

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

## *User's Guide*

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## **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.

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# 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.

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## 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.

# EVM Description

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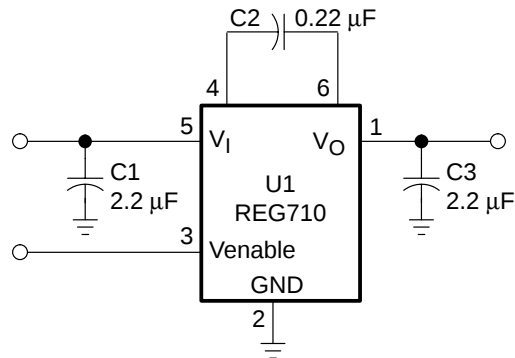
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This Chapter illustrates EVM schematics, layout, and EVM setup

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## 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<sub>IN</sub> 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<sup>2</sup> (approximately 52 mm<sup>2</sup>). The capacitors are optimized for space and performance and have been laid out for 0805 sized pads.

Figure 2–2. Layout of the EVM

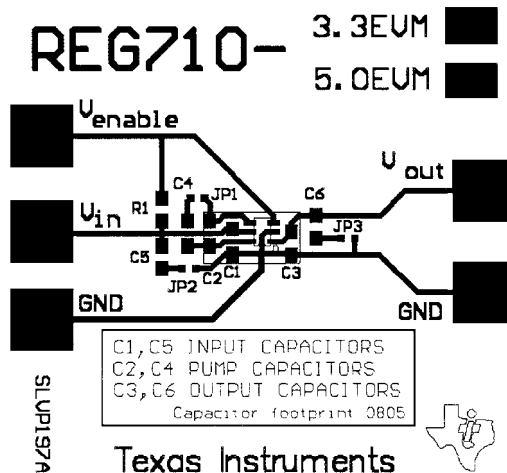
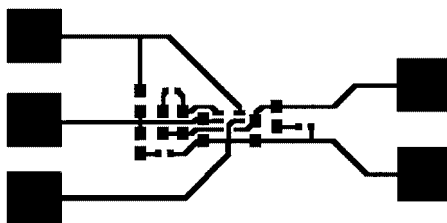


Figure 2–3 shows the metal layer of the board.

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:  $V_{IN} \geq 1.8 \text{ V}$

REG710–5:  $V_{IN} \geq 2.7 \text{ V}$

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

REG710–25, 27, 3, 33:  $I_{load} \leq 10 \text{ mA}$  with  $V_{IN} \geq 1.8 \text{ V}$

REG710–5:  $I_{load} \leq 10 \text{ mA}$  with  $V_{IN} \geq 2.7 \text{ V}$

REG710–25, 27:  $I_{load} \leq 30 \text{ mA}$  with  $V_{IN} \geq 2.0 \text{ V}$

REG710–3, 33:  $I_{load} \leq 30 \text{ mA}$  with  $V_{IN} \geq 2.2 \text{ V}$

REG710–5:  $I_{load} \leq 30 \text{ mA}$  with  $V_{IN} \geq 3.0 \text{ V}$

- 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.