bqTESLA Wireless Power Transmitter Manager EVM

The bqTESLA™ wireless power evaluation kit from Texas Instruments is a high-performance, easy-to-use development kit for the design of wireless power solutions. Consisting of a single-channel transmitter and power supply side receiver and associated magnetics, the kit enables designers to speed the development of their end-applications. The bq500210EVM evaluation module (EVM) provides all basic functions of WPC 1.0-compliant wireless charger pad. The EVM is intended to be used with bq51013EVM or any other WPC 1.0-compliant receiver.

Contents

List of Figures

List of Tables

bqTESLA is a trademark of Texas Instruments.

1 Applications

The bq500210EVM-689 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 bq500210EVM requires single 19-V at 0.5 A power supply to operate and combines on the single printed-circuit board the transmitter electronics, input power socket, LED indicators, and the transmitting coil. The open design allows easy access to key points of the electrical schematic. The board has installed connectors for optional JTAG and serial interfaces that can be helpful to advanced users. This EVM has the following features.

- WPC-certified transmitter
- Transmitter mounting pad to provide correct receiver interface
- Receiver output voltage of 5 V up to 1 A
- Standard A1-type transmitter coil
- LED indicates power transfer state and buzzer indicates start of power transfer.

2 bq500210EVM-689 Electrical Performance Specifications

Table 1 provides a summary of the bq500210EVM-689 performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 1. bq500210EVM-688 Electrical Performance Specifications

Parameter		Notes and Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
V_{IN}	Input Voltage		18.5	19	19.5	V
I_{IN}	Input Current	V_{IN} = Nom, I_{OUT} = Max		0.3	0.5	A
	Input No Load Current	V_{IN} = Nom, I_{OUT} = 0 A		20	50	mA
OUTPUT CHARACTERISTICS						
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}	VIN = Min to Max	V_{IN} = Min to Max	0		1	A
	Output Over Current	V_{IN} = Nom, V_{OUT} = V_{OUT1} - 5%	1		1.1	A
SYSTEMS CHARACTERISTICS						
F_S	Switching Frequency		110	145	200	kHz
ηpk	Peak Efficiency	V_{IN} = Nom; Porx = 2.5		72%		
η	Full-Load Efficiency	V_{IN} = Nom, I_{OUT} = Max		70%		

3 Modifications

See the data sheet (SLUSAL8) when changing components. 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 – Vin

Input power 19 V ±500 mV; connected to J2 also.

4.1.2 J2 – GND

Input power return for input power; connected to J2 also.

4.1.3 J3 – I2C interface

Factory use only

4.1.4 J4 – JTAG (Not Installed)

Factory use only

4.1.5 J5 – Metal Object Detection Threshold

Connection point for external resistor to set trip point for Metal Object Detection. See the bq500210 data sheet for more information (SLUSAL8).

4.1.6 J6 – Select LED Mode

Connection point for external resistor to select LED mode. See the bq500210 data sheet for more information.

4.1.7 J7 – Vin

Input power 19 V ±500 mV; connected to J2 also.

4.1.8 JP1 – NTC

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

4.2 Jumpers/Switches

The control jumpers are described in the following paragraphs.

4.2.1 R23 – LED Scheme

LED indication scheme set resistor; default 42.2 kΩ. For a detailed function description, see the bq500210 data sheet

4.2.2 R51 – MOD-THR

MOD threshold set resistor; default 100 kΩ. For a detailed function description, see the bq500210 data sheet.

4.3 Test Point Descriptions

The test points are described in the following paragraphs.

4.3.1 TP1 – Coil Monitor 1

Test point for measuring ac voltage applied to TX coil.

4.3.2 TP2 – Coil Monitor 2

Test point for measuring ac voltage applied to TX coil.

4.3.3 TP3 – PWR GND

Ground for Switch circuits.

4.3.4 TP4 – Analog GND

Low noise GND

4.3.5 TP5 – Analog GND

Low noise GND

4.3.6 TP6 – Analog GND

Low noise GND

4.3.7 TP7 – Analog GND

Low noise GND

4.3.8 TP8 – DC Buzzer Output

Connection point for external dc buzzer; logic high for 500 ms at start of power transfer to receiver unit.

4.3.9 TP9 – 3.3V Input DC Current

3.3V output from U5 used for low power circuit.

4.3.10 TP10 - Filtered 3.3V

3.3V output with additional filtering for A to D convererters.

4.3.11 TP11 – Gate Drive Voltage

Input voltage to U2, gate driver for power switches.

4.3.12 TP12 – MSP430 3.3V

Filtered 3.3V for MSP430, U4.

4.3.13 TP13 – Demodulation Comm 1 Output

Primary communications channel, input to bq500210 from demodulation circuit.

4.3.14 TP14 – Sleep

Output from bq500210 to 500 ms timer circuit.

5 Schematic and Bill of Materials

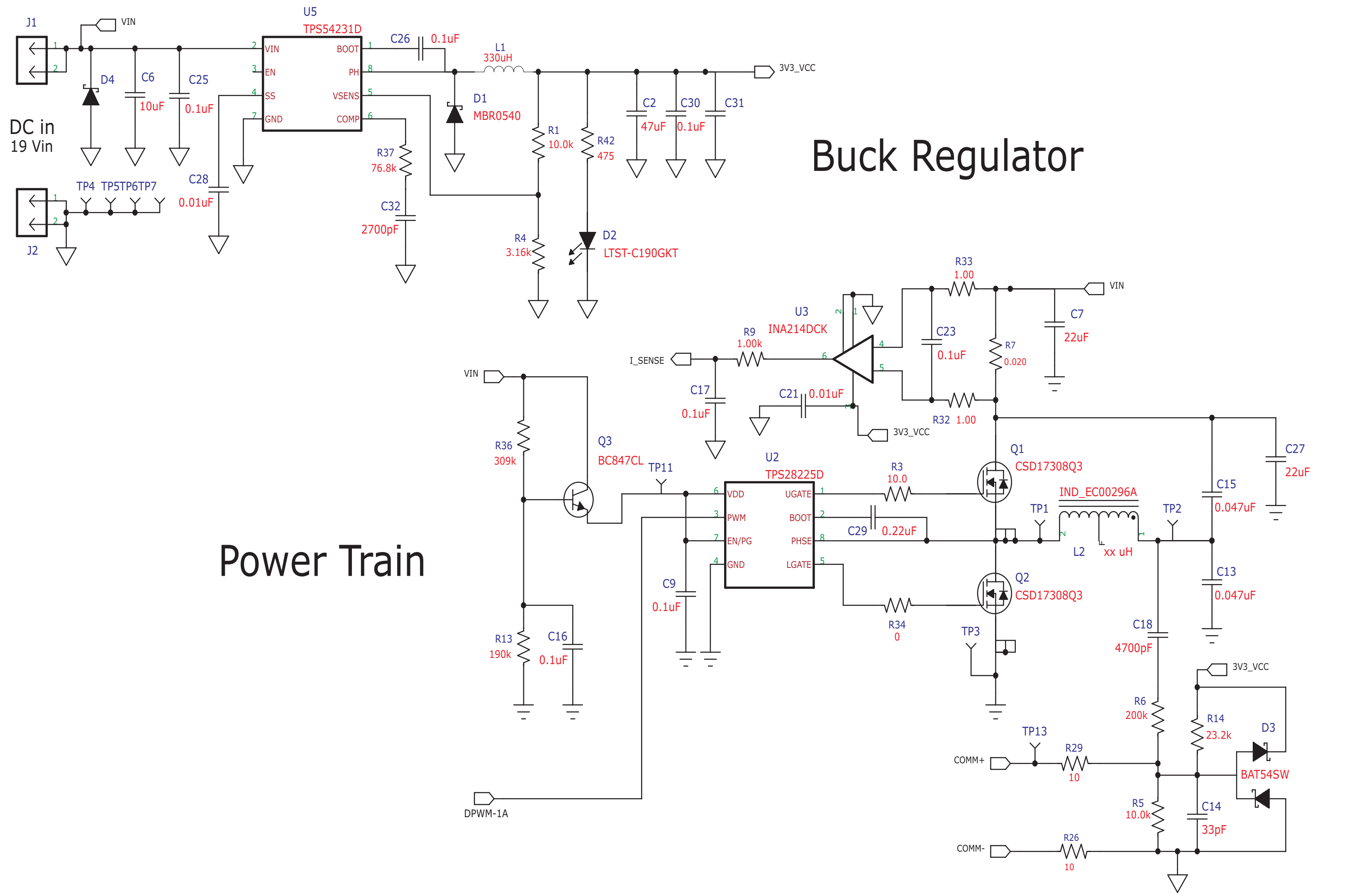


Figure 1. HPA689EVM Schematic (Page 1 of 3)

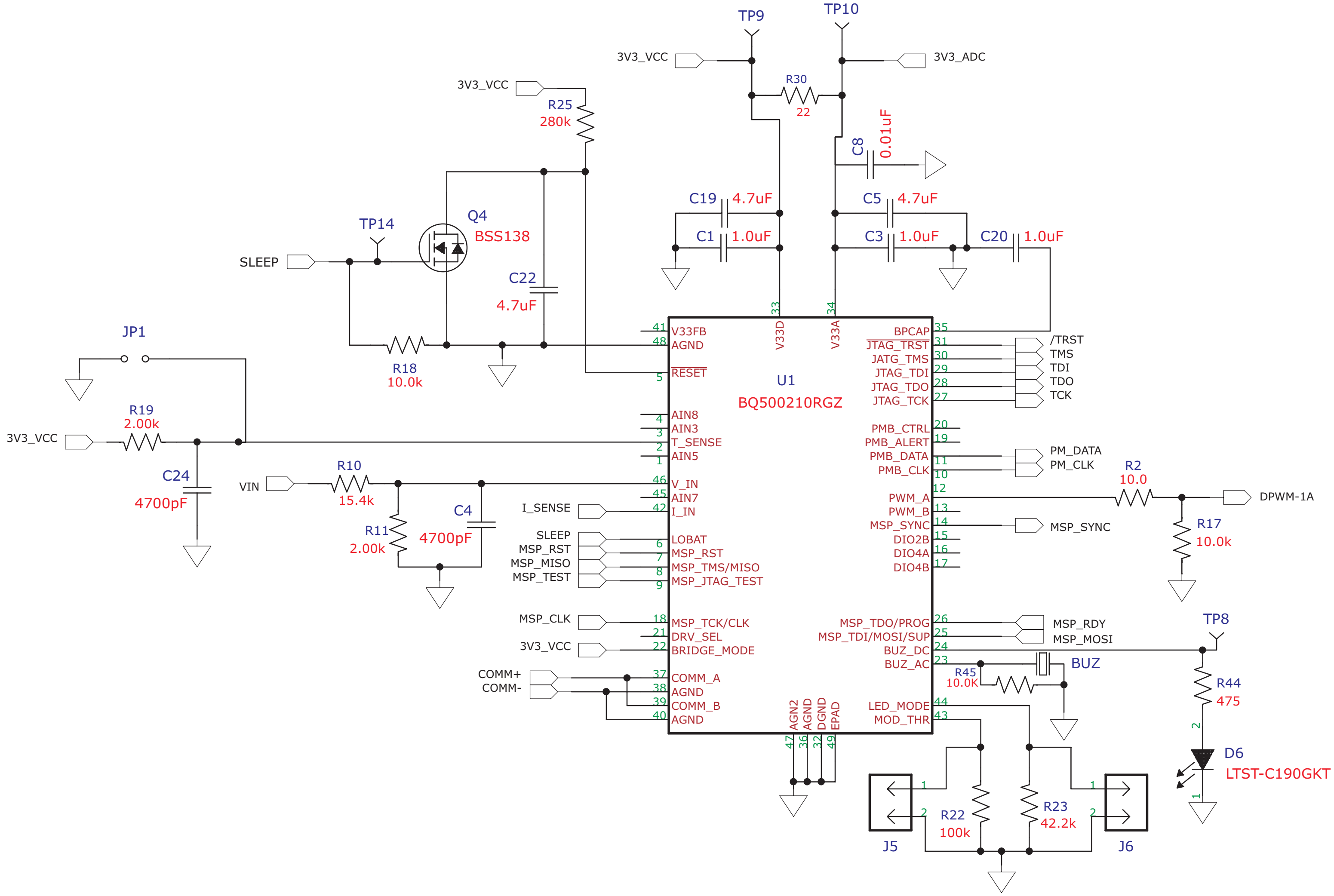


Figure 2. HPA689EVM Schematic (Page 2 of 3)

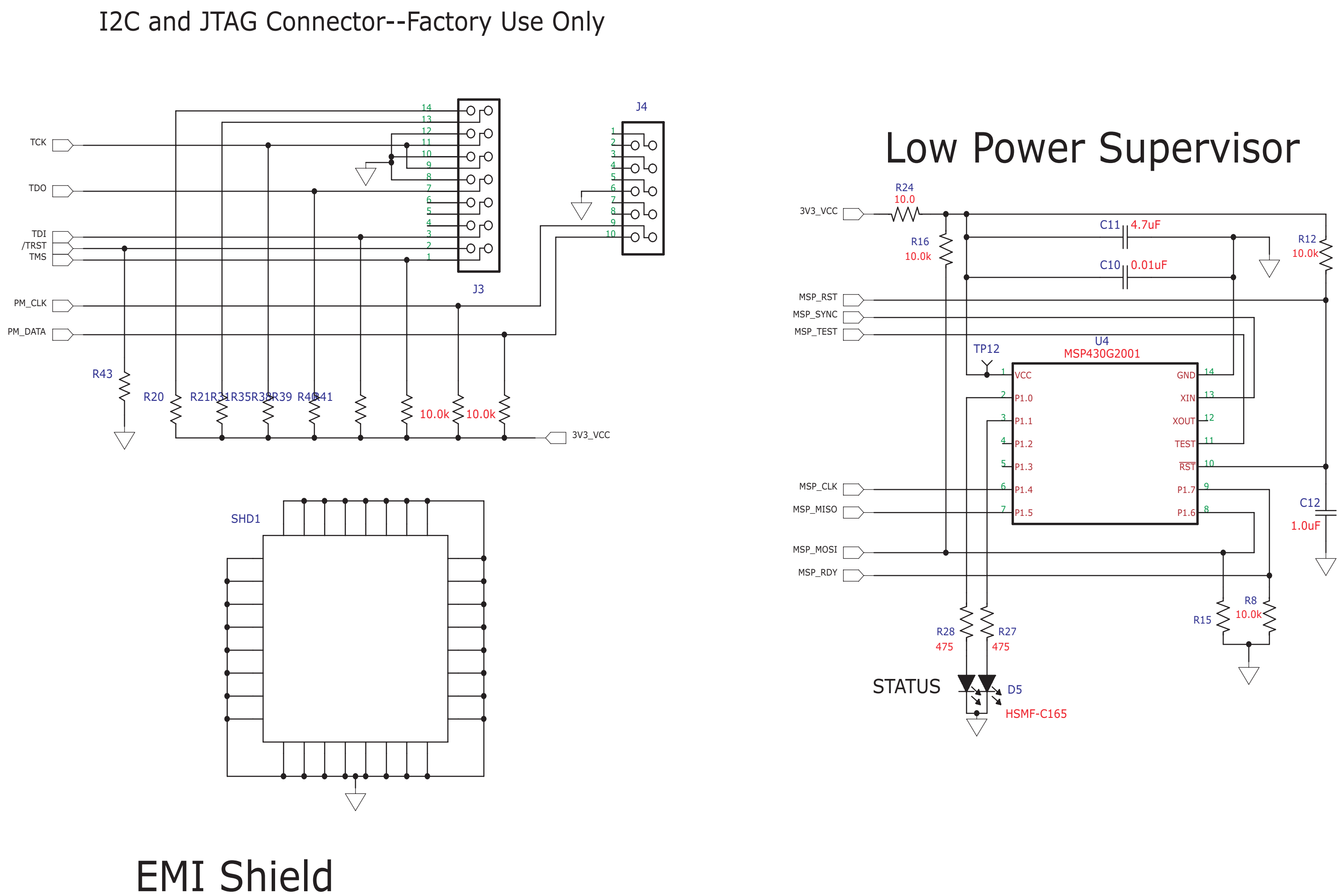


Figure 3. HPA689EVM Schematic (Page 3 of 3)

Table 2. Bill of Materials

COUNT	RefDes	Value	Description	Size	Part Number	MFR
1	BUZ	Buzzer	Piezoelectronic, 12 mm	12 mm	PS1240P02CT3	TDK
4	C1 C3 C12 C20	1.0uF	Capacitor, Ceramic, 16V, X7R, 20%	0603	STD	STD
4	C5 C11 C19 C22	4.7uF	Capacitor, Ceramic, 10V, X7R, 20%	0603	STD	STD
1	C14	33pF	Capacitor, Ceramic, 50V, C0G, 5%	0603	STD	STD
2	C15 C13	0.047uF	Capacitor, Ceramic, 100V, C0G, 5%	1210	Std	STD
7	C17 C9 C23 C16 C25-26 C30	0.1uF	Capacitor, Ceramic, 50V, X7R, 10%	0603	STD	STD
1	C2	47uF	Capacitor, Ceramic, 6.3V, X5R, 20%	1206	STD	STD
1	C29	0.22uF	Capacitor, Ceramic, 50V, X7R, 20%	0603	STD	STD
0	C31	Open	Capacitor, Ceramic,	1206	STD	STD
1	C32	2700pF	Capacitor, Ceramic, 50V, C0G, 5%	0603	STD	STD
3	C4 C18 C24	4700pF	Capacitor, Ceramic, 50V, X7R, 10%	0603	STD	STD
1	C6	10uF	Capacitor, Ceramic, 35V, X5R, 20%	1206	STD	STD
2	C7 C27	22uF	Capacitor, Ceramic, 25V, X5R, 20%	1210	Std	STD
4	C8 C10 C21 C28	0.01uF	Capacitor, Ceramic, 50V, X7R, 10%	0603	STD	STD
1	D1	MBR0540	Diode, Schottky, 0.5A, 40V	SOD-123	MBR0540T1G	On Semi
2	D2 D6	LTST-C190GKT	Diode, LED, Green, 2.1-V, 20-mA, 6-mcd	0603	LTST-C190GKT	Lite On
1	D3	BAT54SW	Diode, Dual Schottky, 200mA, 30V	SOT523	BAT54SWT1G	On Semi
0	D4	Open	Diode, Schottky, 0.5A, 30V	SOD-123	MMSZ5251BT1G	On Semi
1	D5	HSMF-C165	Diode, Bi-Color LED, [GRN/RED] 20mA, 52 mW Max.	0603	HSMF-C165	Avago
1	L1	330uH	Inductor, SMT, 155mA, 1.8ohm	0.189 x 0.189 inch	LPS5030-334MLB	Coilcraft
1	L2	TX Coil	WPC Compliant TX Coil Set with Ferrite Shield	See note 1	EC00296A	Elytone
		TX Coil	WPC Compliant TX Coil Set with Ferrite Shield		Y31-60014F	E & E Magnetic
		TX Coil	WPC Compliant TX Coil Set with Ferrite Shield		X1387	Toko
2	Q1-2	CSD17308Q3	MOSFET, NChan, 30V, 13A, 9.4 milliOhm	QFN3.3x3.3 mm	CSD17308Q3	TI
1	Q3	BC847CL	TRANSISTOR, NPN, HIGH-PERFORMANCE, 500mA	SOT-23	BC847CLT1G	ON Semi
1	Q4	BSS138	MOSFET, Nch, 50V, 0.22A, 3.5 Ohm	SOT23	BSS138	Fairchild
10	R1 R5 R8 R12 R16-18 R40 R41 R45	10.0k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
5	R2, R3, R24, R26, R29	10	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R4	3.16k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R6	200k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R7	0.02	Resistor, Chip, 1/10W, 1%	0805	Std	Std

Table 2. Bill of Materials (continued)

COUNT	RefDes	Value	Description	Size	Part Number	MFR
1	R9	1.00k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R10	15.4k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
2	R11 R19	2.00k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R13	191k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R14	23.2k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	R15 R20-21 R31 R35 R38 R39 R43	Open	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R22	100k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R23	42.2k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
3	R28 R27 R42 R44	475	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R30	22	Resistor, Chip, 1/10W, 1%	0805	Std	Std
2	R32-33	1	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R34	0	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R25	280k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R36	309k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R37	76.8k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	SHD1	Open	Shield, Copper	44.4x44.4 mm	BMI-S-207-F	Laird Tech
1	U1	BQ500210RGZ	IC, Qi Compliant Wireless Power Transmitter Manager	VQFN	BQ500210RGZ	TI
1	U2	TPS28225D	IC, High Frequency 4-Amp Sink Synchronous Buck MOSFET Driver	SO8	TPS28225D	TI
1	U3	INA214DCK	IC, Voltage Output, High or Low Side Measurement, Bi-Directional Zerø-Drift Series	SC-70	INA214AIDCKT	TI
1	U4	MSP430G2001	IC, Mixed Signal Microcontroller	TSSOP	MSP430G2001IPW 14	TI
1	U5	TPS54231D	IC, 2A, 28V Input, Step Down Swift DC/DC Converter W/ eco-Mode	SO8	TPS54231D	TI
Notes:	1A. Elytone Electronics Co., Ltd.: Sales Exec Annie Jya Tel (Taiwan) : www.elytone.com.tw 1B. E&E Magnetic Products, Ltd.: www.eleceltek.com 1C. TOKO: www.tokoam.com					

6 Test Setup

6.1 Equipment

6.1.1 bqTESLA™ Receiver

Use bq51013EVM-725 (BQ51013EVM) or WPC Gen 1.0-compliant receiver to work with this EVM.

6.1.2 Voltage Source

Input voltage source must provide regulated dc voltage of 19 V and be able to deliver at least 0.5-A continuous load current, current limit should be set to 1A.

6.1.3 Meters

Output voltage can be monitor at bq51013EVM-725 TP7 with a voltmeter. Input current into the load must be monitored with an appropriate ammeter. Transmitter input current and voltage can be monitored also, but the meter must use averaging function for reducing error due to communications packets.

6.1.4 Loads

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

6.1.5 Oscilloscope

A dual-channel oscilloscope with appropriate probes is used to observe the COMM_DRV signal at bq51013EVM-725 TP3 and other signals. .

6.1.6 Recommended Wire Gauge

For proper operation, 22 AWG wire is recommended when connecting the bq500210EVM-689 to input supply and bq51013EVM-725 to load.

6.2 Equipment Setup

- With power supply OFF, connect supply to bqTESLA™ transmitter.
- Connect Vin positive power source to J1 and negative terminal of the Vin source connected to J2.
- Do not place bqTESLA™ receiver on transmitter. Connect load to J3 with return to J4, monitor current through load with ammeter, and monitor current to 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.

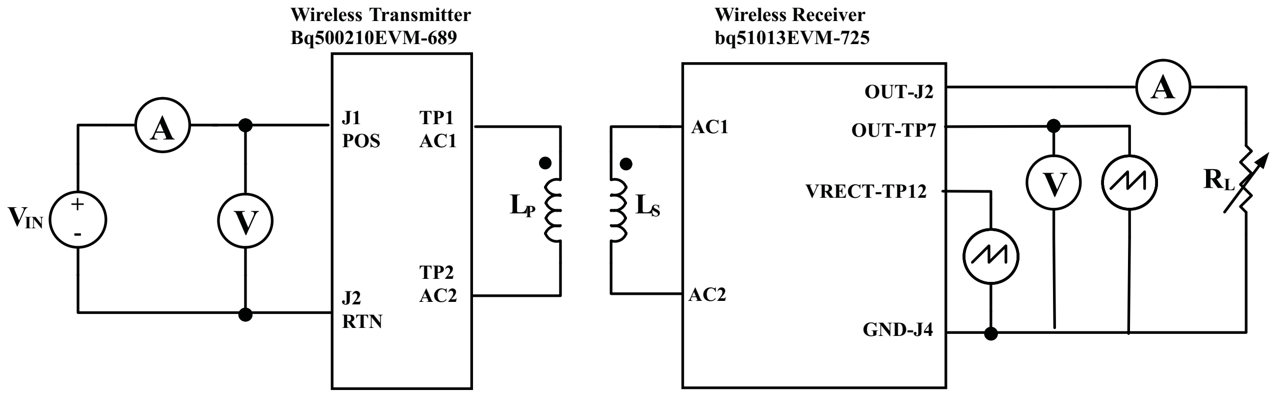


Figure 4. Equipment Setup

6.2.2 EVM Procedures

This section guides the user through a few general test procedures to exercise the functionality of the presented hardware. Some key notes follow:

6.2.2.1 START UP NO RX

Turn on V_{IN}, and observe that the Green Power LED D2 illuminates. Status LED D5 will be off until power tranfer starts.

Apply the scope probe to the test point TP1 and observe a single pulse bursts approximately every 0.5 s. This is Analog Ping probing environment for the presence of a receiver placed on the Tx coil.

6.2.2.2 APPLY RX

Place bq51013EVM-725 EVM on the top of the transmitting coil. Align centers of the receiving and transmitting coils across each other. In the next few seconds, observe Status LED D5 illuminates green, indicating that communication between transmitter and receiver is established and power transfer has began.

- Buzzer will sound at the start of power transfer. Status LED D5 flashes green light during power transfer.
- Typical output voltage is 5 V, and the output current range is 0 mA to 1A.
- Observe continuous sine-wave on the test point TP1 when power transfer is active, frequency will be between 110kHz and 205kHz.
- Make tests and measurements applicable to a normal 5V power supply.

6.2.2.3 EFFICIENCY

To measure system efficiency, measure the output voltage, the output current, input voltage, and input current and calculate efficiency as the ratio of the output power to the input power. It is recommended to average the input current, the comm pulses will modulate the input current distorting the reading. See Figure 5 for efficiency.

6.2.2.4 PARASITIC METAL OBJECT DETECTION

To test the Metal Object Detection (MOD) function. In addition to loading on the output of bq51013EVM-725, apply an electronic load in constant power mode between secondary GND (J4) and TP12 – the output of the secondary side rectifier. Increasing load power from 0 W to over 0.5 W, observe LED D5 of bq500210EVM turning red and the power transfer stopped in approximately 20 s after the MOD threshold was exceeded.

6.2.2.5 THERMAL PROTECTION, NTC

Thermal protection is provided by an NTC resistor connected to JP1. At 1.00V on the sense side (U1-2) thermal fault will be set and unit is shutdown, Status LED D5 will illuminate red. Typical resistor value for fault is 850 ohms. System will try to restart in 5 minutes.

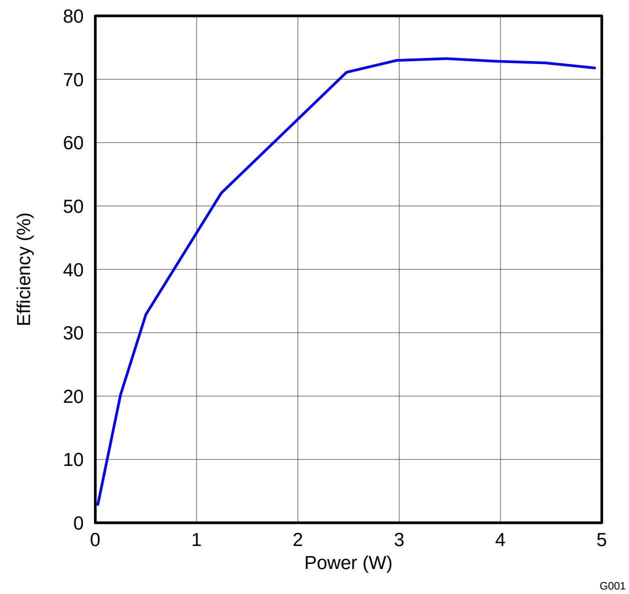


Figure 5. Efficiency v Power, HPA689 Transmitter and HPA725 Reciver

7 bq500210EVM-689 Assembly Drawings and Layout

The following figures show the design of the bq500210EVM printed-circuit board (PCB). The EVM has been designed using a 4-layer, 2-oz, copper-clad circuit board 13.2 cm × 7.24 cm with all components in a 4.5-cm x 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 bq500210 control IC in a practical application. Moving components to both sides of the PCB or using additional internal layers can offer additional size reduction for space-constrained systems.

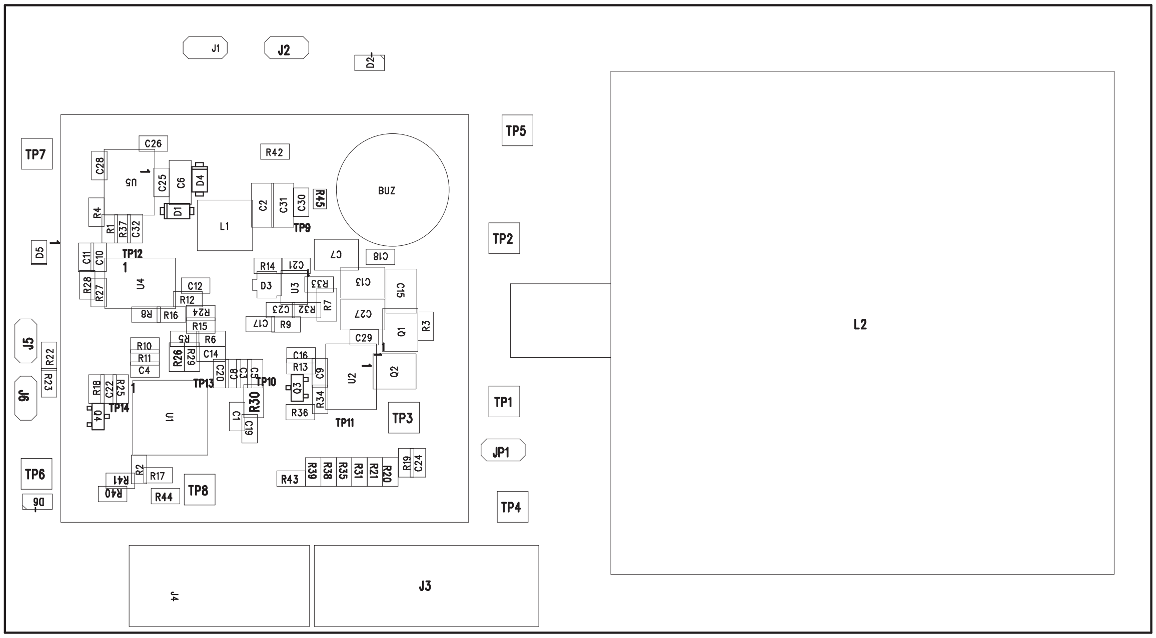
Coil Grounding – A ground plane area under the coil is recommended to reduce noise coupling into the receiver. Ground plane for the EVM is slightly larger than coil footprint and grounded at one point back to the circuit area.

Coil Stack Up and Mounting – The EVM mounting stack-up is as follows:

1. Transmitter coil thickness – 6 mm
2. Sil pad – 0.5 mm
3. Al shim – 1.5 mm

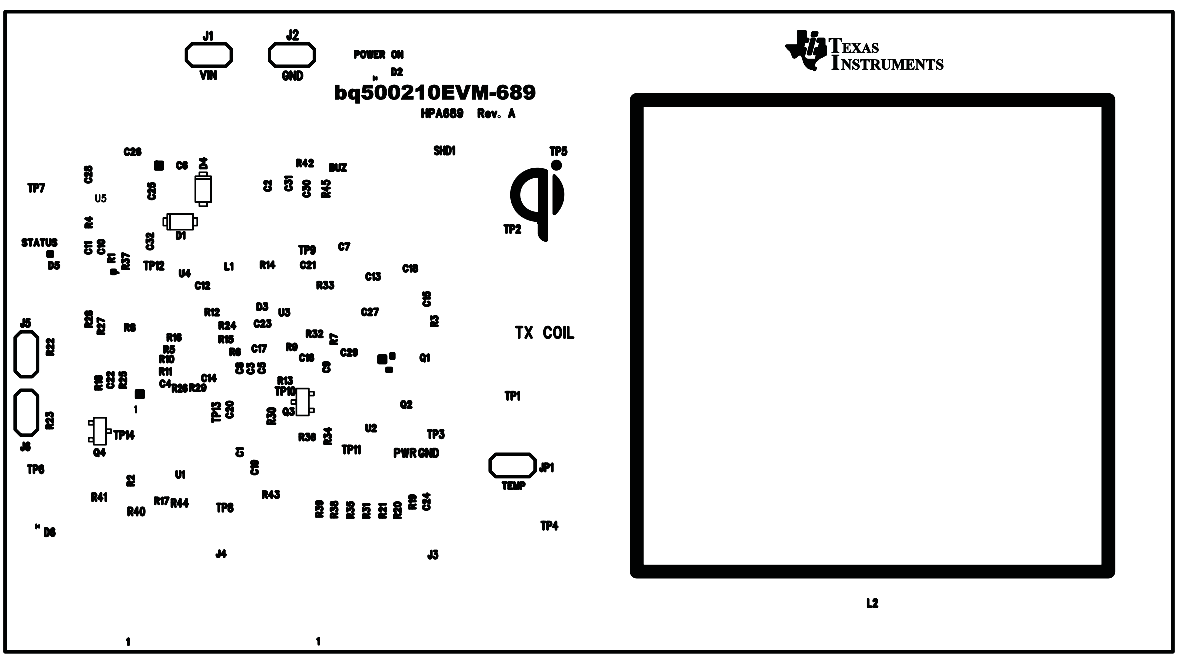
   The overall stack-up is under compression from the cover plate. The AL shim and sil pad is optional for a customer solution optimized for size.

Note: The cover thickness is 0.93 inch, or 2.4 mm is the z-gap thickness for the transmitter.



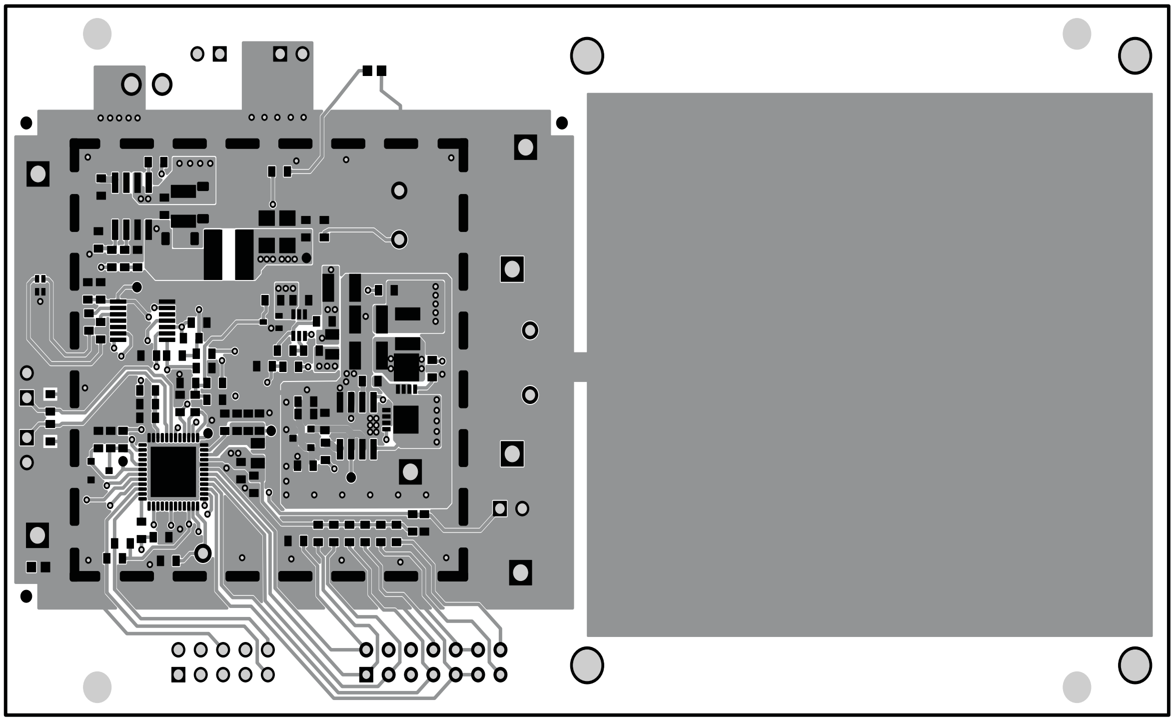
A1

Figure 6. Assembly Top



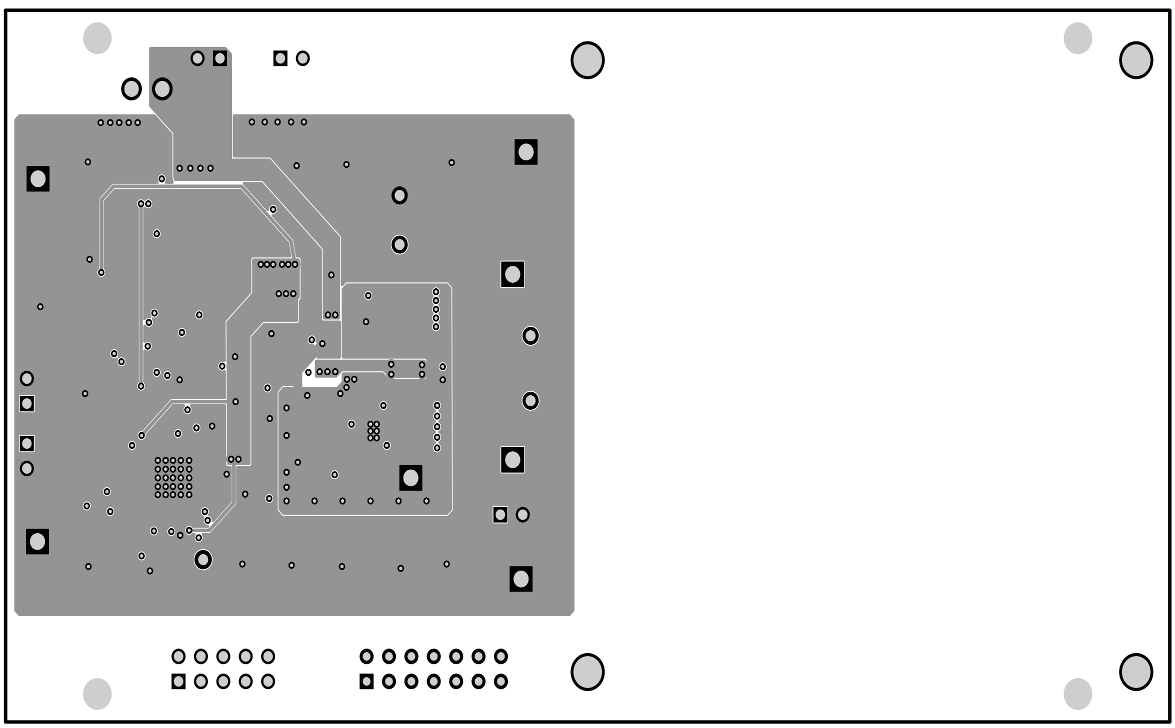
S1

Figure 7. Top Silk



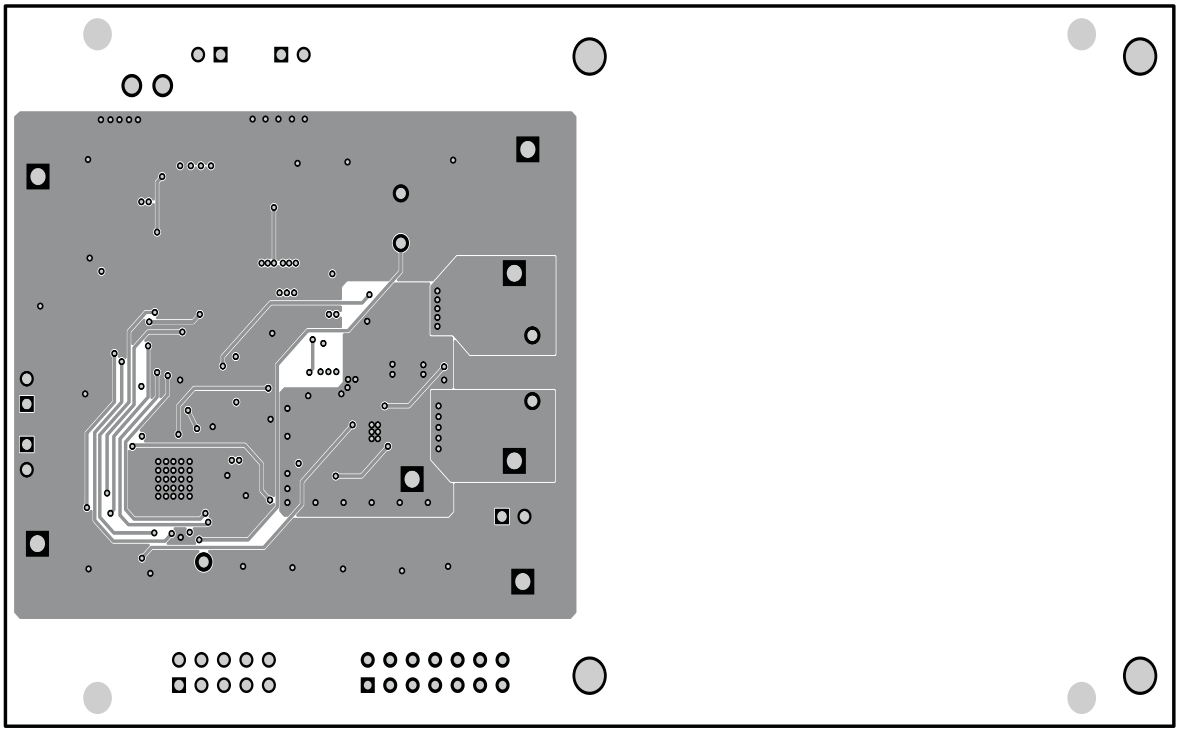
L1

Figure 8. Top Layer



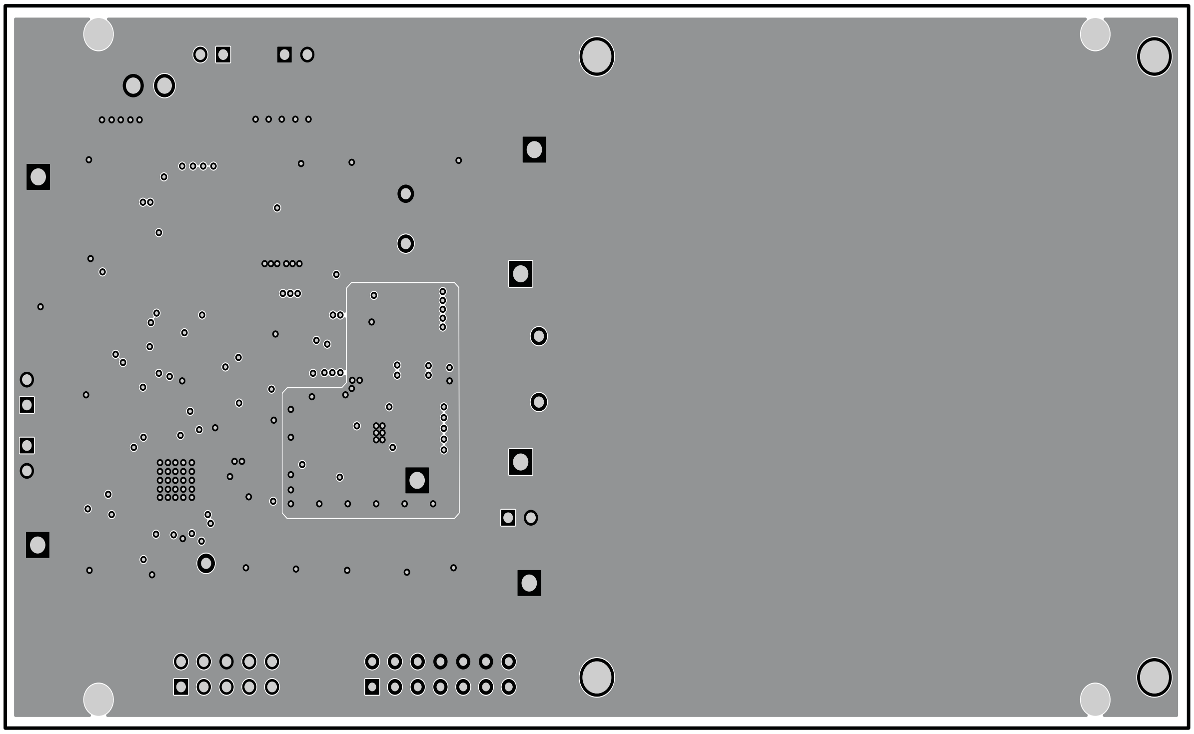
L2

Figure 9. Layer 2



L3

Figure 10. Layer 3



L4

Figure 11. Bottom Layer

8 Reference

For additional information about the bq500210EVM-689 low power wireless power evaluation kit from Texas Instruments, visit the product folder on the TI Web site at http://focus.ti.com/docs/toolsw/folders/print/bqtesla100lp.html.

Evaluation Board/Kit Important Notice

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

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

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

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

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

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

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

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

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

FCC Warning

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

EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 0 V to 20 V and the output voltage range of 0 V to 5 V .

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 65°C. The EVM is designed to operate properly with certain components above 65°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

IMPORTANT NOTICE

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

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

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

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

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

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

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

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

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

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

Products		**Applications**	
Audio	www.ti.com/audio	Communications and Telecom	www.ti.com/communications
Amplifiers	amplifier.ti.com	Computers and Peripherals	www.ti.com/computers
Data Converters	dataconverter.ti.com	Consumer Electronics	www.ti.com/consumer-apps
DLP® Products	www.dlp.com	Energy and Lighting	www.ti.com/energy
DSP	dsp.ti.com	Industrial	www.ti.com/industrial
Clocks and Timers	www.ti.com/clocks	Medical	www.ti.com/medical
Interface	interface.ti.com	Security	www.ti.com/security
Logic	logic.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Power Mgmt	power.ti.com	Transportation and Automotive	www.ti.com/automotive
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com	Wireless	www.ti.com/wireless-apps
RF/IF and ZigBee® Solutions	www.ti.com/lprf		
	TI E2E Community Home Page		e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265