

Using the bq2000EVM

1 Introduction

This user's guide describes the bq2000EVM EVM (an evaluation module for the bq2000 and bq2000T). The EVM provides a convenient method for evaluating the performance of a charge management solution for portable applications using either the bq2000 or bq2000T. A complete and tested charger is presented. The charger is designed to deliver up to 1.0A of continuous output current. The DV2000S1 is shipped with a programmed default charging current of 1.0A. Refer to the bq2000/bq2000T data sheet (literature ID "bq2000") prior to using this EVM for detailed information on the bq2000 or bq2000T device.

1.1 Device Background

The bq2000 is a programmable, monolithic IC for fast-charge management of nickel cadmium (NiCd), nickel metal-hydride (NiMH), or lithium-ion (Li-Ion) batteries in single or multi-chemistry applications. The bq2000 detects the battery chemistry and proceeds with the optimal charging and termination algorithms. This process eliminates undesirable undercharged or overcharged conditions and allows accurate and safe termination of fast charge. Depending on the chemistry, the bq2000 provides a number of charge termination criteria. The bq2000 can terminate charge based on peak voltage detection (PVD) for NiCd and NiMH batteries, minimum charging current for Li-Ion batteries, maximum temperature, or maximum charge time. For safety, the bq2000 inhibits fast charge until the battery voltage and temperature are within user-defined limits. If the battery voltage is below the low-voltage threshold, the bq2000 uses trickle-charge to condition the battery. For NiMH batteries, the bq2000 provides an optional top-off charge to maximize the battery capacity. The integrated high-frequency comparator allows the bq2000 to be the basis for a complete, high-efficiency power-conversion circuit for both nickel-based and lithium-based chemistries.

1.2 EVM Differences

In addition to this bq2000EVM EVM, there are also DV2000S1 and DV2000TS1 EVMs available for evaluating the performance of the bq2000 or bq2000T. The DV2000S1/TS1 boards make use of through-hole devices while the bq2000EVM board was later developed to utilize all surface-mount devices and reduce the physical size of the EVM. Both EVMs provide complete evaluation environments for the bq2000/bq2000T, support up to 4 Li-Ion or 10 NiCd/NiMH cells, are user-programmable for other cell counts, and can operate with or without a charge top-off period. To correctly operate each EVM, consult its corresponding user's guide.

1.3 Performance Specification Summary

Specification	Min	Typ	Max	Unit
Input DC voltage, $V(\text{DC}+) - V(\text{DC}-)$	10		25	V
Battery voltage, $V(\text{BAT}+) - V(\text{BAT}-)$			18	V
Battery charge current, $I(\text{BAT}+)$			1.0	A
Thermistor voltage, $V(\text{TS})$	0		5	V

2 Setup and Configuration

This section describes the jumper connections on the bq2000EVM along with the resulting operation. It describes the different ways this EVM can be used with a variety of battery packs.

2.1 Connection Descriptions

Jumper Designator	Description
J1: DC+	DC input positive voltage from external supply
J1: DC–	DC input ground
J2: BAT+	Positive terminal of the battery or battery pack
J2: BAT–	Negative terminal of the battery or battery pack
J2: TS	Thermistor connection
J2: BAT–	Negative terminal of the battery or battery pack, used for thermistor connection
J3: C/4, 320, Y	Place jumper here for a C/4 charge rate, 320 minute timeout, top-off mode selected
J3: C/4, 320, N	Place jumper here for a C/4 charge rate, 320 minute timeout, top-off mode not selected
J3: C/3, 240, Y	Place jumper here for a C/3 charge rate, 240 minute timeout, top-off mode selected
J3: C/3, 240, N	Place jumper here for a C/3 charge rate, 240 minute timeout, top-off mode not selected
J3: C/2, 160, Y	Place jumper here for a C/2 charge rate, 160 minute timeout, top-off mode selected
J3: C/2, 160, N	Place jumper here for a C/2 charge rate, 160 minute timeout, top-off mode not selected
J3: C, 80, Y	Place jumper here for a C charge rate, 80 minute timeout, top-off mode selected
J3: C, 80, N	Place jumper here for a C charge rate, 80 minute timeout, top-off mode not selected
J3: USER, Y	Place jumper here to select a user-defined charge rate and timeout, uses top-off mode
J3: USER, N	Place jumper here to select a user-defined charge rate and timeout, no top-off mode
J4: Top off Y	Place jumper between Y and COM to select top-off mode
J4: Top off COM	Connect to top-off Y or top-off N
J4: Top off N	Place jumper between N and COM to not use top-off mode
J5: USER	Place jumper here for a user-defined NiCd/NiMH cell count
J5: 10	Place jumper here when using a battery pack of 10 NiCd/NiMH cells in a series configuration
J5: 8	Place jumper here when using a battery pack of 8 NiCd/NiMH cells in a series configuration
J5: 6	Place jumper here when using a battery pack of 6 NiCd/NiMH cells in a series configuration
J5: 5	Place jumper here when using a battery pack of 5 NiCd/NiMH cells in a series configuration
J5: 4	Place jumper here when using a battery pack of 4 NiCd/NiMH cells in a series configuration
J6: 4	Place jumper here when using a battery pack of 4 Li-Ion cells in a series configuration
J6: 3	Place jumper here when using a battery pack of 3 Li-Ion cells in a series configuration
J6: 2	Place jumper here when using a battery pack of 2 Li-Ion cells in a series configuration
J6: 1	Place jumper here when using a battery pack of 1 Li-Ion cells in a series configuration

2.2 Board Setup

The bq2000EVM can be configured as described below.

Number of Cells Selection (JP5, JP6): These jumpers select the number of cells for either Li-Ion or NiCd/NiMH batteries. These jumpers should be changed only if the battery is absent or if the DC supply is not connected to the board. Only one jumper should be placed on a J5 or J6 connection for proper circuit configuration.

Note that there are two *USER* defined connections provided on J5. This connection can be configured for NiCd/NiMH or Li-Ion cell counts other than what are predefined on the bq2000EVM. Configuration is accomplished by placing an appropriate resistor in the USER Y or N position according to the desired battery pack voltage.

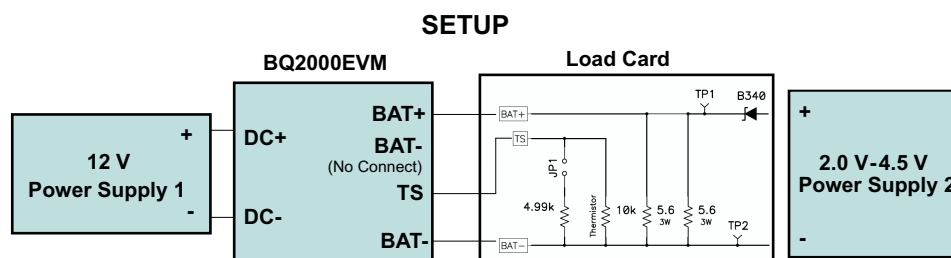
2.3 Setup Procedure – Testing With a Battery Pack

The following procedure outlines how to set up the bq2000EVM when charging a battery pack:

1. Configure the bq2000EVM for the appropriate number and type of cells by placing a single jumper on one of the J5 or J6 connection points.
2. Place a jumper between J4's COM and YES to utilize the bq2000's top-off mode or between COM and NO to not use the top-off mode.
3. Place one jumper on one of the J3 connection points to select a charge rate and timeout duration. If top-off mode is being used, only a J3 connection labeled "Y" should be used. A J3 connection labeled "N" should be used if top-off mode is not being used.
4. Connect the thermistor between TS and the lower BAT–. If using a thermistor is not desired, a 10-k Ω resistor can be connected between TS and BAT–.
5. Connect the battery pack to BAT+ and BAT–.
6. Connect the charging supply to J1 while ensuring that it falls within the bq2000EVM's recommended DC operating range.

2.4 Setup Procedure – Testing Without a Battery Pack

Sometimes it is beneficial to test a battery charger without charging an actual battery due to the long time needed to charge/discharge battery packs. An ideal substitute for a battery is a four-quadrant power supply that can both sink and source current. If a four-quadrant power supply is unavailable, the load card shown below can be used in parallel with a standard two-quadrant power supply. The load card as shown is designed to charge a one-cell lithium-ion battery at 1A constant current charge.



1. Configure the bq2000EVM for the appropriate number and type of cells by placing a single jumper on one of the J5 or J6 connection points.
2. Place a jumper between J4's COM and YES to utilize the bq2000's top-off mode or between COM and NO to not use the top-off mode.
3. Place one jumper on one of the J3 connection points to select a charge rate and timeout duration. If top-off mode is being used, only a J3 connection labeled "Y" should be used. A J3 connection labeled "N" should be used if top-off mode is not being used.
4. Connect the load card as shown above. A 10-k Ω thermistor or 10-k Ω resistor can be added to the load card for convenience. The JP1 header and 4.99-k Ω resistor are added to demonstrate the temperature sensing feature of the bq2000EVM. When the jumper is removed, the EVM will charge as normal. Installing the jumper simulates an over-temperature condition and the charger will turn off.
5. Connect the second power supply to the load card as shown. The series diode is added to protect the power supply from sinking current and potential damage. Turn power supply two on so that it is within the voltage range set in step one (4.2V/cell if simulating a lithium-ion battery is desired, or 1.2V/cell if a nickel-based battery is desired).
6. Connect the charging supply to J1 while ensuring that it falls within the bq2000EVM's recommended DC operating range.

The load card allows a two-quadrant power supply to be used because it sinks current to BAT– through the shunt resistors. The above load card is designed for charging a single lithium-ion battery at 1A constant current. The charge range for a one-cell lithium-ion battery is 2.7 V to 4.2 V. Whenever the voltage on power supply two is less than 2.7 V, the bq2000EVM will be off and power supply two will

Setup and Configuration

source current through the shunt resistors. The charging algorithm for the bq2000EVM depends on the charge voltage that it sees on BAT+. As the voltage on power supply two is increased to within the set charge range of the bq2000EVM, the bq2000EVM will turn on into constant current mode and will source its set charge current (1A) into the load card. As the voltage provided by power supply two is increased, it will source enough current into the load card such that:

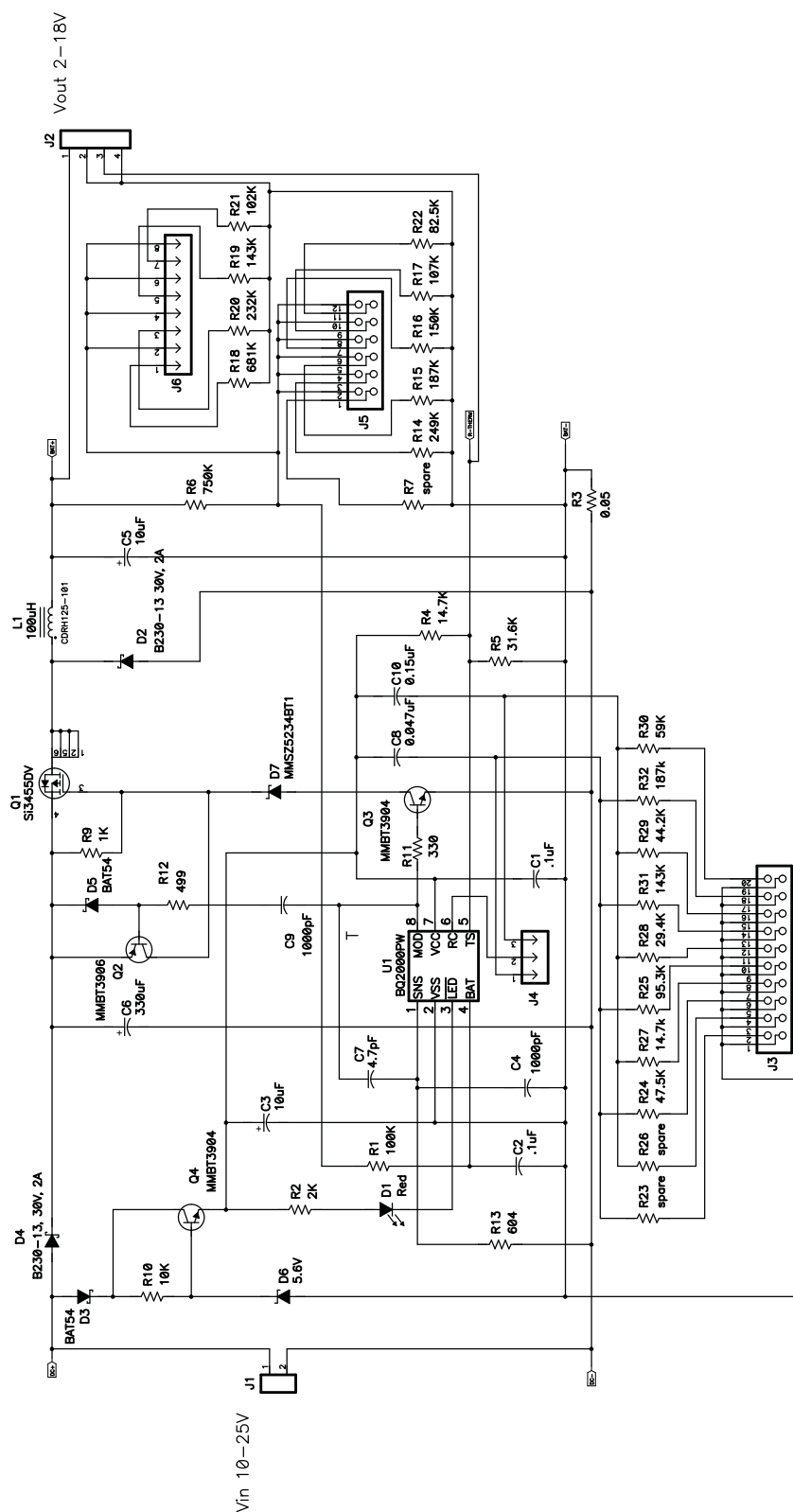
$V_{ps2} = R_{load} \times (I_{ps2} + I_{charge})$, where I_{charge} is the constant current charge sourced by the bq2000EVM, I_{ps2} is the current sourced by power supply two, R_{load} is the parallel resistance between BAT+ and BAT–, and V_{ps2} is the voltage on power supply two.

Once the voltage on power supply two goes above the termination point set on the bq2000EVM, the bq2000EVM will shut off and all current will be sourced by power supply two. To design a load card for an arbitrary battery pack, the following procedure can be used.

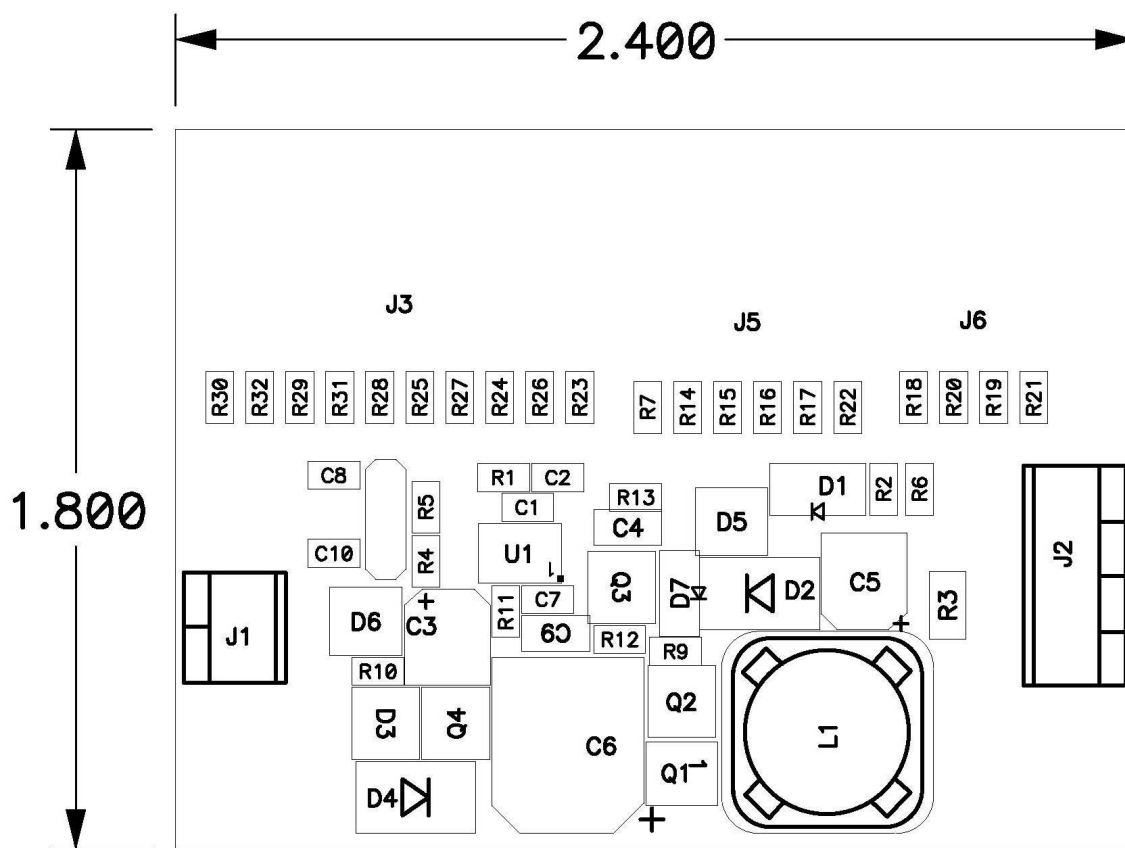
1. Determine the minimum (V_{min}) and maximum (V_{max}) charging voltages for the desired battery pack.
2. Determine the desired constant current charge (I_{chg})
3. Calculate the resistance (R_{load}) needed between BAT+ and BAT– by the following equation:

$$R_{load} = V_{min} / I_{chg}$$
4. Calculate the power that will be dissipated by the shunts resistance (P_{shunt}):

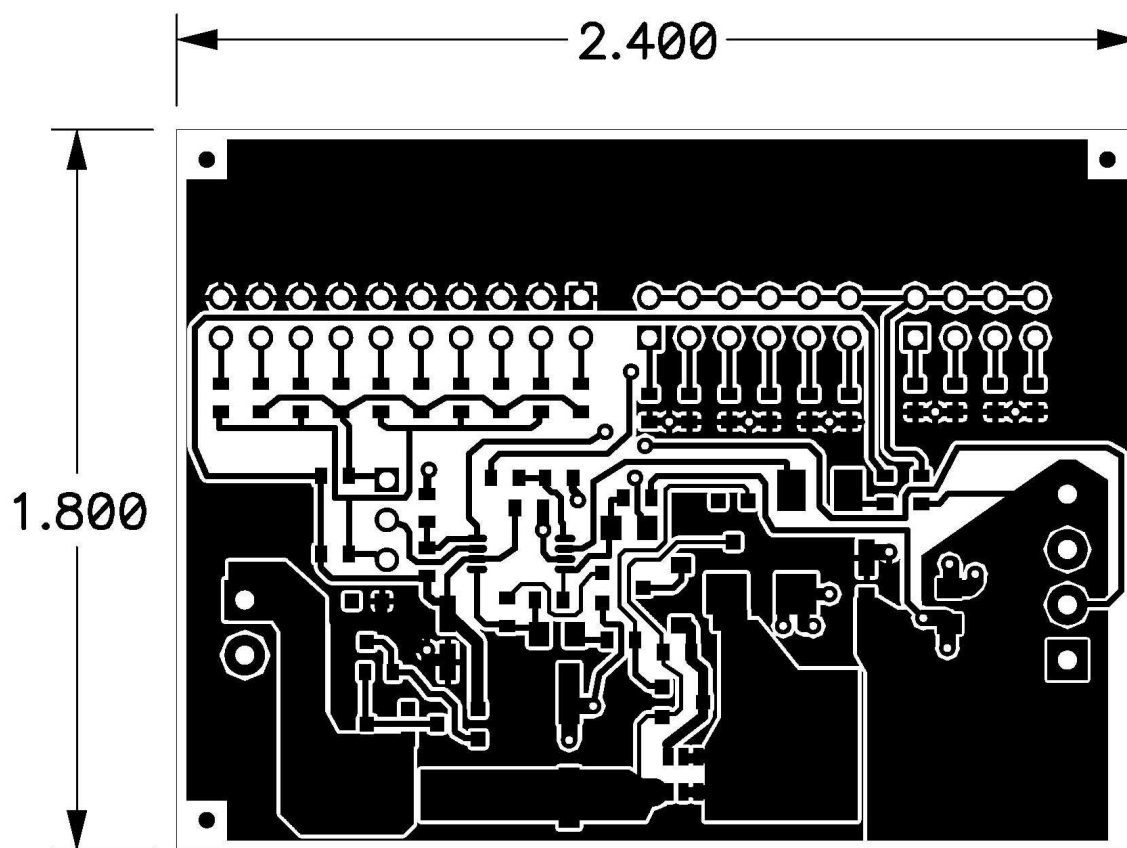
$$P_{shunt} = V_{max}^2 / R_{load}$$
5. Choose a combination of parallel resistors that meet the equivalent resistance and overall power dissipation rating needed to satisfy the above equations. **NOTE: Make sure power resistors are heat sunk properly to handle the amount of power to avoid overstressing the components.**



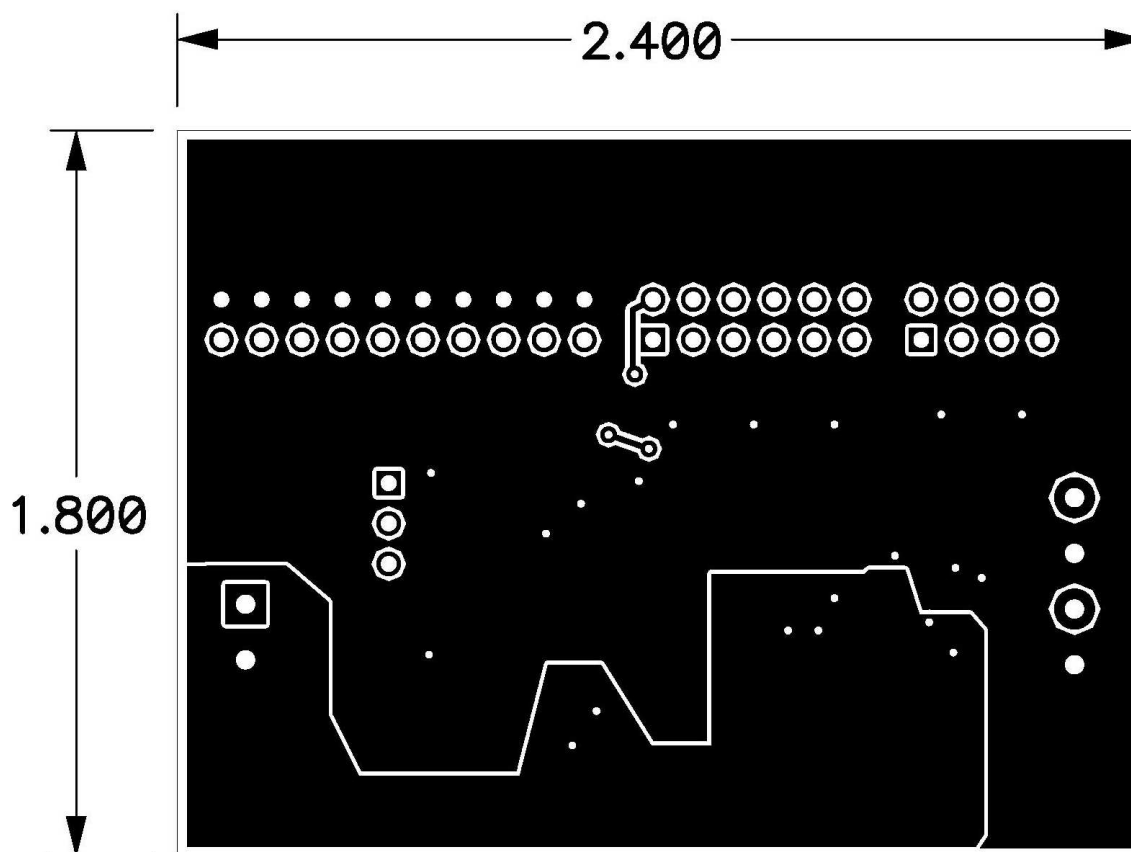
4 Physical Layouts



Top Assembly



Layer 1



Layer 2

5 Bill of Materials

Table 1. HPA250A Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
2	C1, C2	0.1μF	Capacitor, Ceramic, X7R, 0.1 μF	0603	{std}	
1	C10	0.15μF	Capacitor, Ceramic, X7R, 0.15 μF, 16V	0603	{std}	
2	C3, C5	10μF	Capacitor, Aluminum, 10μF, 25V, 20%	0.177 × 0.177	EEV-FK1E100R	Panasonic
2	C4, C9	1000pF	Capacitor, Ceramic, 1000pF, 50V, X7R	0805	{std}	{std}
1	C6	330μF	Capacitor, Aluminum, SM, 330μF, 25V, 0.16Ω (FK series)	8 × 10 mm	EEV-FK1E331P	Panasonic
1	C7	4.7pF	Capacitor, Ceramic, 4.7pF, 50V, NPO	0603	{std}	{std}
1	C8	0.047μF	Capacitor, Ceramic, X7R, 0.047μF, 25V	0603	{std}	
1	D1	Red	Diode, LED, Red, 1.7V, 40mcd, SM	1210	SML-LX2832SRC-TR	Lumex
2	D2, D4	B230-13 30V, 2A	Diode, Schottky, 2A, 30V	SMB	B230-13	Diodes, Inc.
2	D3, D5	BAT54	Diode, Schottky, 200mA, 30V	SOT23	BAT54	Vishay-Liteon
1	D6	5.6V	Diode, Zener, 5.6V, 350mW	SOT23	BZX84C5V6T	Diodes, Inc.
1	D7	MMSZ5234BT1	Diode, Zener, 6.2V, 500mW	SOD-123	MMSZ5234BT1	On Semi
1	J1		Terminal block, 2pin, 6A, 3,5 mm	0.27 × 0.25"	ED1514	OST
1	J2		Terminal block, 4pin, 6A, 3,5 mm	0.55 × 0.25"	ED1516	OST
1	J3		Header, 2x10pin, 100mil spacing (36-pin strip)	0.100 × 10 × 2"	PTC36DAAN	Sullins
1	J4		Header, 3pin, 100mil spacing, (36-pin strip)	0.100 × 3"	PTC36DAAN	Sullins

Table 1. HPA250A Bill of Materials (continued)

Count	RefDes	Value	Description	Size	Part Number	MFR
1	J5		Header 2x6 pin, 100mil spacing (36-pin strip)	0.100 × 2 × 6"	PTC36DAAN	Sullins
1	J6		Header 2x4 pin, 100mil spacing (36-pin strip)	0.20 × 0.40	PTC36DAAN	Sullins
1	L1	100μH	Inductor, SMT, 100μH, 1.3A, 160mΩ	0.472 sq	CDRH125-101	Sumida
1	Q1	Si3455DV	MOSFET, Pch, -30V, 2.3A, 190mΩ	Micro6	Si3455DV	Vishay-Liteon
1	Q2	MMBT3906	Bipolar, PNP, 40V, 200mA, 0.22W	SOT23	MMBT3906-7	On Semi
2	Q3, Q4	MMBT3904	Bipolar, NPN, 40V, 200mA, 250mW	SOT23	MMBT3904	Fairchild
1	R1	100kΩ	Resistor, Chip, 100kΩ, 1/16W, 1%	0603	Std	Std
1	R11	330Ω	Resistor, Chip, 330Ω, 1/16W, 1%	0603	Std	Std
1	R12	499Ω	Resistor, Chip, 499Ω, 1/16W, 1%	0603	Std	Std
1	R13	604Ω	Resistor, Chip, 604Ω, 1/16W, 1%	0603	Std	Std
1	R14	249kΩ	Resistor, Chip, 249kΩ, 1/16W, 1%	0603	Std	Std
2	R15, R32	187kΩ	Resistor, Chip, 187kΩ, 1/16W, 1%	0603	Std	Std
1	R16	150kΩ	Resistor, Chip, 150kΩ, 1/16W, 1%	0603	Std	Std
1	R17	107K	Resistor, Chip, 107kΩ, 1/16W, 1%	0603	Std	Std
1	R18	681kΩ	Resistor, Chip, 681kΩ, 1/16W, 1%	0603	Std	Std
2	R19, R31	143kΩ	Resistor, Chip, 143kΩ, 1/16W, 1%	0603	Std	Std
1	R2	2kΩ	Resistor, Chip, 2kΩ, 1/16W, 1%	0603	Std	Std
1	R20	232kΩ	Resistor, Chip, 232kΩ, 1/16W, 1%	0603	Std	Std
1	R21	102kΩ	Resistor, Chip, 102kΩ, 1/16W, 1%	0603	Std	Std
1	R22	82.5kΩ	Resistor, Chip, 82.5kΩ, 1/16W, 1%	0603	Std	Std
1	R24	47.5kΩ	Resistor, Chip, 47.5kΩ, 1/16W, 1%	0603	Std	Std
1	R25	95.3kΩ	Resistor, Chip, 95.3kΩ, 1/16W, 1%	0603	Std	Std
1	R27	14.7kΩ	Resistor, Chip, 14.7kΩ, 1/16W, 1%	0603	Std	Std
1	R28	29.4kΩ	Resistor, Chip, 29.4kΩ, 1/16W, 1%	0603	Std	Std
1	R29	44.2kΩ	Resistor, Chip, 44.2kΩ, 1/16W, 1%	0603	Std	Std
1	R3	0.05Ω	Resistor, Chip, 0.05Ω, 1/10W, 1%	0805	Std	Std
1	R30	59kΩ	Resistor, Chip, 59kΩ, 1/16W, 1%	0603	Std	Std
1	R4	14.7kΩ	Resistor, Chip, 14.7kΩ, 1/16W, 1%	0603	Std	Std
1	R10	10kΩ	Resistor, Chip, 10kΩ, 1/16W, 1%	0603	Std	Std
1	R5	31.6kΩ	Resistor, Chip, 31.6kΩ, 1/16W, 1%	0603	Std	Std
1	R6	750kΩ	Resistor, Chip, 750kΩ, 1/16W, 1%	0603	Std	Std
0	R7, R23, R26	spare	Resistor, Chip, Ohms, 1/16W, 1%	0603	Std	Std
1	R9	1kΩ	Resistor, Chip, 1kΩ, 1/16W, 1%	0603	Std	Std
1	U1	BQ2000PW	IC, Fast Charge, Multi-chemistry	TSSOP-8	BQ2000PW	TI
1	Circuit board	HPA250	Circuit board		HPA250	Any
1	RT1		Thermister, 10kΩ	0.095 x 1.150 In	NTC103AT	Semitec

Notes: 1. These assemblies are ESD sensitive, ESD precautions shall be observed.
2. These assemblies must be clean and free from flux and all contaminants. Use of no clean flux is not acceptable.
3. These assemblies must comply with workmanship standards IPC-A-610 Class 2.
4. Ref designators marked with an asterisk (**) cannot be substituted.
All other components can be substituted with equivalent MFG's components.
5. After testing RT1 is taped to the bottom of UUT with ESD tape.

6 References

1. bq2000 data sheet, <http://focus.ti.com/lit/ds/symlink/bq2000.pdf>
2. Using the bq2000/T to Control Fast Charge, <http://focus.ti.com/lit/an/slva064b/slva064b.pdf>

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 customer 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. - SSZZ017A - February 2006

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.

EVALUATION BOARD/KIT IMPORTANT NOTICE (continued)

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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2007, Texas Instruments Incorporated

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 10 V to 25 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 50°C. The EVM is designed to operate properly with certain components above 50°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 © 2007, 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:

Products

Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DSP	dsp.ti.com
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
Low Power Wireless	www.ti.com/lpw

Applications

Audio	www.ti.com/audio
Automotive	www.ti.com/automotive
Broadband	www.ti.com/broadband
Digital Control	www.ti.com/digitalcontrol
Military	www.ti.com/military
Optical Networking	www.ti.com/opticalnetwork
Security	www.ti.com/security
Telephony	www.ti.com/telephony
Video & Imaging	www.ti.com/video
Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2007, Texas Instruments Incorporated