

## ***bq25046EVM-687 Evaluation Module***

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 5-V power supply receiver and associated magnetics, the kit enables designers to speed the development of their end-applications.

### **Contents**

1	Applications .....	2
2	bq25046EVM-687 Electrical Performance Specifications .....	2
3	Modifications .....	2
4	Connector and Test Point Descriptions .....	2
	4.1 Input/Output Connections .....	2
	4.2 Jumpers/Switches .....	3
	4.3 Test Point Descriptions .....	3
5	Schematic and Bill of Materials .....	5
6	Test Setup .....	9
	6.1 Equipment .....	9
	6.2 Equipment Setup .....	9
	6.3 Load Step .....	10
	6.4 Load Dump .....	11
	6.5 V-Adapter Input .....	12
	6.6 Start-Up .....	13
	6.7 Disable Shutdown .....	14
7	bq25046EVM-687 Assembly Drawings and Layout .....	15
8	Reference .....	19

### **List of Figures**

1	HPA687EVM Schematic, Sheet 1 of 3 .....	5
2	HPA687EVM Schematic, Sheet 2 of 3 .....	6
3	HPA687EVM Schematic, Sheet 3 of 3 .....	7
4	Equipment Setup .....	10
5	Load Step .....	11
6	Load Dump .....	12
7	V-Adapter Input .....	13
8	Start-Up .....	14
9	Equipment Shutdown Wireless Disable .....	15
10	Top Assembly .....	16
11	Second Layer .....	17
12	Bottom Copper Layer .....	18
13	Bottom Assembly .....	19

### **List of Tables**

1	bq25046EVM-687 Electrical Performance Specifications .....	2
2	Bill of Materials .....	8

## 1 Applications

The bq25046EVM-687 evaluation module (EVM) demonstrates the receiver portion of the bqTESLA™ wireless power system. This receiver EVM is a complete receiver-side solution that produces 5 V out at up to 1 A when coupled with the bqTESLA™ transmitter. Two key bqTESLA™ devices are shown on this EVM, the bq25046 and MSP430bq1010, and external components that support the two devices for a complete solution.

- The bqTESLA™ receiver can be used in any number of low-power battery portable devices as a power source for charging. With contact-free charging capability, no connections to the device are needed.
- Output voltage of 5 V up to 1 A
- External adapter switchover and control circuit
- Low-profile, external pick-up coil
- Frame is configured to provide correct receiver to transmitter spacing.
- Room above coil for testing with battery, key for tuning

## 2 bq25046EVM-687 Electrical Performance Specifications

Table 1 provides a summary of the bq25046EVM-687 performance specifications. All specifications are given for an ambient temperature of 25°C.

**Table 1. bq25046EVM-687 Electrical Performance Specifications**

Parameter		Notes and Conditions	Min	Typ	Max	Unit
<b>INPUT CHARACTERISTICS</b>						
V <sub>IN</sub>	Input Voltage	Typical V-rectified voltage at TP4	4	5.5	8	V
V <sub>ADAPTER</sub>	Adapter Input Voltage		4		15	V
OVP	Input Overvoltage Protection	Voltage at V-rectified		15		V
<b>OUTPUT CHARACTERISTICS</b>						
V <sub>OUT</sub>	V J2 to J5 (TP6)			5		V
I <sub>OUT</sub>	I J2			1		A
<b>SYSTEMS CHARACTERISTICS</b>						
F <sub>S</sub>	Switching Frequency		110		205	kHz
Eff	Efficiency	Output Current 500 mA		70		%

## 3 Modifications

See the data sheet ([SLUSA83](#)) or ([SLAS696](#)) when changing components. To aid in such customization of the EVM, the board was designed with devices having 0603 or larger footprints. A real implementation likely occupies less total board space.

Note that changing components can improve or degrade EVM performance. For example, V-rectified can be adjusted slightly higher by changing the ratio of R15 and R17; this increases voltage drop on the bq25046, reducing efficiency but improving regulation at high load.

## 4 Connector and Test Point Descriptions

### 4.1 Input/Output Connections

The connections points are described in the following paragraphs.

#### 4.1.1 J1 - External Adapter Input, J3-GND

Power can be provided to simulate an external adapter applied to the receiver. When this is done, an End Power Transfer is sent to the transmitter which enters a low power state. External adapter voltage must be a minimum of 4 V but not exceed 15 V.

#### 4.1.2 J2 - Output Voltage, J5-GND

Output voltage must be 5 V with a possible current of up to 1 A.

#### 4.1.3 J4 - Programming Connector for MSP430

This connector is not populated and is not used with the MSP430BQ1010.

### 4.2 Jumpers/Switches

The control jumpers are described in the following paragraphs.

#### 4.2.1 JP1 - Current Limit During Comm

This function can be enabled or disabled. Default jumper setting is disabled.

#### 4.2.2 JP2 - Terminate on Current

This function can be enabled or disabled.

When disabled, it has no impact on operation.

When enabled, the End Power Transfer is sent to the transmitter when:

- 1.) Output current falls below 100 mA for 3 minutes.
- 2.) Output current falls below 30 mA for 5 seconds.

Default Shorting Jumper setting is disabled.

#### 4.2.3 JP3 - Error

This jumper sends End Power Transfer and terminates operation. Default Shorting Jumper setting is disabled

### 4.3 Test Point Descriptions

The test points are described in the following paragraphs.

#### 4.3.1 TP1 - AC Input 1

This is the test point for measuring ac voltage applied to the EVM from the receiver coil.

#### 4.3.2 TP2 - AC Input 2

This is the test point for measuring ac voltage applied to the EVM from the receiver coil.

#### 4.3.3 TP3 - Overvoltage Protection Gate Drive

When V-Rect voltage exceeds 15 V, the Overvoltage Protection circuit becomes active. At that point, this test point begins to rise above 0 V, and the load input ac bus reduces output voltage.

#### 4.3.4 TP4 - Rectified Voltage

Input ac voltage is rectified into dc voltage and applied to the input of the bq25046. This test point provides monitoring of that test point.

#### 4.3.5 TP5 - BQ Output Voltage

The bq25046 regulates output voltage at 5 V; this test point provides monitoring for this voltage.

**4.3.6 TP6 - V-Out**

V-Out can be 5 V from the bq25046 or voltage from the adapter input.

**4.3.7 TP7 - Power-Good Signal**

When input to the bq25046 is above UVLO, this signal is low.

**4.3.8 TP8 - Charge Signal**

When the bq25046 output is enabled, this signal is low.

**4.3.9 TP9 - AC Detect Signal**

When the ac signal is present, this signal is high; when the voltage exceeds 1.65 V, the MSP430bq1010 is enabled.

**4.3.10 TP10 - Comm Drive Signal**

This test point is the serial communications signal with the transmitter.

**4.3.11 TP11 - ISET\_Scale Output Current**

This is the output signal from the bq25046 that is proportional to the output current.

**4.3.12 TP12 - External Adapter Detect**

When external adapter voltage is applied, this input signal is applied to the MSP430bq1010 to send End Power Transfer.

**4.3.13 TP13 - Enable 2**

This is one of two enable input signals to the bq25046 from the MSP430bq1010.

**4.3.14 TP14 - Enable 1**

This is one of two enable input signals to the bq25046 from the MSP430bq1010.

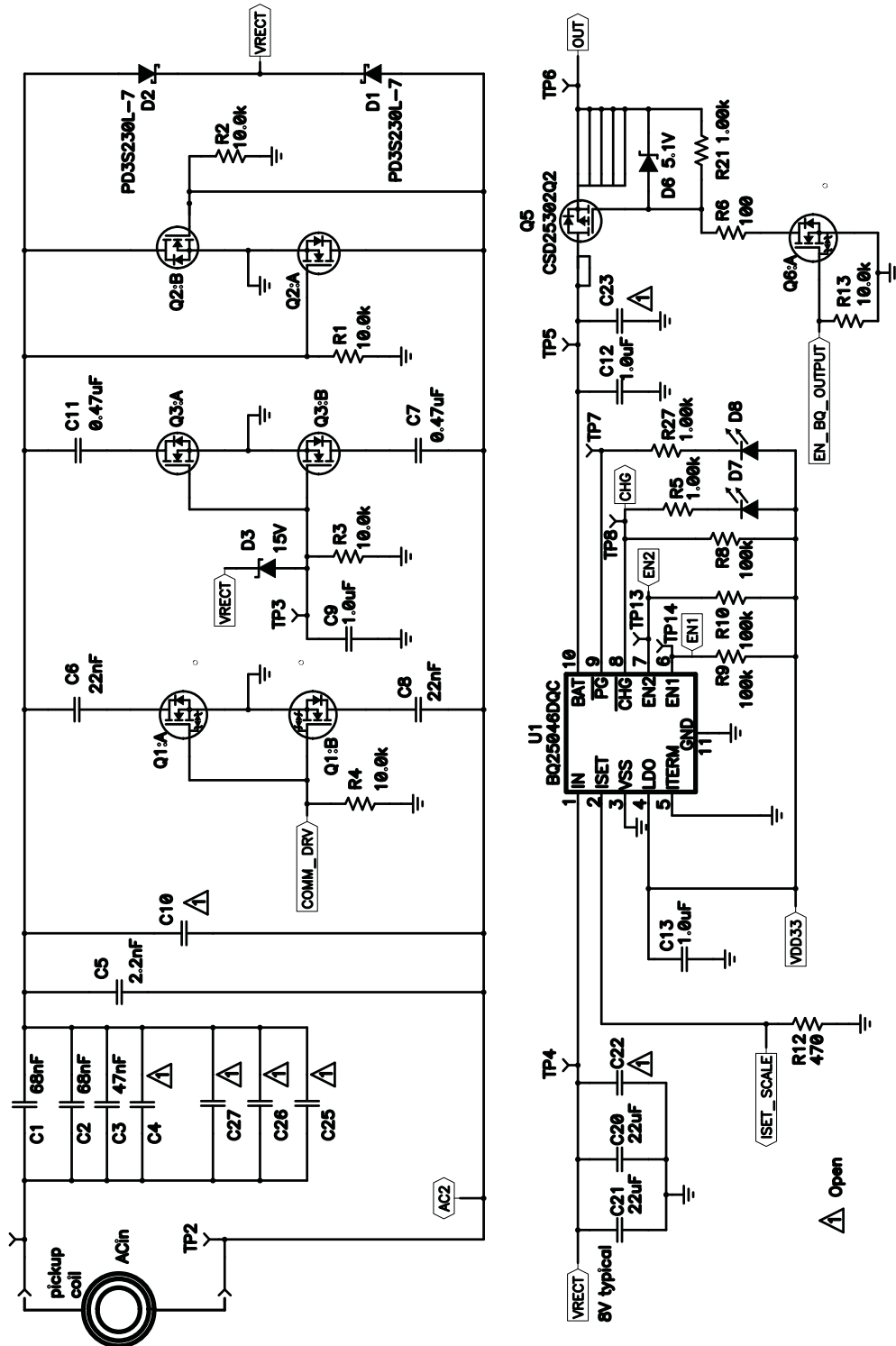
**4.3.15 TP15 - Output Enable Signal**

This is the output signal from the MSP430bq1010 that connects the output from the bq25046.

**4.3.16 TP16 - Adapter Switch Drive Signal**

This test point is the switch circuit drive signal that transitions out between the adapter input and the bq25046 output.

5 Schematic and Bill of Materials



NOTE: For Reference Only, See Table 2 for Specific Values

Figure 1. HPA687EVM Schematic, Sheet 1 of 3

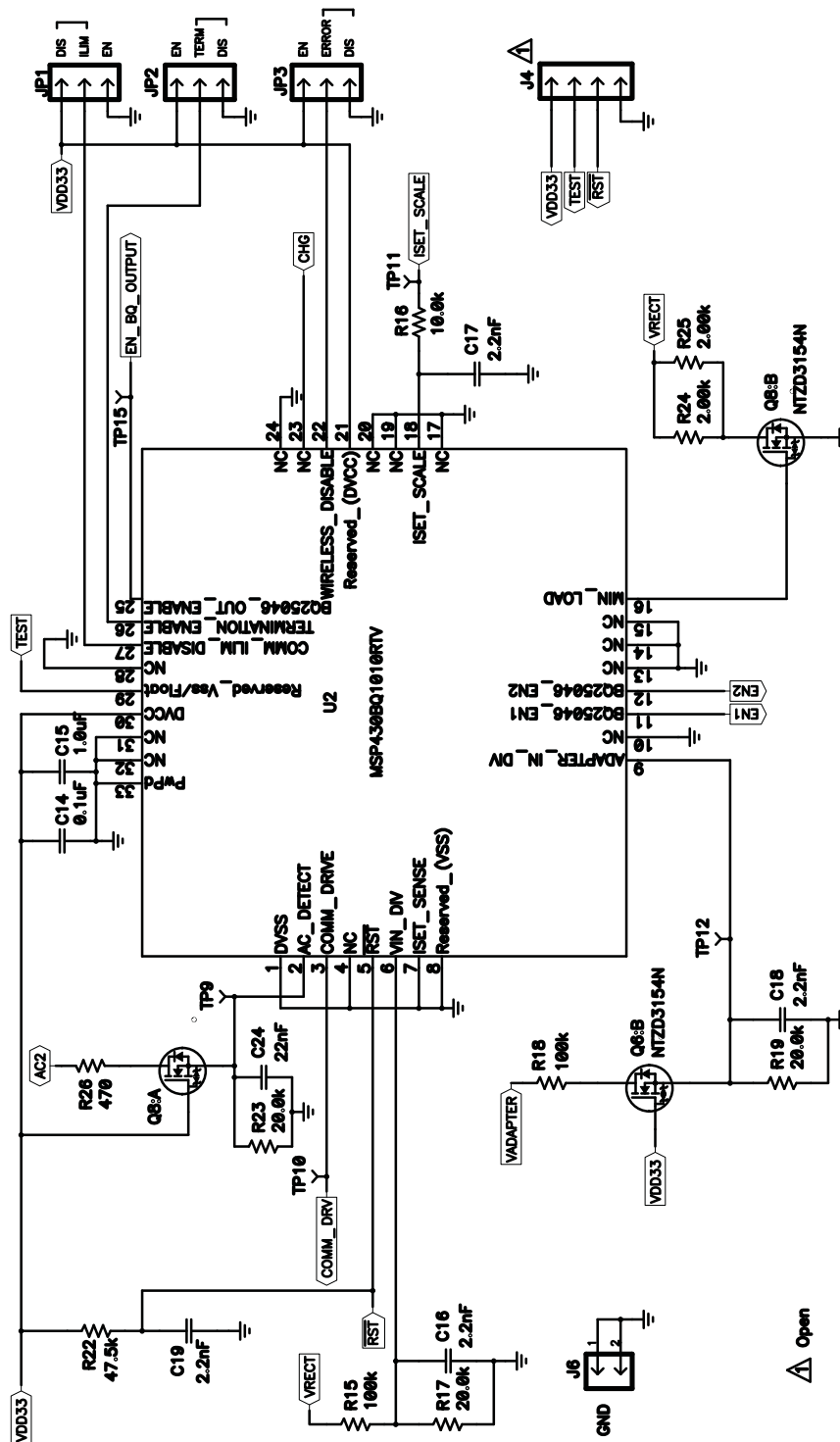


Figure 2. HPA687EVM Schematic, Sheet 2 of 3

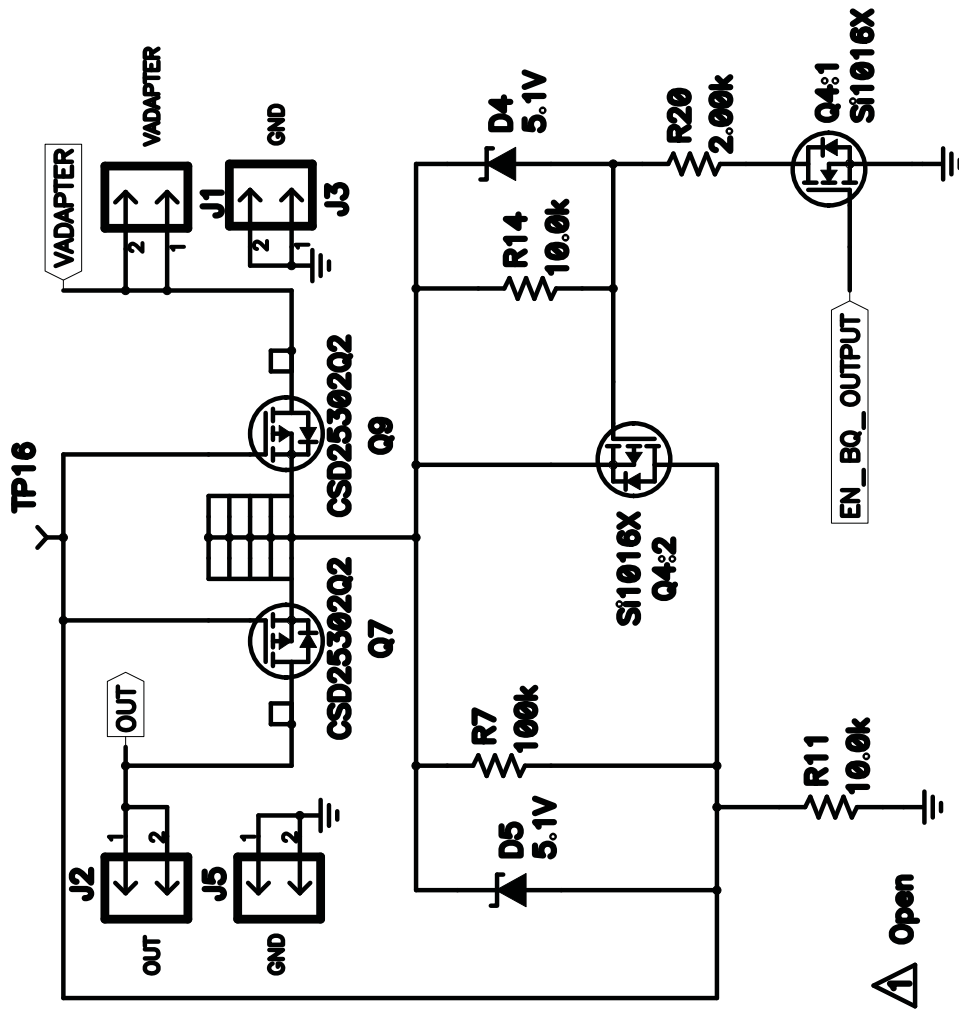


Figure 3. HPA687EVM Schematic, Sheet 3 of 3

**Table 2. Bill of Materials**

Count	RefDes	Value	Description	Part Number	MFR
2	C1, C2	68 nF	Capacitor, Ceramic, 50V, X7R, 10%	GRM188R71H683KA93D	Murata
1	C3	47 nF	Capacitor, Ceramic, 50V, X7R, 10%	Std	Std
0	C4	Open	Capacitor, Ceramic	open	open
5	C5, C16–C19	2.2 nF	Capacitor, Ceramic, 50V, X7R, 10%	Std	Std
3	C6, C8, C24	22 nF	Capacitor, Ceramic, 50V, X7R, 10%	GRM188R71H223KA01D	Murata
2	C7, C11	0.47 $\mu$ F	Capacitor, Ceramic, 25V, X7R, 10%	Std	Std
3	C9, C13, C15	1.0 $\mu$ F	Capacitor, Ceramic, 6.3V, X7R, 10%	Std	Std
0	C10	Open	Capacitor, Ceramic	Std	open
1	C12	1.0 $\mu$ F	Capacitor, Ceramic, 10V, X5R, 20%	Std	Std
1	C14	0.1 $\mu$ F	Capacitor, Ceramic, 50V, X7R, 20%	Std	Std
2	C20, C21	22 $\mu$ F	Capacitor, Ceramic, 25V, X7R, 10%	Std	Std
0	C22	Open	Capacitor, Ceramic, 25V, X7R, 10%	Std	Std
0	C23	Open	Capacitor, Ceramic, 10V, X5R, 20%	Std	Std
0	C25–C27	Open	Capacitor, Ceramic, 50V, C0G, 5%	GRM31C5C1H683JA01L	Murata
2	D1, D2	PD3S230L-7	Diode, Schottky, 2A, 30V	PD3S230L-7	Diodes
1	D3	15V	Diode, Zener, 15V, 500mW	MMSZ5245B-7-F	Diodes
3	D4–D6	5.1V	Diode, Zener, 5.1V	MMSZ5231B-7-F	Diodes
2	D7, D8	SML-LXT0805GW-TR	LED, Green	SML-LXT0805GW-TR	Lumex
3	Q1, Q6, Q8	NTZD3154N	MOSFET, Dual Nch, 20V, 540mA, 0.5 $\Omega$	NTZD3154NT1G	On Semi
2	Q2, Q3	FDMB3800N	MOSFET, Dual NChan, 30V, 4.8A, 40 m $\Omega$	FDMB3800N	Fairchild
1	Q4	Si1016X	MOSFET, Dual Nch, 20V, 0.6A, 0.7 $\Omega$ , Pch, –20V, –0.4 A, 1.2 $\Omega$	Si1016X	Vishay
3	Q5, Q7, Q9	CSD25302Q2	Trans, Pch NexFET, 20V, 5 A, 56 m $\Omega$	CSD25302Q2	TI
8	R1–R4, R11, R13, R14, R16	10.0k	Resistor, Chip, 1/16W, 1%	Std	Std
3	R5, R21, R27	1.00k	Resistor, Chip, 1/16W, 1%	Std	Std
1	R6	100	Resistor, Chip, 1/16W, 1%	Std	Std
6	R7–R10, R15, R18	100k	Resistor, Chip, 1/16W, 1%	Std	Std
2	R12, R26	470	Resistor, Chip, 1/16W, 1%	Std	Std
3	R17, R19, R23	20.0k	Resistor, Chip, 1/16W, 1%	Std	Std
1	R20	2.00k	Resistor, Chip, 1/16W, 1%	Std	Std
1	R22	47.5k	Resistor, Chip, 1/16W, 1%	Std	Std
2	R24, R25	2.00k	Resistor, Chip, 0.1W, 1%	Std	Std
1	U1	BQ25046DQC	IC, 1.2A, Single-Input, Single Cell Li-Ion BATTERY CHARGER with 50mA LDO	BQ25046DQC	TI
1	U2	MSP430BQ1010RTV	IC, Wireless Receiver-Side Communication and Power Monitoring	MSP430BQ1010RTV	TI
1			Coil, RX with Attractor	IWAS-4832FF-50	Vishay



## 6 Test Setup

### 6.1 Equipment

#### 6.1.1 bqTESLA™ Transmitter

Power for the bq25046EVM-687 receiver EVM is supplied through a bqTESLA™ transmitter or WPC-certified transmitter. The input ac voltage is applied to the receiver through the coil located in the receiver bottom.

#### 6.1.2 Voltage Source

Input power supply to the bqTESLA™ transmitter is typically 19 Vdc  $\pm$ 200 mV at 500 mA maximum, but consult transmitter specification. To simulate an external adapter, an additional 5 V at the 1-A power supply is used.

#### 6.1.3 Meters

Output voltage can be monitored at TP6 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 multichannel oscilloscope with appropriate probes is used to observe the COMM\_DRV signal at TPS10 and other signals.

#### 6.1.6 Recommended Wire Gauge

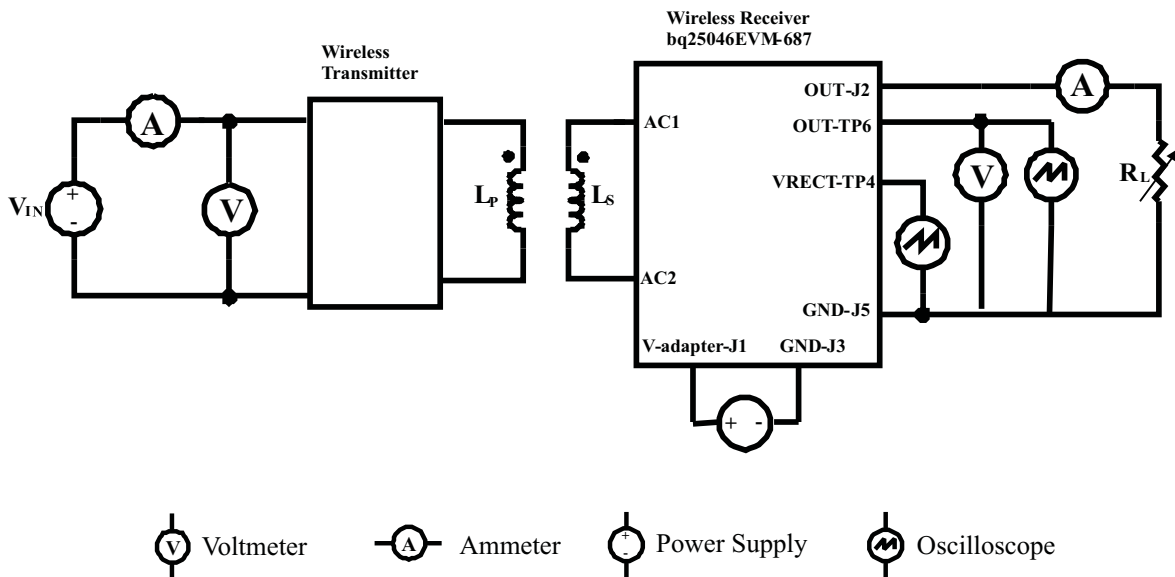
For proper operation, 22 AWG wire is recommended when connecting the bq25046EVM-687EVM to loads.

### 6.2 Equipment Setup

- With the power supply OFF, connect supply to the bqTESLA™ transmitter.
- Place the bqTESLA™ receiver on the transmitter.
- Connect load to J2 with return to J5, monitor current through load with ammeter, and monitor current to load at TP6.
- Typical output voltage is 5 V, and the output current range is 0 mA to 1 A.

#### 6.2.1 Equipment Setup Diagram

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


**Figure 4. Equipment Setup**

### 6.2.2 EVM Setup Procedures

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

- To probe the output voltage of the receiver, connect the probe to TP6.
- To probe the rectifier voltage, connect the probe to TP4.
- The V-adapter supply which simulates an external adapter is connected to J1.
- All voltmeters must be Kelvin connected (at the pin) to the point of interest.
- The output load is recommended to be a variable power resistor or electronic load.

### 6.3 Load Step

The procedure for load step is as follows:

- Set up the test bench as described in [Section 6.2](#).
- Power TX with 19 V.
- Provide a load step from no load (high impedance) to 5  $\Omega$  or 1 A (if using a current source load).
- Monitor load current, rectifier voltage, and output voltage as shown in the following illustrations.

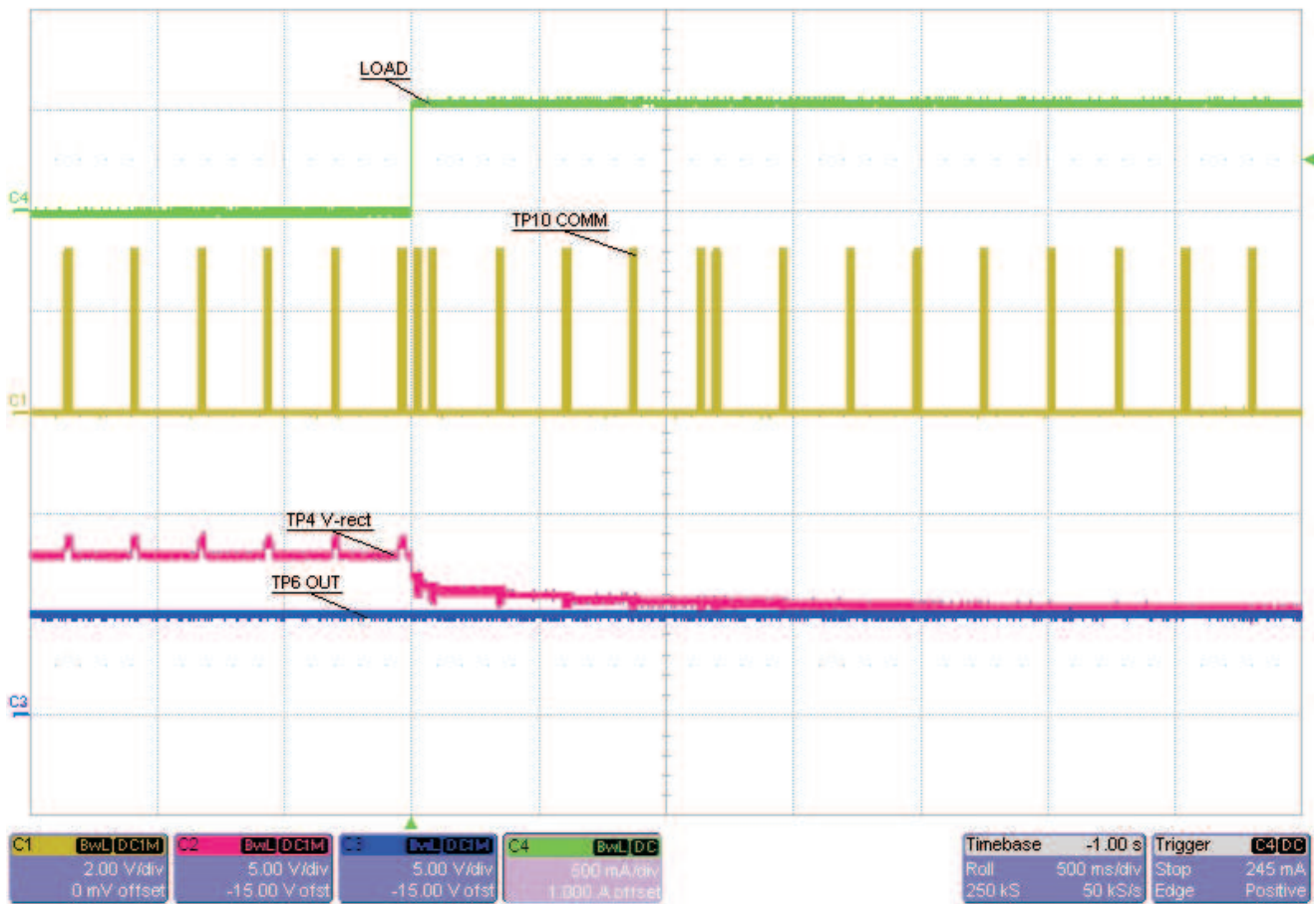


Figure 5. Load Step

### 6.4 Load Dump

The procedure for load dump is as follows:

- Set up the test bench as described in [Section 6.2](#).
- Power TX with 19 V.
- Provide a load dump from 5 Ω or 1 A (if using a current source load) to no load (high impedance).
- Monitor load current, rectifier voltage, and output voltage as shown in the following illustration.

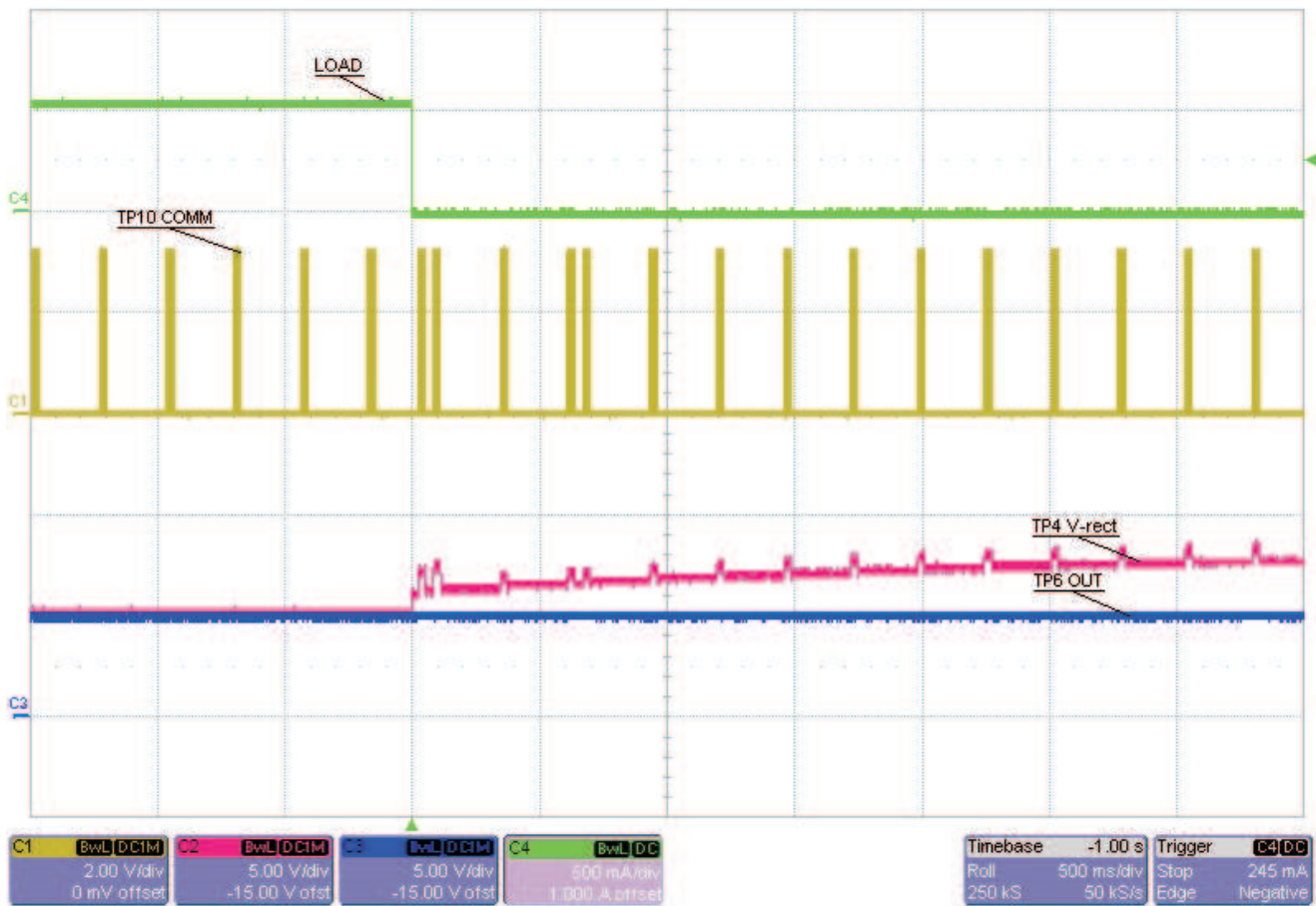


Figure 6. Load Dump

## 6.5 V-Adapter Input

The procedure for external adapter (wired adapter) testing is as follows:

- Set up the test bench as described in [Section 6.2](#).
- Power TX with 19 V.
- Load output (the following was loaded with a 6-Ω resistor).
- Apply a 5-V V-adapter input voltage.
- Monitor load current, rectifier voltage, output voltage, and V-adapter voltage as shown in the following illustration.

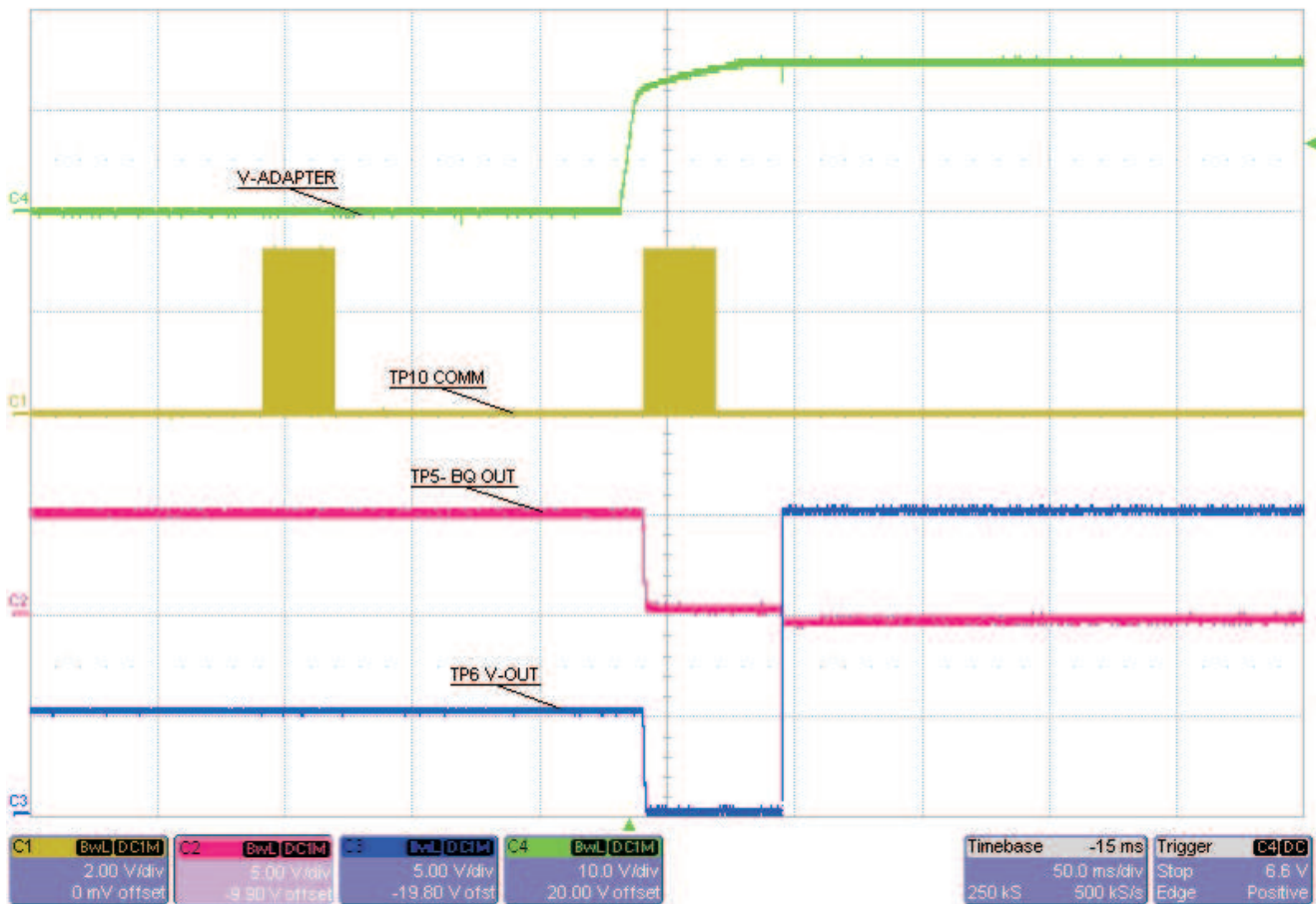


Figure 7. V-Adapter Input

## 6.6 Start-Up

The procedure demonstrates start-up and shows the Signal Strength Packet, ID Packet, and Config Packet followed by Control Error Packet:

- Set up the test bench as described in [Section 6.2](#).
- Power TX with 19 V.
- Trigger scope sweep on TP9 AC Det.
- While observing Comm signal at TP10, the first packet will be Signal Strength Packet, indicating received power.
- Second packet is Identification, ID Packet, and this is Configuration Packet; the first three are only sent at start-up.
- The following packets are control error packets which change the operating point of the transmitter.

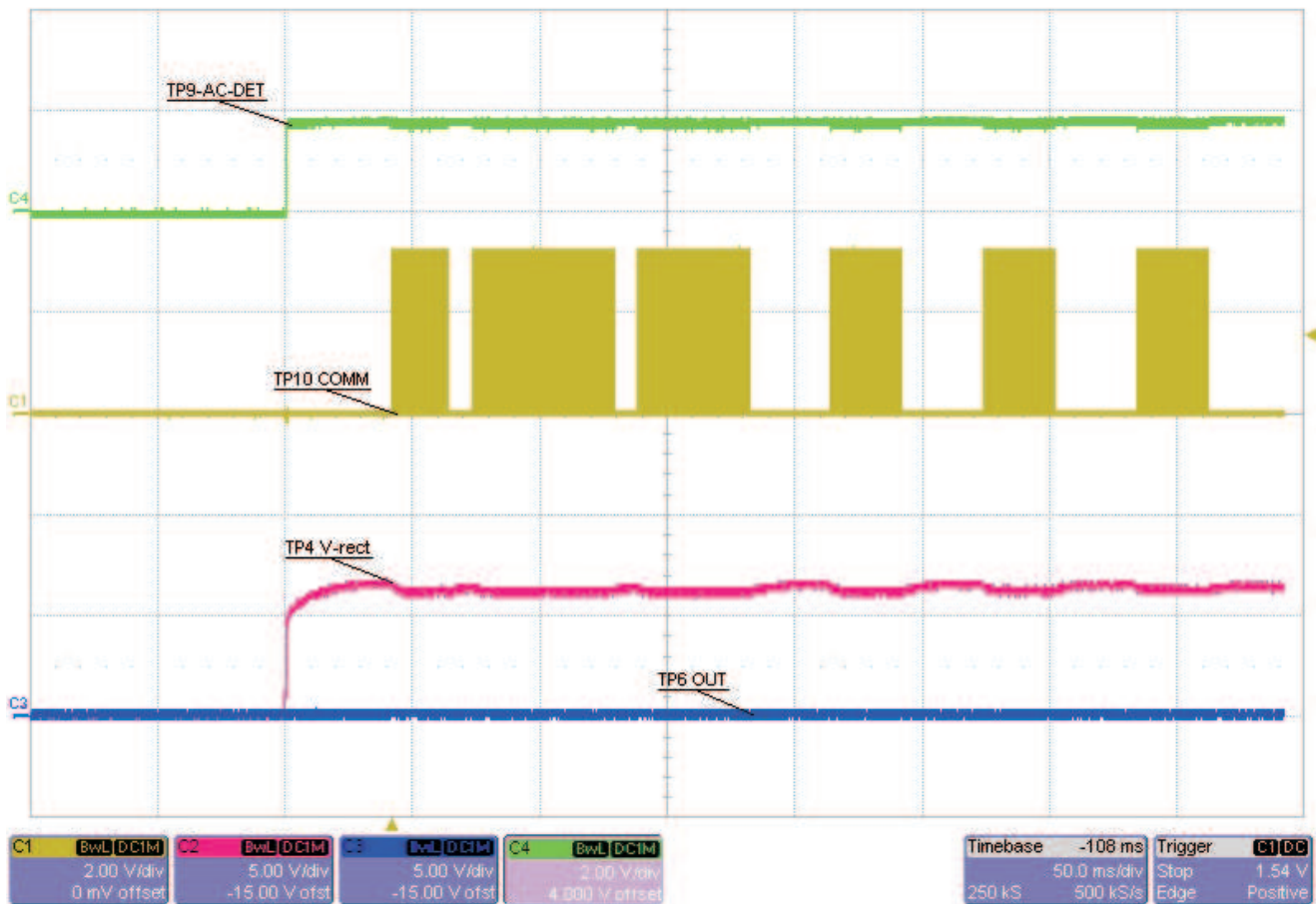


Figure 8. Start-Up

## 6.7 Disable Shutdown

The jumper JP3 sends an End Power Transfer to Transmitter, Shutdown:

- With unit operating normally, move jumper JP3 from DIS to EN position.
- LED D7 and D8 turn OFF; output voltage drops to 0 V.
- Return jumper to DIS position, lift RX off TX pad, and place back down; RX restarts.
- Note: Returning jumper to DIS does not turn unit back on. Unit will restart in 5 minutes after the jumper is set to DIS.

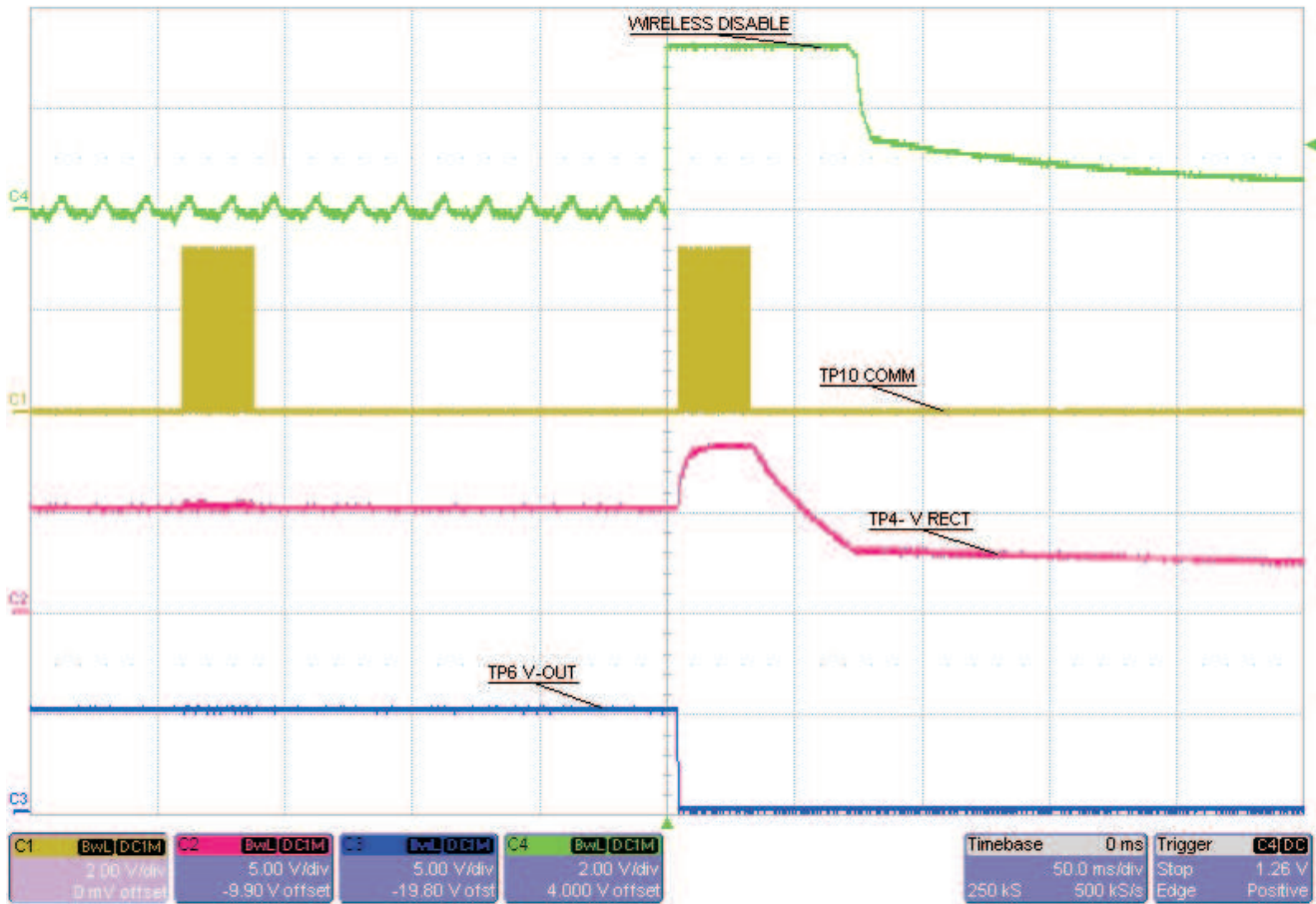


Figure 9. Equipment Shutdown Wireless Disable

## 7 bq25046EVM-687 Assembly Drawings and Layout

The following figures (Figure 10 through Figure 13) show the design of the bq25046EVM-687 printed-circuit board. The EVM has been designed using a 2-layer, 2-oz, copper-clad printed-circuit board 2.1-in. x 2.1-in. area to provide the user easy viewing, probing, and evaluating of the bq25046 and MSP430bq1010 control ICs in a practical double-sided application. Moving components to both sides of the PCB or using additional internal layers can offer additional size reduction for space-constrained systems.

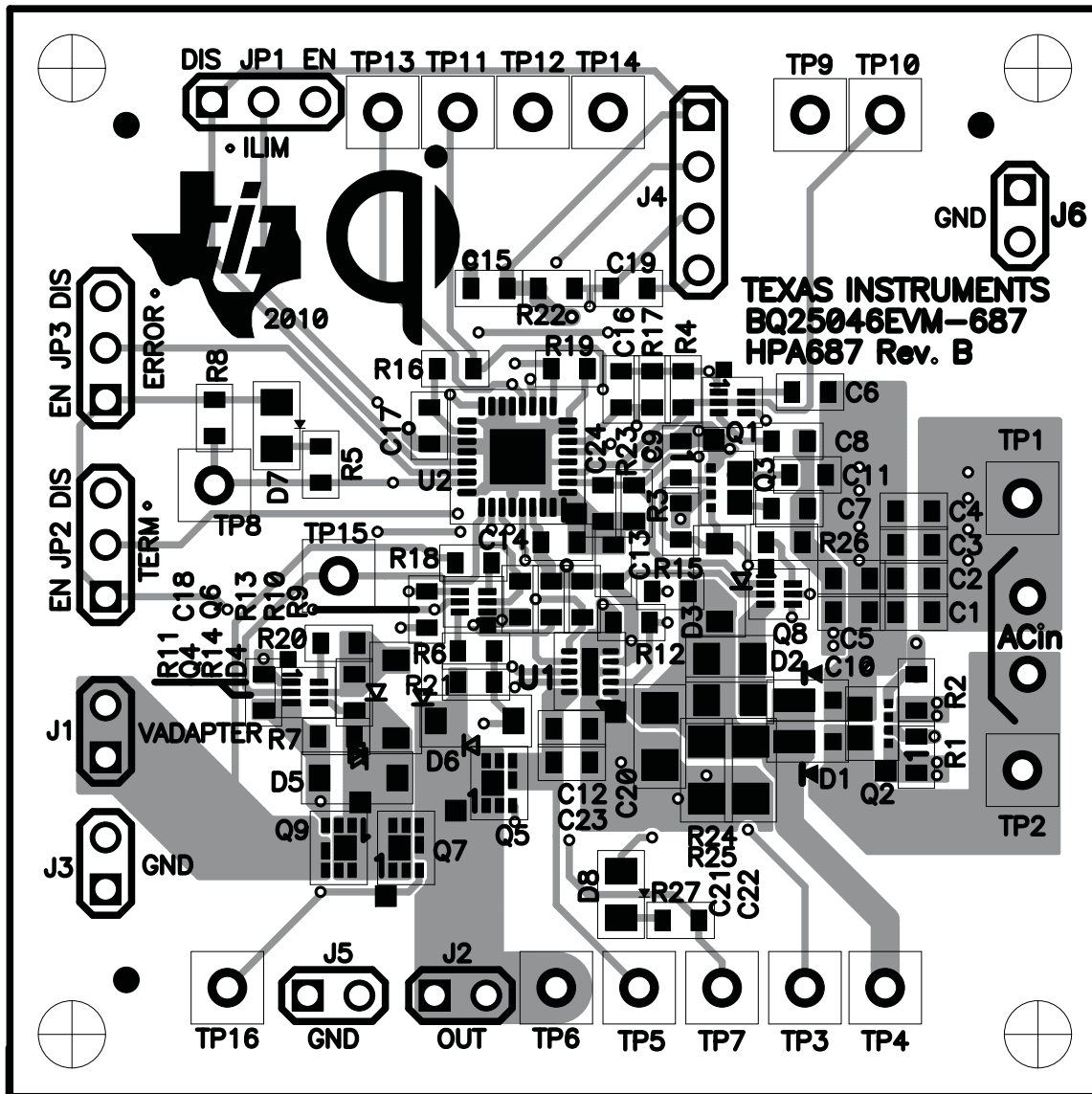


Figure 10. Top Assembly



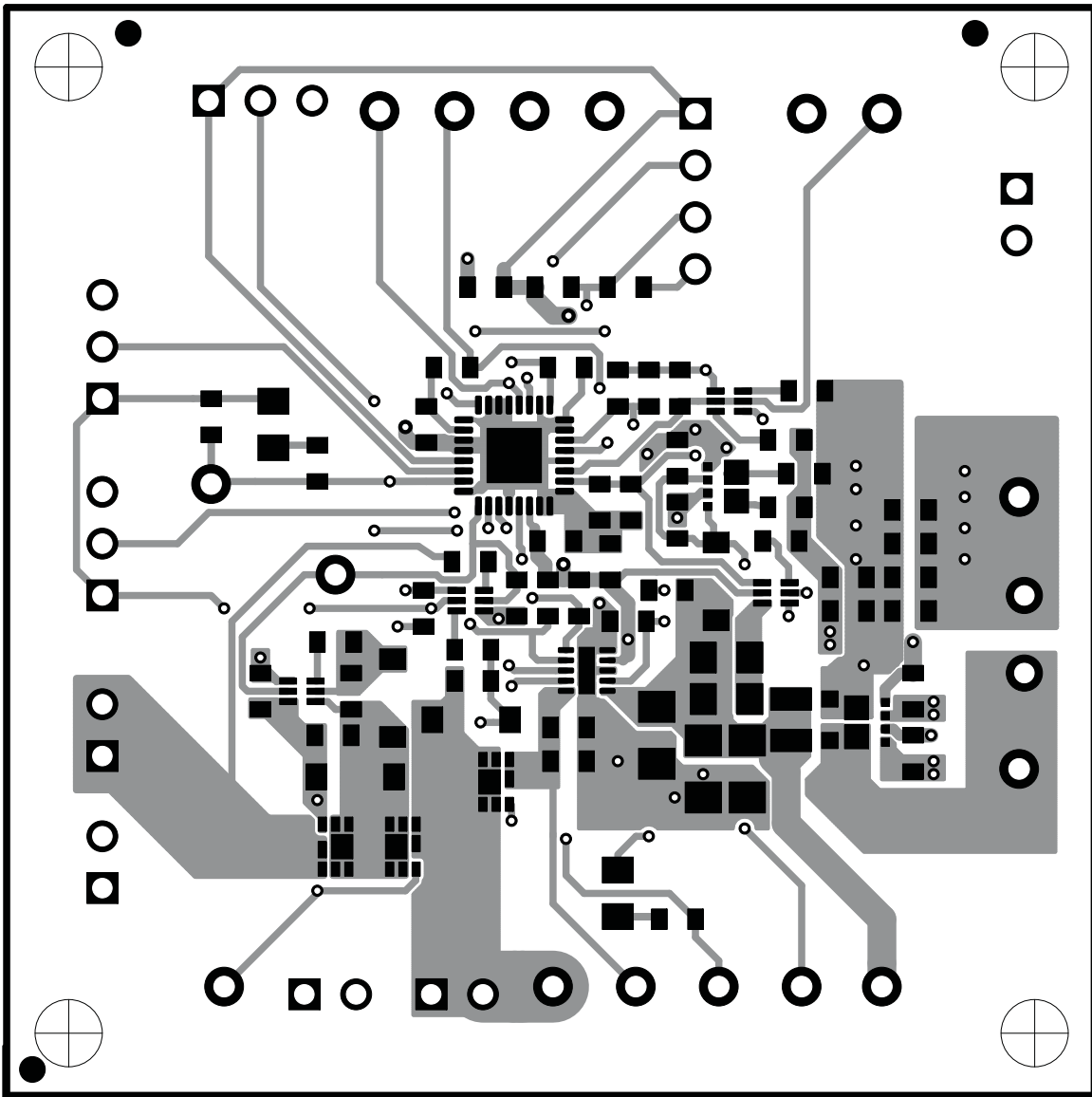


Figure 11. Second Layer

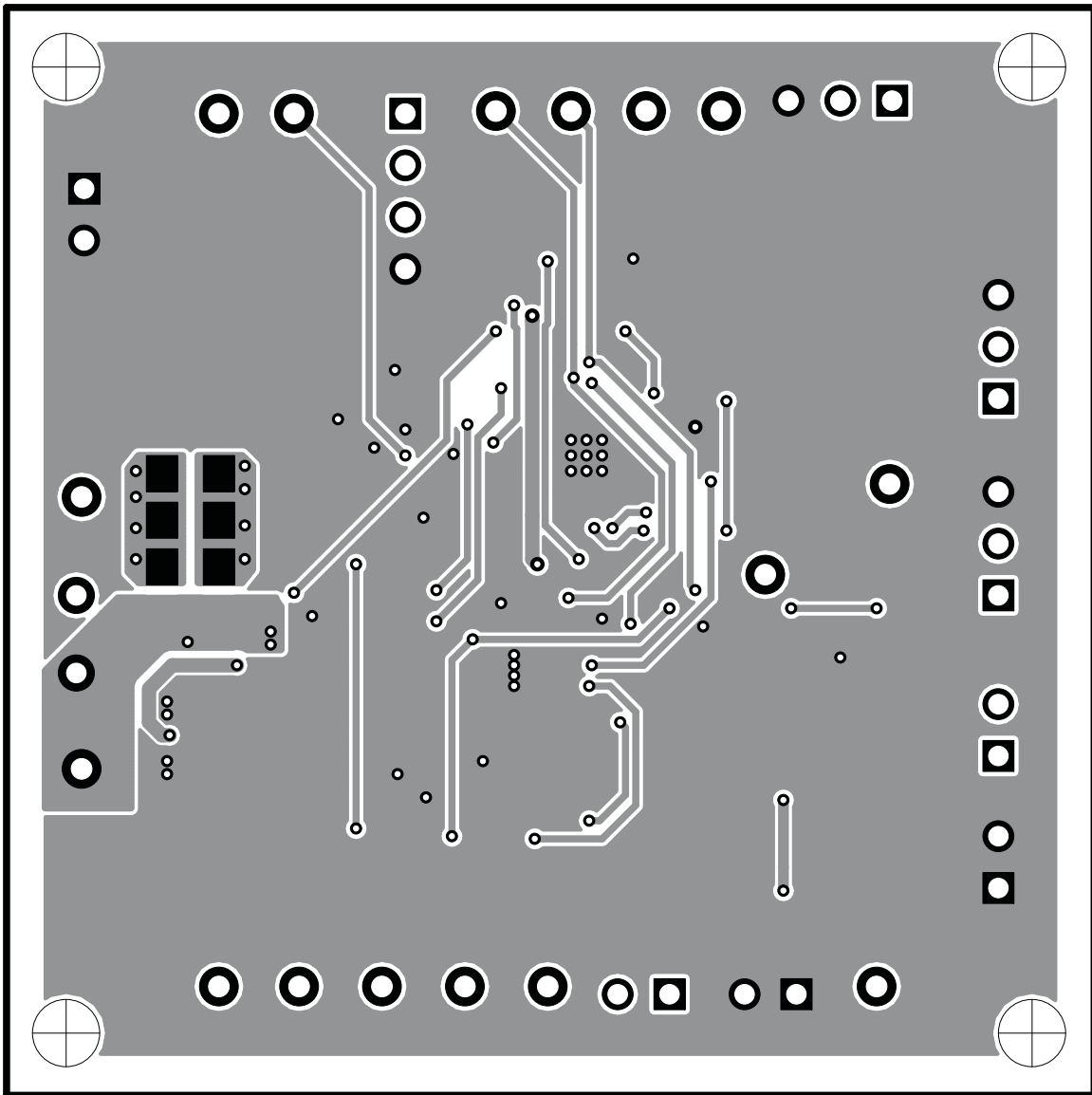


Figure 12. Bottom Copper Layer

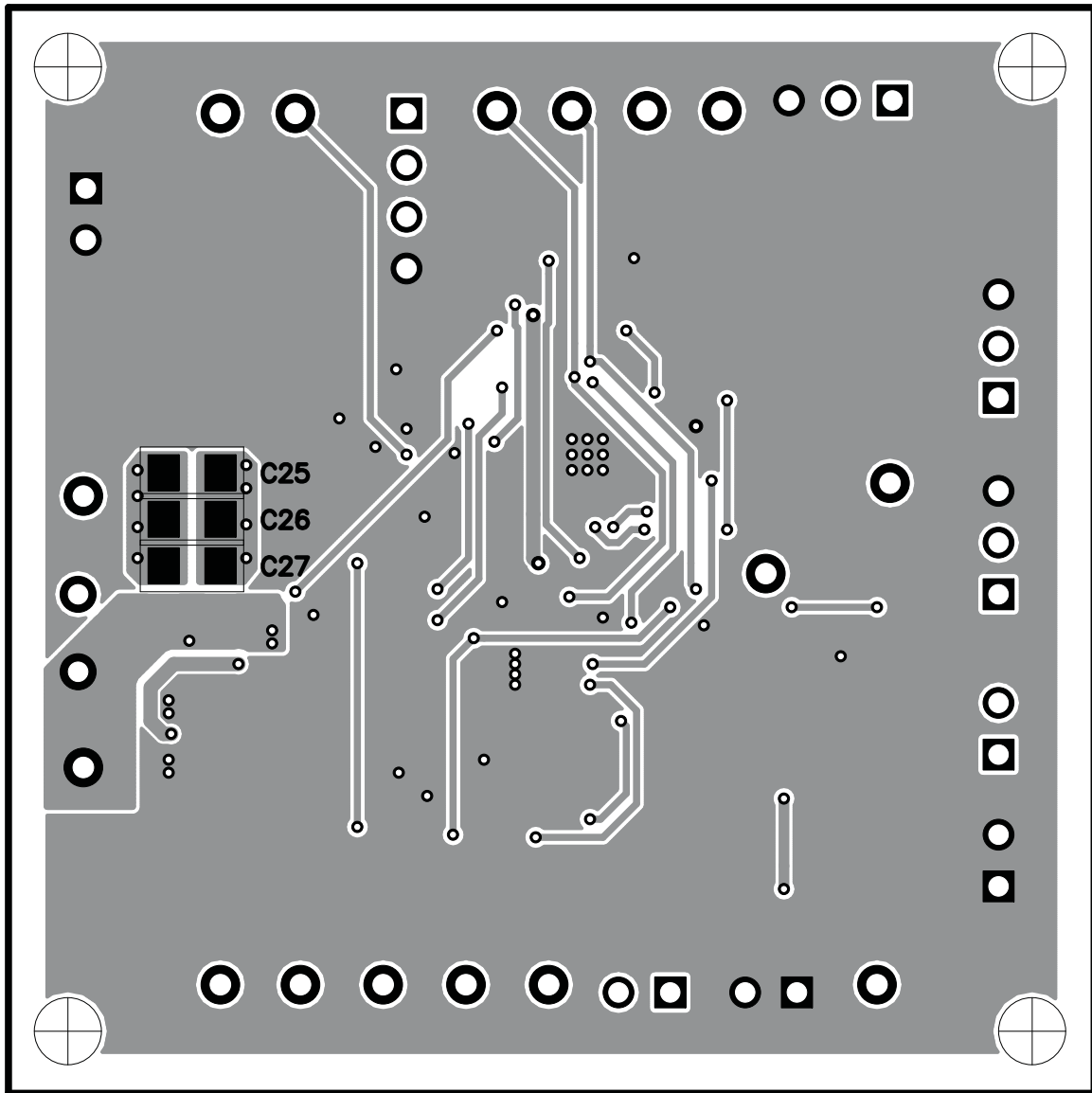


Figure 13. Bottom Assembly

## 8 Reference

For additional information about the bqTESLA100LP 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](http://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 8 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  
Copyright © 2010, Texas Instruments Incorporated

## IMPORTANT NOTICE

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

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

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

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

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

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

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

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

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

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

<b>Products</b>		<b>Applications</b>	
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>	Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>	Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>	Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>	Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>	Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>	Energy	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>	Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>	Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>	Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>	Space, Avionics & Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>	Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
		Wireless	<a href="http://www.ti.com/wireless-apps">www.ti.com/wireless-apps</a>

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2010, Texas Instruments Incorporated