TEXAS INSTRUMENTS

Evaluation Module (EVM) for Buck-Boost Charge Pump REG710

User's Guide

November 2001

Power Management Products

SLVU056

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 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.

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.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

EVM IMPORTANT NOTICE

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

This evaluation kit being sold by TI is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not considered by TI to be fit for commercial use. As such, the goods being provided may not be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety measures typically found in the end product incorporating the goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may not meet the technical requirements of the directive.

Should this evaluation kit not meet the specifications indicated in the EVM User's Guide, the 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. Please be aware that the products received may not be regulatory compliant or agency certified (FCC, UL, CE, etc.). 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 EVM User's Guide and, specifically, the EVM Warnings and Restrictions notice in the EVM User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact the TI application engineer.

Persons handling the product must have electronics training and observe good laboratory practice standards.

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.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 1.8 V to 5.5 V with an output current up to 30 mA.

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.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

Contents

Figures

Tables

Chapter 1

Introduction

The evaluation module (EVM) for the new Texas Instruments (TI) charge pump devices REG710–25 to REG710–5 helps designers to evaluate these devices.

With these EVMs it is possible to evaluate all different modes of the devices, as well as their performance. Only a dc voltage source is needed to operate the EVM.

The layout of charge pumps is critical, similar to the layout of inductive dc/dc converters. The suggested layout of the EVM board can be used as a reference to reduce design time.

The Texas Instruments REG710 charge pumps are regulated voltage converters intended for use with a single cell Li-Ion or two and three nickel or alkaline based cells. The REG710–25, REG710–27, REG710–3, and REG710–33 have output voltages of 2.5 V, 2.7 V, 3.0 V, and 3.3 V respectively from an input signal between 1.8 V and 5.5 V. The REG710–5 has an output voltage of 5.0 V from an input voltage between 2.7 V and 5.5 V.

Topic **Page**

1.1 Basic Operation of the Device

Except for the REG710–5, the REG710 series of charge pumps work in a buck/boost fashion. They will produce a regulated output over the entire input range.

The charge pump consists of switches, oscillator, bandgap, comparator, and mode control circuits. The comparator senses a divided down version of output voltage and compares that to the bandgap voltage. If the sensed output voltage is less than the bandgap voltage, the part begins pumping. When the sensed output voltage is greater than the bandgap voltage, the pumping stops. This pulse frequency modulation is how the charge pump regulates the output. The mode control circuit determines if the part needs to operate in boost or buck mode.

In boost mode the pump capacitor is charged up from the input and then connected between the input and output. In buck mode, the pump capacitor is connected to the input and ground. The output capacitor receives current pulses from the switches.

Chapter 2

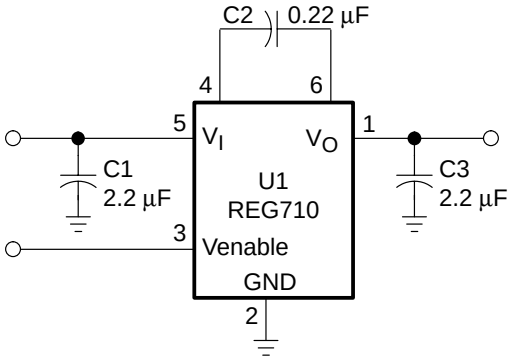
EVM Description

This Chapter illustrates EVM schematics, layout, and EVM setup

Topic **Page**

2.1 Schematic of the EVM

Figure 2–1. Schematic of the EVM



For all necessary signals there are single-pin connectors on the board. To operate the board, connect a power source with the appropriate voltage level between V_{IN} and GND.

A pullup resistor at EN may be added to ensure that the device starts without a signal applied to the EN-pin. Connect EN to GND to disable the device. In this state the supply current of the IC decreases to < 0.01 µA. When the EVM is used with the pullup resistor, R1, be aware that this resistor draws more current than the device itself. For operating the device in low current mode, this resistor has to be removed.

An additional GND-pin has been added for your convenience.

C4 to C6 are 0805-size SMD-footprints. These parts are not necessary for operation and have only been added for test purposes. They can be used as test points or to easily increase the value of a capacitor by adding an other one in parallel.

Table 2–1. Bill of Materials

Reference	Part	Description
U1	REG710	Buck-boost charge pump IC
C1, C3	2.2 µF/6.3V; 0805	Input and output capacitors
C2	0.22 µF/16V; 0805	Pump capacitor
R1	1 MΩ; 0805	Optional pullup resistor
C4 to C6	0805 Footprint	Additional capacitors for test purposes

2.2 Layout of the EVM

Figure 2–2 shows the placement of the components of the EVM. The components are only placed on the top layer of the board, and the board is routed with a single layer of metal. The size of the EVM is 2 inches x 2 inches. The total space required for the IC and the capacitors on the EVM is only about 0.08 in^2 (approximately 52 mm^2). The capacitors are optimized for space and performance and have been laid out for 0805 sized pads.

Figure 2–2. Layout of the EVM

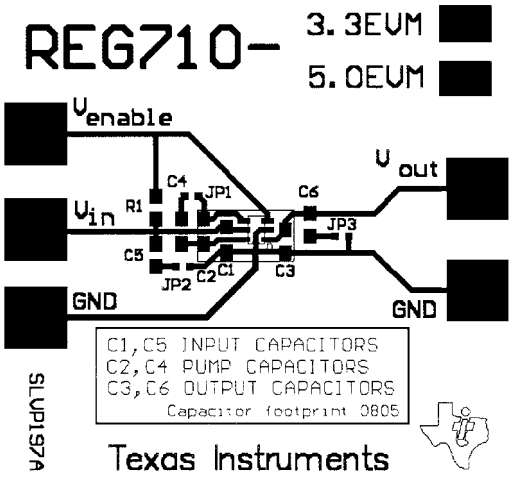
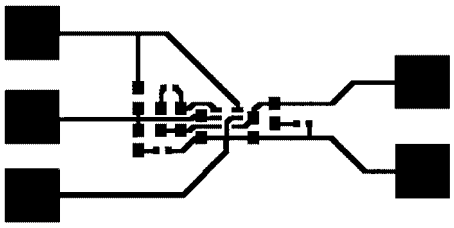


Figure 2–3 shows the metal layer of the board.

Figure 2–3. Metal Layer



2.3 Setup of the EVM

For proper operation of the EVM, follow these steps:

1) Connect a signal source (or a battery pack) with the appropriate voltage between the V_{IN} and GND:

   REG710–25, 27, 3, 33: V_{IN} >= 1.8 V
   REG710–5: V_{IN}>= 2.7 V

2) Connect a load to the output between V_{OUT} and GND.

   REG710–25, 27, 3, 33: Iload <= 10 mA with V_{IN} >= 1.8 V
   REG710–5: Iload <= 10 mA with V_{IN} >= 2.7 V

   REG710–25, 27: Iload <= 30 mA with V_{IN} >= 2.0 V
   REG710–3, 33: Iload <= 30 mA with V_{IN} >= 2.2 V
   REG710–5: Iload <= 30 mA with V_{IN} >= 3.0 V

3) Connect Venable to Vin to enable the device or to GND to disable the device. An optional pullup resistor can be placed on the board to ensure that the device starts immediately.