

bq500211A bqTESLA Wireless Power TX EVM

The bqTESLA™ wireless power transmitter evaluation module from Texas Instruments is a high-performance, easy-to-use development module for the design of wireless power solutions. The single-channel transmitter enables designers to speed the development of their end-applications. The bq500211A EVM evaluation module (EVM) provides all basic functions of a Qi-compliant, wireless charger pad. The EVM is intended to be used with bq51013AEVM-764, -765 or any other Qi-compliant receiver. The EVM supports both the WPC 1.0 and WPC 1.1 receivers. The transmitter EVM is a 5-V input design which powers a standard WPC low-power 5-W receiver. The bq500211AEVM-210 supports the bq500211A device.

Contents

1	Applications	2
2	bq500211AEVM-210 Electrical Performance Specifications	2
3	Modifications	2
4	Connector and Test Point Descriptions	3
4.1	Input/Output Connections	3
4.2	Test Point Descriptions	3
5	Schematic and Bill of Materials	5
6	Test Setup	10
6.1	Equipment	10
6.2	Equipment Setup	10
7	bq500211AEVM-210 Assembly Drawings and Layout	12
8	Reference	16

List of Figures

1	bq500211AEVM-210 Schematic, Page 1 of 3	5
2	bq500211AEVM-210 Schematic, Page 2 of 3	6
3	bq500211AEVM-210 Schematic, Page 3 of 3	7
4	Equipment Setup	11
5	Efficiency versus Power, bq500211AEVM-210 Transmitter and HPA764 Receiver.....	12
6	Assembly Top.....	13
7	Top Silk	13
8	Top Layer.....	14
9	Layer 2	14
10	Layer 3	15
11	Bottom Layer.....	15

List of Tables

1	bq500211AEVM-210 Electrical Performance Specifications	2
2	Bill of Materials	8

1 Applications

The bq500211AEVM-210 evaluation module demonstrates the transmitter portion of the bqTESLA™ wireless power system. This transmitter EVM is a complete transmitter-side solution that powers a bqTESLA™ receiver. The bq500211A EVM requires a single 5-V power supply capable of up to 2 A to operate and combines the transmitter electronics, input power socket, LED indicators, and the transmitting coil on the single printed-circuit board (PCB). The open design allows easy access to key points of the electrical schematic. The board has an installed serial interface connector for more advanced operation. This EVM has the following features:

- WPC 1.1 Foreign Object Detection (FOD) and WPC 1.0 Parasitic Metal Object Detection (PMOD)
- Dynamic Power Limiting™ (DPL) allows operation from a 5-V supply with limited current capability (for example, a USB port).
- Transmitter-coil mounting pad providing the correct receiver interface
- Input power is really available at 5 V
- Standard WPC A11-type transmitter coil with no magnet
- LED indicates power transfer or power fault state
- Audio indication of start-of-power transfer though a board-mounted buzzer

2 bq500211AEVM-210 Electrical Performance Specifications

Table 1 provides a summary of the bq500211AEVM-210 performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 1. bq500211AEVM-210 Electrical Performance Specifications

Parameter		Notes and Conditions	Min	Typ	Max	Unit
Input Characteristics						
V _{IN}	Input voltage		4.90	5.0	5.10	V
I _{IN}	Input current	V _{IN} = Nom, I _{OUT} = Max		1.50	2.0	A
	Input no-load current	V _{IN} = Nom, I _{OUT} = 0 A		200		mA
	Input stand-by current	V _{IN} = Nom		20		mA
Output Characteristics – Receiver bq51013AEVM-764 or -765						
V _{OUT}	Output voltage	V _{IN} = Nom, I _{OUT} = Nom	4.5	5	5.1	V
	Output ripple	V _{IN} = Nom, I _{OUT} = Max			200	mV _{PP}
I _{OUT}	V _{IN} = Min to Max	V _{IN} = Min to Max	0		1	A
	Output overcurrent	V _{IN} = Nom	1		1.1	A
Systems Characteristics						
F _S	Switching frequency	Switching frequency varies with load	110		205	kHz
η _{pk}	Peak efficiency	V _{IN} = Nom, P _{Out} RX = 2.5 W		72		%
η	Full-load efficiency	V _{IN} = Nom, I _{OUT} = Max		70		%

3 Modifications

See the data sheet ([SLUSBB1](#)) when changing components.

Use LED Mode – Resistor R23 to change the behavior of the status LED, D4. The standard value is 42.2 kΩ for control option 1, see the data sheet for additional settings.

NTC – Connector JP1 provides the option for connecting a negative temperature coefficient (NTC) sensor for thermal protection, see the data sheet for additional settings.

EMI Shield – The board is laid out so that a shield can be placed over the active circuit area, Laird Technology BMIS-207 can be used.

4 Connector and Test Point Descriptions

4.1 Input/Output Connections

The connection points are described in the following paragraphs.

4.1.1 J1 – V_{IN}

Input power 5 V $\pm$ 100 mV, return at J2.

4.1.2 J2 – GND

Return for input power, input at J1.

4.1.3 J3 – JTAG

Factory use only.

4.1.4 J4 – Serial Interface

Factory use only.

4.1.5 JP2 – LED Mode

External connection for LED MODE resistor, if R23 is removed.

4.1.6 JP4 – Select for Normal or Power Limiting

Shorting this header enables the DPL feature and the input current is limited to 500 mA. With this connector open, operation is normal, there is no restriction on input power.

4.1.7 JP3 – FOD / PMOD Enable

With this header open, FOD / PMOD is not active. With the shorting jumper installed, FOD is active for WPC 1.1 RX and PMOD active for WPC 1.0 RX. See the data sheet for additional details.

4.1.8 JP1 – NTC

The connection point for the external temperature sensor. See the data sheet for more information.

4.2 Test Point Descriptions

The test points are described in the following paragraphs.

4.2.1 TP1 – Coil Drive Q1 / Q2

H-Bridge drive signal.

4.2.2 TP2 – Coil Monitor L / C

Coil signal at junction between coil and capacitors.

4.2.3 TP3 – PWR GND

Ground for switch circuits.

4.2.4 TP4 – Analog GND

Low-noise GND

4.2.5 TP5 – Analog GND

Low-noise GND

4.2.6 TP6 – Analog GND

Low-noise GND

4.2.7 TP7 – Analog GND

Low-noise GND

4.2.8 TP8 – DC Buzzer Output

The connection point for an external DC buzzer; logic high for 500 ms at the start of power transfer to receiver unit.

4.2.9 TP9 – 3.3-VDC

Voltage for low-power circuits.

4.2.10 TP10 - Filtered 3.3 V

3.3-V output with additional filtering for A-to-D converters.

4.2.11 TP11 – Input voltage

Input voltage from J1.

4.2.12 TP12 – MSP430 3.3 V

Filtered 3.3 V for MSP430, U4.

4.2.13 TP13 – Demodulation Comm 1 Output

Primary communications channel, input to bq500211A, U1 from demodulation circuit.

4.2.14 TP14 – Sleep

Output from bq500211A, U1 to sleep timer circuit.

4.2.15 TP15 – Coil Drive Q3 and Q4 Side

H-Bridge drive signal Q3 and Q4.

4.2.16 TP16 – DPWM Signal

Digital output signal from bq500211A to H-Bridge drive for Q1 and Q2.

4.2.17 TP17 – DPWM Signal

Digital output signal from bq500211A to H-Bridge drive for Q3 and Q4.

4.2.18 TP18 – Spare Pin

Unused output from bq500211A.

4.2.19 TP19 – I_Sense

Input current-sense voltage, scale 1 V = 1 A.

5 Schematic and Bill of Materials

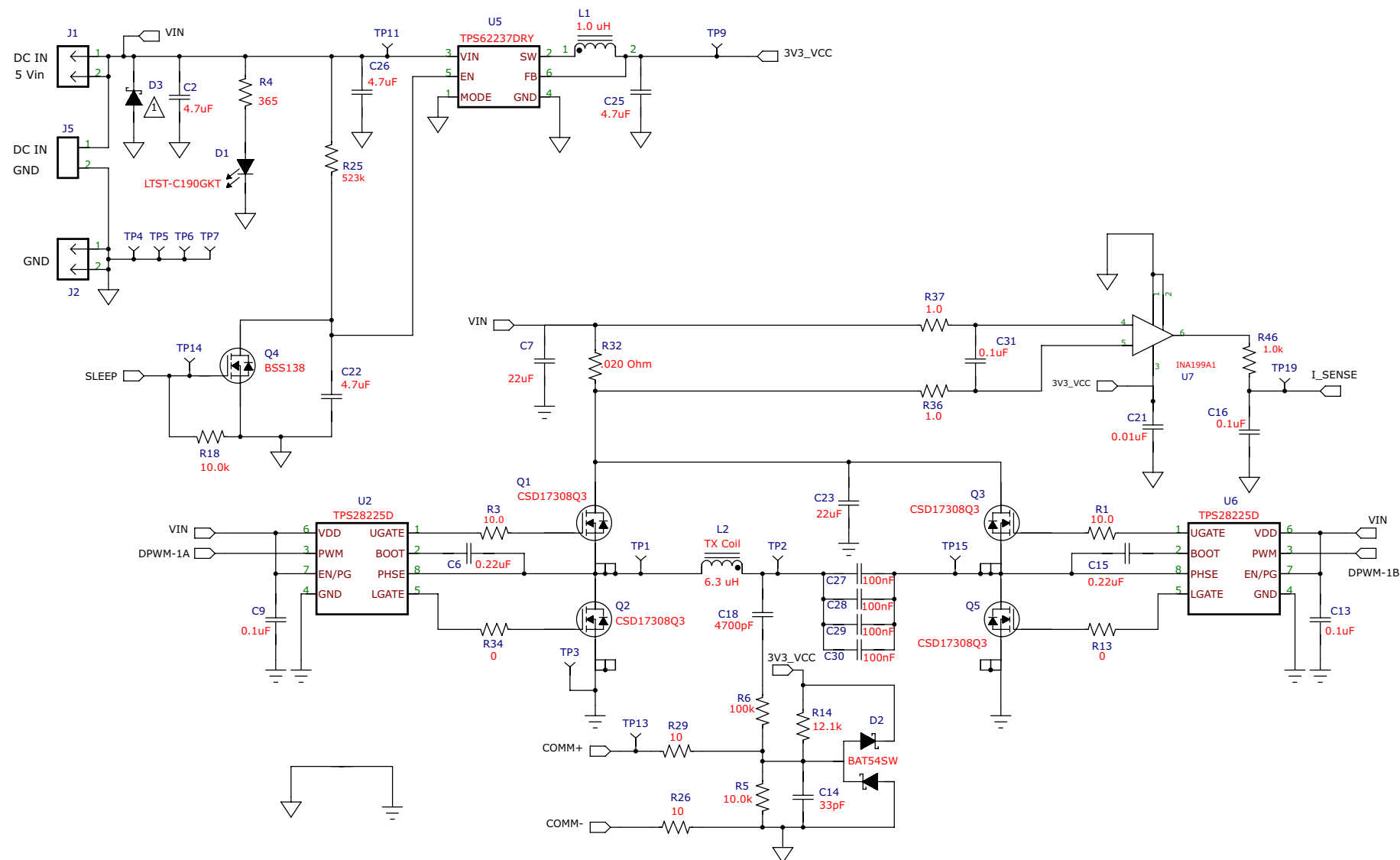
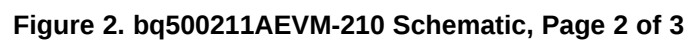


Figure 1. bq500211AEVM-210 Schematic, Page 1 of 3



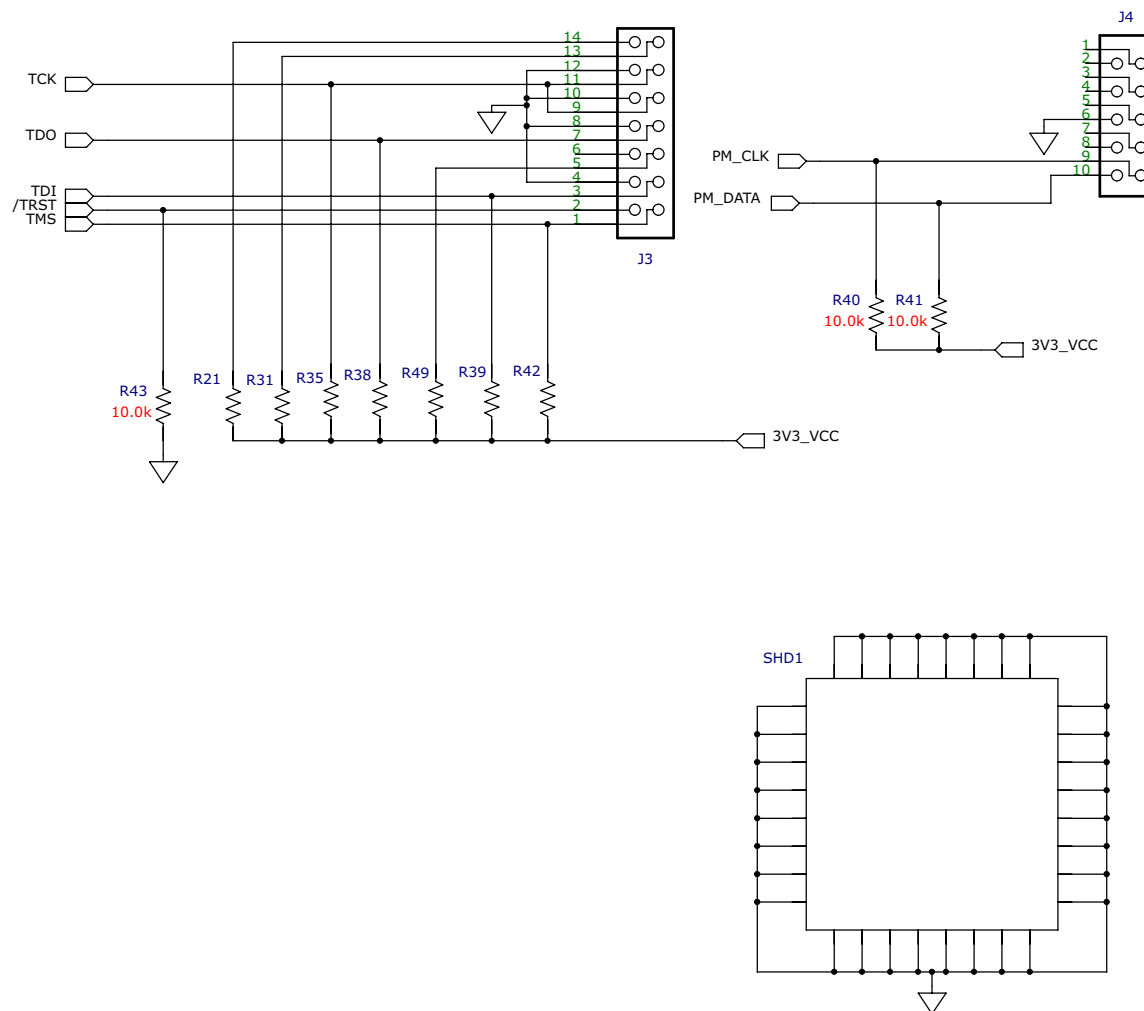


Figure 3. bq500211AEVM-210 Schematic, Page 3 of 3

Table 2. Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
1	BUZ	Buzzer	Piezoelectronic, 12 mm	12 mm	PS1240P02CT3	TDK
1	C14	33pF	Capacitor, Ceramic, 50V, C0G, 5%	0603	Std	Std
1	C12	1000pF	Capacitor, Ceramic, 10V, COG, 5%	0603	Std	Std
3	C4, C18, C24	4700pF	Capacitor, Ceramic, 50V, X7R, 10%	0603	Std	Std
2	C21, C10	0.01uF	Capacitor, Ceramic, 50V, X7R, 10%	0603	Std	Std
5	C13, C16, C17, C9, C31	0.1uF	Capacitor, Ceramic, 50V, X7R, 10%	0603	Std	Std
4	C27, C28, C29, C30	100nF	Capacitor, Ceramic, COG, 50V, 5%	1812	C4532COG1H104J	TDK
2	C15, C6	0.22uF	Capacitor, Ceramic, 50V, X7R, 20%	0603	Std	Std
4	C1, C3, C8, C20	1.0uF	Capacitor, Ceramic, 16V, X7R, 20%	0603	Std	Std
7	C22, C25, C5, C11, C19, C26, C2	4.7uF	Capacitor, Ceramic, 10V, X5R, 20%	0603	Std	Std
1	C31	2.2uF	Capacitor, Ceramic, 10V, X5R, 20%	0603	Std	Std
2	C23, C7	22uF	Capacitor, Ceramic, 25V, X5R, 20%	1210	Std	Std
2	D1, D5	LTST-C190GKT	Diode, LED, Green, 2.1-V, 20-mA, 6-mcd	0603	LTST-C190GKT	Lite On
1	D2	BAT54SW	Diode, Dual Schottky, 200mA, 30V	SOT523	BAT54SWT1G	On Semi
0	D3	Open	Diode, Schottky, 0.5A, 30V	SOD-123	MMSZ5251BT1G	On Semi
1	D4	HSMF-C165	Diode, Bi-Color LED, [GRN/RED] 20mA, 52 mW Max.	0603	HSMF-C165	Avago
1	L1	1.0 uH	Inductor, SMT, 800 mA, ±20%	0805	LQM21PN1R0MC0	Murata
	Alternate L1	1.0 uH	Inductor, SMT, 800 mA, ±20%	0805	74479775210	Wurth
1	L2	6.3 uH	Inductor, WPC TX Coil	53 × 53 mm	760-308-111	Wurth
4	Q1, Q2, Q3, Q5	CSD17308Q3	MOSFET, NChan, 30V, 13A, 9.4 milliOhm	QFN3.3x3.3 mm	CSD17308Q3	TI
2	Q4, Q6	BSS138	MOSFET, Nch, 50V, 0.22A, 3.5 Ohm	SOT23	BSS138	Fairchild
1	R10	15.4k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R11	2.00k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
2	R13, R34	0	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R32	0.020 Ohm	Resistor, Chip, 1/4W, 1%, 200ppm	0805	ERJ-6BWFR020V	Panasonic
7	R1-3, R24, R26, R29, R47	10	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R7	22	Resistor, Chip, 1/10W, 1%	0805	Std	Std
2	R36, R37	1.0 ohm	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R4	365	Resistor, Chip, 1/16W, 1%	0603	Std	Std
2	R27, R28, R44	475	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R46	1k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
2	R16, R48	3.32k	Resistor, Chip, 1/16W, 1%	0603	Std	Std

Table 2. Bill of Materials (continued)

Count	RefDes	Value	Description	Size	Part Number	MFR
14	R5, R8, R9, R12, R16, R18, R19, R30, R33, R41, R45, R40, R43, R51	10.0k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R14	12.1k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R23	42.2k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R6	100k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R20	100k	Resistor, Chip, 1/16W, 1%	0402	Std	Std
1	R25	523k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	R15, R50, R21, R31, R35, R38, R49, R39, R42	Open	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	U1	BQ500211ARGZ	IC, Qi Compliant Wireless Power Transmitter Manager	7X7 QFN	BQ500211ARGZ (R/T)	TI
2	U2 U6	TPS28225D	IC, High Frequency 4-Amp Sink Synchronous Buck MOSFET Driver	SO8	TPS28225D	TI
1	U4	MSP430G2001	IC, Mixed Signal Microcontroller	TSSOP	MSP430G2001IPW14	TI
1	U5	TPS62237DRY	IC, 3MHz Ultra Small Step Down Converter, 3.3 V	USON	TPS62237DRY	TI
1	U7	INA199A1	IC, Current Monitor, High or Low Side Measurement	SC-70	INA199A1	TI
1	U8	TLV70033DCK	IC, 150mA, Low IQ, LDO Regulator	SOT	TLV70033DCK	TI
0	SHD1	Open	Shield, Copper	44.4x44.4 mm	BMI-S-207-F	Laird Tech

6 Test Setup

6.1 Equipment

6.1.1 bqTESLA™ Receiver

Use the bq51013AEVM-764 or a Qi-compliant receiver to work with this EVM.

6.1.2 Voltage Source

The input voltage source must provide a regulated DC voltage of 5 V and deliver at least 2-A continuous load current; current limit must be set to 3 A.

CAUTION

To help assure safety integrity of the system and minimize risk of electrical shock hazard, always use a power supply providing suitable isolation and supplemental insulation (double insulated). Compliance to IEC 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, Part 1, General Requirements, or its equivalent is strongly suggested, including any required regional regulatory compliance certification approvals. Always select a power source that is suitably rated for use with this EVM as referenced in this user manual.

6.1.3 Meters

Monitor the output voltage at the bq51013AEVM-764 test point TP7 with a voltmeter. Monitor the input current into the load with an appropriate ammeter. You can also monitor the transmitter input current and voltage, but the meter must use the averaging function for reducing error, due to communications packets.

6.1.4 Loads

A single load is required at 5 V with a maximum current of 1 A. The load can be resistive or electronic.

6.1.5 Oscilloscope

Use a dual-channel oscilloscope with appropriate probes to observe the COMM_DRV signal at bq51013AEVM-764 TP3 and other signals.

6.1.6 Recommended Wire Gauge

For proper operation, use 22-AWG wire when connecting the bq500211AEVM-210 to the input supply and the bq51013AEVM-764 to the load.

6.2 Equipment Setup

- With the power supply OFF, connect the supply to the bqTESLA™ transmitter.
- Connect the V_{IN} positive power source to J1, and connect the negative terminal of the V_{IN} source to J2.
- Do not place the bqTESLA™ receiver on the transmitter. Connect a load to J3 with a return to J4, monitor current through the load with the ammeter, and monitor the current to the load at TP7. All voltmeters must be Kelvin connected (at the pin) to the point of interest.

6.2.1 Equipment Setup Diagram

The diagram in [Figure 4](#) shows the test setup.

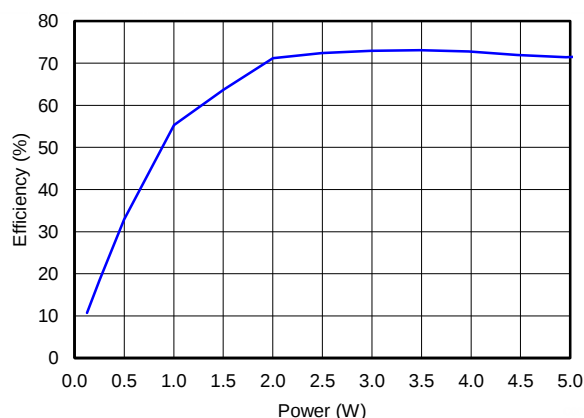


Figure 5. Efficiency versus Power, bq500211AEVM-210 Transmitter and HPA764 Receiver

6.2.2.4 Dynamic Power Limiting

Dynamic Power Limiting (DPL) allows operation from a 5-V supply with limited current capability. DPL is controlled by JP4, which pulls U1 pin 4 high or low. With the jumper open (pin 4 High) the IC monitors input voltage and when that voltage is observed drooping, the output power is limited to reduce the load and provide some operating margin relative to the supply's capability. With a shorting jumper installed (pin 4 Low), the IC restricts output power such that the input current remains below 500 mA, compatible with a USB port. See the data sheet for additional information on the DPL function

6.2.2.5 Thermal Protection, NTC

Thermal protection is provided by an NTC resistor connected to JP1. At 1 V on the sense side (U1-2), the thermal fault is set, and the unit is shut down. The status LED, D5, illuminates red. The typical resistor value for fault is 850 Ω . The system tries to restart in 5 minutes.

7 bq500211AEVM-210 Assembly Drawings and Layout

Figure 6 through Figure 11 show the design of the bq500211AEVM PCB. The EVM has been designed using a 4-layer, 2-oz, copper-clad circuit board 13.2 cm $\times$ 7.24 cm with all components in a 4.5-cm $\times$ 4.5-cm active area on the top side and all active traces to the top and bottom layers to allow the user to easily view, probe, and evaluate the bq500211A control IC in a practical application. Moving components to both sides of the PCB or using additional internal layers offers additional size reduction for space-constrained systems. Gerber files are available for download from the EVM product folder.

A 4-layer PCB design is recommended to provide a good low-noise ground plane for all circuits. A 2-layer PCB presents a high risk of poor performance. Grounding between the bq500211A GND pin 47, 36, and 32 and filter capacitor returns C19, C1, C5, and C3 should be a good low-impedance path.

Coil Grounding – A ground plane area under the coil is recommended to reduce noise coupling into the receiver. The ground plane for the EVM is slightly larger than the coil footprint and grounded at one point back to the circuit area.

Note: The clear plastic cover thickness (0.93 in or 2.4 mm) is the z-gap thickness for the transmitter.

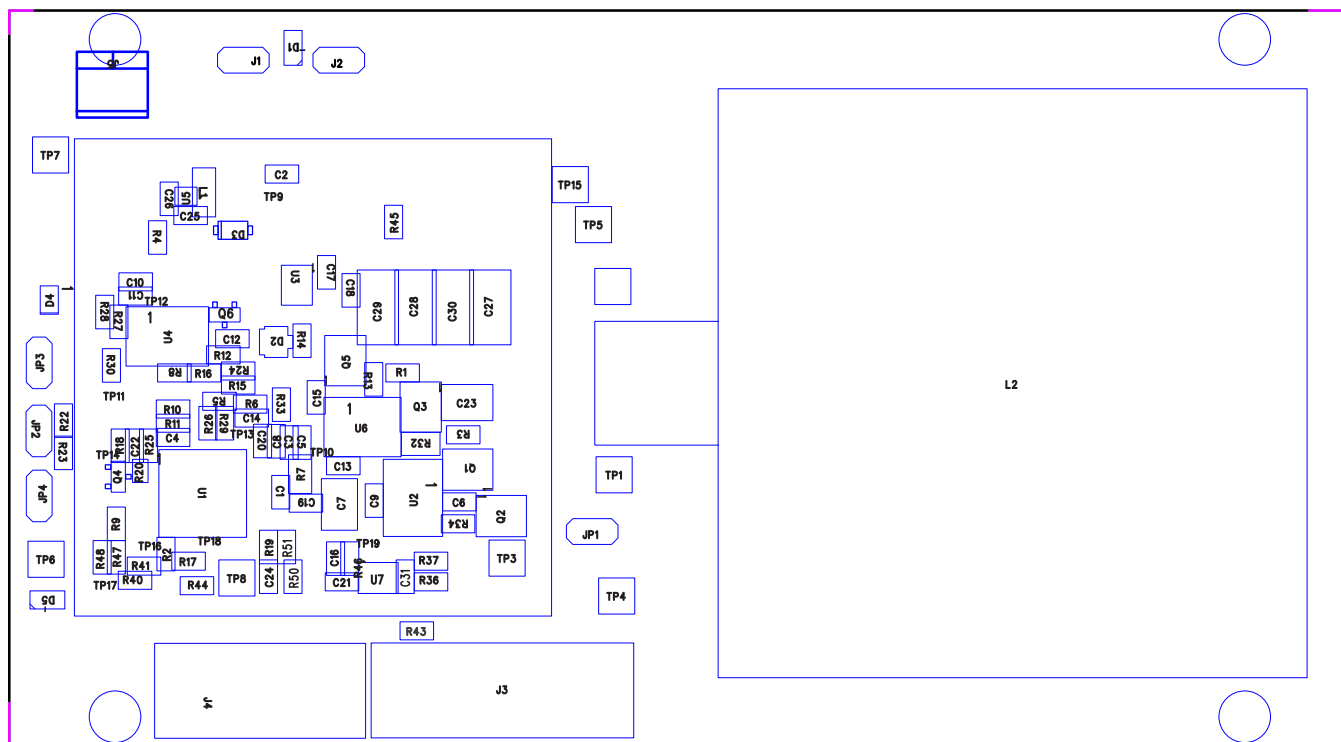


Figure 6. Assembly Top

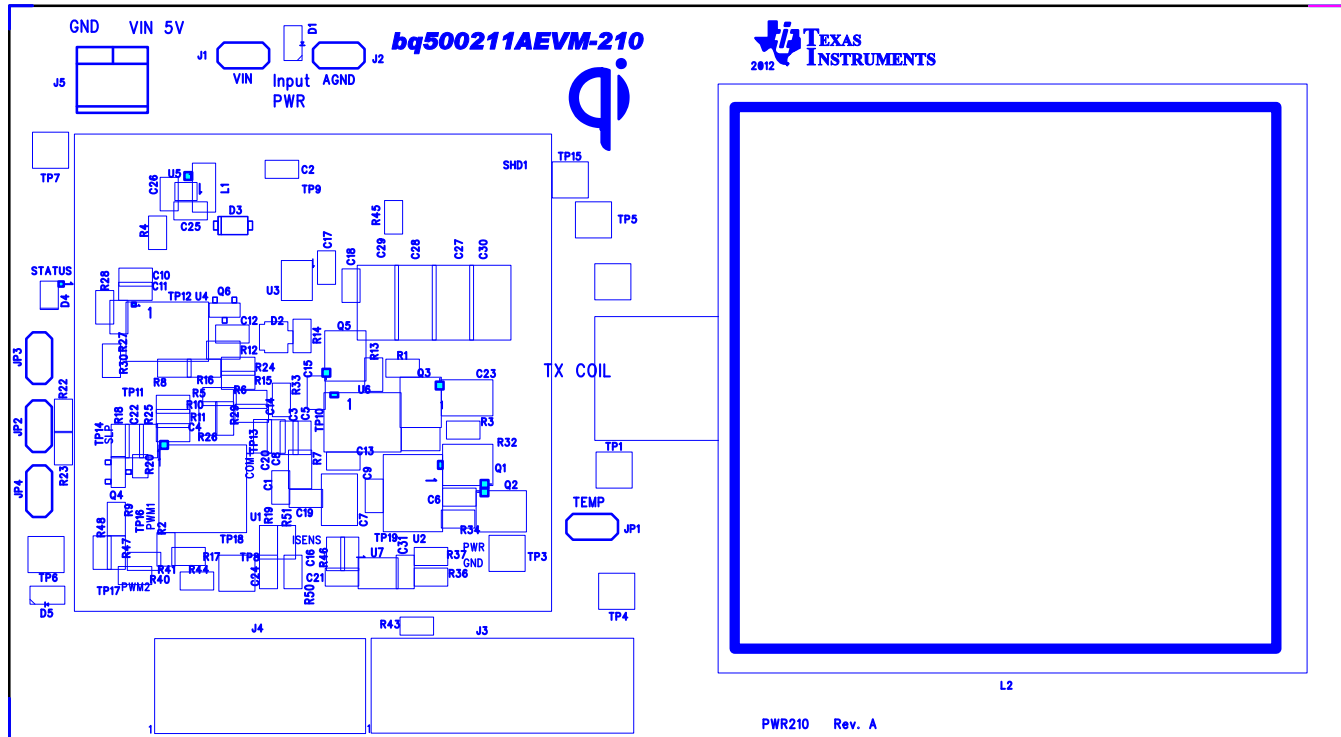


Figure 7. Top Silk

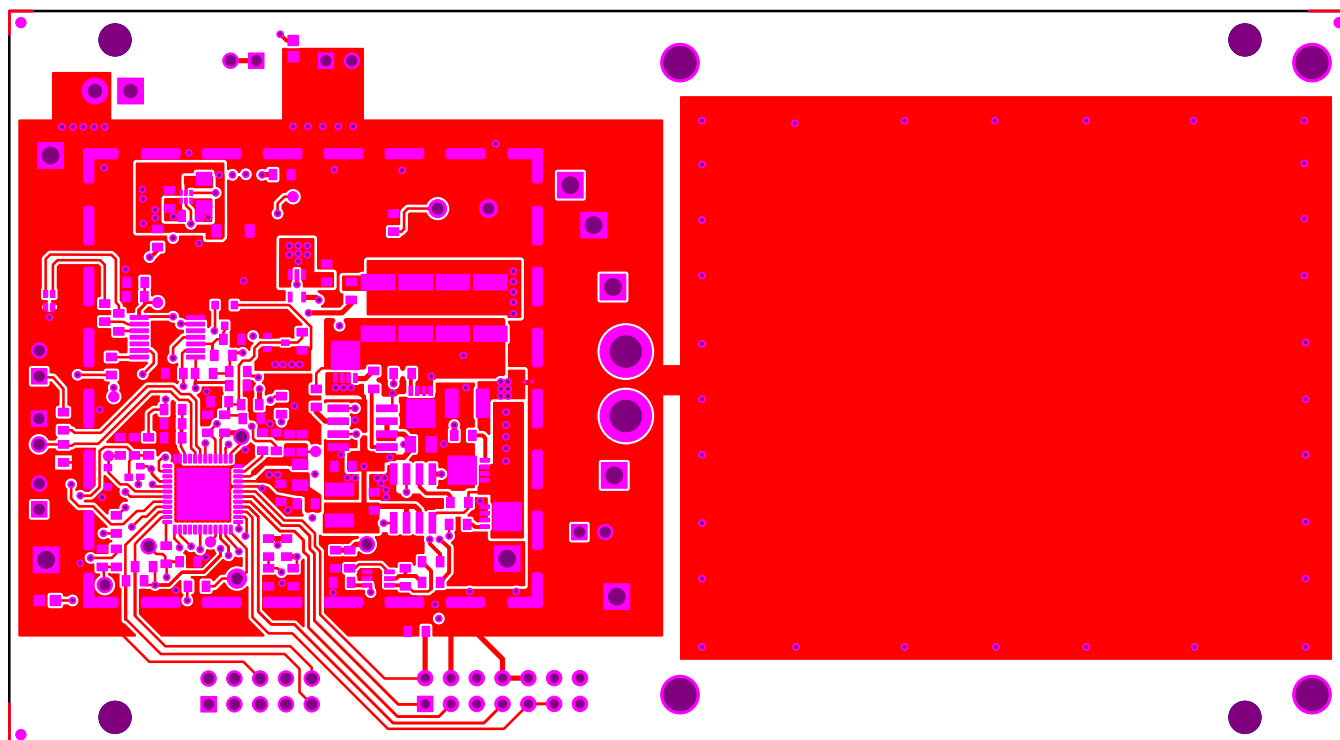


Figure 8. Top Layer

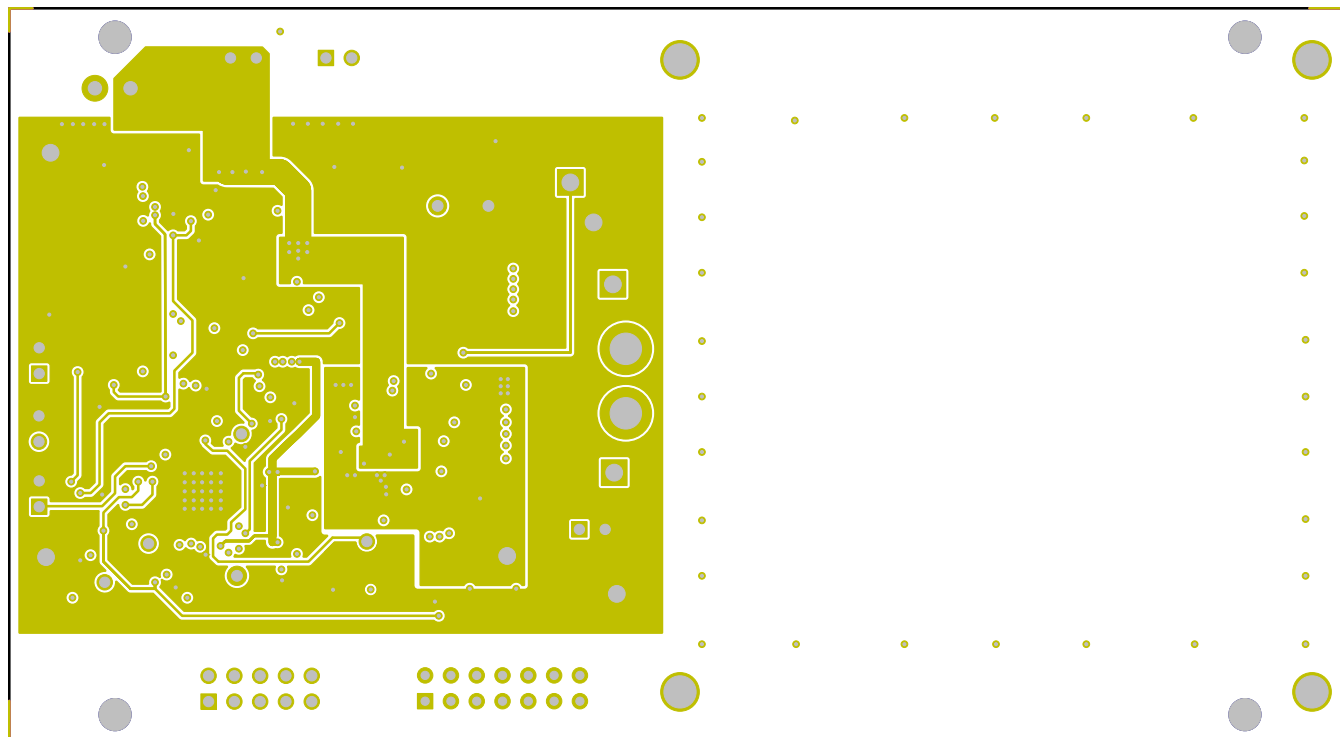


Figure 9. Layer 2

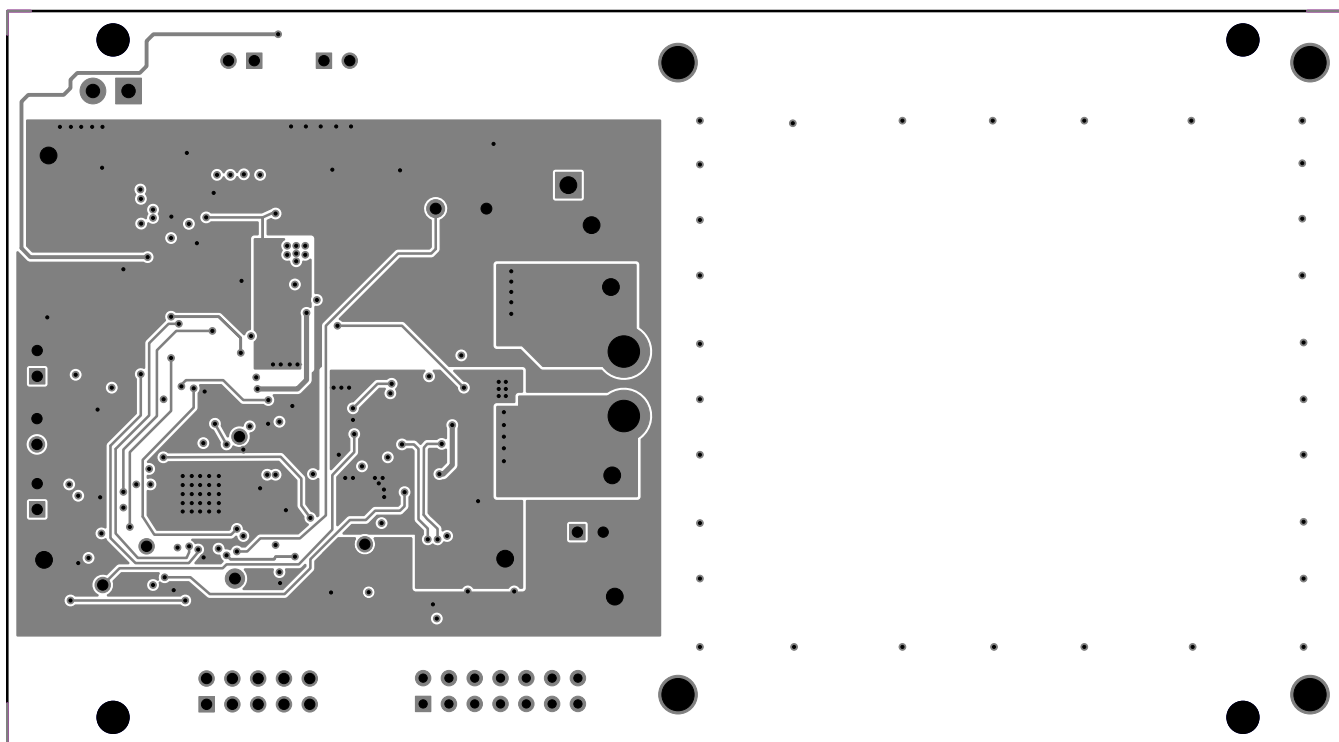


Figure 10. Layer 3

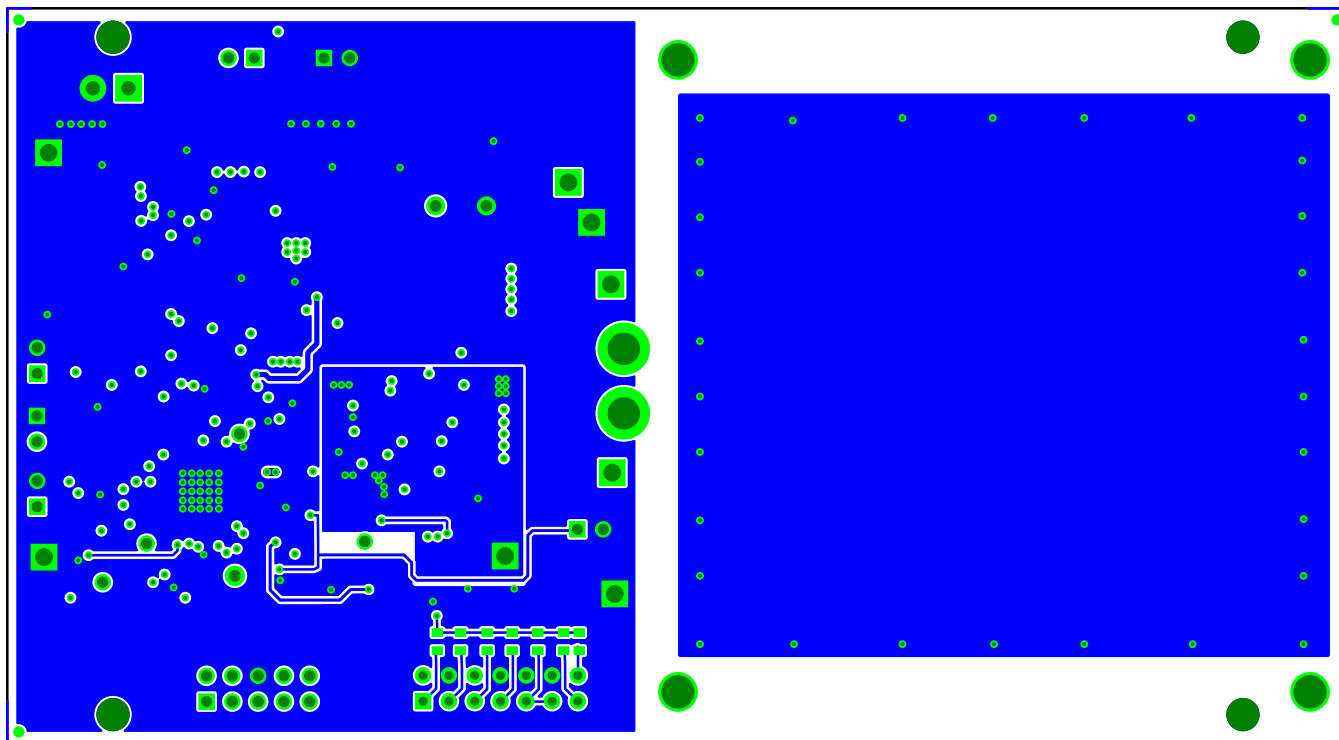


Figure 11. Bottom Layer

8 Reference

For additional information about the bq500211AEVM-210 low-power, wireless, power evaluation kit from Texas Instruments, visit the product folder on the TI Web site at <http://www.ti.com/product/bq500211a>

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

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.

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 LIMITED 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. 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.

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 visit www.ti.com/esh or contact TI.

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. 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.

REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM is subject to the Federal Communications Commission (FCC), Industry Canada (IC) and European Union CE Mark rules.

FCC – FEDERAL COMMUNICATIONS COMMISSION Part 18 Compliant

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 18 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.

Note: There is no required maintenance of this device from a FCC compliance perspective.

IC – INDUSTRY CANADA ICES-001 Compliant

This ISM device complies with Canadian ICES-001.

Cet appareil ISM est conforme à la norme NMB-001 du Canada.

European Union CE Mark

This ISM device complies with Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC – the **EMC Directive, tested to EN55011: 2007, Industrial Scientific and Medical (ISM) radio-frequency equipment.**

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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2013, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

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

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license 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 significant portions 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. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

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.

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	www.ti.com/audio
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
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com