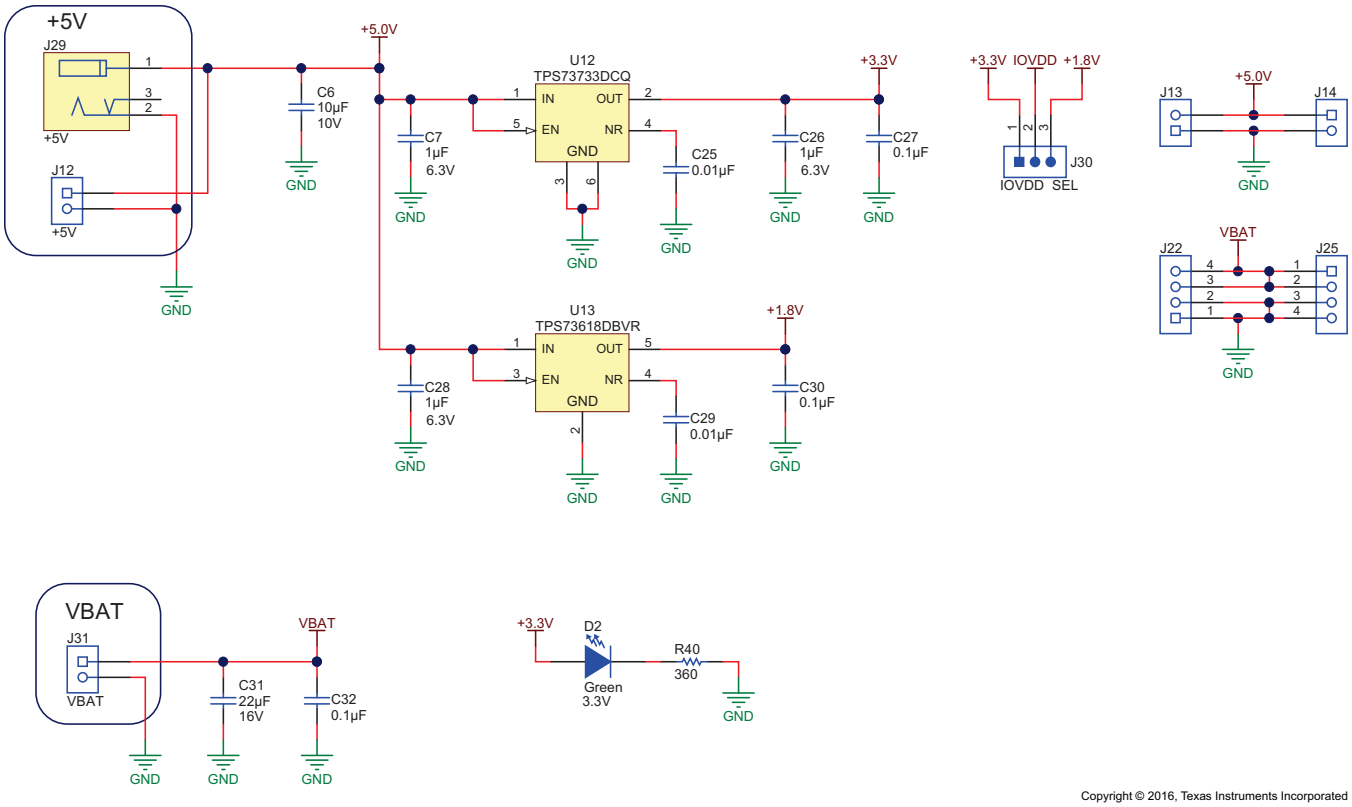

Figure 10. Schematic Page 6

6.2 PCB Layout

Figure 11 through Figure 22 illustrate the EVM PCB layouts.

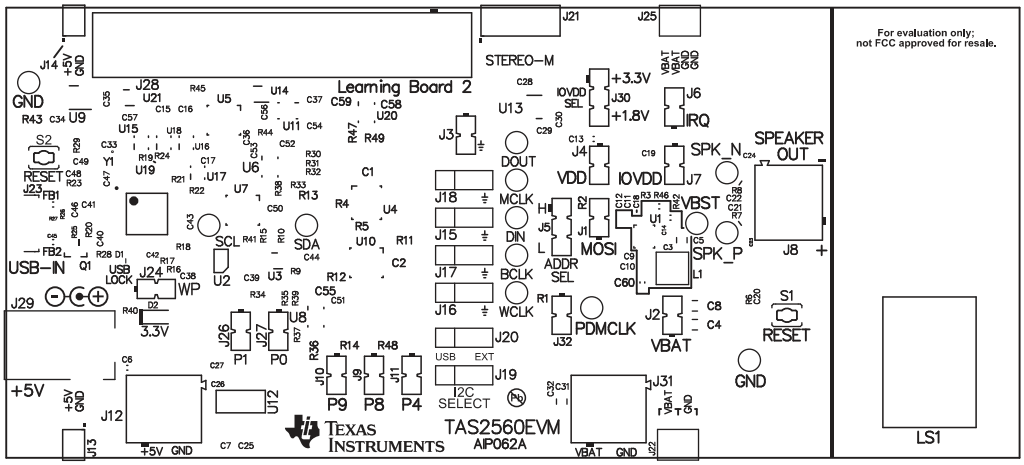

Figure 11. PCB Layer 1

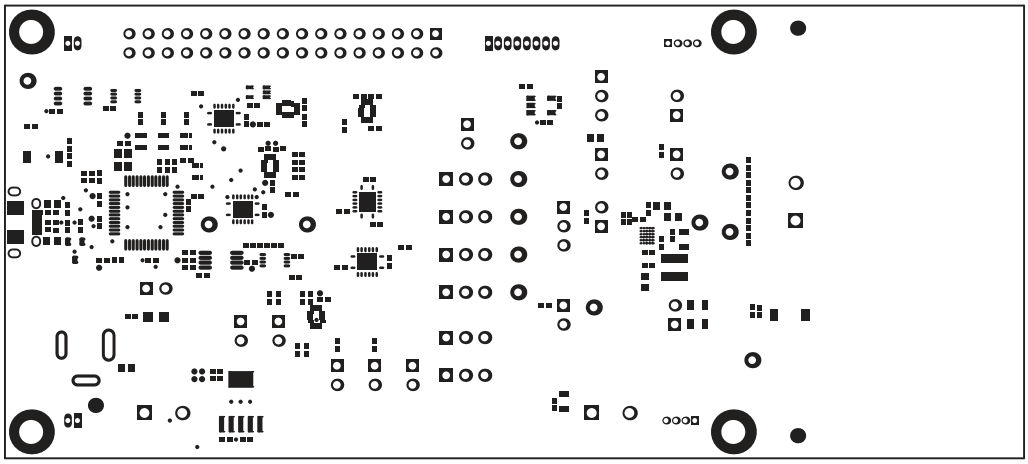

Figure 12. PCB Layer 2

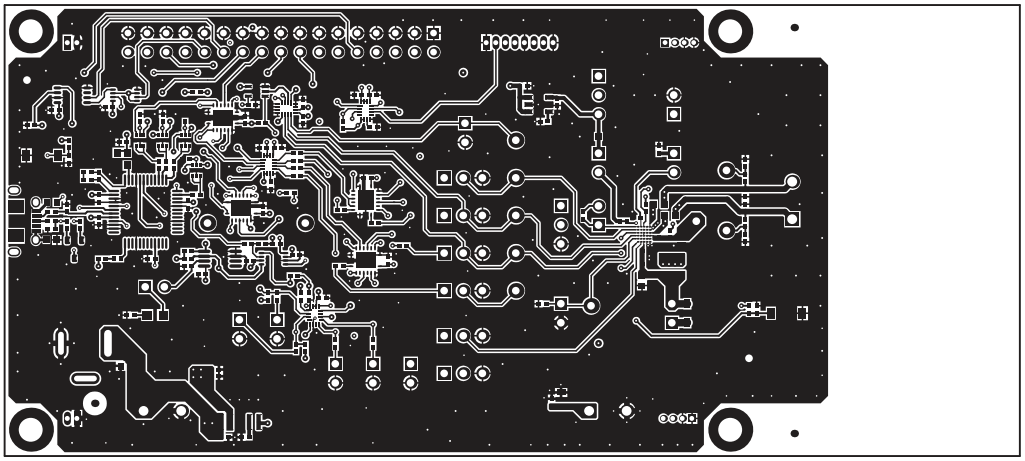

Figure 13. PCB Layer 3

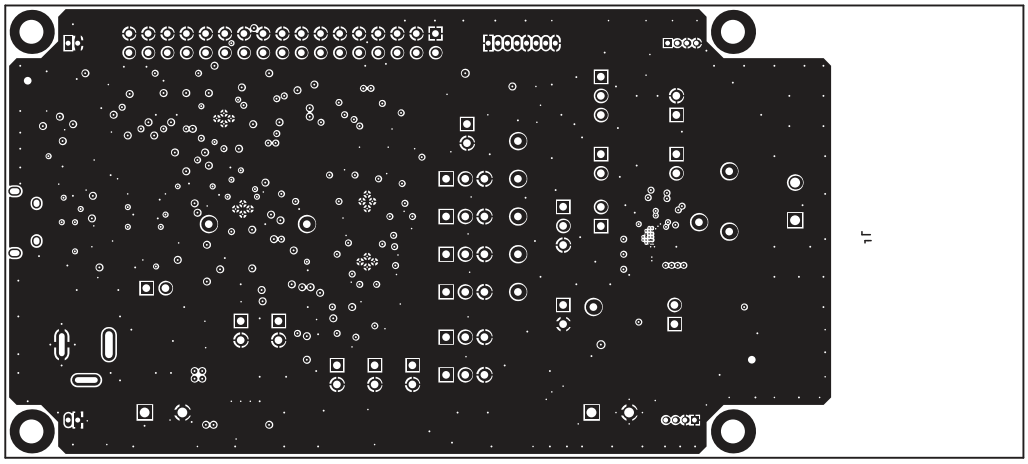

Figure 14. PCB Layer 4

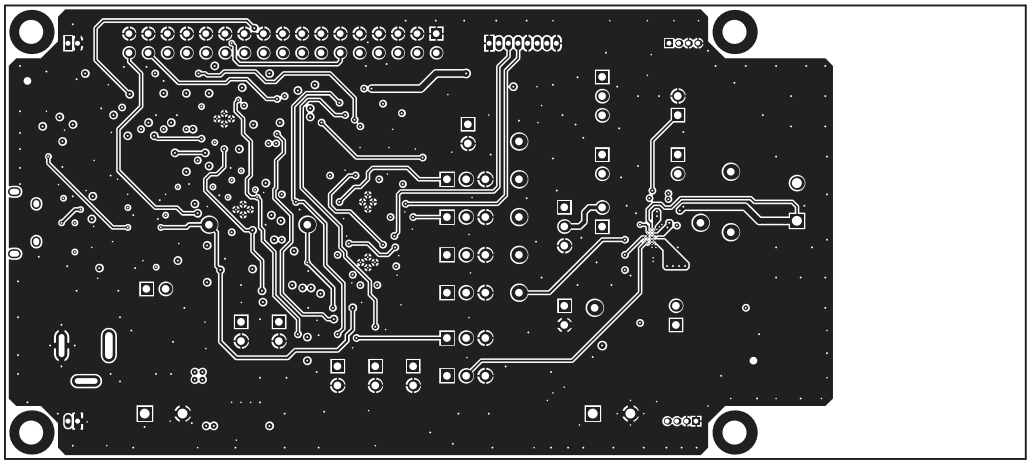

Figure 15. PCB Layer 5

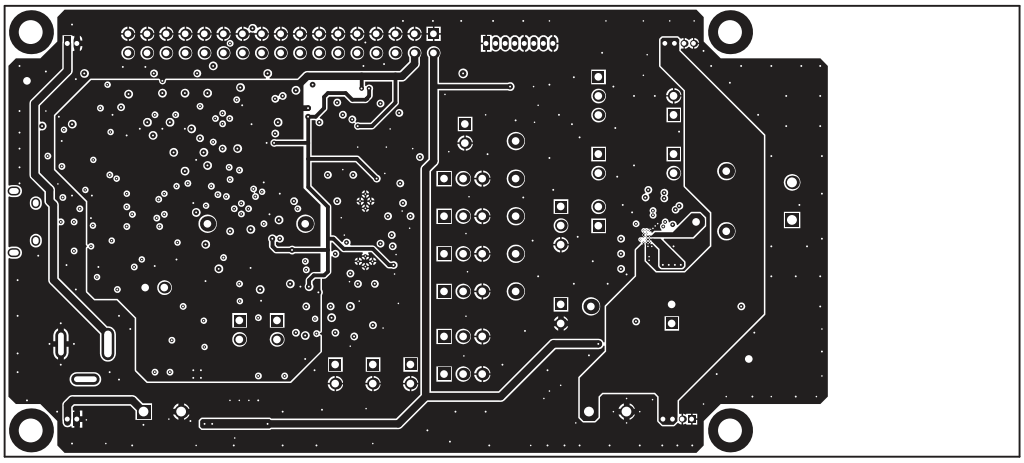

Figure 16. PCB Layer 6

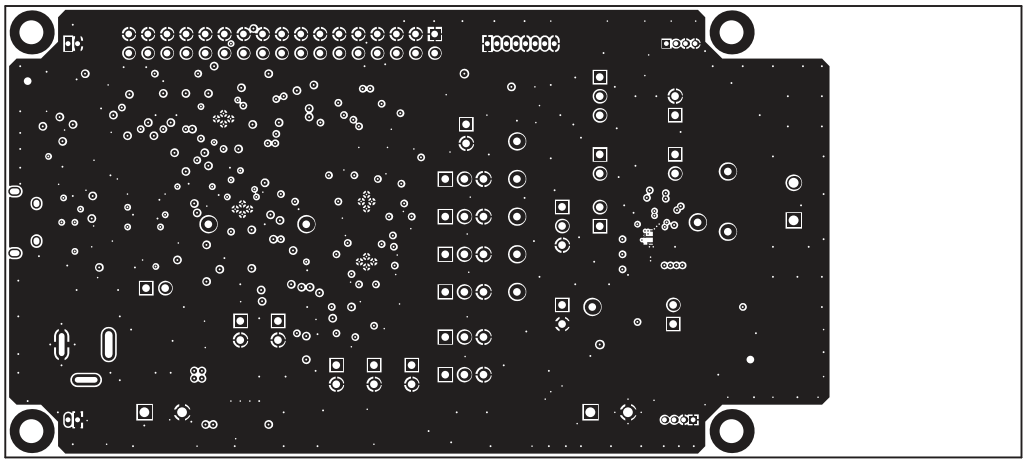

Figure 17. PCB Layer 7

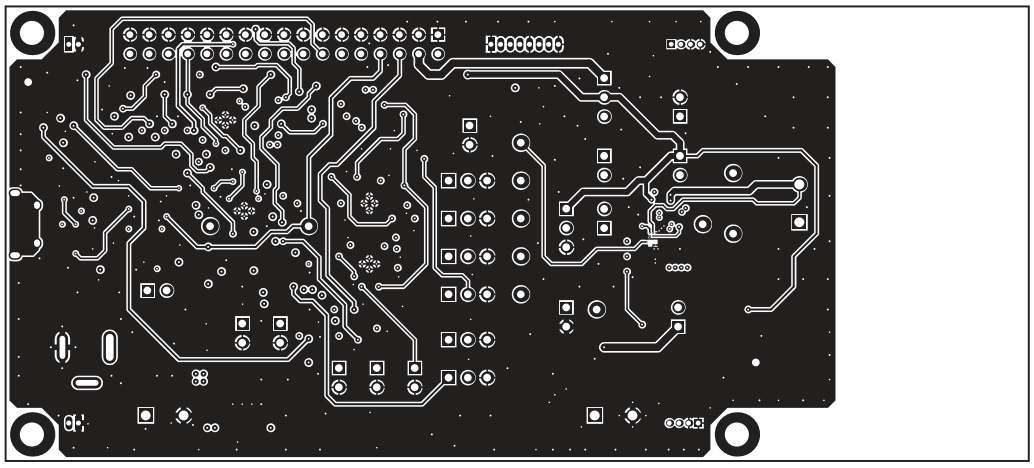

Figure 18. PCB Layer 8

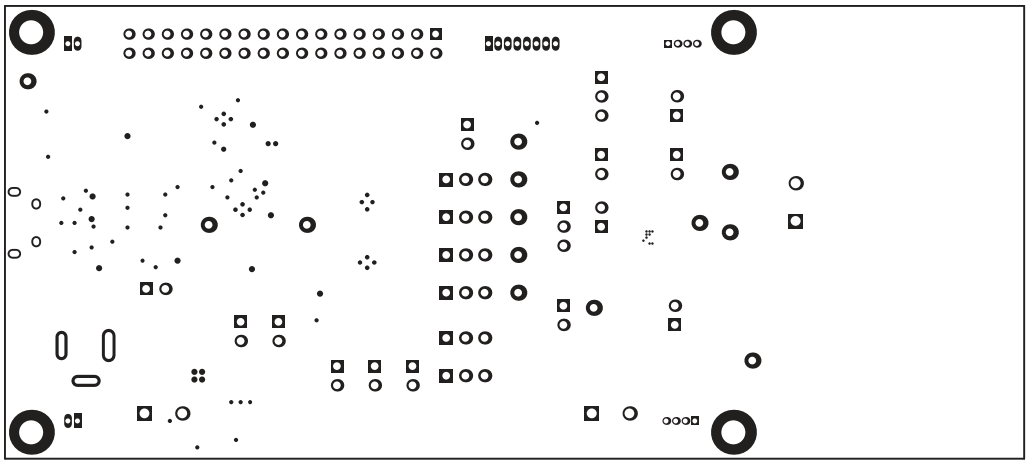

Figure 19. PCB Layer 9

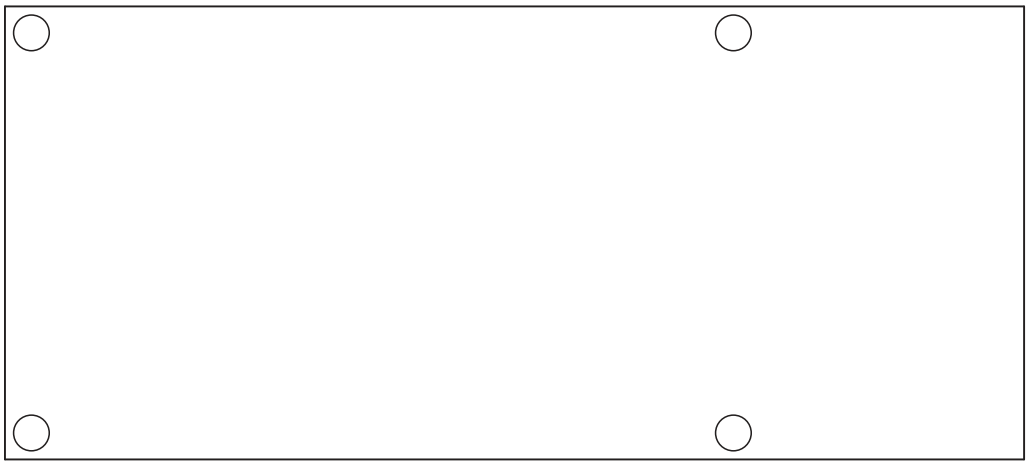

Figure 20. PCB Layer 10

Symbol	Hit Count	Finished Hole Size	Plated	Hole Type	Physical Length	Rout Path Length
⊠	1	1.010mm (39.76mil)	PTH	Slot	3.560mm (140.16mil)	2.550mm (100.39mil)
✡	2	0.760mm (29.92mil)	PTH	Slot	3.050mm (120.08mil)	2.290mm (90.16mil)
⊠	2	0.800mm (31.50mil)	PTH	Slot	1.000mm (39.37mil)	0.200mm (7.87mil)
⊕	2	0.800mm (31.50mil)	PTH	Slot	1.300mm (51.18mil)	0.500mm (19.69mil)
□	4	3.175mm (125.00mil)	PTH	Round		
C	6	1.300mm (51.18mil)	PTH	Round		
A	8	0.650mm (25.59mil)	PTH	Round		
⊠	9	0.150mm (5.91mil)	PTH	Round		
B	12	0.660mm (26.00mil)	PTH	Round		
○	16	0.200mm (7.87mil)	PTH	Round		
▽	32	1.020mm (40.16mil)	PTH	Round		
◇	33	1.016mm (40.00mil)	PTH	Round		
✡	34	0.890mm (35.04mil)	PTH	Round		
▽	91	0.203mm (8.00mil)	PTH	Round		
✡	309	0.254mm (10.00mil)	PTH	Round		
	561 Total					

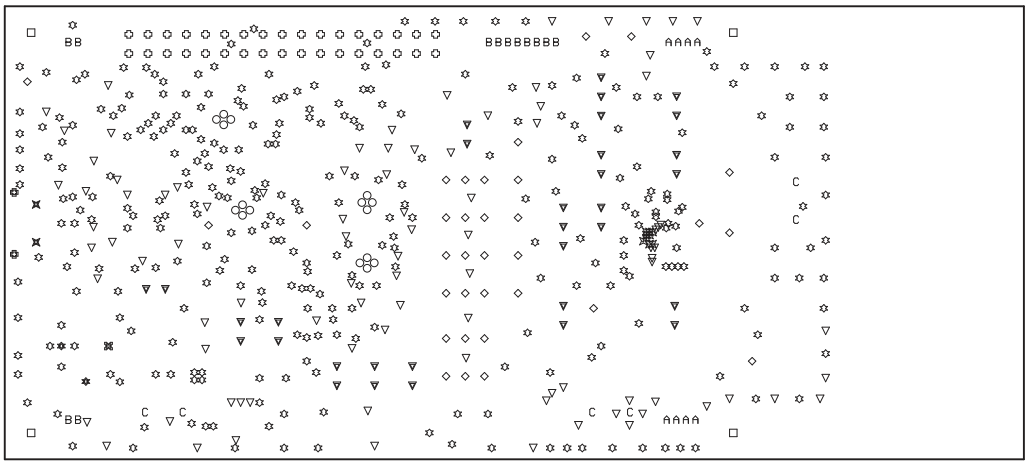

Figure 21. PCB Layer 11

Figure 22. PCB Layer 12

6.3 Bill of Materials

Table 2 details the EVM BOM.

Table 2. Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacture	Alternate Part Number[1]	Alternate Manufacturer
PCB	1		Printed Circuit Board		AAP062	Any		
C1, C2, C9, C11, C18, C27, C30, C32, C50, C51, C52, C53, C54, C55, C58, C59	16	0.1uF	CAP, CERM, 0.1uF, 10V, +/-10%, X7R, 0402	0402	GRM155R71A104KA01D	MuRata		
C3	1	0.1uF	CAP, CERM, 0.1 µF, 16 V, +/- 10%, X7R, 0402	0402	GRM155R71C104KA88D	MuRata		
C5, C8, C31	3	22uF	CAP, CERM, 22 µF, 16 V, +/- 10%, X5R, 0805	0805	C2012X5R1C226K125AC	TDK		
C6, C13, C60	3	10uF	CAP, CERM, 10 µF, 10 V, +/- 20%, X5R, 0603	0603	C1608X5R1A106M080AC	TDK		
C7, C10, C12, C19, C26, C28	6	1uF	CAP, CERM, 1uF, 6.3V, +/-20%, X5R, 0402	0402	C1005X5R0J105M	TDK		
C14, C25, C29	3	0.01uF	CAP, CERM, 0.01uF, 6.3V, +/-10%, X7R, 0402	0402	GRM155R70J103KA01D	MuRata		
C15, C16, C17, C33, C34, C35, C36, C37, C38, C39, C40, C41, C42, C43, C44, C49, C56, C57	18	0.1uF	CAP, CERM, 0.1uF, 16V, +/-10%, X7R, 0402	0402	GRM155R71C104KA88D	MuRata		
C20	1	0.1uF	CAP, CERM, 0.1 µF, 10 V, +/- 10%, X7R, 0402	0402	GRM155R71A104KA01D	MuRata		
C45, C46	2	47pF	CAP, CERM, 47pF, 25V, +/-5%, C0G/NP0, 0402	0402	GRM1555C1E470JA01D	MuRata		
C47	1	100pF	CAP, CERM, 100pF, 50V, +/-5%, C0G/NP0, 0402	0402	GRM1555C1H101JA01D	MuRata		
C48	1	1000pF	CAP, CERM, 1000pF, 50V, +/-5%, C0G/NP0, 0402	0402	GRM1555C1H102JA01D	MuRata		
D1	1	Blue	LED, Blue, SMD	Blue LED	SMLP12BC7TT86	Rohm		
D2	1	Green	LED, Green, SMD	LED_0805	LTST-C171GKT	Lite-On		
FB1, FB2	2	220 ohm	2.2A Ferrite Bead, 220 ohm at 100MHz, SMD	0603	MPZ1608S221A	TDK		
H1, H2, H3, H4	4		MACHINE SCREW PAN PHILLIPS 4-40	Machine Screw, 4-40, 1/4"	PMSSS 440 0025 PH	B&F Fastener Supply		
H5, H6, H7, H8	4		ROUND STANDOFF 4-40 ALUM 1/2"	ROUND STANDOFF 4-40 ALUM 1/2"	2027	Keystone		
H9	1		Custom Cable For Connecting Stereo EVM Boards. IDC34 Ribbon Cable With Offset Pins.	IDC34 Custom Cable	CBL007	Any Shop		
J1, J2, J3, J4, J6, J7, J9, J10, J11, J24, J26, J27, J32	13		Header, 2.54 mm, 2x1, Tin, TH	Header, 2.54 mm, 2x1, TH	TSW-102-07-T-S	Samtec		
J5, J30	2		Header, 2.54 mm, 3x1, Tin, TH	Header, 2.54 mm, 3x1, TH	TSW-103-07-T-S	Samtec		
J8, J12, J31	3		Terminal Block, 5 mm, 2x1, Tin, TH	Terminal Block, 5 mm, 2x1, TH	691 101 710 002	Wurth Elektronik eiSos		

(1) Unless otherwise noted in the Alternate Part Number and/or Alternate Manufacturer columns, all parts may be substituted with equivalents.

Table 2. Bill of Materials (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacture	Alternate Part Number[1]	Alternate Manufacturer
J13, J14	2		Receptacle, 50 mil, 2x1, Gold, R/A, TH	Receptacle, 2x1, 50mil, R/A	851-43-002-20-001000	Mill-Max		
J15, J16, J17, J18, J19, J20	6	1x3	Header, 100mil, 3x1, Gold, TH	PBC03SAAN	PBC03SAAN	Sullins Connector Solutions		
J21	1		Receptacle, 50 mil, 8x1, Gold, R/A, TH	Receptacle, 8x1, 50mil, R/A	851-43-008-20-001000	Mill-Max		
J22, J25	2		SOCKET .050" GRID SIP 4 POS R/A, TH	R/A 4x1 receptacle	851-43-004-20-001000	Mill-Max		
J23	1		Connector, Receptacle, Micro-USB Type AB, R/A, Bottom Mount SMT	Connector, USB Micro AB	DX4R205JJAR1800	JAE Electronics		
J28	1		Header (shrouded), 2.54 mm, 17x2, Gold, TH	Header (shrouded), 2.54 mm, 17x2, TH	N2534-6002-RB	3M		
J29	1		Power Jack, mini, 2.5mm OD, R/A, TH	Jack, 14.5x11x9mm	RAPC712X	Switchcraft		
L1	1	2.2uH	Inductor, Shielded, Composite, 2.2uH, 3.7A, 0.02 ohm, SMD	4x2x4mm	XFL4020-222MEB	Coilcraft		
LS1	1		TAS2555 EVM Speaker	Speaker, 20x26mm.	DMSP1217P-J-01	AAC Technologies		
Q1	1	0.3V	Transistor, NPN, 40V, 0.15A, SOT-23	SOT-23	MMBT2222A	Fairchild Semiconductor		
R1, R3, R6, R15, R38, R39, R43, R44, R49	9	10.0k	RES, 10.0k ohm, 1%, 0.063W, 0402	0402	CRCW040210K0FKED	Vishay-Dale		
R2	1	22.0k	RES, 10.0k ohm, 1%, 0.063W, 0402	0402	CRCW040210K0FKED	Vishay-Dale		
R4, R5, R11, R12, R30, R31, R32, R33	8	0	RES, 0 ohm, 5%, 0.063W, 0402	0402	CRCW04020000Z0ED	Vishay-Dale		
R13, R34, R36, R47	4	47k	RES, 47 k, 5%, 0.063 W, 0402	0402	CRCW040247K0JNED	Vishay-Dale		
R14, R35, R37, R48	4	2.2k	RES, 2.2 k, 5%, 0.063 W, 0402	0402	CRCW04022K20JNED	Vishay-Dale		
R16	1	4.99k	RES, 4.99k ohm, 1%, 0.063W, 0402	0402	CRCW04024K99FKED	Vishay-Dale		
R17, R18	2	10.0k	RES, 10.0 k, 1%, 0.063 W, 0402	0402	CRCW040210K0FKED	Vishay-Dale		
R19, R21, R22, R24, R45	5	49.9	RES, 49.9 ohm, 1%, 0.063W, 0402	0402	CRCW040249R9FKED	Vishay-Dale		
R20	1	15.0k	RES, 15.0k ohm, 1%, 0.063W, 0402	0402	CRCW040215K0FKED	Vishay-Dale		
R23	1	3.09k	RES, 3.09k ohm, 1%, 0.063W, 0402	0402	CRCW04023K09FKED	Vishay-Dale		
R25	1	1.50k	RES, 1.50k ohm, 1%, 0.063W, 0402	0402	CRCW04021K50FKED	Vishay-Dale		
R26, R27	2	27.4	RES, 27.4 ohm, 1%, 0.063W, 0402	0402	CRCW040227R4FKED	Vishay-Dale		
R28, R40	2	360	RES, 360 ohm, 5%, 0.063W, 0402	0402	CRCW0402360RJNED	Vishay-Dale		
R29	1	100k	RES, 100k ohm, 1%, 0.063W, 0402	0402	CRCW0402100KFKED	Vishay-Dale		
R41	1	0	RES, 0, 5%, 0.063 W, 0402	0402	CRCW04020000Z0ED	Vishay-Dale		
R42, R46	2	0	RES, 0, 5%, 0.1 W, 0603	0603	CRCW06030000Z0EA	Vishay-Dale		
S1, S2	2		Switch, Tactile, SPST-NO, 0.05A, 12V, SMT	Switch, 4.4x2x2.9 mm	TL1015AF160QG	E-Switch		
SHUNT1, SHUNT2, SHUNT3, SHUNT4, SHUNT5, SHUNT6, SHUNT7, SHUNT8, SHUNT9, SHUNT10, SHUNT11, SHUNT12, SHUNT13, SHUNT14, SHUNT15, SHUNT16, SHUNT17, SHUNT18, SHUNT19	19	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec	969102-0000-DA	3M

Table 2. Bill of Materials (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacture	Alternate Part Number[1]	Alternate Manufacturer
TP1, TP2, TP3, TP4, TP5, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15	13	Orange	Test Point, Miniature, Orange, TH	Orange Miniature Testpoint	5003	Keystone		
TP6, TP7	2	Black	Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone		
U1	1		WCSP30-YFF	YFF00030BFBA	TAS2560YFF	Texas Instruments		Texas Instruments
U2	1		EEPROM, 256KBIT, 400KHZ, MSOP8	MSOP-8	24LC256-I/MS	Microchip		
U3	1		TCA9406 Dual Bidirectional 1-MHz I2C-BUS and SMBus Voltage Level-Translator, 1.65 to 3.6 V, -40 to 85 degC, 8-pin US8 (DCU), Green (RoHS & no Sb/Br)	DCU0008A	TCA9406DCUR	Texas Instruments	Equivalent	Texas Instruments
U4, U5, U7, U10	4		Dual 1-of-4 FET Multiplexer / Demultiplexer 2.5-V / 3.3-V Low-Voltage High-Bandwidth Bus Switch, RGY0016A	RGY0016A	SN74CB3Q3253RGYR	Texas Instruments		Texas Instruments
U6, U11, U20	3		4-BIT DUAL-SUPPLY BUS TRANSCEIVER WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS, RSV0016A	RSV0016A	SN74AVC4T774RSVR	Texas Instruments		None
U8	1		Low-Voltage 8-Bit I2C and SMBus I/O Expander, 1.65 to 5.5 V, -40 to 85 degC, 16-pin UQFN (RSV), Green (RoHS & no Sb/Br)	RSV0016A	TCA6408ARSVR	Texas Instruments	Equivalent	None
U9	1		Single 2-Line to 1-Line Data Selector Multiplexer, DCT0008A	DCT0008A	SN74LVC2G157DCTR	Texas Instruments		None
U12	1		Single Output LDO, 1 A, Fixed 3.3 V Output, 2.2 to 5.5 V Input, with Reverse Current Protection, 6-pin SOT-223 (DCQ), -40 to 125 degC, Green (RoHS & no Sb/Br)	DCQ0006A	TPS73733DCQ	Texas Instruments	Equivalent	None
U13	1		Single Output Low Noise LDO, 400 mA, Fixed 1.8 V Output, 1.7 to 5.5 V Input, with Reverse Current Protection, 5-pin SOT-23 (DBV), -40 to 85 degC, Green (RoHS & no Sb/Br)	DBV0005A	TPS73618DBVR	Texas Instruments	Equivalent	None
U14	1		Single Bus Buffer Gate With 3-State Output, DCK0005A	DCK0005A	SN74LVC1G125DCKR	Texas Instruments	SN74LVC1G125DCKT	Texas Instruments
U15, U16, U17, U18	4		DUAL BUFFER GATE, DRL0006A	DRL0006A	SN74LVC2G34DRLR	Texas Instruments		None
U19	1		USB Streaming Controller, PFB0048A, NRND	PFB0048A	TAS1020BPFBR	Texas Instruments	TAS1020BPFB	Texas Instruments
U21	1		Triple BUFFER GATE	DRL0006A	SN74LVC3G34DCUR	Texas Instruments		None
Y1	1		Oscillator, 6MHz, 3.3V, SMD	2.5x1x2.5mm	625L3I006M00000	CTS Electrocomponents		
C4	0	22uF	CAP, CERM, 22 µF, 16 V, +/- 10%, X5R, 0805	0805	C2012X5R1C226K125AC	TDK		
C21, C22	0	1000pF	CAP, CERM, 1000pF, 50V, +/-5%, C0G/NP0, 0402	0402	GRM1555C1H102JA01D	MuRata		
C23, C24	0	4700pF	CAP, CERM, 4700 pF, 50 V, +/- 10%, X7R, 0402	0402	GRM155R71H472KA01D	MuRata		
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A		
R7, R8	0	1.00k	RES, 1.00 k, 1%, 0.063 W, 0402	0402	CRCW04021K00FKED	Vishay-Dale		
R9, R10	0	2.00k	RES, 2.00 k, 1%, 0.063 W, 0402	0402	CRCW04022K00FKED	Vishay-Dale		

STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (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/lsds/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/lsds/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.

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2. 実験局の免許を取得後ご使用いただく。
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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:*

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.

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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 ANDCONDITIONS 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.

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Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

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