LM3263 DSBGA Evaluation Module

1 Introduction

The LM3263 Evaluation Module is a working demonstration of a step-down DC-DC converter optimized for powering multimode 2G/3G/4G RF power amplifiers (PAs) from a single Lithium-Ion cell.

The LM3263 steps down an input voltage from 2.7V to 5.5V to a dynamically adjustable output voltage of 0.4V to 3.6V. The output voltage is externally programmed through the RFFE Digital Control Interface and is set to ensure efficient operation at all power levels of the RF PA.

This application note contains information about the evaluation module. For more details and electrical characteristics, please refer to the LM3263 datasheet (SNVS837).

2 Operating Conditions

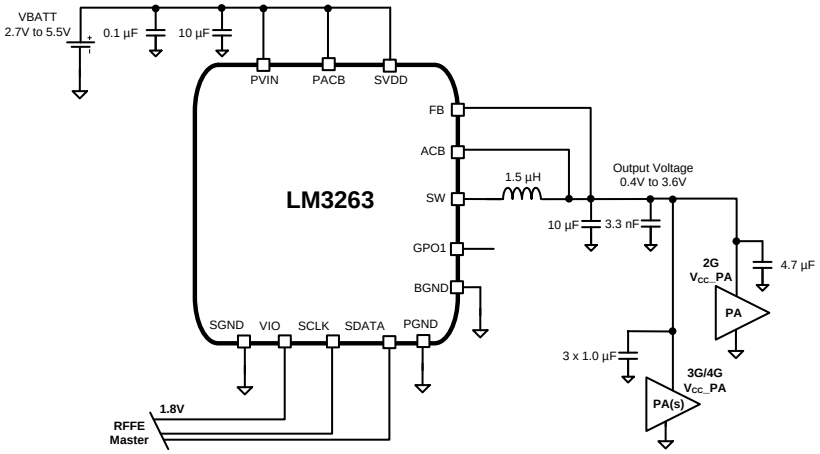
The device will operate under the following conditions:

- V_{IN} range: 2.7V to 5.5V
- V_{OUT} Range: 0.4V to 3.6V
- I_{OUT} range: 0mA to 2.5A

3 Package

The LM3263 is available in a 16-bump (0.4 mm pitch) lead-free DSBGA package.

4 Typical Application Circuit



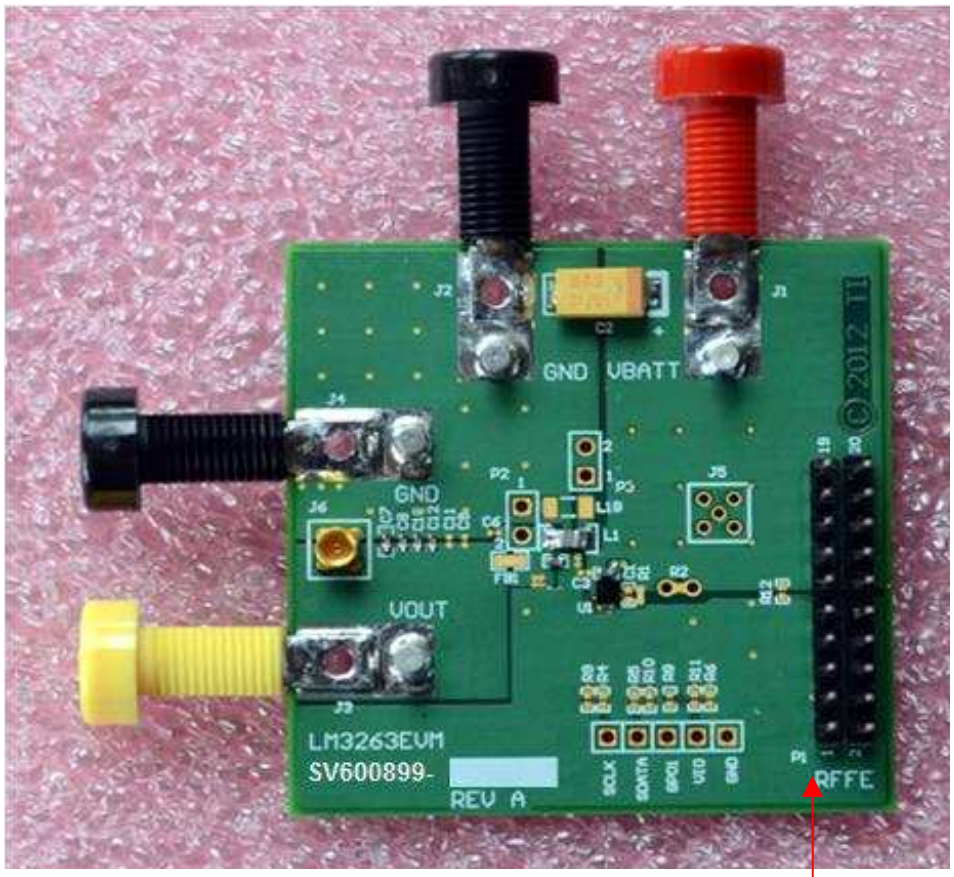
All trademarks are the property of their respective owners.

Copyright © 2013, Texas Instruments Incorporated

5 Bill of Materials

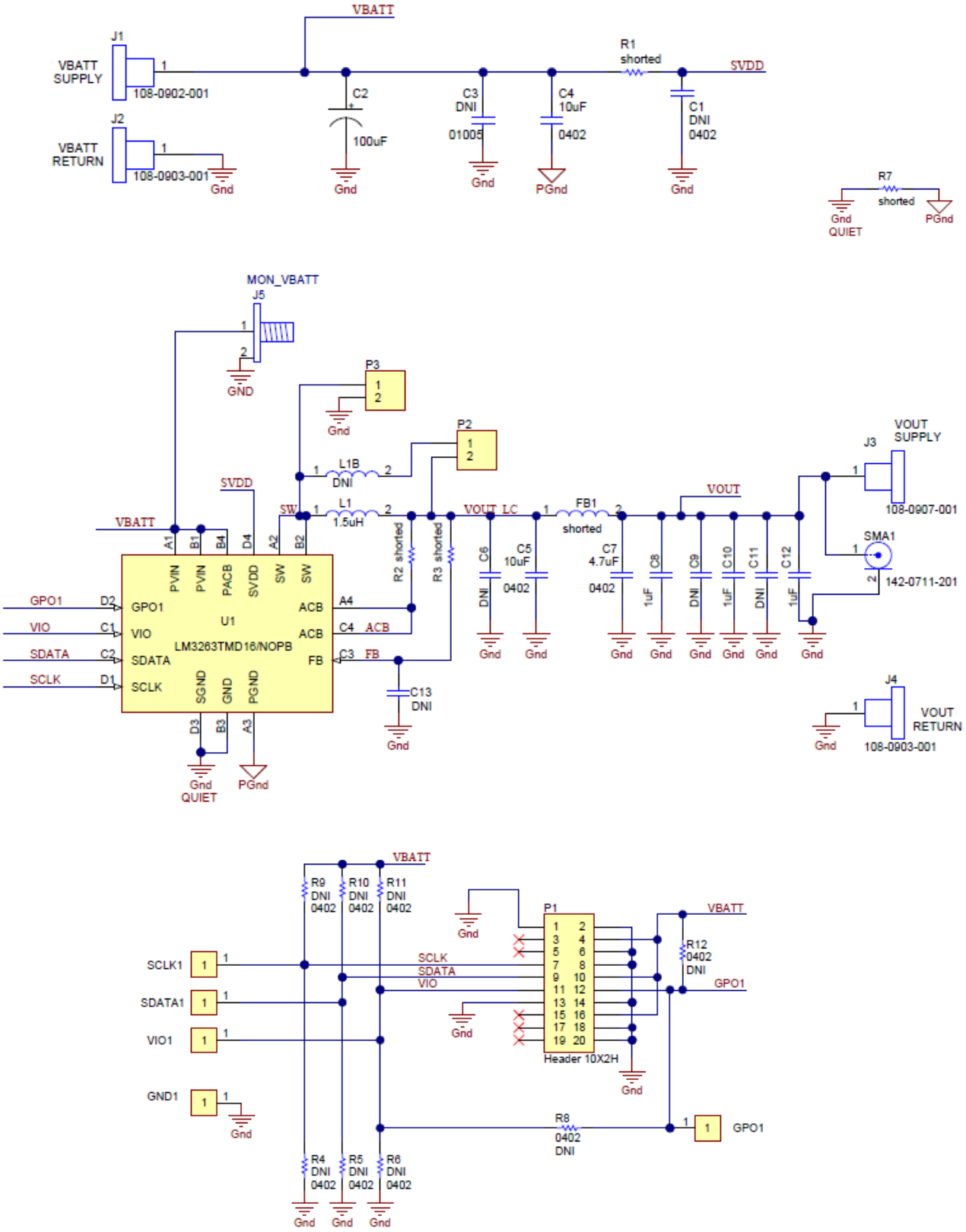
Designator	Model	Description	Manufacturer
U1	LM3263TM	DC-DC converter	Texas Instruments
C2	T495D107K010A	100 µF, 10V, 3216 (7343) Low ESR Tantrum Cap	Kemet
C4	CL05A106MP5NUNB	10 µF, 10V, 0402 (1005) Input Bulk capacitor	Samsung
C5	CL05A106MP5NUNB	10 µF, 10V, 0402 (1005) Output Bulk capacitor	Samsung
C7	CL05A475MP5NRNB	4.7 µF, 10V, 0402 (1005) Resemble VCC PA decoupling capacitor	Samsung
C8, C10, C12	C0603X5R0J105M	1.0 µF, 6.3V, 0201 (0603) Resemble VCC PA decoupling capacitor	TDK
L1	DFE201610C-1R5N	1.5uH, 2.0 x 1.6 x 1.0 mm, Inductor	Toko

6 Evaluation Module Photo



Copyright © 2013, Texas Instruments Incorporated

7 Evaluation Module Schematic



Note: R4, R5, R6, R9, R10, R11, R12 are internal use only.

Copyright © 2013, Texas Instruments Incorporated

8 Connecting to the Module

1. Connect VBATT to the RED (+) and BLACK (GND) banana connector pins.
2. Connect the load (resistor or PA) to the YELLOW (+) and BLACK (GND) banana connector pins.
3. Connect PC USB Power to the LM8335EVM using a micro-USB Type “B” cable.
4. Connect the RFFE interface ribbon cable from LM8335EVM to the LM3263 Evaluation Module "20-pin Connector" and align VIO, SDATA, SCLK, and GND.
5. Refer to the Section 11 for information on turning on VIO and other RFFE related questions.

8.1 Module Layers

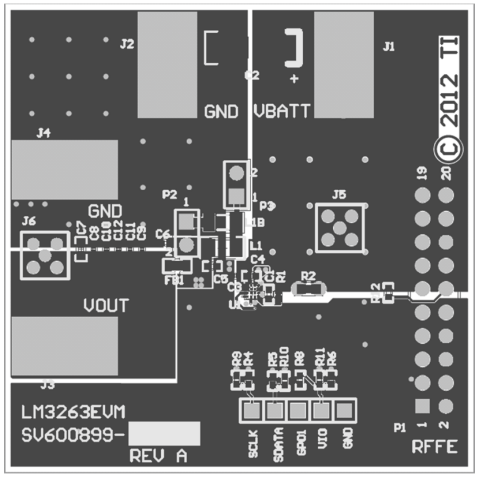


Figure 1. Top Layer

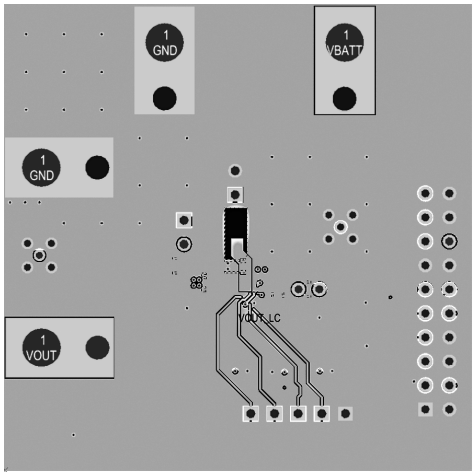


Figure 2. Mid Layer 1

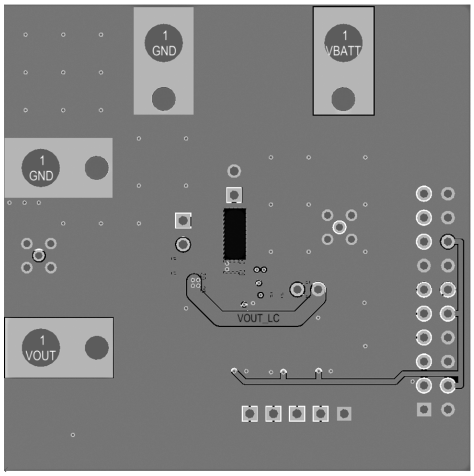


Figure 3. Mid Layer 2

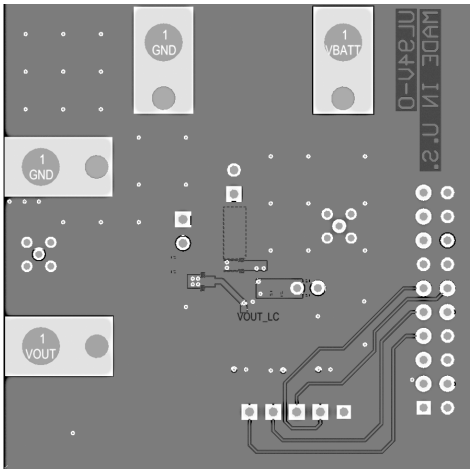


Figure 4. Bottom Layer

Copyright © 2013, Texas Instruments Incorporated

9 Connection Diagram

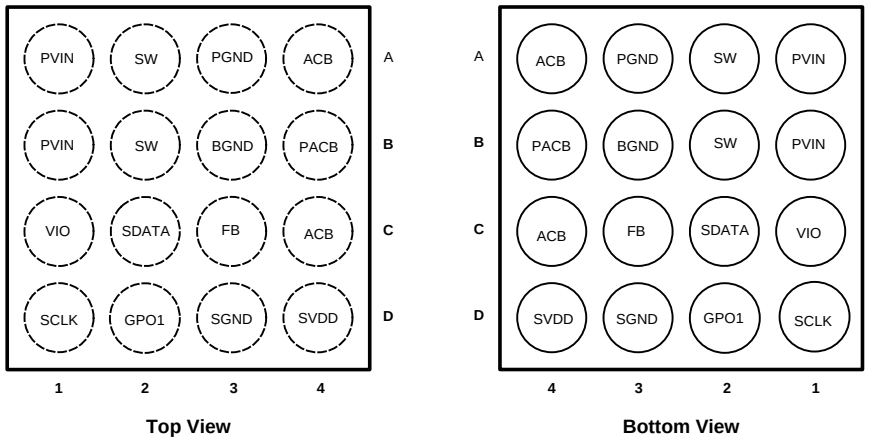


Figure 5. Connection Diagram

10 Pin Descriptions

Pin #	Name	Description
A1	PVIN	Power Supply Voltage Input to the internal PFET switch.
B1		
C1	VIO	VIO functions as the RFFE interface reference voltage. VIO also functions as reset and enable input to the LM3263. Typically connected to voltage regulator controlled by RF or Baseband IC.
D1	SCLK	Digital control interface RFFE Bus clock input. Typically connected to RFFE master on RF or Baseband IC. SCLK must be held low when VIO is not applied.
A2	SW	Switching Node connection to the internal PFET switch and NFET synchronous rectifier.
B2		
C2	SDATA	Digital control interface 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.
D2	GPO1	General Purpose Output. Also used to reconfigure USID.
A3	PGND	Power Ground to the internal NFET switch.
B3	BGND	ACB, Analog Bypass Ground and Digital Ground.
C3	FB	Feedback Analog Input. Connect to the output at the output filter capacitor.
D3	SGND	Signal Analog Ground (Low Current).
A4	ACB	ACB and Analog Bypass output. Connect to the output at the output filter capacitor.
C4		
B4	PACB	ACB Power Supply Input.
D4	SVDD	Analog Power Supply Voltage.

11 Appendix: LM3263 GUI Software User Guide

11.1 Introduction

The LM3263 software interface facilitates RFFE serial communication between a PC and the LM3263 via the LM8335 evaluation module (EVM). This version of the software is provided for initial evaluation of the LM3263.

Copyright © 2013, Texas Instruments Incorporated

11.2 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

11.3 Items Needed

1. LM3263 Evaluation Module;
2. LM8335 Evaluation Module (EVM, including Micro USB "B" cable - order from www.ti.com);
3. LM3263EVM-to-LM8335EVM Ribbon Cable; and
4. LM3263 GUI program (download from www.ti.com).

11.4 Software Installation

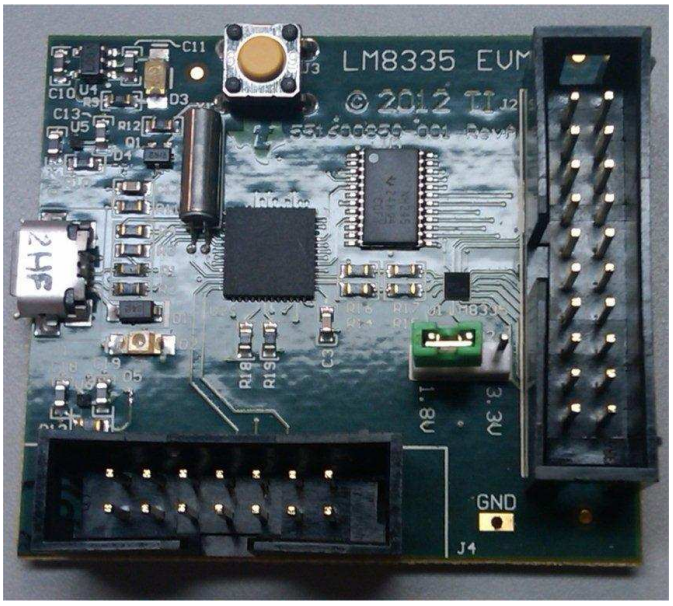
NOTE: 1. Version 4.0 or later Microsoft .NET Framework software is required and must be downloaded from Microsoft.

2. 2010 (32-bit standard RTE) or later version of NI LabVIEW Run-Time Engine is required and must be downloaded from the Texas Instruments website.

1. Execute setup.exe onto a computer.
2. "TI\LM3263 RFFE Interface" directory will be created under C:\Program Files. Click "Next".
3. Click the radio button "I accept the License Agreement", and click "Next".
4. Then click "Next".
5. Then click "Finish". Installation Completed.

11.5 Startup Sequence

Micro USB-B connector



Ribbon cable connector from LM3263EVM to LM8335EVM; Connector showing the following PINS:
- GND (Pin #1, Pin #8)
- SCLK (Pin #7)
- SDATA (Pin #9
- VIO (Pin #11)

Figure 6. LM8335EVM

1. Connect the USB interface board (LM8335EVM) to a PC using the USB cable. VDDIO jumper is connected VDDIO to 1.8V. Two LEDs (D2, D3) turn on.
2. Connect the LM3263 evaluation module to the LM8335EVM using the provided ribbon cable.

Copyright © 2013, Texas Instruments Incorporated

3. Run the “LM3263 RFFE Interface” in the Start/All Programs menu. All radio buttons are grayed out except “VIO CONTROL”.

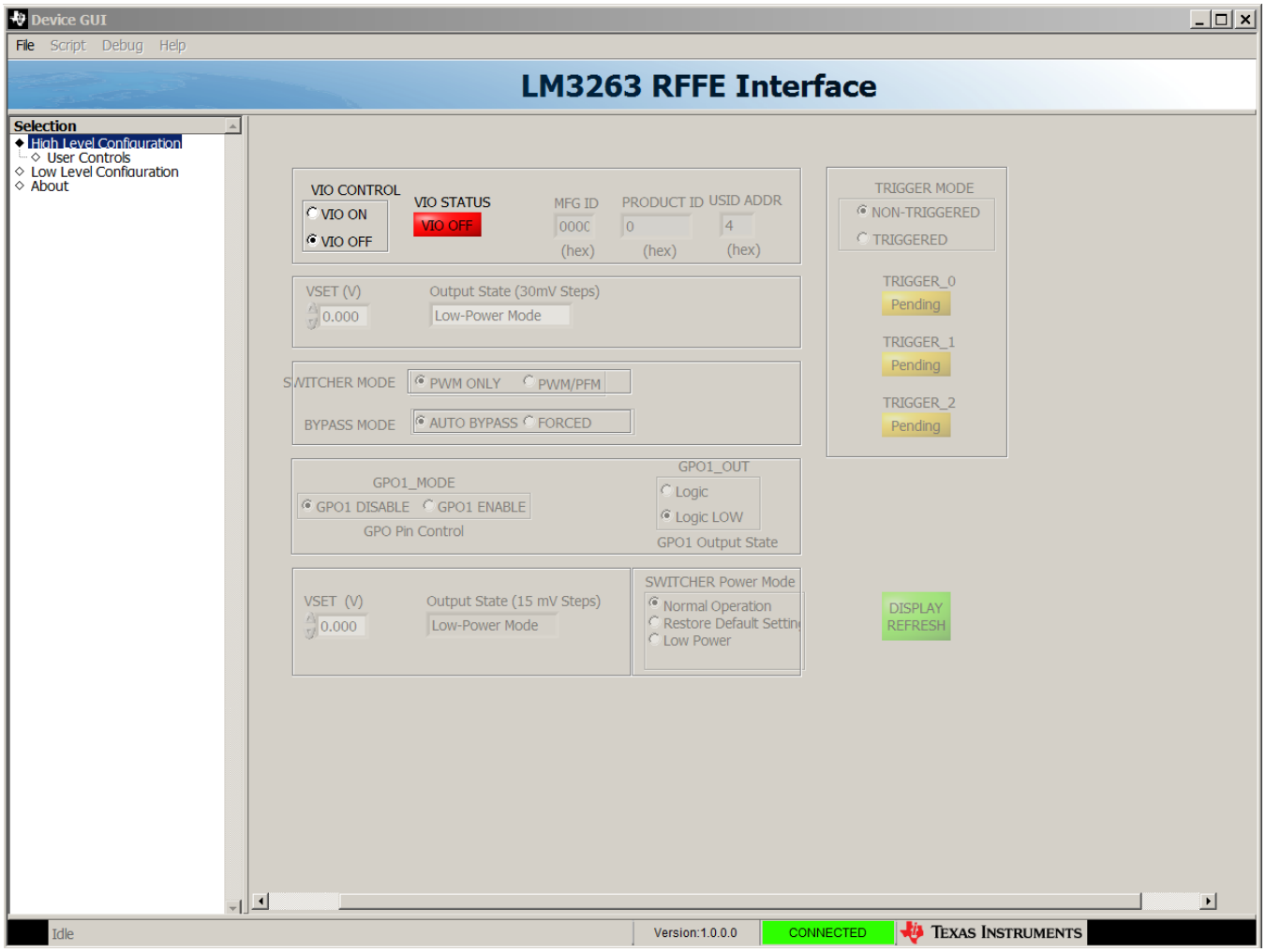


Figure 7. LM3263 GUI Initial Screen

4. Apply power supply voltage to the LM3263 VBATT within the input voltage range of 2.7V to 5.5V.
5. Click “VIO ON”. “VIO STATUS” turns to “VIO ON” in green. And all control boxes and radio buttons are enabled.
6. The default "TRIGGER MODE" in this GUI is "Non-Triggered" to make evaluation simpler, as opposed to the device default mode, which is "Triggered".
7. To set the expected output voltage, click the up/down arrow or type in the desired output voltage at the control box of the “VSET (V)”.

Copyright © 2013, Texas Instruments Incorporated

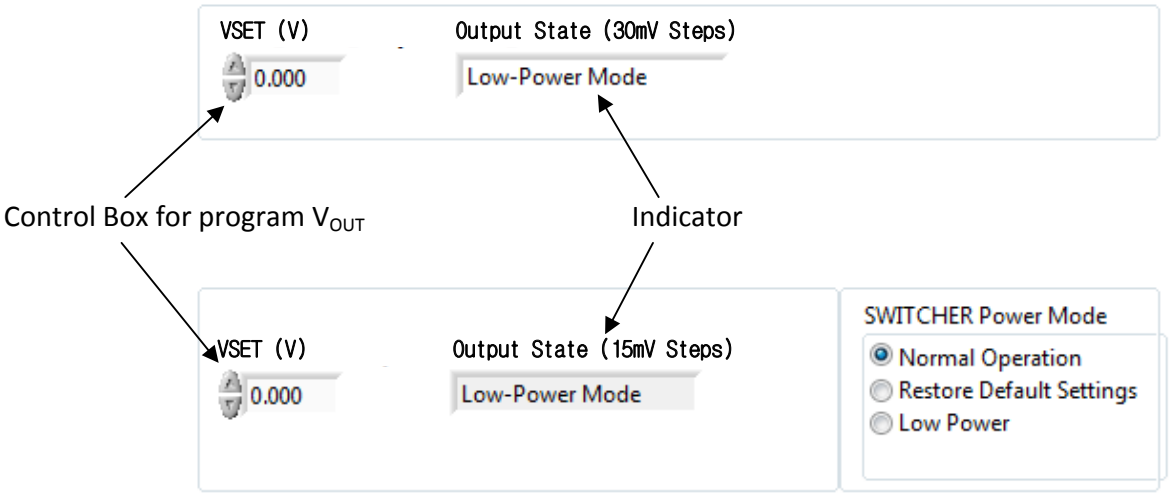


Figure 8. Programming Output Voltage Windows

NOTE: The other controls in the GUI are dependent on the register map as seen in Section 12.

Copyright © 2013, Texas Instruments Incorporated

12 Programmable Registers

Addr	Register Contents					
00h	**REGISTER _0**					
	Bits	**Function**	**Default**	**Trigger**[1]	**R/W**	**Description**
	7	RSVD	0	N/A	N/A	Reserved
	6:0	VSET[7:1]	00h	Yes	R/W	**Register 00h interacts with Register 03h.** DC-DC converter mode and output voltage control bits 00h : Low-Power Mode 01h : Reserved 02h : Standby Mode 03h to 7Eh : Active Mode, Setting Output Voltage is enabled. Output voltage can be set 0.4V to 3.6V by 0Dh to 78h with 30 mV steps 7Fh : Forced-Bypass Mode. VSET[7:1] (dec) = Desired V_{OUT} / 0.03 (round up decimals), then converts a decimal number to hexadecimal.
01h	**SMPS_CFG**					
	Bits	**Function**	**Default**	**Trigger**[1]	**R/W**	**Description**
	7:6	RSVD	0	N/A	N/A	Reserved
	5	MODE	0	Yes	R/W	Switching mode select bit 0: Forced-PWM Mode (PWM only) 1: Auto-PFM Mode (PFM/PWM)
	4	BYPS	0	Yes	R/W	Forced bypass bit 0: Auto-Bypass Mode 1: Forced-Bypass Mode
	3:0	RSVD	0h	N/A	N/A	Reserved
02h	**GPO_CTRL**					
	Bits	**Function**	**Default**	**Trigger**[1]	**R/W**	**Description**
	7	GPO1_OUT	0	Yes	R/W	GPO1 output control 0: Low state 1: High state
	6	GPO1_MODE	0	Yes	R/W	GPO1 Mode Selection 0 : General Purpose Output disabled 1 : General Purpose output driven by GPO1_OUT.
	5:0	RSVD	00h	N/A	N/A	Reserved
03h	**VSET_CTRL**					
	Bits	**Function**	**Default**	**Trigger**[1]	**R/W**	**Description**
	7:0	VSET[7:0]	00h	Yes	R/W	DC-DC converter mode and output voltage fine control bits 00h-01h : Low-Power Mode 02h-03h : Reserved 04h-05h : Standby Mode 06h to FDh : Active Mode, Setting Output Voltage is enabled. Output voltage can be set 0.4V to 3.6V by 1Bh to F0h with 15 mV steps FEh-FFh : Forced Bypass Mode. VSET[7:0] (dec) = Desired V_{OUT} / 0.015 (round up decimals), then converts a decimal number to hexadecimal.

(1) Trigger=Yes: When all PM_TRIG.TRIG_MSK_* bits are set '1', REGISTER_0 will be written immediately during a write operation. If any PM_TRIG.TRIG_MSK_* bits are cleared ('0'), REGISTER_0 will not be updated to the new value after a write operation only after an unmasked PM_TRIG.TRIG_* bit is subsequently written to a '1'.

Copyright © 2013, Texas Instruments Incorporated

Addr	Register Contents					
1Ah	RFFE_STATUS					
	Bits	Function	Default	Trigger[2]	R/W	Description
	7	SWRESET	0	No		Software Reset. A write to '1' will cause all registers except for USID to be reset. Will always read back '0'.
	6	CMD_FRAME_PERR	0	No		Set if parity error detected in command frame. Cleared on read. Write will have no effect on this bit.
	5	CMD_LENGTH_ERR	0	No		Error when transaction interrupted by new SSC. Cleared on read. Write will have no effect on this bit.
	4	RSVD	0	No		Reserved
	3	DATA_FRAME_PERR	0	No		Write data frame parity error. Cleared on read. Write will have no effect on this bit.
	2	RD_UNUSED_REG	0	No		Read command to an invalid register. Cleared on read. Write will have no effect on this bit.
	1	WR_UNUSED_REG	0	No		Write command to an invalid register. Cleared on read. Write will have no effect on this bit.
	0	BID_GID_ERR	0	No		Read command with a broadcast ID or Group ID. Cleared on read. Write will have no effect on this bit.
1Bh	GROUP_ID					
	Bits	Function	Default	Trigger[2]	R/W	Description
	7:4	RSVD	0h	N/A	N/A	Reserved
	3:0	GSID	0h	No		Group Slave ID.
1Ch	PM_TRIG					
	Bits	Function	Default	Trigger[2]	R/W	Description
	7:6	PWR_MODE	10b	No	R/W	Power Mode Bits. 00b = Active Mode 01b = Restore default settings 10b = Low-Power Mode 11b = Reserved
	5	TRIG_MSK_2	0	No		Mask bit for Trigger 2. Broadcast write to this bit is ignored.
	4	TRIG_MSK_1	0	No		Mask bit for Trigger 1. Broadcast write to this bit is ignored.
	3	TRIG_MSK_0	0	No		Mask bit for Trigger 0. Broadcast write to this bit is ignored.
	2	TRIG_2	0	No		Write to a '1' loads trigger registers with last written value TRIG_MSK_2 is cleared. Write to '0' has no affect.
	1	TRIG_1	0	No		Write to a '1' loads trigger registers with last written value TRIG_MSK_1 is cleared. Write to '0' has no effect.
	0	TRIG_0	0	No		Write to a '1' loads trigger registers with last written value TRIG_MSK_0 is cleared. Write to '0' has no effect.

(2) Trigger=Yes: When all PM_TRIG.TRIG_MSK_* bits are set '1', REGISTER_0 will be written immediately during a write operation. If any PM_TRIG.TRIG_MSK_* bits are cleared ('0'), REGISTER_0 will not be updated to the new value after a write operation only after an unmasked PM_TRIG.TRIG_* bit is subsequently written to a '1'.

Copyright © 2013, Texas Instruments Incorporated

Addr	Register Contents					
1Dh	PRODUCT ID					
	Bits	Function	Default	Trigger[3]	R/W	Description
	7:0	PRODUCT_ID	82h	No	R	Product Identification Bits. Product ID default value cannot be overwritten.
1Eh	MANUFACTURER ID, LSB					
	Bits	Function	Default	Trigger[3]	R/W	Description
	7:0	MANID[7:0]	02h	No	R	Manufacturer Identification, bits 7:0. Manufacturer ID default value cannot be overwritten.
1Fh	MANUFACTURER ID, MSB					
	Bits	Function	Default	Trigger[3]	R/W	Description
	7:6	RSVD	00b	N/A	N/A	Reserved
	5:4	MANID[5:4]	01b	No	R	Manufacturer Identification, bits 5:4. Manufacturer ID default value cannot be overwritten.
	3:0	USID	010xb	No		Unique Slave Identifier. Bit 0 (x) of USID is tied to the state of the GPO1 pin. 0100b: GPO1= Low state or floating 0101b: GPO1= High state

(3) Trigger=Yes: When all PM_TRIG.TRIG_MSK_* bits are set '1', REGISTER_0 will be written immediately during a write operation. If any PM_TRIG.TRIG_MSK_* bits are cleared ('0'), REGISTER_0 will not be updated to the new value after a write operation only after an unmasked PM_TRIG.TRIG_* bit is subsequently written to a '1'.

Copyright © 2013, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license 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 significant portions 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. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2013, Texas Instruments Incorporated