Using the LM3632A Evaluation Module

User's Guide

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LM3632EVM User's Guide

1 Introduction

The Texas Instruments LM3632EVM evaluation module (EVM) helps designers evaluate the operation and performance of the LM3632A Backlight + Bias Power + Flash Driver. The device offers configurability via I^2C-compatible interface. All three blocks can be enabled via the I^2C interface. In addition, the Flash Driver and LCM Bias can be enabled externally using the STROBE and LCM_EN pins. The module utilizes two strings of 8 backlight LEDs connected in series and a flash LED mounted on the EVM.

The EVM contains one LM3632A device (see Table 1).

Table 1. Device and Package Configurations

BACKLIGHT + FLASH + LCM BIAS DRIVER	IC	PACKAGE
U1	LM3632A	0.4 mm-pitch, 30-pin DSBGA

2 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, set up and use the LM3632EVM.

2.1 Input/Output Connector Description

2.1.1 Input / GND

There are three input terminals and one ground for the EVM, providing a power (VIN) and ground (GND) connection to allow the user to attach the EVM to a cable harness. The three input terminals allow the user to split the input to the three boost drivers so that the input power to each block can be measured independently. All three input terminals can be shorted together by jumpers J8, J9, and J10 or by 0-Ω resistors R4, R5, and R6 (not assembled).

2.1.2 EN (J14)

This is the jumper used to enable the LED driver (HWEN pin). The driver will be enabled when the HWEN pin is high (VIO) and disabled when it is low (GND).

2.1.3 VIO (J21)

This pin provides power for the I^2C lines (Clock and Data) and for the HWEN pin. It is recommended that this pin is connected to the VIN pin. If desired, it can be connected to the 3.3-V line provided by the USB interface connector. In this configuration, communication via the I^2C interface may not be possible if the supply voltage to the LED driver is below approximately 3 V.

2.1.4 LCM1EN (J15) & LCM2EN (J16)

These jumpers can be used to externally enable the VPOS and VNEG outputs of the LCM Bias block. The outputs will be enabled when the pins are high (VIO) and disabled when left floating. There are 300-kΩ pull-down resistors to GND on both of these pins. The LCMEN1 & LCMEN2 pins can also be controlled externally by applying a signal directly to the pins.

2.1.5 Backlight LED Connector (JBD)

This jumper connects the backlight LED strings to the outputs of the backlight boost output pin, BL_OUT. Place jumper between BLOUT & DBL pins.

2.1.6 Backlight LED Configuration Connectors

The user can use these connectors to configure each string's number of LEDs. The default configuration is 8 LEDs in series (no jumpers). To achieve a configuration of 2 LEDs in series place a jumper on location "2", 3 LEDs on location "3" and so on. For example, placing the jumpers as shown on Figure 1, will configure string 2 with 6 LEDs and string 1 with 7 LEDs.

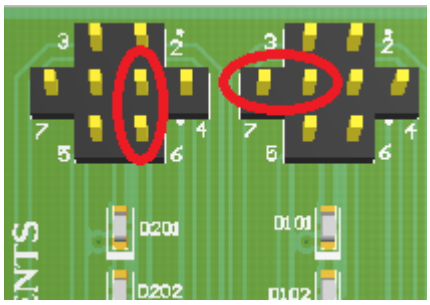

Figure 1. Backlight LED Configuration Example

2.1.7 JFD Jumper

The JFD is used to connect the on-board flash LED to the LED output of the flash driver.

2.1.8 PWM (J18)

This pin is the PWM input signal for backlight LED current adjustment. It can be driven externally or if connected to pin PWM0 via a jumper it can be driven by a using the General User Interface (GUI) software provided.

2.1.9 STROBE (J17)

This pin provides an external method for initiating a flash event. The STROBE pin is connected to ground via a 300-kΩ resistor internal to the LM3632. To externally drive this pin, either connect a control signal directly to the STROBE pin of the connector or place a jumper between connector pins STROBE and PWM1. The PWM1 pin can be configured as ON, OFF, time-adjustable voltage pulse or continuous voltage pulses of adjustable frequency and duty cycle via the GUI software provided.

2.1.10 TX (J19)

This pin is used to initiate a TX-interrupt event. The TX pin is connected to ground via a 300-kΩ resistor internal to the LM3632. To externally drive this pin, either connect a control signal directly to the TX pin of the connector or place a jumper between connector pins TX and PWM2. The PWM2 pin can be configured as ON, OFF, time-adjustable voltage pulse, or continuous voltage pulses of adjustable frequency and duty cycle via the GUI software provided.

2.1.11 SDA / SCL (J20)

These connections allow the user to externally control the I^2C lines. For independent control of the I^2C lines, *do not* connect the VIO jumper to either the 3.3 V or the VIN pin.

2.1.12 FOUT, FLED (J25)

These provide access to the regulated outputs of the flash driver and the flash LED current source. The user can measure VOUT with reference to GND, VLED with reference to GND and current source headroom directly between V_{OUT} and V_{LED}.

2.1.13 LCMOUT, VPOS (J26)

These provide access to the regulated output of the LCM bias boost and the VPOS output. The user can measure LCMOUT and VPOS with reference to GND.

2.1.14 VNEG, CF-, CF+ (J24)

These provide access to the regulated inverting charge pump output (VNEG) and to the charge pump positive and negative flying cap connections. The user can measure V_{NEG} with reference to GND and can monitor the voltage waveforms at the flying cap terminals.

2.1.15 BLSW (J13), FSW (J12), LCMSW (J11)

These connectors can be used to monitor the voltage waveforms at the switch pin of each boost circuit.

VINBL/VIN (J8), VINLCM/VIN (J10), VINF/VIN (J9)

The user can monitor the inductor current and input current waveforms for each of the three boost blocks by omitting these jumpers and using separate wires from the power supply to the inductors and VIN. This will remove the input capacitors from the inductors and eliminate their filtering effect to the inductor current.

2.1.16 JFS – Flash LED Current Measurement

The LM3632EVM provides a way to accurately measure the LED current through the LED on board. Resistor RFS (0.1 Ω) is placed between the cathode of flash LED (DF) and Ground. The user can first measure the resistor value accurately, by applying a known current through connector DFHF and ground and measuring the voltage between DFHS and DFLS. Then, during normal flash or torch operation, the voltage measured across the resistor divided by the resistor value will equal the current through the resistor (and the LED).

2.1.17 JB1S & JB2S – Backlight String Current Measurements

The LM3632EVM provides a way to accurately measure the current through the backlight LED strings on board. Resistors RB1S & RB2S (10 Ω) are placed between the LED strings and the current sink inputs of the LM3632. The user can measure the voltage across the resistor(s) and calculate the current(s) through the resistor(s) by dividing the voltage by 10 Ω.

2.2 Setup

The input voltage range for the LM3632A is 2.7 V to 5 V. The on-board backlight and flash LEDs should be connected, and the jumpers should be properly configured for proper operation. This is the recommended setting, using shorting blocks:

- VIO to VIN (J21), Except for silicon A0
- EN to VIO (J14)
- Flash LED (JFD) shorted
- Backlight LEDs (JBD) shorted
- J8 shorted or R4 = 0 Ω
- J9 shorted or R5 = 0 Ω
- J10 shorted or R6 = 0 Ω
- PWM to PWM0 (J18) or external signal
- STROBE to PWM1 (J17) or external signal
- TX to PWM2 (J19) or external signal

In this configuration, the device will power up when power is applied and all outputs can be enabled. Refer to Figure 2 for recommended jumper placement.

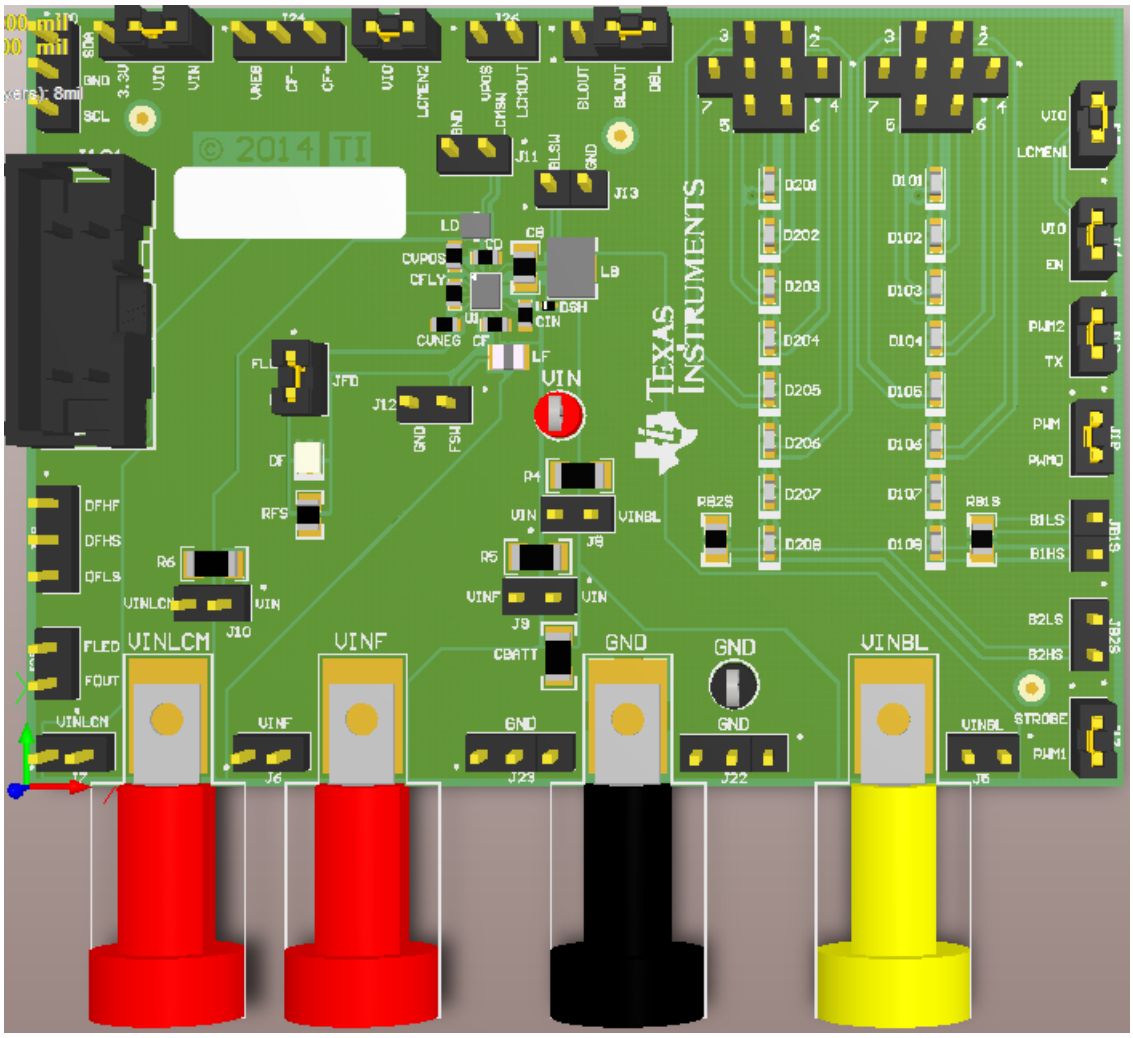

Figure 2. LM3632EVM Recommended Jumper Placement

3 Board Layout

Figure 3, Figure 4, Figure 5, Figure 6, Figure 7 and Figure 8 show the board layout for the LM3632EVM. The EVM offers resistors, capacitors, and jumpers to enable the device and to configure it as desired.

The LM3632A will dissipate power, especially during high currents and long duration flash events. Power will also be dissipated on the flash and backlight LEDs. The EVM layout is designed to minimize temperature rise during operation. It is recommended that in order to prevent overheating, repeated flash events in very short time intervals is avoided.

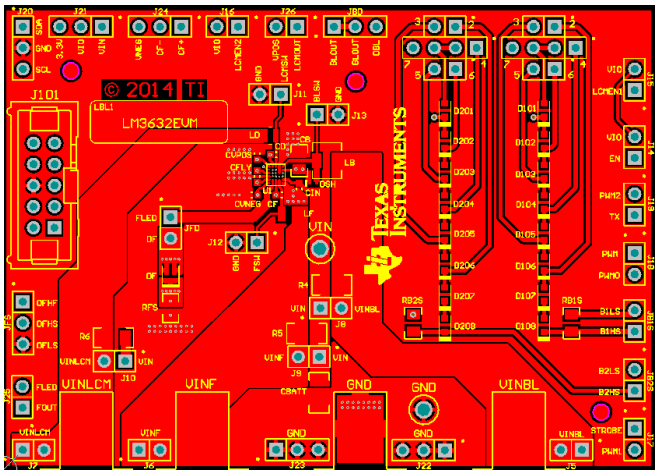

Figure 3. Top Assembly Layer

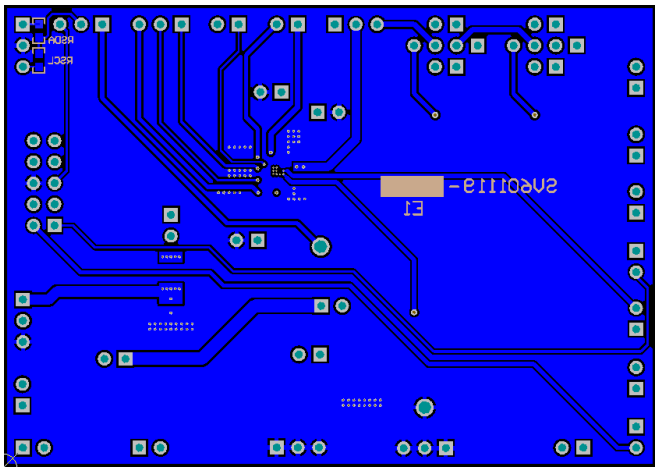

Figure 4. Bottom Assembly Layer

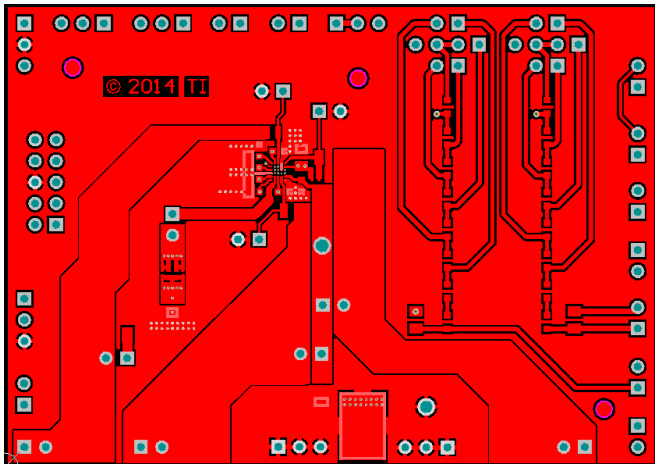

Figure 5. Top Layer Routing

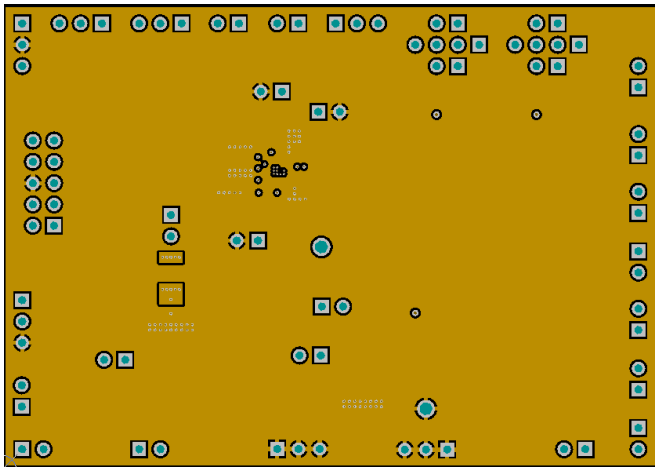

Figure 6. Middle Layer 1 Routing

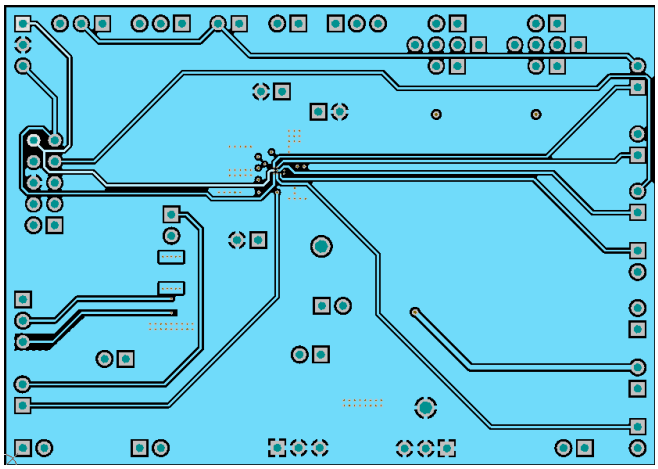

Figure 7. Middle Layer 2 Routing

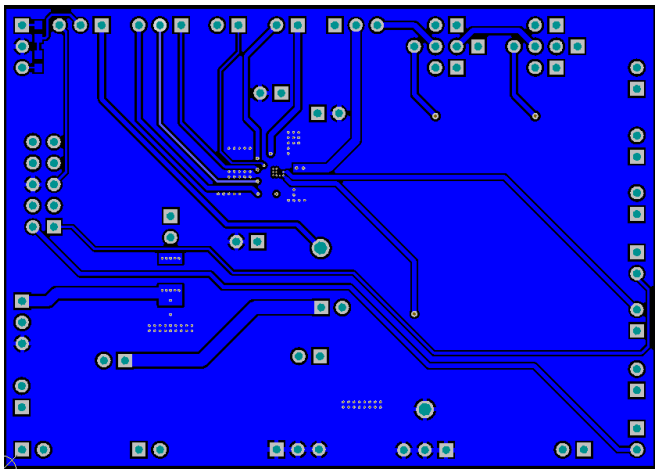

Figure 8. Bottom Routing

4 Schematic

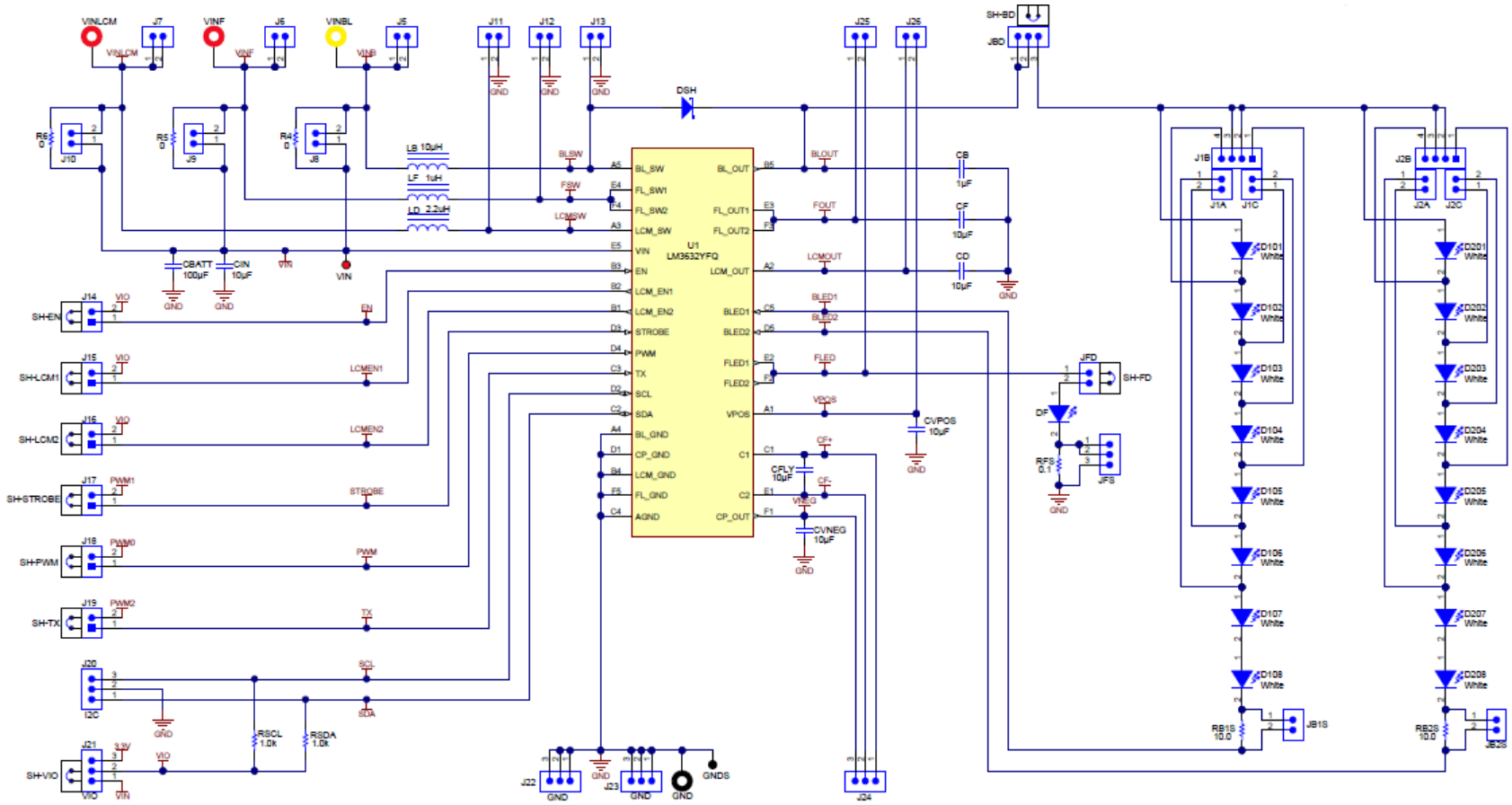

Figure 9. LM3632EVM Schematic

Table 2. Bill of Materials

ITEM	DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER
1	PCB	Printed Circuit Board	Any	SV601119
2	CB	CAP, CERM, 1uF, 50V, +/-10%, X7R, 0805	TDK	C2012X7R1H105K125AB
3	CBATT	CAP, CERM, 100uF, 6.3V, +/-20%, X5R, 1206	MuRata	GRM31CR60J107ME39L
4	CD	CAP, CERM, 10uF, 6.3V, +/-20%, X5R, 0603	TDK	C1608X5R0J106M
5	CF	CAP, CERM, 10uF, 6.3V, +/-20%, X5R, 0603	TDK	C1608X5R0J106M
6	CFLY	CAP, CERM, 10uF, 6.3V, +/-20%, X5R, 0603	TDK	C1608X5R0J106M
7	CIN	CAP, CERM, 10uF, 6.3V, +/-20%, X5R, 0603	TDK	C1608X5R0J106M
8	CVNEG	CAP, CERM, 10uF, 6.3V, +/-20%, X5R, 0603	TDK	C1608X5R0J106M
9	CVPOS	CAP, CERM, 10uF, 6.3V, +/-20%, X5R, 0603	TDK	C1608X5R0J106M
10	D101	LED, White, SMD	Rohm	SML312WBCW1
11	D102	LED, White, SMD	Rohm	SML312WBCW1
12	D103	LED, White, SMD	Rohm	SML312WBCW1
13	D104	LED, White, SMD	Rohm	SML312WBCW1
14	D105	LED, White, SMD	Rohm	SML312WBCW1
15	D106	LED, White, SMD	Rohm	SML312WBCW1
16	D107	LED, White, SMD	Rohm	SML312WBCW1
17	D108	LED, White, SMD	Rohm	SML312WBCW1
18	D201	LED, White, SMD	Rohm	SML312WBCW1
19	D202	LED, White, SMD	Rohm	SML312WBCW1
20	D203	LED, White, SMD	Rohm	SML312WBCW1
21	D204	LED, White, SMD	Rohm	SML312WBCW1
22	D205	LED, White, SMD	Rohm	SML312WBCW1
23	D206	LED, White, SMD	Rohm	SML312WBCW1
24	D207	LED, White, SMD	Rohm	SML312WBCW1
25	D208	LED, White, SMD	Rohm	SML312WBCW1
26	DF	LED, Cool White, SMD	Philips Lumileds	LXCL-EYW4
27	DSH	Diode, Schottky, 30V, 0.5A, SOD-923	ON Semiconductor	NSR0530P2T5G
28	FID1	Fiducial mark. There is nothing to buy or mount.	N/A	N/A
29	FID2	Fiducial mark. There is nothing to buy or mount.	N/A	N/A
30	FID3	Fiducial mark. There is nothing to buy or mount.	N/A	N/A
31	GND	Standard Banana Jack, Insulated, Black	Keystone	6092
32	GNDS	Test Point, Compact, Black, TH	Keystone	5006
33	J1A	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S
34	J1B	Header, TH, 100mil, 4x1, Gold plated, 230 mil above insulator	Samtec	TSW-104-07-G-S
35	J1C	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S
36	J2A	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S
37	J2B	Header, TH, 100mil, 4x1, Gold plated, 230 mil above insulator	Samtec	TSW-104-07-G-S
38	J2C	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S
39	J5	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S
40	J6	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S
41	J7	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S
42	J8	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S
43	J9	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S
44	J10	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S
45	J11	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S
46	J12	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S
47	J13	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S
48	J14	Header, 100mil, 2x1, Gold, TH	Samtec	TSW-102-07-G-S
49	J15	Header, 100mil, 2x1, Gold, TH	Samtec	TSW-102-07-G-S
50	J16	Header, 100mil, 2x1, Gold, TH	Samtec	TSW-102-07-G-S
51	J17	Header, 100mil, 2x1, Gold, TH	Samtec	TSW-102-07-G-S
52	J18	Header, 100mil, 2x1, Gold, TH	Samtec	TSW-102-07-G-S

Table 2. Bill of Materials (continued)

ITEM	DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER
53	J19	Header, 100mil, 2x1, Gold, TH	Samtec	TSW-102-07-G-S
54	J20	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-103-07-G-S
55	J21	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-103-07-G-S
56	J22	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-103-07-G-S
57	J23	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-103-07-G-S
58	J24	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-103-07-G-S
59	J25	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S
60	J26	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S
61	J101	Header (shrouded), 100mil, 5x2, High-Temperature, Gold, TH	3M	N2510-6002-RB
62	JB1S	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S
63	JB2S	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S
64	JBD	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-103-07-G-S
65	JFD	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S
66	JFS	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-103-07-G-S
67	LB	Inductor, Shielded, Ferrite, 10uH, 1A, 0.23 ohm, SMD	TDK	VLF403212MT- 100M
68	LBL1	Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	Brady	THT-14-423-10
69	LD	Inductor, Shielded, Ferrite, 2.2uH, 1.05A, 0.195 ohm, SMD	TDK	VLS201612ET-2R2M
70	LF	Inductor, Shielded, Metal Composite, 1uH, 2.6A, 0.058 ohm, SMD	Toko	DFE201610P-1R0M
71	R4	RES, 0 ohm, 5%, 0.25W, 1206	Yageo America	RC1206JR-070RL
72	R5	RES, 0 ohm, 5%, 0.25W, 1206	Yageo America	RC1206JR-070RL
73	R6	RES, 0 ohm, 5%, 0.25W, 1206	Yageo America	RC1206JR-070RL
74	RB1S	RES, 10.0 ohm, 0.1%, 0.1W, 0805	Bourns	CRT0805-BY-10R0ELF
75	RB2S	RES, 10.0 ohm, 0.1%, 0.1W, 0805	Bourns	CRT0805-BY-10R0ELF
76	RFS	RES, 0.1 ohm, 5%, 0.125W, 0805	Panasonic	ERJ-6RSJR10V
77	RSCL	RES, 1.0k ohm, 5%, 0.1W, 0603	Vishay-Dale	CRCW06031K00JNEA
78	RSDA	RES, 1.0k ohm, 5%, 0.1W, 0603	Vishay-Dale	CRCW06031K00JNEA
79	SH-BD	Shunt, 100mil, Gold plated, Black	3M	969102-0000-DA
80	SH-EN	Shunt, 100mil, Gold plated, Black	3M	969102-0000-DA
81	SH-FD	Shunt, 100mil, Gold plated, Black	3M	969102-0000-DA
82	SH-LCM1	Shunt, 100mil, Gold plated, Black	3M	969102-0000-DA
83	SH-LCM2	Shunt, 100mil, Gold plated, Black	3M	969102-0000-DA
84	SH-PWM	Shunt, 100mil, Gold plated, Black	3M	969102-0000-DA
85	SH-STROBE	Shunt, 100mil, Gold plated, Black	3M	969102-0000-DA
86	SH-TX	Shunt, 100mil, Gold plated, Black	3M	969102-0000-DA
87	SH-VIO	Shunt, 100mil, Gold plated, Black	3M	969102-0000-DA
88	U1	LED Driver, YFQ0030ACAC	Texas Instruments	LM3632A
89	VIN	Test Point, TH, Compact, Red	Keystone	5005
90	VINBL	BANANA JACK, 15A, Insulated, Nylon,Yellow	Emerson Network Power	108-0907-001
91	VINF	Standard Banana Jack, Insulated, Red	Keystone	6091
92	VINLCM	Standard Banana Jack, Insulated, Red	Keystone	6091

5 USB Interface Board and I²C-Compatible Interface Program

Texas Instruments has created an I²C-compatible program and USB docking board that helps exercise the part in a simple way. This section describes how to use the USB docking board and interface software.

The LM3632EVM has the means to “plug into” the USB docking board. The USB docking board provides all the control signals for the simple interface. Power to the part must be provided externally. A USB cable (provided) must be connected to the board from a PC.

The I²C-compatible interface program provides all of the control that the LM3632A device requires. For proper operation, the USB docking board should be plugged into the PC before the interface program is opened. Once connected, and the program is executed, a basic interface window will open. Figure 10 shows the default settings.

All GUI user activities result in immediate action. The only exception is the Enable Register 0x0A; in order to update the register contents to the displayed settings, the “WRITE” button needs to be selected. This is done in order to allow the user to turn on/off both the backlight and flash blocks simultaneously.

The GUI is configured in register blocks. Please refer to the LM3632A datasheet (SNVSA63) Register Maps section for register configuration details.

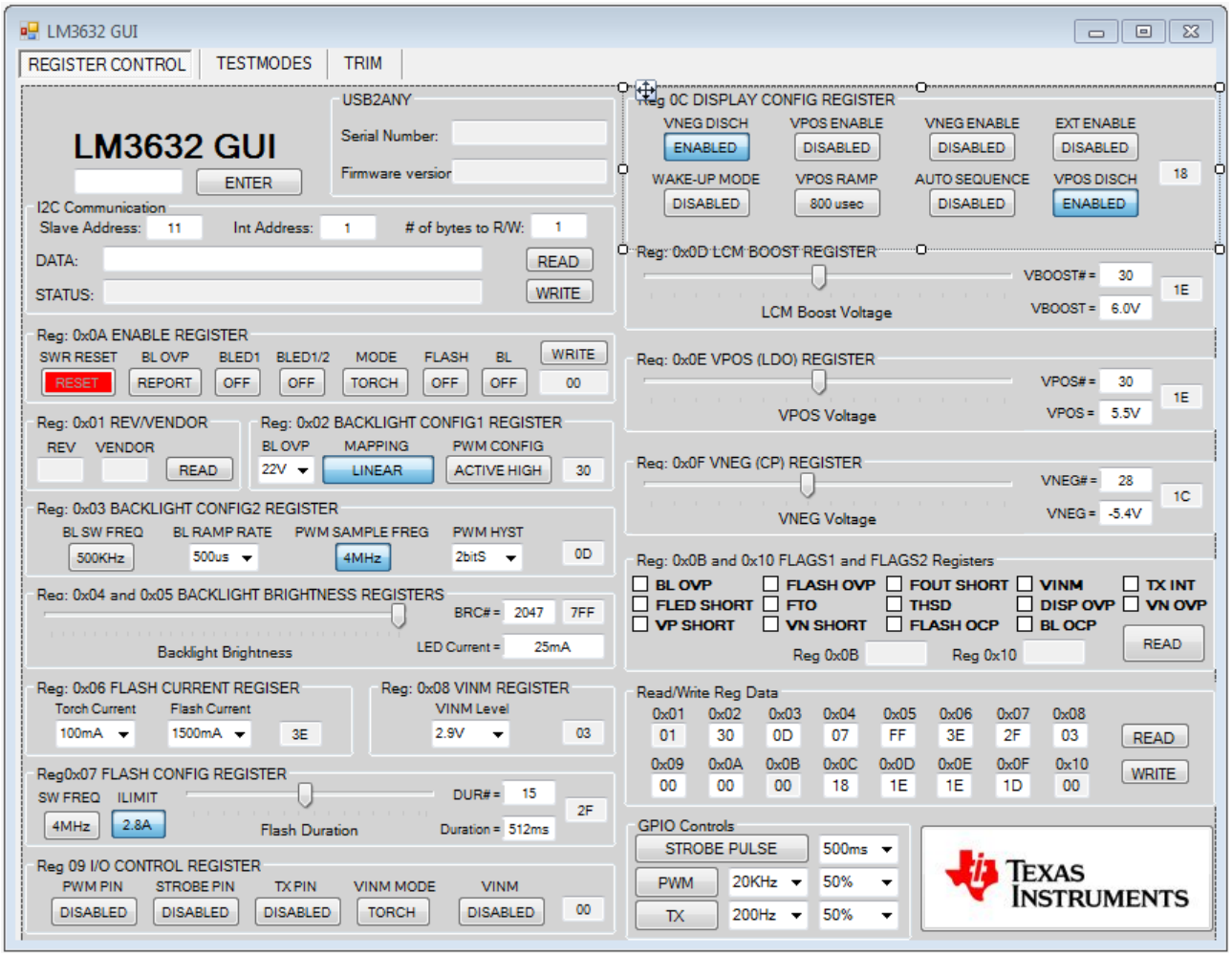

Figure 10. LM3632A General User Interface

5.1 Establishing I²C Communication

1. Verify that the Firmware version on the upper left side of the GUI shows 2.6.5.3, and a serial number is displayed. If not, plug and unplug the USB cable on the USB2ANY box.
2. Perform a “Read” of register 0x01. The return values should be VENDOR = 01 and REV = 02. If it returns nothing it means communication is not established properly. Vary the VIO supply voltage until the proper values are read.
3. Once I²C communication has been established, select boxes “BLED1” or “BLED1/2” and “BL” (they should display “ON”) and then select “WRITE” on “Reg. 0x0A ENABLE REGISTER”. The field STATUS on the top left of the GUI should say “No error” or “Success” if the write command was properly received and the backlight LEDs should glow. **Note**: The default backlight OVP setting for the LM3632A is 22 V, so under default conditions the backlight boost circuit will operate in OVP mode, and the light will be dim. Refer to Section 5.4 section for details.
4. If the backlight LEDs don’t glow, and there are no error messages in the “STATUS” window, close the GUI, recycle power to the LM3632A, unplug, then plug the USB2ANY cable from the USB2ANY box and try again.

5.2 I²C Communication Block

The GUI provides fields that allow for general I²C interaction. Simply populate the fields with the desired internal register address and data (for write operation) and perform a read or write action. The general I²C communication interface allows for burst “write” and “read” operations. As an example, populating the internal address field with “03”, the “# of bytes to “READ/WRITE” field with “5” and the “DATA” field with “02 a5 80 13 2f”, then selecting “WRITE” would attempt to write data “0x02” to register 0x03, data 0xa5 to register 0x04, data 0x80 to register 0x05, data 0x13 to register 0x06 and data 0x0f to register 0x07. Field “STATUS” displays communication error messages.

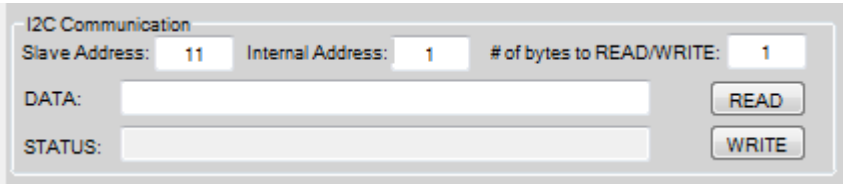

Figure 11. I²C Communication Fields

5.3 SWR RESET Button

Selecting the “RESET” button in register 0x0A sets bit[7] of register 0x0A to “1” which causes the LM3632A to configure all registers to their default values. The GUI fields are updated to reflect the register contents. Upon completion of its register updates, the LM3632A resets bit[7] to “0” (no further action by the user is required).

5.4 Backlight Operation

1. Configure the number of backlight LEDs for both strings as desired (refer to Section 2.1)
2. Select the desired BL OVP voltage level in register 0x02, based on the number of LEDs used.
3. Turn on one or both backlight strings by selecting box “BLED1” or “BLED1/2” and box “BL”, then selecting “WRITE” in register 0x0A.

5.5 Flash/Torch Operation

1. I²C Mode: Select TORCH or FLASH mode by selecting field “MODE” accordingly, select field “FLASH” then select “WRITE” in register 0x0A.
2. STROBE Mode: Enable STROBE in register 0x09, follow instructions in step 1, then provide a voltage pulse on the STROBE pin.

5.6 VPOS/VNEG Operation

1. I²C Mode: VPOS & VNEG can be enabled in I²C mode by the corresponding field in register 0x0C. Field “EXT ENABLE” must be disabled in order to turn VPOS and/or VNEG on in I²C mode.
2. External Node: Enable “EXT ENABLE” in register 0x0C, then pull pins LCMEN1 and LCMEN2 high to enable VPOS and VNEG, respectively.

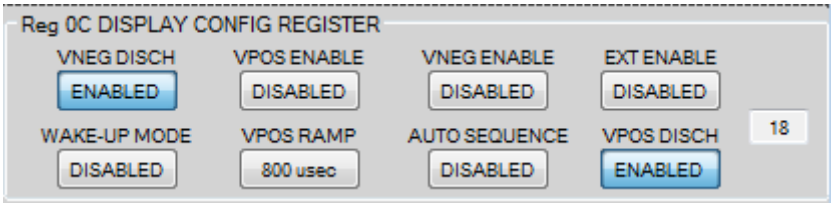

Figure 12. Display Bias Configuration Register Fields

5.7 Flag Registers

Registers 0x0B and 0x10 (right side of GUI) contain the fault and flag bits of the LM3632A. Some bits are report only while others are fault bits (see LM3632A datasheet (SNVSA63) for fault/flag definitions and options). Faults inhibit subsequent enabling of the affected block, while flags do not. Select “READ” to read the fault/flag status of both registers and clear the registers.

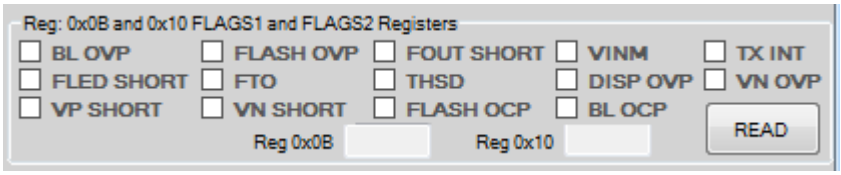

Figure 13. Flags Read Register

5.8 General Register Read/Write

The LM3632EVM GUI includes a block that allows for a quick register “read” or “write” action. Selecting the “READ” button performs a read of all registers and updates the corresponding fields of the GUI. Populating the register fields with the desired data and performing a “WRITE” writes the data to all registers and updates the corresponding GUI fields.

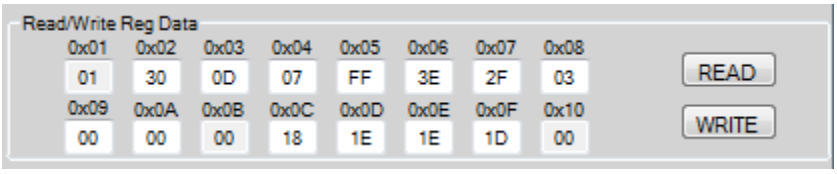

Figure 14. General Register Fields

5.9 GPIO Controls

The LM3632EVM provides the user with the capability to control the STROBE, PWM and TX inputs of the LM3632A without the need of an external supply. In order for the signals to be applied to the corresponding LM3632A input pin(s) the appropriate jumpers need to be placed (see Section 2.1 for STROBE, PWM, and TX jumper placement).

To force a pulse on the STROBE pin the user can select a pulse width from the dropdown menu then select the “STROBE PULSE” button. Selecting “ON” or “OFF” on the dropdown menu sets the STROBE pin high or low, respectively.

The user can choose among a few frequencies and duty cycle increment combinations of continuous pulses for the backlight PWM and flash TX input pins. A duty cycle of 0% sets the voltage(s) low and a duty cycle of 100% sets the voltage(s) high.

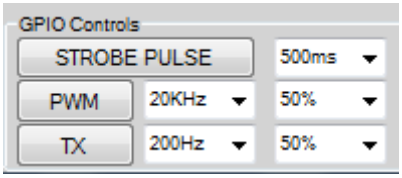

Figure 15. GPIO Controls

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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.*
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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

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