ATL431LI Adjustable Shunt Regulator EVM

The ATL431LIEVM is an adjustable voltage reference evaluation module that demonstrates the ATL431LI integrated circuit in its new X2SON (DQN) small form factor from Texas Instruments (TI).

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1 Overview

The ATL431LIEVM is an adjustable voltage reference evaluation module that demonstrates the ATL431LI integrated circuit in its new X2SON (DQN) small form factor from Texas Instruments (TI).

The ATL431LI is a low-power counterpart to the TL431LI, having lower minimum cathode current (Ik_{min} = 80 μA vs 1.0 mA). Like TL431LI, ATL431LI is used in conjunction with its key components to behave as a single voltage reference, error amplifier, voltage clamp or comparator with integrated reference.

The ATL431LI can be operated and adjusted to cathode voltages from 2.5 V to 36 V, making this part optimum for a wide range of end equipment in industrial, auto, telecom, and computing. In order for this device to behave as a shunt regulator or error amplifier, > 80 μA (I_{min}(max)) must be supplied into the cathode pin. Under this condition, feedback can be applied from the Cathode and Ref pins to create a replica of the internal reference voltage.

The ATL431LIEVM is configured with a fix voltage output and load capacitor. A test point can be connected to an external power supply to provide power. All of the ATL431 input and output pins are accessible for external connection via test points. For users looking for a EVM to test the SOT23-3 variant, use the *ATL431 EVM* because it is compatible with the ATL431LI.

1.1 ATL431LIEVM Features

- X2SON land pattern for the ATL431LI in X2SON
- Footprints for resistors
- Multiple test points outputs for voltage measurement

Table 1. ATL431LIEVM Specification

Key Parameters	
Supply Voltage:	0 V – 36V (Limit to 20V for default EVM option without a load)
Programmable Cathode Voltage:	2.5 V – 36 V (EVM is fixed at 5V, change R1 & R2 for other options)
Cathode Current:	80 μA to 15 mA

CAUTION

Applying voltages above the limitations given in Table 1 may cause permanent damage to your hardware.

1.2 Schematic

The schematic for the ATL431LIEVM is illustrated in Figure 1.

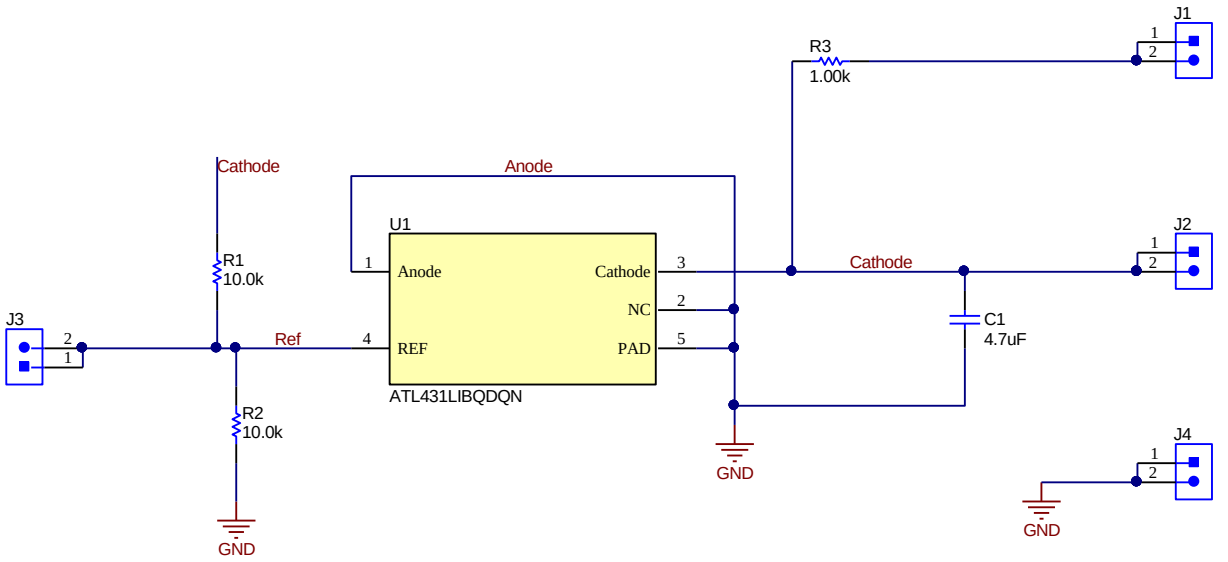

Figure 1. ATL431LIEVM Schematic

1.3 PCB

The PCB layout for the ATL431LIEVM is illustrated in Figure 2.

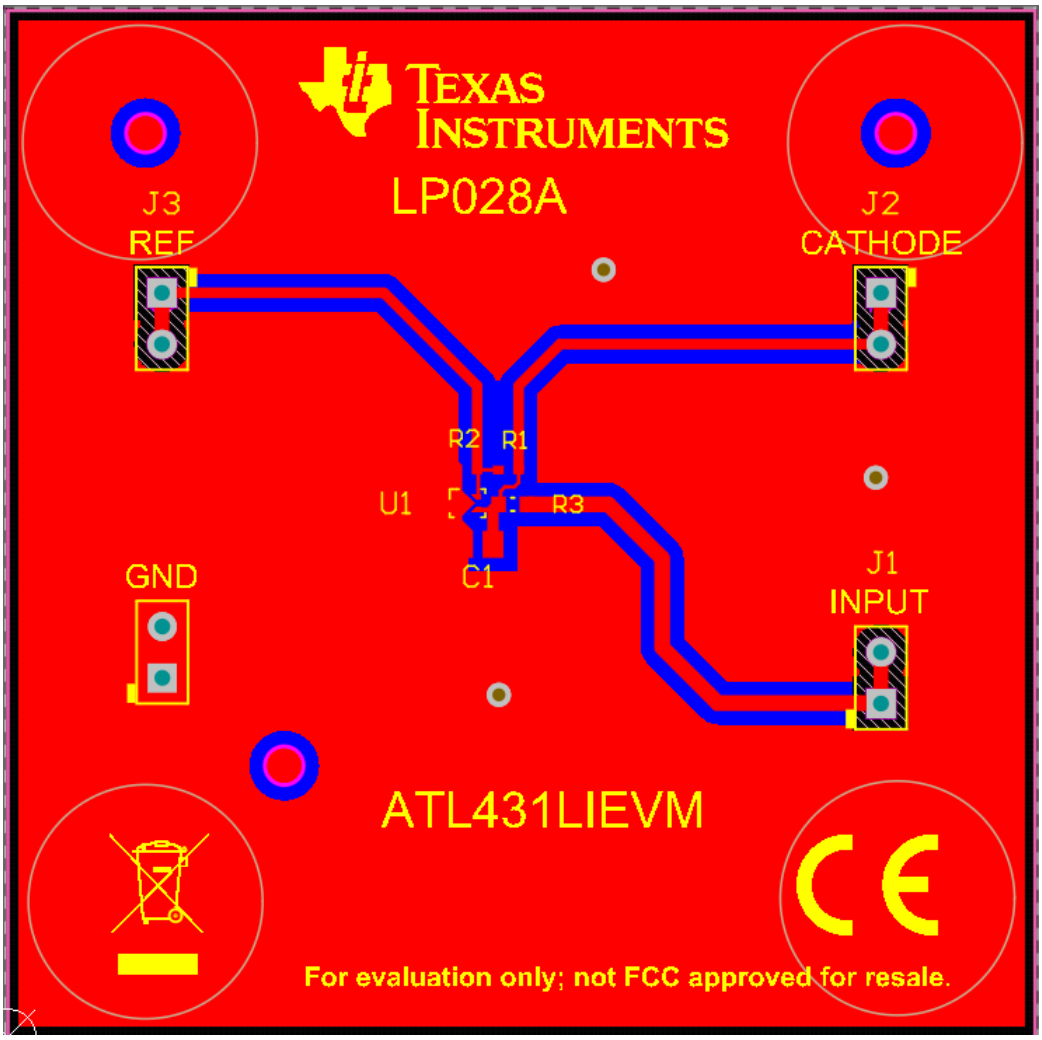

Figure 2. ATL431LIEVM PCB Layout

2 Quick Setup Guide

This section describes the setup to quickly check the functionality of the ATL431LIEVM.

2.1 Electrostatic Discharge Warning

Many of the components on the ATL431LIEVM are susceptible to damage by electrostatic discharge (ESD). Customers are advised to observe proper ESD handling precautions when unpacking and handling the EVM, including the use of a grounded wrist strap at an approved ESD workstation.

CAUTION

Failure to observe ESD handling procedures may result in damage to EVM components.

2.2 Unpacking the EVM

After opening the ATL431LIEVM package, ensure that the following is included:

1 pc. ATL431LIEVM board using one ATL431LIBQDQN

2.3 Power Supply Setup and Functional Test

A 10-V power supply capable of 10 mA of current is required.

Connect the positive power supply lead to the “INPUT” on J1. Connect the negative power supply lead to "GND" on J4.

Connect a voltmeter positive terminal to "CATHODE" on J2. Connect the negative voltmeter terminal to "GND" on J4.

3 EVM Theory and Operation

The following schematic is representative of the ATL431LIEVM.

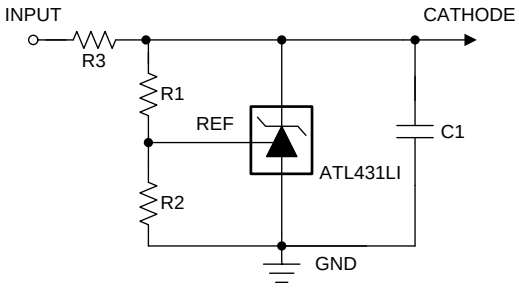

Figure 3. Base Shunt Regulator Schematic

The ATL431LIEVM is designed to allow users to evaluate the configuration in Figure 3. With the provided footprints, a user can change the passive components to better suit their application. As shown in Figure 2, the EVM is designed to allow users to evaluate the small form factor of the ATL431LI in X2SON (DQN). This EVM also has the land pattern for the ATL431LI X2SON which allows users to test the device in their system with the provided pins.

3.1 Setting the Cathode Current (I_{KA})

R_3 should be set in conjunction with V_{INPUT} and the desired cathode voltage (V_{KA}) to provide enough current for operation. The ATL431LI needs > 80 µA in order to operate in the proper gain region for accurate regulation. Use Equation 1 to determine the cathode current.

$$I_{KA} = \frac{V_{INPUT} - V_{KA}}{R_3} - \frac{V_{KA}}{(R_1 + R_2)} \quad (1)$$

When setting I_{KA}, be sure to not exceed the absolute maximum rating of 15 mA for the cathode current.

3.2 Setting the Cathode Voltage (V_{KA})

R_1 and R_2 must be selected to determine the Cathode Voltage. Use Equation 2 to determine the cathode voltage. As I_{REF} is 400 nA maximum, the $I_{REF} \times R_1$ portion of the equation is almost negligible unless large values are used.

$$V_{KA} = V_{REF} \times \left(1 + \frac{R_1}{R_2}\right) + I_{REF} \times R_1 \quad (2)$$

When setting V_{KA}, be sure to not exceed the absolute maximum rating of 36V for the cathode voltage. Along with maximum voltage, stability must be taken in to account as there are operating regions that are susceptible to oscillations

3.3 Checking Stability and Transient Response

One of the issues that many designers face designing with shunt regulators is stability and response/clamp time. The ATL431LIEVM users should choose (C_1) based on figure 13 of the *ATL431LI datasheet*.

4 Test Modes

The ATL431LIEVM can be configured to measure practically every parameter shown in the typical characteristics of the datasheet. This configuration might require the switching of the passive components, such as R_1 and R_2, to other values.

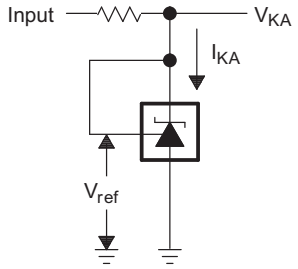

Figure 4. Test Circuit for $V_{KA} = V_{ref}$

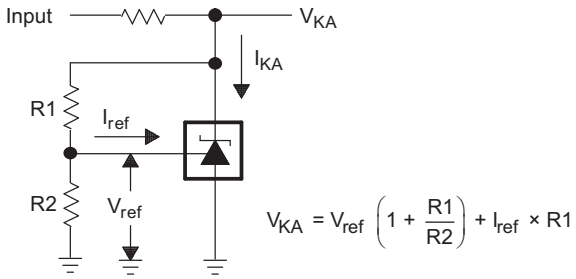

Figure 5. Test Circuit for $V_{KA} > V_{ref}$

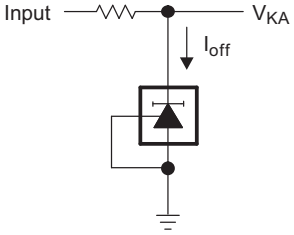

Figure 6. Test Circuit for I_{off}

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This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

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(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

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Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

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2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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