Using the LM3279 Evaluation Board

User's Guide

Literature Number: SNOU093
MARCH 2013

LM3279 Evaluation Board

1 Introduction

The LM3279 evaluation board is a working demonstration of a buck-boost DC-DC converter designed to generate output voltages above or below a given input voltage particularly suitable for cell-phone applications powering 3G/4G Power Amplifiers, as well as other portable devices.

For more details and electrical characteristics about the converter operation, please refer to the LM3279 datasheet. If you are considering using the LM3279 in a system design, please see the “PCB Layout Considerations” section of the device data sheet.

2 Operating Conditions

The board will operate under the following conditions:

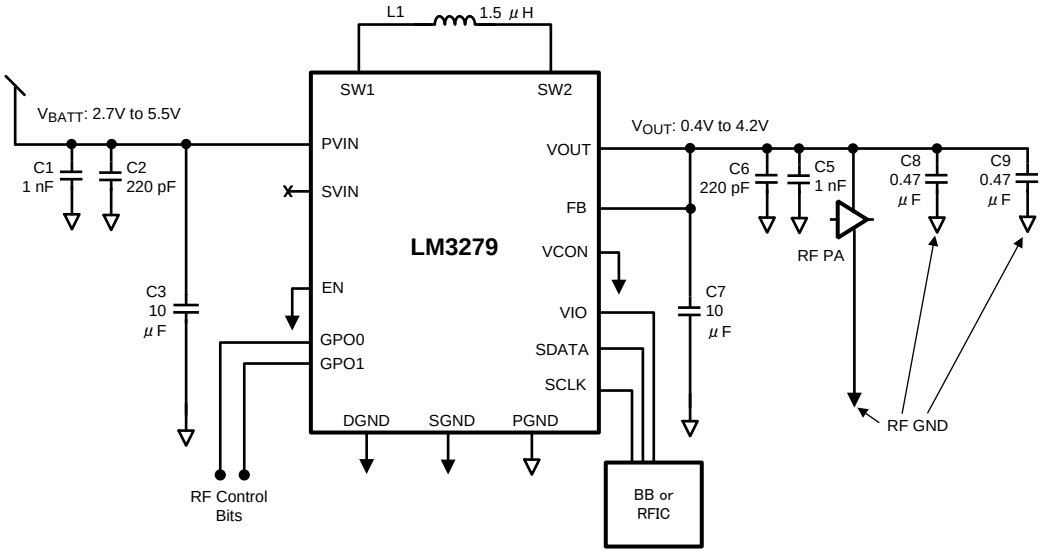
- V_{IN} range: 2.7V ≤ V_{IN} ≤ 5.5V
- Adjustable V_{OUT}
  - RFFE Digital Control: 0.4V to 4.2V
  - Analog Control: 0.6V to 4.2V
- VCON range: 0.2V to 1.4V
- V_{OUT} equation: V_{OUT} = 3 x VCON
- I_{OUT} range: 1A Max. for V_{BATT} ≥ 3.2V

3 Package

The LM3279 is available in an 16-bump lead-free DSBGA package.

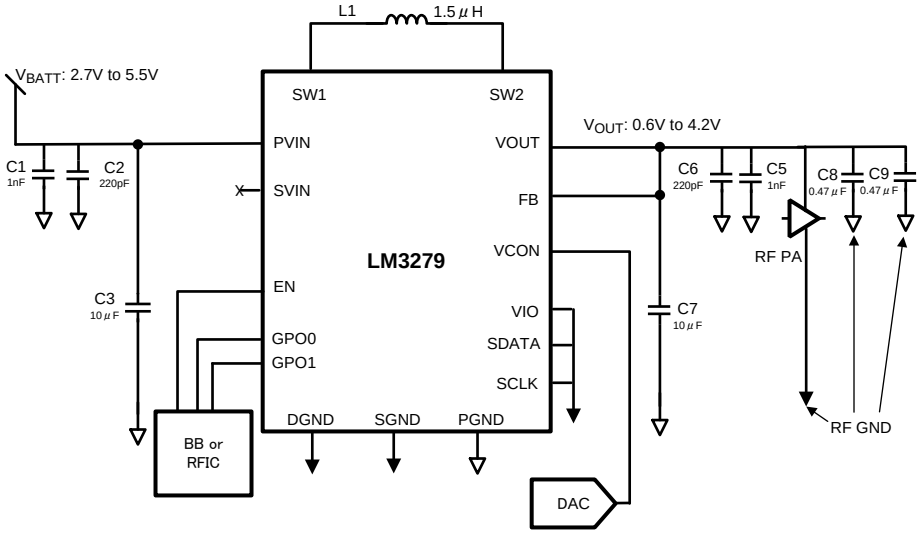
4 Typical Application Circuits

Figure 1. RFFE Digital Circuit



Note: C1, C2, C5 and C6 are optional.

Figure 2. Analog Circuit



Note: C1, C2, C5 and C6 are optional.

5 Bill of Materials for LM3279 Evaluation Board

Table 1. LM3279 BOM

Designator	Description	Value	Part Number	Manufacturer
C3	CIN	10 µF	CL05106MQ5NUNC	Samsung
C7	COUT			
L1	Inductor	1.5 µH	DFE201610C1R0M	TOKO

Table 2. Optional High-Frequency and PA Decoupling Capacitors

Designator	Description	Value	Part Number	Manufacturer
C1/C5	High. Freq. Input Cap.	1nF	GRM022R60J102KE19	Murata
C2	CIN	220 pF	GRM022R71A221KA01	
C6	COUT			
C8	Emulates PA decoupling input capacitor	0.47 µF	GRM033R60J474MA01	
C9				
C10		—	Not populated	
R1	—	—		

6 RFFE Communication

The LM3279 Evaluation Board is designed to connect to the LM8335 EVM. Configuration and control of the LM3279 is performed using the LM3279 Evaluation GUI Software provided on the included CD ROM. Refer to Appendix A: Software User Manual for the LM3279 Evaluation GUI Software installation instructions.

7 Evaluation Board Layout

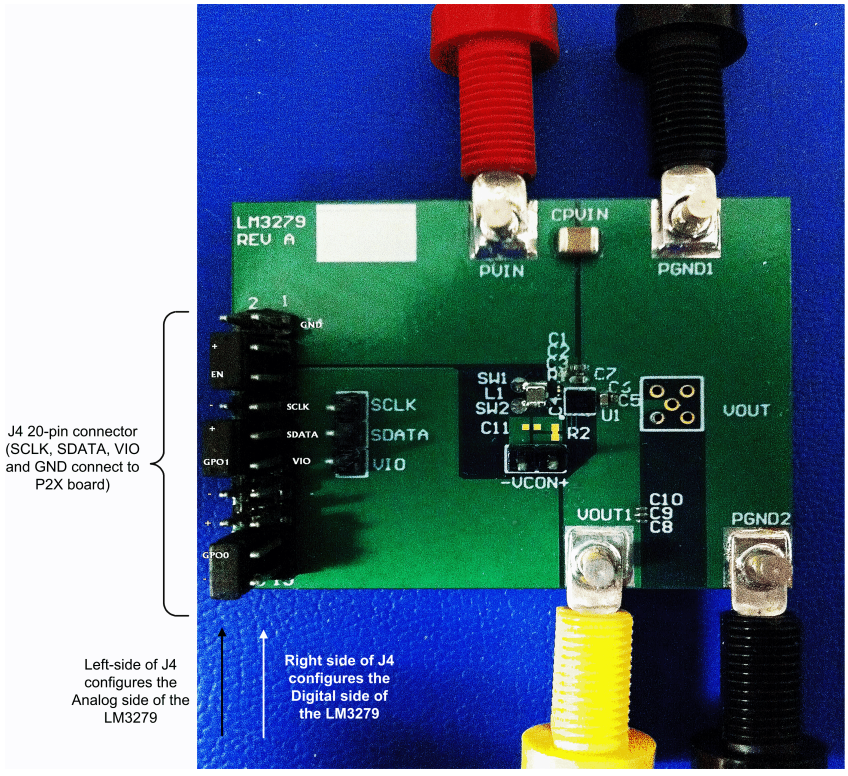


Figure 3. Photo of LM3279 Evaluation Board

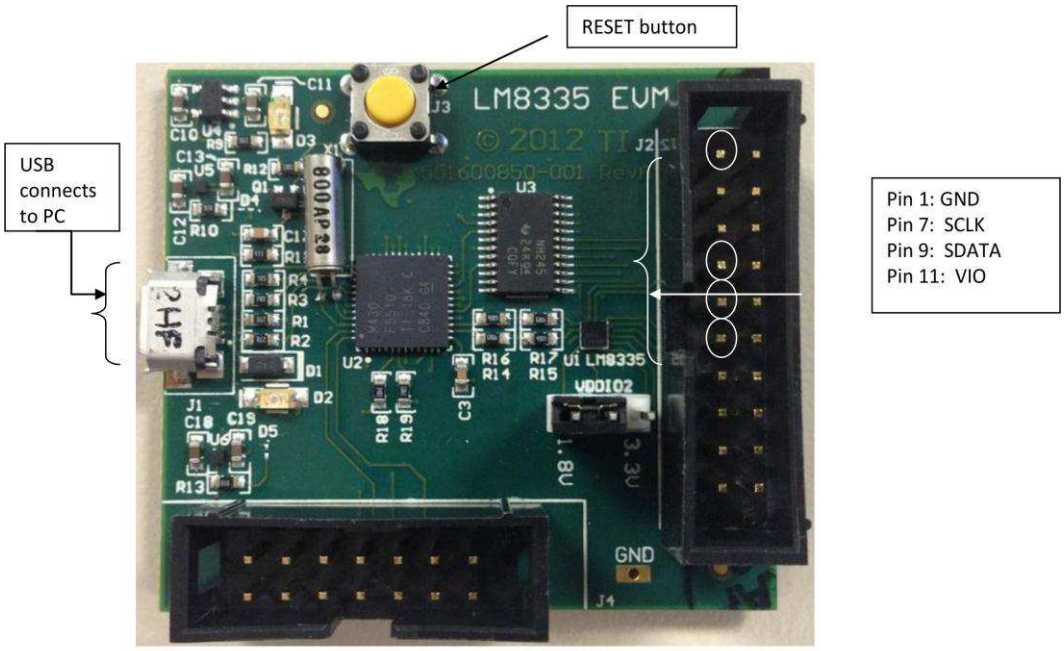


Figure 4. LM8335 RFFE Interface Evaluation Module

7.1 CONNECTIONS

1. VIN is connected to the red (PVIN) and black (PGND1) banana connector pins.
2. The load (RL or PA) is connected to the yellow (VOUT1) and black (PGND2) Output banana connector pins.
3. Connect PC USB Port to the LM8335 “J1” using a micro-USB Type “B” Cable.
   - (Note: The LM8335 EVM is powered by the PC thru the USB cable.)
4. Connect the 4 wire Pin RFFE Interface Cable from LM8335 “J2” to LM3279 Eval Board “J4” and align SDATA, SCLK, VIO and GND for Digital Implementation.
   - (Note: Left side of “J4” connector configures the part into an Analog state and the right side for the connector configures the device into Digital implementation.)
5. Refer to Analog and Digital implementation description for the LM3279 below in the Startup Sequence section.

7.2 LM3279 Schematic

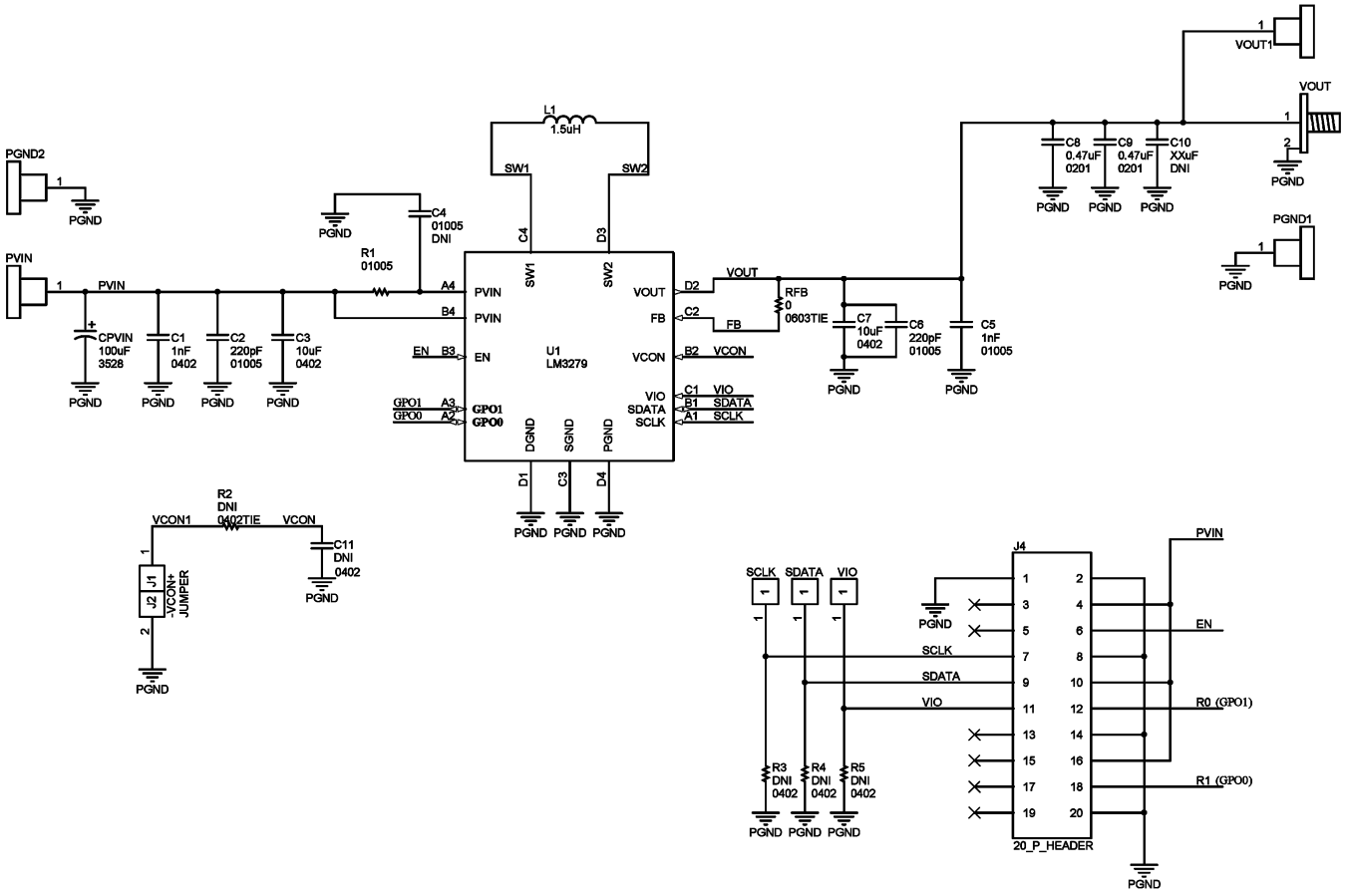


Figure 5. LM3279 PCB Schematic

8 LM3279 PCB Layout and Layers

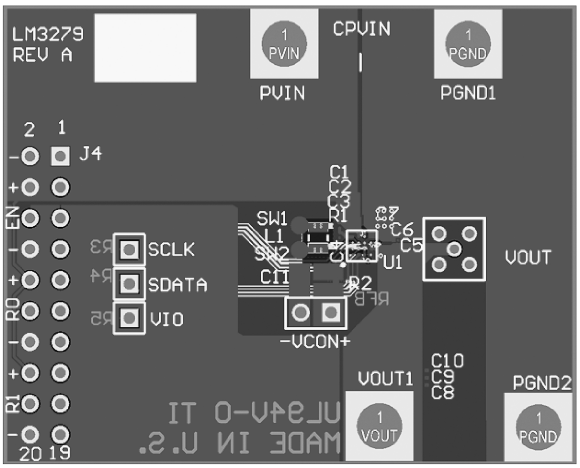


Figure 6. Top Layer 1

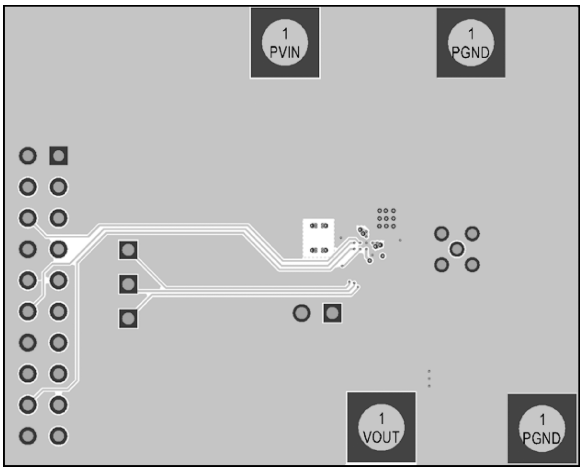


Figure 7. Mid-Layer 1

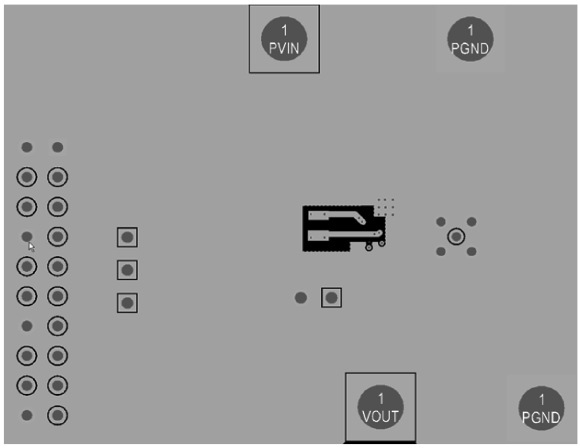


Figure 8. Mid-Layer 2

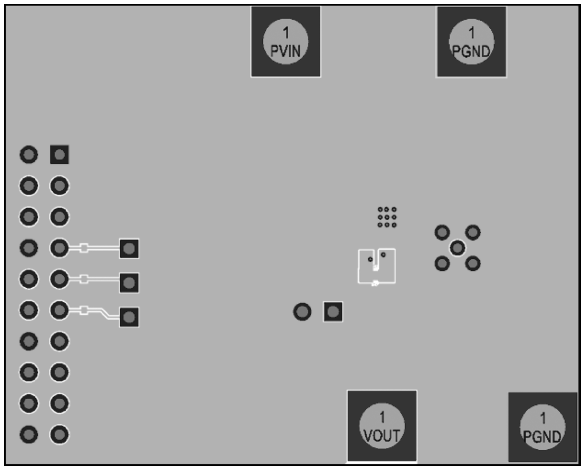


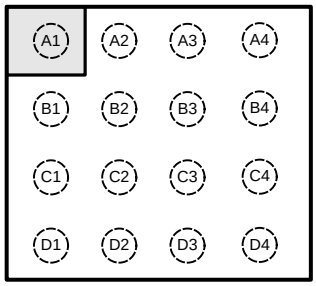
Figure 9. Bottom Layer

9 Programmable Registers

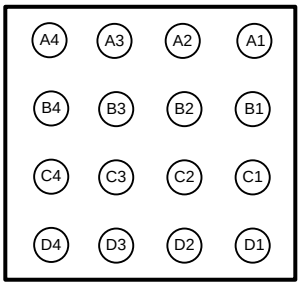
ADDRESS	REGISTER CONTENTS		
00h	**VSET_CTRL**		
	Bits	**Name**	**Description**
	7	Reserved	Reserved bit. Default = 0.
	6:0	VSET_CTRL[6:0]	DCDC voltage control bits. V_{SET_CTRL}=00h puts the part into a low power mode. V_{SET_CTRL} = 02h puts the part in a standby mode. V_{SET_CTRL} = 0Bh corresponds to 0.4V and 75h corresponds to 4.212V.
01h	**STATE_CTRL**		
	Bits	**Name**	**Description**
	7:6	STATE_CTRL[1:0]	PWM PFM state control bits. 00b = Force PFM 01b = PWM if V_{OUT} < 1.5 **(default)** 10b = PWM if V_{OUT} < 2.1 and I_{OUT} < 100 mA 11b = Force PWM
	5:0	Reserved	
02h	**GPO_CTRL**		
	Bits	**Name**	**Description**
	7	GPO0	GPO0 control bit. 0b = Output set to low level **(default)** 1b = Output set to high level
	6	GPO1	GPO1 control bit. 0b = Output set to low level **(default)** 1b = Output set to high level
03h-1Bh	**RESERVED**		
	Bits	**Name**	**Description**
			Reserved registers for configuration, test and trim.
1Ch	**PM_TRIG**		
	Bits	**Name**	**Description**
	7:6	PWR_MODE[1:0]	Power Mode Bits. 00b = normal operation 01b = default settings 10b = low power 11b = reserved
	5:0	TRIG_REG[5:0]	Reserved for trigger bits.

1Dh	PRODUCT_ID		
	Bits	**Name**	**Description**
	7:0	PRODUCT_ID[7:0]	Product identification bits. Set to A0h.
1Eh	**MANUFACTURER_ID**		
	Bits	**Name**	**Description**
	7:0	MANUFACTURER_ID[7:0]	Manufacturer Identification bits 7:0 1Eh are LSB for TI.
1Fh	**USID**		
	Bits	**Name**	**Description**
	7:6	SPARE[1:0]	This is a read-only register that is reserved and yields a value of 00b at readback. Potentially used in future for extending manufacturer ID field.
	5:4	MANUFACTURER_ID[5:4]	Manufacturer identification bits 5:4 01h are MSB for TI.
	3:0	USID[3:0]	Unique Slave Identifier default 0101b.

10 Connection Diagram



Top View



Bottom View

11 Pin Descriptions

Pin #	Name	Description
A1	SCLK	Digital control interface (DCON) RFFE Bus clock input. Typically connected to RFFE master on RF or Baseband IC. SCLK must be held low when VIO is not applied.
B1	SDATA	Digital control interface (DCON) RFFE Bus data input/output. Typically connected to RFFE master on RF or Baseband IC. SDATA must be held low when VIO is not applied.
C1	VIO	Digital control interface (DCON) 1.8V supply input. VIO functions as the RFFE interface reference voltage. VIO also functions as reset and enable input to LM3279. Bypass capacitor should be connected between VIO and GND. Typically connected to voltage regulator controlled by RF or Baseband IC. When VIO = HIGH, EN shall be connected to GND.
D1	DGND	Digital Ground.
A2	GPO0	Multipurpose GPIO. When VIO = HIGH, GPO0 is a general purpose output for configuring RF front end circuitry. When the GPO0 control bit in Register 02 is set to 1, the output is driven to a 1.8V (VIO) high logic level , and the output is pulled to a low logic level when the GPO0 control bit is set to 0. When EN = HIGH, R0 input Gain-state control pin of RF PA (input has an internal pullup resistor).
B2	VCON	Voltage Control Analog input. When EN = HIGH, VCON controls the output voltage in PWM and PFM modes. When in digital control, VCON can be left as no connect or conneted to system ground.
C2	FB	Feedback input to inverting input of error amplifier. Connect output voltage directly to this node at load point.
D2	VOUT	Regulated output voltage of LM3279. Connect this to a 10 µF ceramic output filter capacitor to GND.
A3	GPO1	Multipurpose GPIO. When VIO = HIGH, GPO1 is a general purpose output for configuring RF front end circuitry. When the GPO1 control bit in Register 02 is set to 1, the output is driven to a 1.8V (VIO) high logic level, and the output is pulled to a low logic level when the GPO1 control bit is set to 0. When EN = HIGH, R1 input Gain-state control pin of RF PA (input has an internal pullup resistor).
B3	EN	Enable Pin. Pulling this pin higher than 1.2V enables part to function in analog control mode. VIO must be tied to ground.
C3	SGND	Signal Ground for analog circuits and control circuitry.
D3	SW2	Switch pin for Internal Power Switches M3 and M4. Connect inductor between SW1 and SW2.
A4	SVIN	SVIN is no connect. Analog supply is internally connected to PVIN.
B4	PVIN	Power MOSFET input and power current input pin. Typically connected to VBATT. Optional low-pass filtering may help buck and buck-boost modes for radiated EMI and noise reduction.
C4	SW1	Switch pin for Internal Power Switches M1 and M2. Connect inductor between SW1 and SW2.
D4	PGND	Power Ground for Power MOSFETs and gate drive circuitry.

12 Appendix A: Software User Manual

12.1 INTRODUCTION

This manual instructs a user how to set up and begin operating the LM8335 board, which is a RFFE interface allowing communication to the LM3279 eval board from a PC.

12.2 GENERAL INFORMATION

“The RF Front-End Control Interface (later referred to as RFFE) was developed to offer a common and widespread method for controlling RF front-end devices. There are a variety of front-end devices, including Power Amplifiers (PA), Low-Noise Amplifiers (LNA), filters, switches, power management modules, antenna tuners and sensors. These functions may be located either in separate devices or integrated into a single device, depending on the application.” -MIPI ® Alliance Specification for RFFE

This allows users to be able to control more than one device using a master and multiple slaves.

12.3 ITEMS NEEDED:

1. LM8335 Evaluation Board (https://estore.ti.com/LM8335EVM-General-Purpose-Output-Expander-with-MIPI-RFFE-Host-Interface-Evaluation-Module-P4279.aspx);
2. LM3279 evaluation board;
3. Micro USB “B” cable;
4. PC with USB port available;
5. GUI executable program (download from the web); and
6. 4-wire cable to connect from the LM8335 board to LM3279 board.

12.4 GUI INTERFACE EXECUTABLE AND DOWNLOAD

1. Run the GUI interface executable and download onto computer.
   - Note: Microsoft .NET Framework software is required and must be downloaded from Microsoft.

12.5 STARTUP SEQUENCE

1. For Digital Control: Place the EN pin of the LM3279 “Low” from the 20 pin connector “J4”, and leave the GPO0(R1)/1(R0) pins floating. Connect and align the SDATA, SCLK, VIO, and GND pins together from the LM8335 board (refer to Figure 3 and Figure 4).
2. Power up VIN (within the VIN range of 2.7V to 5.5V).
3. Start the LM3279 GUI Software.
4. A window will appear (Figure 10); click “OPEN” to establish connectivity between the LM3279 stand-alone eval board and the LM8335 board.
5. Another window will appear Figure 11 with the programmable registers of the LM3279.
6. Click “VIO_On” to enable the device. Make sure that VIO=1.8V on the LM3279EVM on VIO header.
7. Configure the Output voltage, Mode, and mode of operation for LM3279 to desired configuration (refer to Figure 11).
8. For Analog Control: Place 0Ω resistors to R3, R4 and R5 making SDATA, SCLK, VIO forced “Low.”
9. Power up VIN (within the VIN range of 2.7V to 5.5V).
10. Set VCON pin voltage to desired voltage (0.2 to 1.4V)
11. Set EN, R0 (GPO1) and R1 (GPO0) to the desired logic levels, then VOUT should present as expected.

12.6 GUI - SOFTWARE CONFIGURATION

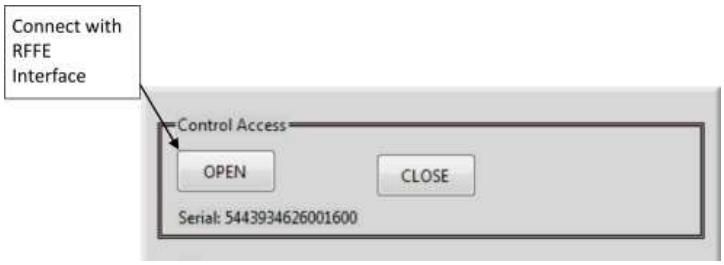


Figure 10. Startup Window for Initializing GUI

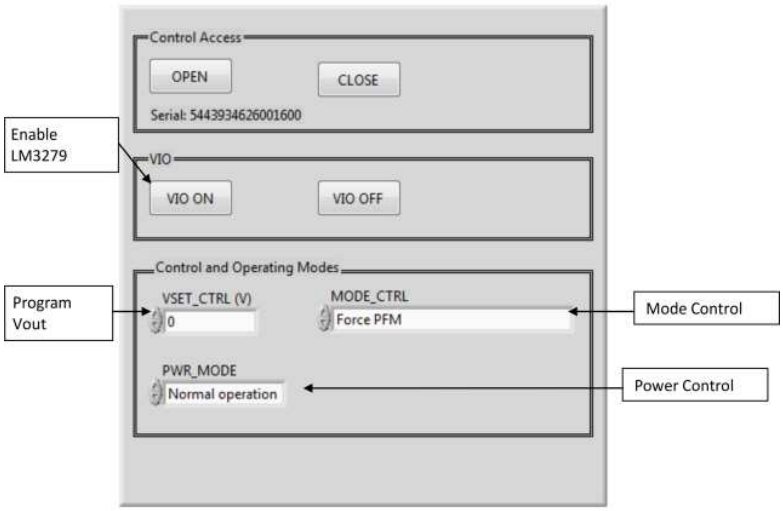


Figure 11. Programming GUI Window

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General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

Caution

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.

FCC Interference Statement for Class A EVM devices

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.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- 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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (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.

Concerning EVMs including detachable antennas

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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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.

Concernant les EVMs avec antennes détachables

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.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

Texas Instruments Japan Limited
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3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. 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 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible 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, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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