

## **VCA8500BOARD**

The Texas Instruments VCA8500BOARD evaluation module makes it easy to evaluate the performance of the TI VCA8500 variable gain amplifier. This user's guide provides a description of the evaluation module and its operation, schematic diagram, bill of materials, and the printed-circuit board layout.

If going from a Rev B BOARD to a Rev C BOARD, /CS has been changed to RESET.

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## 1 Description

The Texas Instruments VCA8500BOARD evaluation module makes it easy to evaluate the performance of the VCA8500 variable gain amplifier. The evaluation module operates in three modes: Default Power Up, PC Control, and Direct Control. Default-Power-Up mode does not require any external clocking or data input to enable the operation of the VCA8500. The functionality in Default-Power-Up mode is limited to factory-programmed modes. PC-Control mode uses the included software to operate all of the functions of the VCA8500. The software was written on Windows™ XP and its operation has been verified with Windows™ XP. Direct-Control mode uses external control and data signals to control the functions of the VCA8500.

The VCA8500BOARD has the following features:

- Easy testing of the VCA8500
- Single-ended input
- Three modes of operation:
  - Default Power Up
  - PC Control
  - Direct Control

## 2 Initial Configuration

### 2.1 Power Supply

The VCA8500BOARD has provisions for six separate power supplies:

- +5 V: Positive VCA Supply
  - This positive 5 V supplies the CW and VCA circuits. (P2)
- +3.3 V: Positive VCA Supply
  - This positive 3.3 V supplies the LNA, Digital circuit and VCA Outputs . Ensure that all three pads of W1 solder jumper are shorted. (P2)
- +5 V/–5 V: Supplies for all other circuitry
  - These supply all other +5 V/–5 V requirements onboard. (P4)
- +15 V/–15 V: Supplies for CW Amplifiers
  - These supplies are optional for the CW amplifiers only. The user does not need them connected unless using CW Mode. To drive these amplifiers with +15 V/–15 V, W2 and W3 solder jumpers should be open. (P3)

## 3 Signals

### 3.1 Input Signals

The input signals are applied to SMA connectors J1 to J8. The input impedance of the VCA is 8 kΩ. The inputs are ac-coupled into the LNA of the VCA8500 through 1-μF capacitors and do not attenuate the input signal.

### 3.2 Output Signals

The outputs of the evaluation module are located at SMA connectors J21 through J28 for the TGC outputs, and J10 to J19 for the CW outputs. The outputs from the VCA8500 are buffered with operational amplifiers.

### 3.3 TGC Outputs

The differential TGC outputs are buffered by operational amplifiers (OPA842) in a differential configuration with a differential gain of 1. When testing the VCA8500BOARD, outputs J21 through J28 (TGC outputs) must be terminated into 50-Ω loads such as those of a spectrum analyzer. This termination results in the proper matching for the output amplifiers, and no loss has to be taken into account.

### 3.4 CW Outputs

Figure 1 shows the CW output circuit. This circuit is duplicated for each CW output.

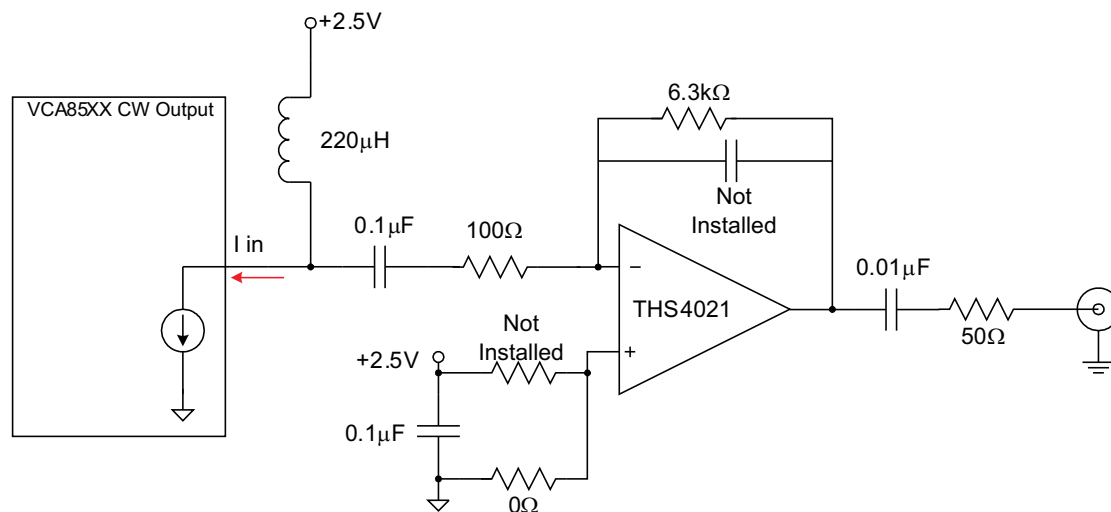


Figure 1. CW Output Circuit

The CW outputs are current outputs and require a current-to-voltage conversion in order to view the outputs with an oscilloscope or spectrum analyzer. The THS4021 operational amplifier is used as the current-to-voltage converter.

When using the VCA8500, the CW outputs need a compliance voltage of +2.5 V. The circuit in Figure 1 shows how the compliance voltage is applied to the VCA8500 device through a 220-µH inductor. The CW output circuit allows the noise of the CW path to be measured. This configuration is the reason for the large feedback resistor in the output amplifier circuit. Before summing more than two CW channels, ensure that the output amplifier does not exceed its maximum output capability. To increase the output capability of the THS4021 ensure that W2 and W3 are open and supply ±15 V to P3.

## 4 Microcontroller

The VCA8500BOARD contains a microcontroller to access internal functions. The microcontroller provides the evaluation module the ability to be controlled by software running on a PC. The microcontroller is run from its own internal oscillator set to 12 MHz. The only external clock signals are those used to communicate to the VCA8500 via the serial data clock line, and the embedded clock signal in the RS-232 communications circuit. The RS-232 clock operates only when data is being sent from the personal computer (PC) to the microcontroller. The serial communication from the PC to the microcontroller is set to 19200 kbps (baud rate). This baud rate is set internally on the microcontroller and is configured automatically in the PC software.

## 5 Modes of Operation

The three modes of operation for the VCA8500BOARD are Default Power Up, PC Control, and Direct-Control.

### 5.1 Default-Power-Up Mode

If no external source or PC control is available, the VCA8500 powers up in a default mode, which sets the VCA8500 to TGC mode with these settings, PGA Gain 20 dB, Clamp Level Disabled, and Filter Bandwidth 15 MHz.

### 5.2 PC Control Mode

This mode requires P10 to be shorted using surface-mount jumpers. This allows the VCA to interface with the microcontroller. Switch S1 is not installed, and the settings are hard-wired to PC-Control mode. The VCA8500 is controlled by the software running on a PC. At this point, the serial cable included with the VCA8500BOARD must be connected to the PC serial port. The program called VCA8500EVM then sets the proper baud rate for communication with the VCA8500BOARD. By using a PC to control the VCA8500, the entire device functionality is available for testing. The software provides the ability to select any of the clamp ranges, filter bandwidth, PGA gains settings, direct an input to any CW output, or power down the chip completely.

### 5.3 Direct Control Mode

Remove solder jumpers from P10, and connect the external source to DIN, CLK, DOUT, and  $\overline{CS}$ . These are SMA connectors J30, J31, J32, and J33, respectively. This allows for direct control of the VCA8500 with an external control source such as a digital word generator.

## 6 VCA8500BOARD Full-Access Software

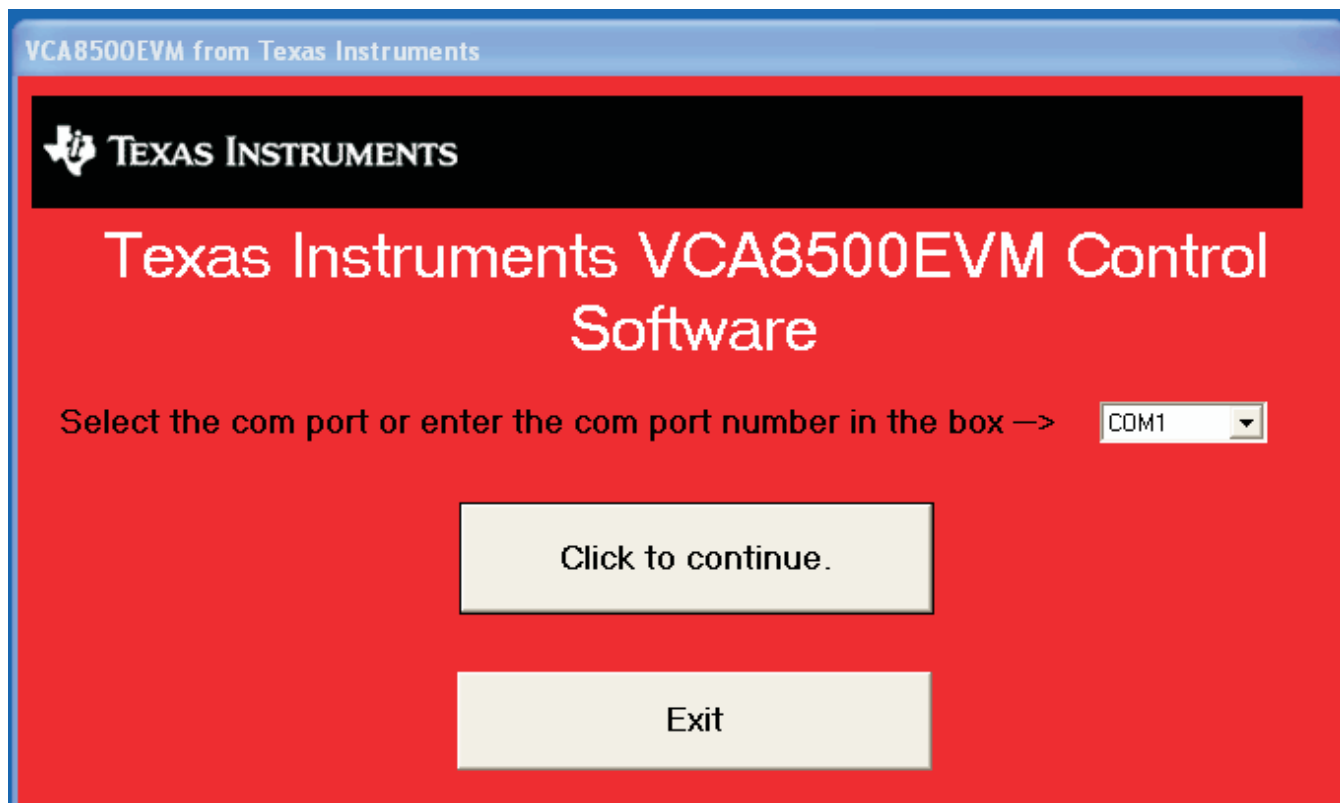
The TI website includes full-access installation software, data sheet, and EVM schematic

### 6.1 Loading the Software

Download the zip file from the TI website at <http://www.ti.com/product/vca8500>. . Select the folder called *Installation Software*, and double-click on Setup.exe. The installation wizard guides you through the rest of the installation process.

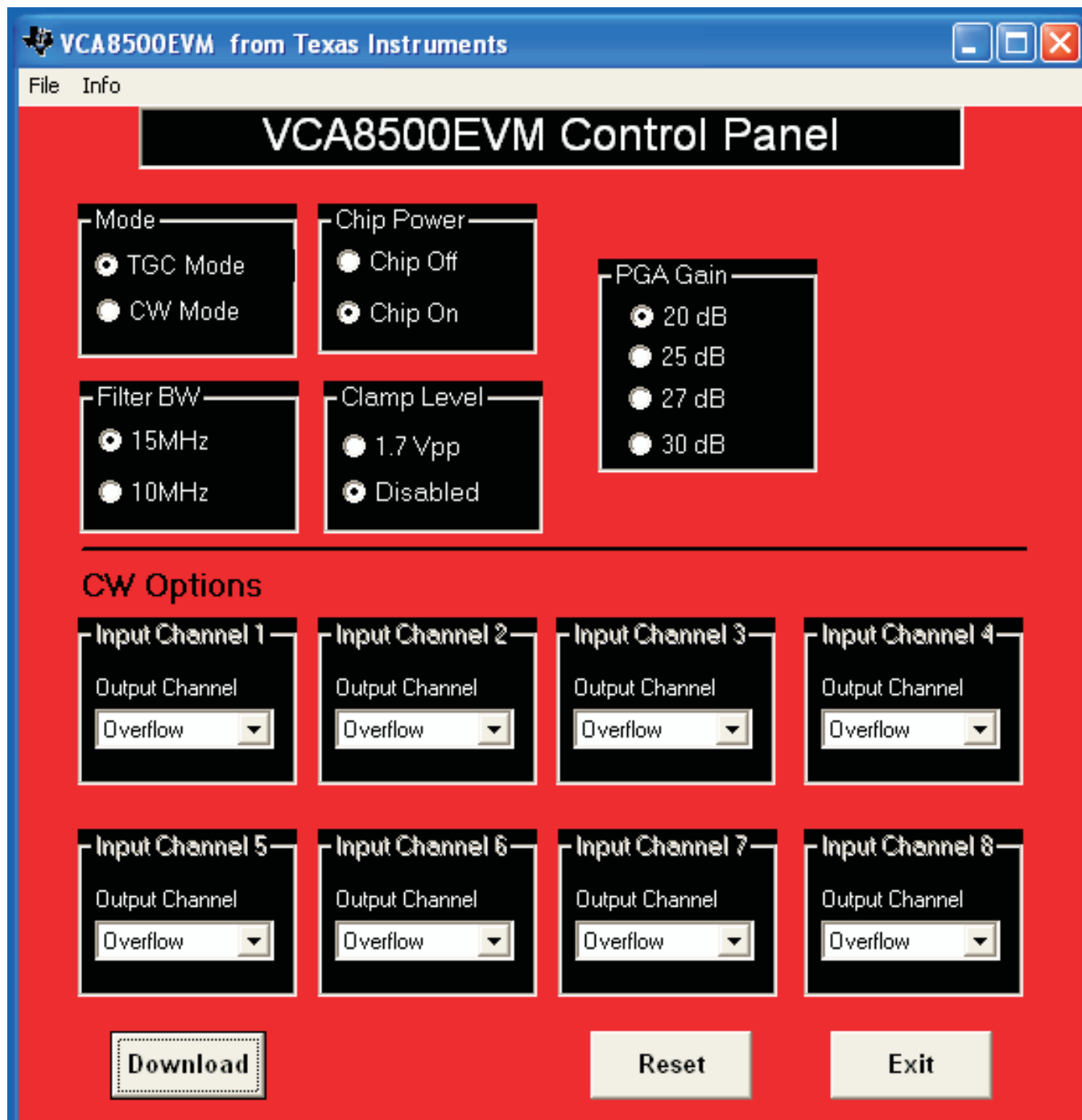
### 6.2 Initial Start-up Screen

[Figure 2](#) shows the initial start-up screen.



**Figure 2. Initial Start-up Screen**

If COM1 is used, then click the *Click to continue* box. Otherwise, select the correct COM port from the list that the program provided prior to selecting the continue box.

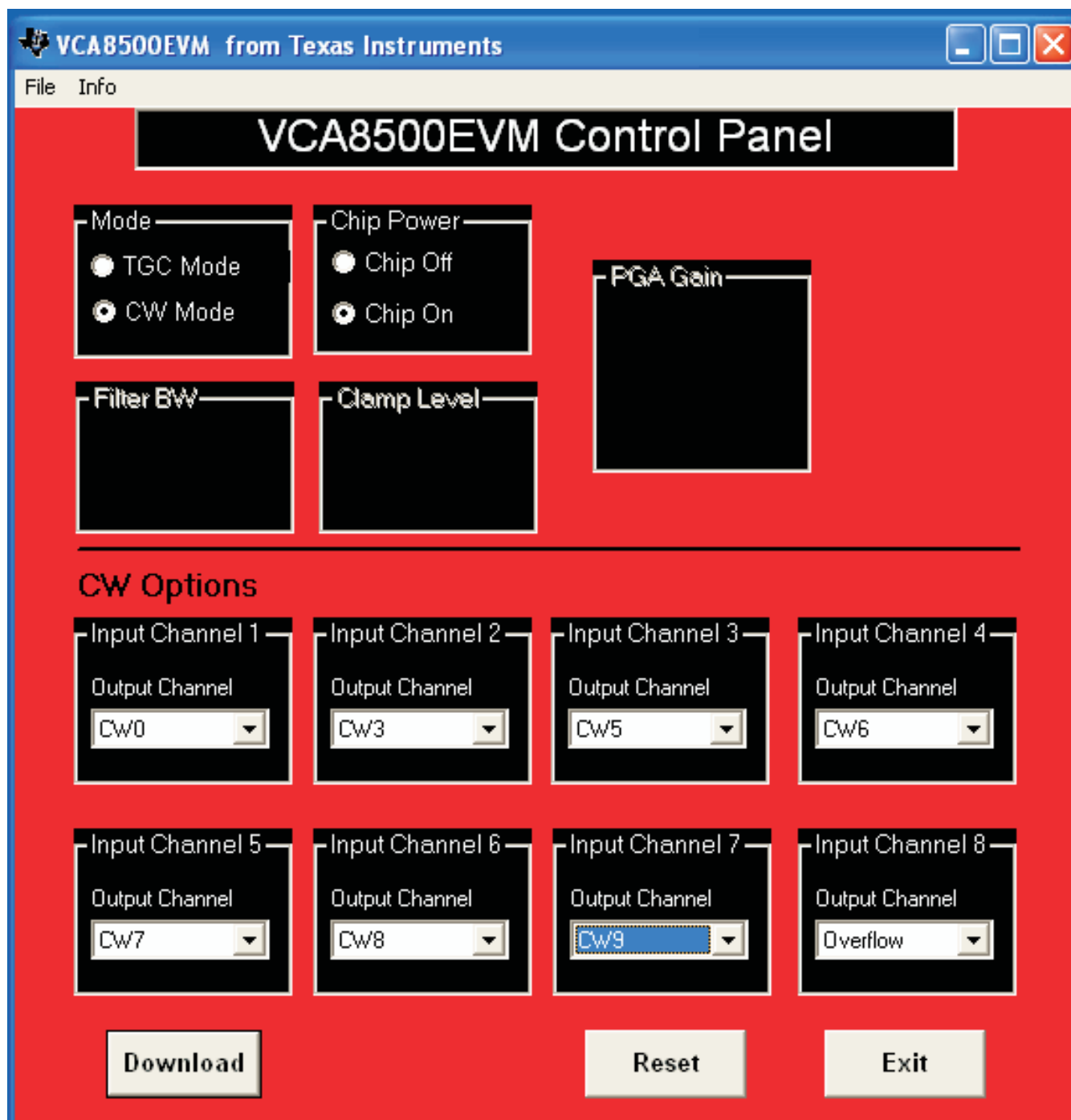


**Figure 3. Main Program Window**

The main program window allows the user to choose the mode of operation. [Figure 3](#) displays the default program settings. In order to activate these settings, click *Download*. When *Reset* is selected, all options are set to these same default settings, but the user must press *Download* again in order for the changes to take effect. The Chip Power option only affects the VCA8500 and no other IC on the evaluation board. If TGC mode is selected, the *Clamp Level*, *Filter Bandwidth*, and *PGA Gain* options become available. If CW mode is selected, the CW options become available and the other functions are disabled.

When the selections have been made, click *Download* to send the data to the VCA8500 in this case.

When the VCA8500BOARD is controlled by the software, any input to the VCA8500 can be routed to any of the CW outputs via the CW Options selections. Each input channel is listed with a pull-down menu to select any of the ten available outputs (CW0 to CW9) or the Overflow option, which effectively disables the channel. Figure 4 shows this process.



**Figure 4. CW Options Selection**

Once all the selections have been made, click Download to send the data to the VCA8500. It is possible, because of the flexible nature of the software, to direct all inputs to one output. This is permissible and can be supported as long as the output amplifiers in the CW current-to-voltage converters are driven with a  $\pm 15\text{-V}$  supply (P3); also, W2 and W3 need to be open. The maximum output current from one input channel is 3 mA.

The EVM software is available on the Texas Instruments Web site, [ti.com](http://ti.com), by looking in the VCA8500 product folder in the *Tools and Software* section.

### 6.3 Other Program Functions

Selecting the *Exit* command button exits the program. The *Help* pull-down menu contains information on the program and support information.

## 7 Printed-Circuit Board Layout, Bill of Materials, and Schematic

This section provides the printed-circuit board layout, the bill of materials, and the schematics.

### 7.1 Printed-Circuit Board Layout

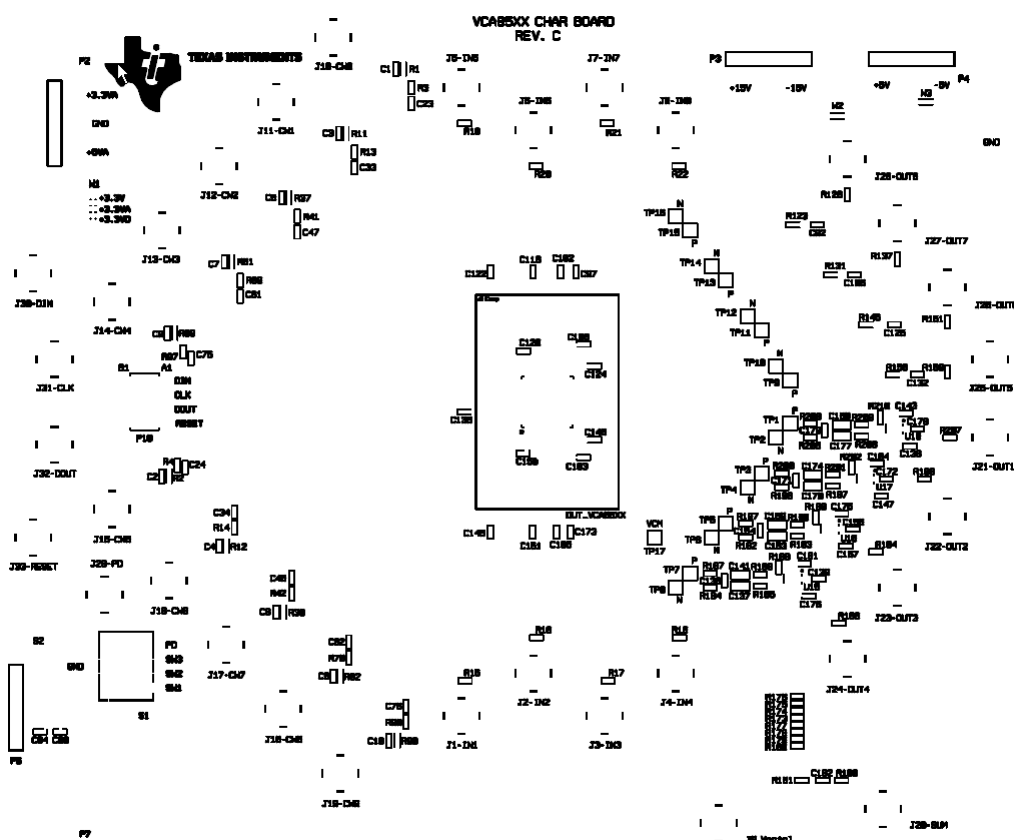
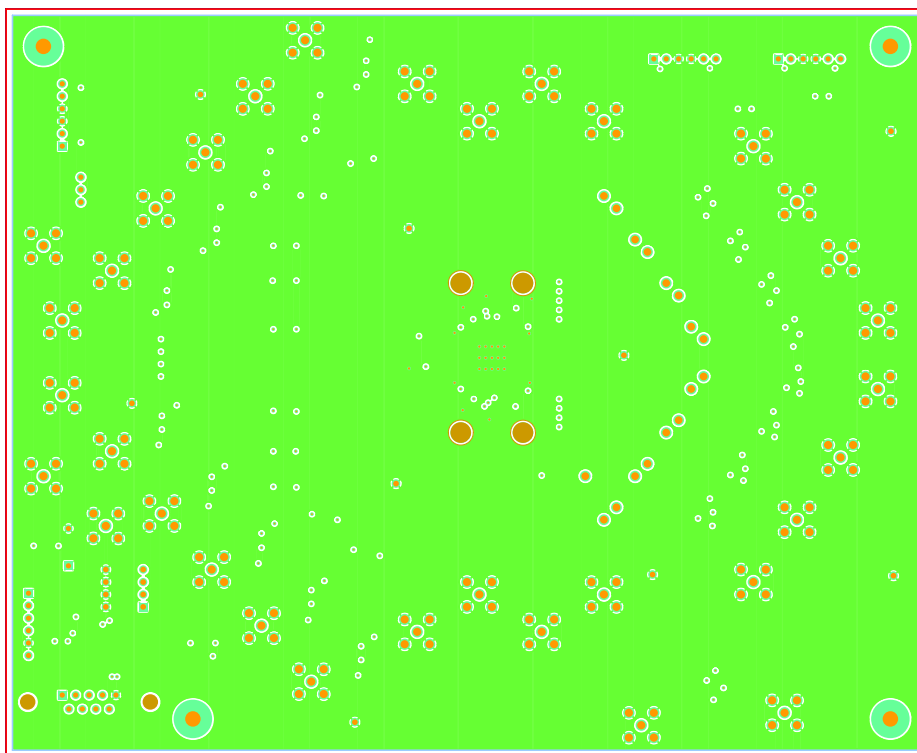
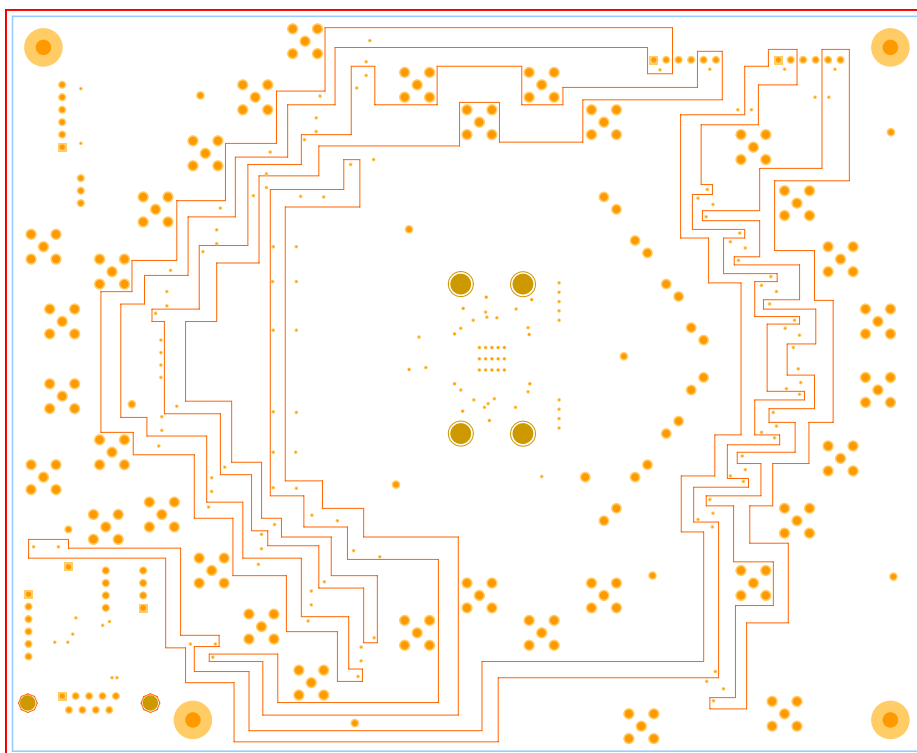


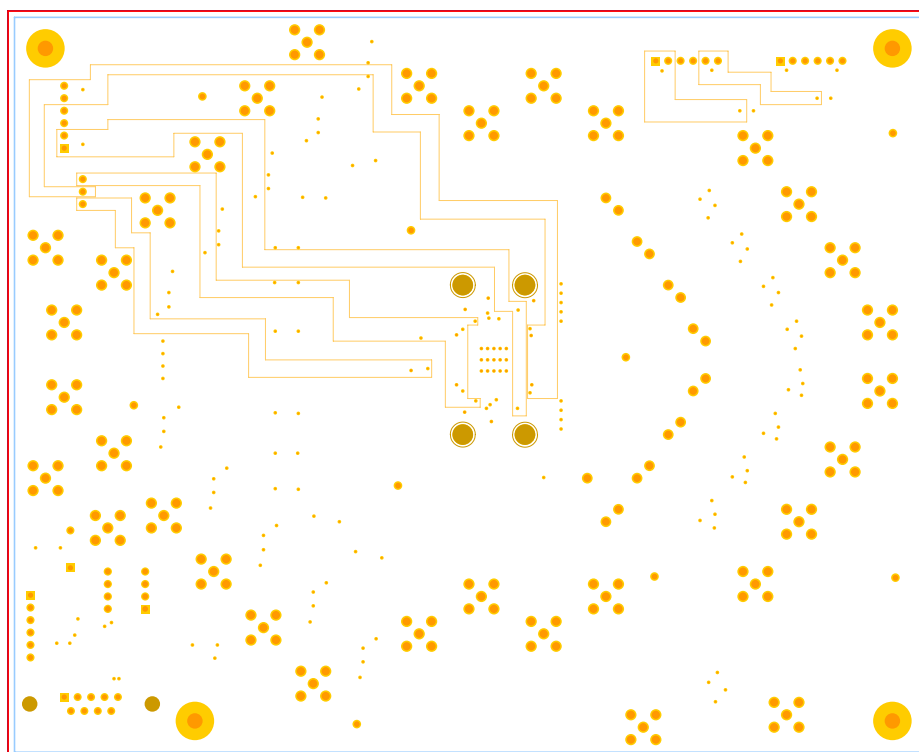
Figure 5. Silkscreen — Top Layer



**Figure 6. Ground**



**Figure 7. Power Plane 1**



**Figure 8. Power Plane 2**



**Figure 9. Ground**

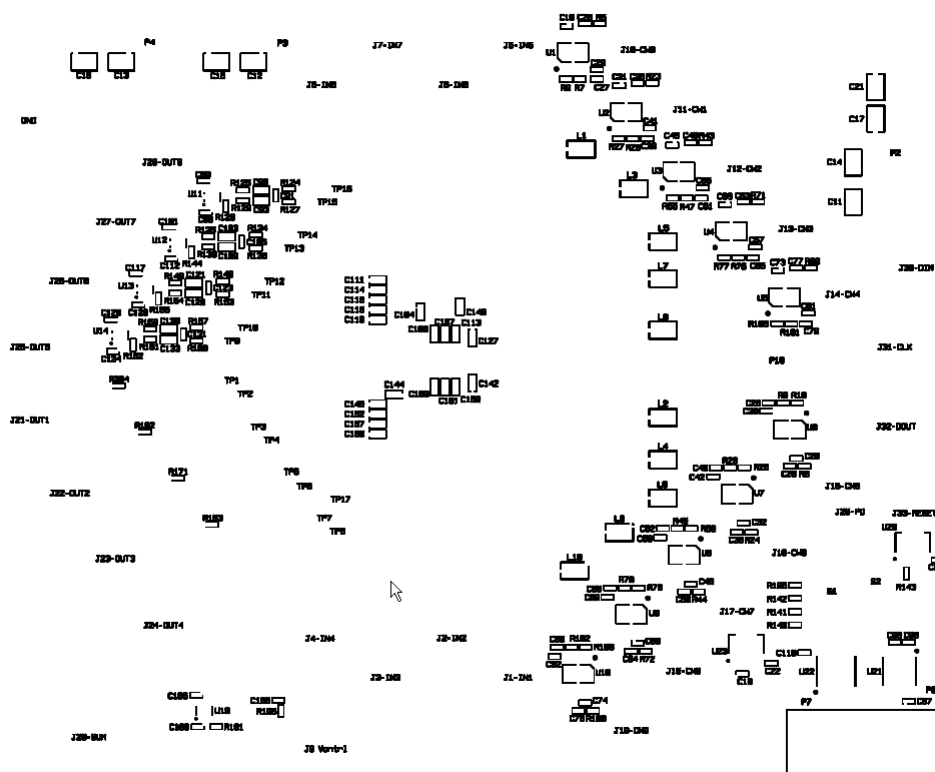


Figure 10. Silkscreen — Bottom Layer

## 7.2 Bill of Materials

**Table 1. Bill of Materials**

Item	Qty	Mfg	Mfg Part#	Ref Des	Description	Value or Function
	REF	–	VCA85XXB	–	ASSEMBLY	–
	REF	–	VCA85XXB	–	SCHEMATIC	–
	1	XX	VCA85XXB	–	FABRICATION	–
	REF	–	VCA85XXB	–	ARTWORK	–
1	19	Kemet	C0402C103K3RAC	C25, C26, C35, C36, C49, C50, C63, C64, C77, C78, C92, C106, C125, C132, C139, C156, C162, C172, C179	Capacitor, SMT, 0402	Capacitor, SMT, 0402,CER, 0.01µF, 25V, 10%, X7R
2	75	Kemet	C0402C104K8PAC	C18–C20, C22–C24, C27–C34, C39–C42, C45–C48, C51, C52, C55, C56, C59–C62, C65–C68, C73–C76, C79–C82, C87–C89, C94, C95–C99, C101, C108, C110, C112, C117, C120, C124, C128, C129, C134–C136, C143, C146, C147, C150, C155, C163, C164, C166–C168, C175, C176, C181	Capacitor, SMT, 0402	Capacitor, SMT, 0402, CER, 0.1µF, 10V, 10%, X5R
3	8	TDK	C1005X5R0J105M	C97, C102, C116, C122, C145, C151, C165, C173	Capacitor, SMT, 0402	Capacitor, SMT, 0402, CER, 1.0µF, 6.3V, 20%, X5R
4	10	Panasonic Not Installed	ECJ-0EC1H100D	C1–C10	Capacitor, SMT, 0402	Capacitor, SMT, 0402,CER, 10pF, 50V, ±0.5pF, NPO
5	8	Panasonic Not Installed	ECJ-0EC1H470J	C91, C105, C123, C131, C138, C154, C171, C178	Capacitor,SMT,0402	Capacitor, SMT, 0402, CER, 47pF, 50V, 5%, NPO
6	20	Kemet	C0603C225K9PAC	C100, C104, C107, C111, C113–115, C118, C119, C127, C142, C144, C148, C149, C152, C157, C158, C160, C161, C169	Capacitor, SMT, 0603	Capacitor, CER, SMT, 0603, 2.2µF, 6.3V, X5R, 10%
7	16	Kemet	C0603C103J5RAC	C90, C93, C103, C109, C121, C126, C130, C133, C137, C141, C153, C159, C170, C174, C177, C180	Capacitor, SMT, 0603	Capacitor, CER, COG/NPO, 50V, 5%, 0.01µF
8	8	Kemet	C1210C156K4PACTU	C11–C17, C21	Capacitor, SMT	Ceramic capacitor, SMT, 1210, 15µF, 16V, 10%, X5R
9	1	Not Installed	D1833400	BB Clamp	Clamp	Clamp, PAP64, 10X10, Tucson, 166 mils HOLE 4PL
10	33	Johnson Components	142-0701-201	J1-IN1, J2-IN2, J3-IN3, J4-IN4, J5-IN5, J6-IN6, J7-IN7, J8-IN8, J15-CW5, J16-CW6, J17-CW7, J18-CW8, J19-CW9, J14-CW4, J13-CW3, J12-CW2, J11-CW1, J10-CW0, J21-OUT1, J22-OUT2, J23-OUT3, J24-OUT4, J28-OUT8, J27-OUT7, J26-OUT6, J25-OUT5, J20-SUM, J29-PD, J30-DIN, J31-CLK, J32-DOU, J33-CS, J9 Vcntrl	CON, SMA, THU	SMA coax straight PCB Jack receptacle, 155TL, BRASS/GOLD
11	1	AMP	745781-4	P7	CONN, DSUB, 9P	DSUB, 9 Pin, R/A FEM
12	1	Molex Not Installed	015-19-0080	P10	CONN, SMT, 8P	Header, SMT, 8P, Dual row, 0.1LS, Vertical, C-GRID
13	1	C&K Not Installed	BD04	S1	DIP Switch, Thu, DIP-8	DIP Switch, THU, 8 Pins,SPSTx4, 100LS
14	1	TI	VCA8500	DUT_VCA85XX	DUT, SMT, QFN-64	DUT, SMT, QFN, RGC-64, 0.5mm LS, 9x9x1mm, THRM.PAD
15	4	Samtex	TSW-106-05-G-S	P2–P4, P6	Header, THU, 6P	Header 1X6 .1CTR
16	1	Maxim	MAX3221CAE	U21	IC, SMT, 16P	RS-232 Transceivers
17	10	TI	THS4021CD	U1–U10	IC, SMT, 8P	420 MHz High speed current feedback AMP
18	1	TI	REG104GA-2.5G4	U23	IC, SMT, SOT223-6EP	2.5V, DMOS 1A Low-dropout regulator
19	1	TI	REG104GA-3.3	U20	IC, SMT, SOT223-6EP	3.3V, DMOS 1A Low-dropout regulator
20	8	TI / Burr-Brown	OPA842IDBV	U11–U18	IC, SMT, SOT23-5	Wideband, LOW DIST, Unity-gain stable, voltage-feedback OP AMP
20B	1	TI / Burr-Brown	OPA820IDBV	U19	IC, SMT, SOT23-5	Wideband, LOW DIST, Unity-gain stable, voltage-feedback OP AMP
21	1	Cypress	CY8C2633-24PVXI	U22	IC, SMT, SSOP-20	CYPRESS PSoC Mixed-signal array

Table 1. Bill of Materials (continued)

Item	Qty	Mfg	Mfg Part#	Ref Des	Description	Value or Function
22	10	Panasonic	ELJFA221J	L1–L10	Inductor, SMT	220μH, 5%
23	1	Panasonic Parts on Order Not Installed	EVQPE104K	S2	Jumper, THRU, 2P	Square light touch switch, SMT, SPST, High-density, space saving
24	2	Solder Shorted	JUMPER-0402	W2, W3	Solder jumper, SMT, 2P, 0402	Jumper, SMT0402
25	1	Solder Short 3 pads	JUMPER-0402-3P	W1	Solder jumper, SMT, 3P	Short all 3 pads
26	26	Vishay	CRCW0402000Z	R9, R10, R27, R28, R55, R56, R77, R78, R105, R106, R124, R127, R134, R138, R148, R153, R157, R160, R164, R167, R182, R187, R196, R200, R205, R208	RES, SMT, 0402	RES, SMT, 0402, 1/16W, 0 Ω
26B	26	Vishay Not Installed	CRCW0402000Z	R7, R8, R15–R22, R25, R26, R47, R48, R75, R76, R101, R102	RES, SMT, 0402	RES, SMT, 0402, 1/16W, 0 Ω
27	10	Vishay/Dale	CRCW04021000F100	R3, R4, R13, R14, R41, R42, R69, R70, R97, R98	RES, SMT, 0402	RES, SMT, 100 Ω, 1/16W, 1%, 100ppm
28	1	Vishay/Dale	CRCW04021001F100	R195	RES, SMT, 0402	RES, SMT, 1kΩ, 1/16W, 1%, 100ppm
29	5	Vishay/Dale	CRCW04024701F100	R140–R143, R185	RES, SMT, 0402	RES, SMT, 4.7 kΩ, 1/16W, 1%, 100ppm
30	20	Vishay/Dale	CRCW040249R9F100	R5, R6, R23, R24, R43, R44, R71, R72, R99, R100, R126, R137, R151, R159, R166, R184, R190, R191, R198, R207	RES, SMT, 0402	RES, SMT, 49.9 Ω, 1/16W, 1%, 100ppm
31	16	Vishay/Dale	CRCW04021001F100	R123, R125, R131, R135, R145, R149, R156, R158, R163, R165, R171, R183, R192, R197, R204, R206	RES, SMT, 0402	RES, SMT, 0402, 1kΩ, 1%, 1/16W
32	9	Panasonic	ERJ-2RKF4020X	R173–R181	RES, SMT, 0402	RES, SMT, 0402, 402 Ω, 1%, 1/16W
33	10	Panasonic	ERJ-2RKF6341X	R1, R2, R11, R12, R37, R38, R61, R62, R89, R90	RES, SMT, 0402	RES, SMT, 0402, 6.34 kΩ, 1%, 1/16W
34	16	Vishay/Dale	CRCW0402499RFKED	R128, R129, R139, R144, R154, R155, R161, R162, R168, R169, R188, R189, R201, R202, R209, R210	RES, SMT, 0402	RES, SMT, 0402, 499 Ω, 1%, 1/16W
35	9		1902D	STANDOFFS Hex 4-40	With 1/4" 4-40 Screws	
<b>SPECIAL NOTES AND INSTRUCTIONS</b> Notes: 1) Line items 4, 5, 9, 12, 13, 23, 26B – Components are not installed. 2) Line items 24 and 25 – W1 Short all three pads. Short W2 and W3. 3) Line item 20B – U19 Use OPA820 in place of the OPA642						

## 7.3 Schematic

The schematic drawings appear on the following page.

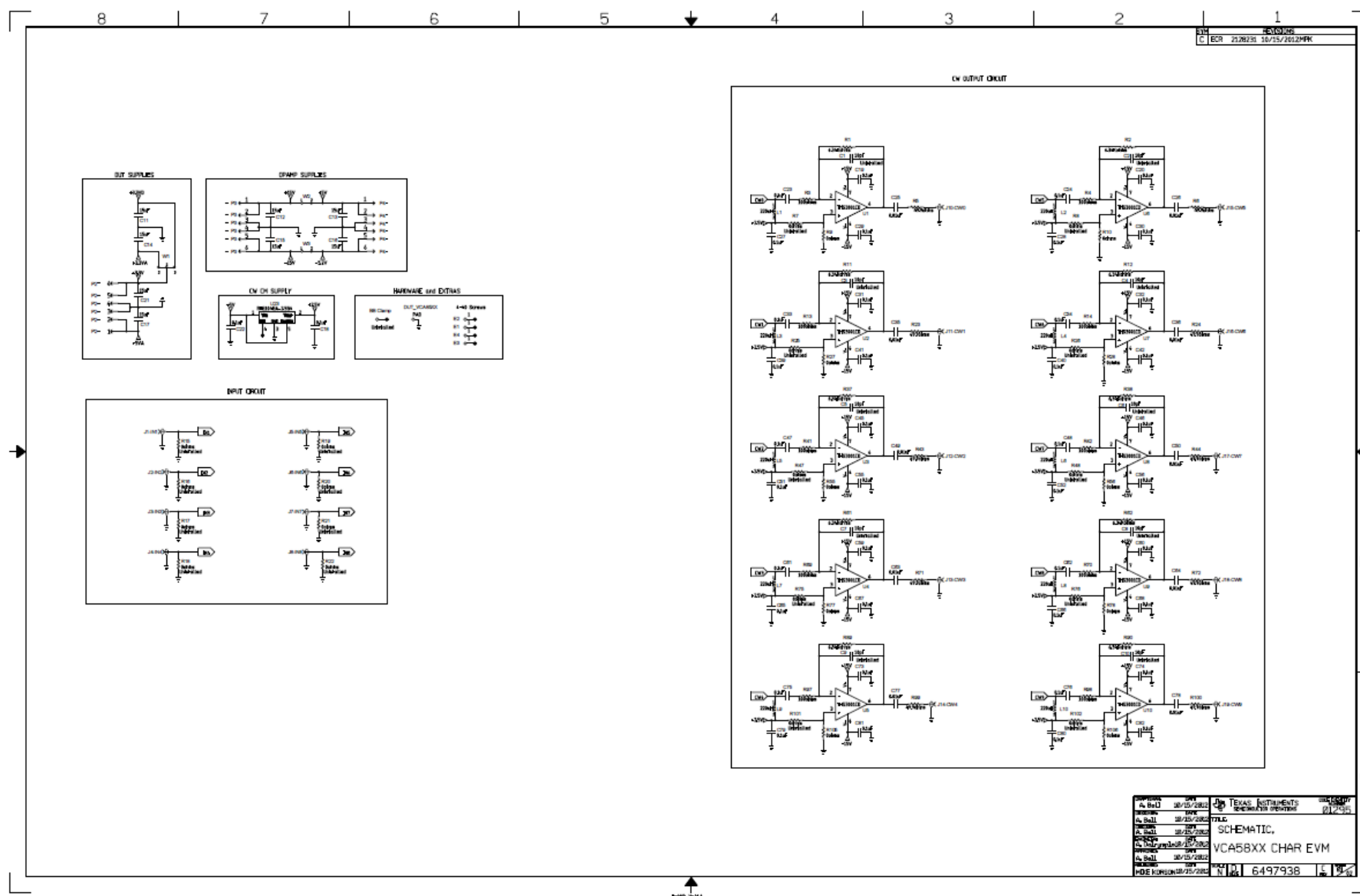


Figure 11. Schematic Pg.1

SLOU216B–January 2008–Revised January 2013  
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## EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of and the output voltage range of .

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 . The EVM is designed to operate properly with certain components above 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.

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As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module 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 or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment 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.

### General Statement for EVMs including a radio

*User Power/Frequency Use Obligations:* This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

### 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

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**

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.

**For EVMs annotated as IC – INDUSTRY CANADA Compliant**

This Class A or B digital apparatus complies with Canadian ICES-003.

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

**Concerning EVMs including radio transmitters**

This device complies with Industry Canada licence-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.

**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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

**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.

**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.

## **【Important Notice for Users of this Product in Japan】**

**This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan**

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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## EVALUATION BOARD/KIT/MODULE (EVM) WARNINGS, RESTRICTIONS AND DISCLAIMERS

**For Feasibility Evaluation Only, in Laboratory/Development Environments.** Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure 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.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

**Certain Instructions.** It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. 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 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

**Agreement to Defend, Indemnify and Hold Harmless.** You agree to 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 use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

**Safety-Critical or Life-Critical Applications.** If you intend to evaluate the components for possible 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, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
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DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
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Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
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