

Using the LM3565 Evaluation Module

User's Guide



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LM3565EVM User's Guide

1 Introduction

The Texas Instrument LM3565EVM evaluation module (EVM) helps designers evaluate the operation and performance of the LM3565 4MHz High-Current LED driver. The device offers configurability via I²C-compatible interface. It can be enabled in Flash or Torch mode via the I²C interface or externally using the Strobe and Torch pins. The module utilizes two LEDs (D1 & D2) mounted on the EVM.

The EVM contains one Synchronous Boost LED Flash Driver (See [Table 1](#)).

Table 1. Device and Package Configurations

FLASH LED DRIVER	IC	PACKAGE
U1	LM3565	YZR0016AAA

2 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, set up and use the LM3565EVM.

2.1 Input/Output Connector Description

Input / GND - These are the power input terminals for the driver. The terminal block provides a power (VIN) and ground (GND) connection to allow the user to attach the EVM to a cable harness.

HWEN - This is the jumper used to enable the LED driver. The driver will be enabled when the HWEN pin is high (VIO) and disabled when it is low (GND). An RC filter is connected between the HWEN pin and the Enable pin of the device. This is to allow the input voltage of the driver to rise before the voltage on the Enable pin rises, upon initial power-up of the driver.



Figure 1. Enable Jumper Settings

VIO - This pin provides power for the I²C lines (Clock & 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 3.3V line provided by the USB interface connector. In this configuration, communication via the I²C interface may not be possible if the supply voltage to the LED driver is below approximately 3V.

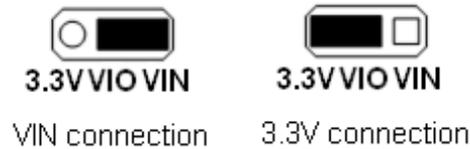


Figure 2. VIO Jumper Settings

J5 - LEDs - is the jumper used to connect the on-board flash LEDs to the LED output of the driver.

STROBE - This pin provides an external method for initiating a flash or torch event. The STROBE pin is connected to ground via a 300 K Ω resistor internal to the LM3565. 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 PWM0. Pin PWM0 can be configured as ON, OFF, time-adjustable voltage pulse or continuous voltage pulses of adjustable frequency and duty cycle via the General User Interface software provided.



Figure 3. STROBE Jumper Settings

TORCH - This pin provides an external method for initiating a torch event without having to write the command through the I²C-compatible interface. The TORCH pin is connected to ground via a 300 K Ω resistor internal to the LM3565. To externally drive this pin, either connect a control signal directly to the TORCH pin of the connector or place a jumper between connector pins TORCH and PWM1. Pin PWM1 can be configured as ON, OFF, time-adjustable voltage pulse or continuous voltage pulses of adjustable frequency and duty cycle via the General User Interface software provided.

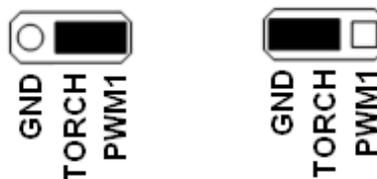


Figure 4. TORCH Jumper Settings

TX - This pin is used to initiate a TX-interrupt event. The TX pin is connected to ground via a 300 K Ω resistor internal to the LM3565. 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. Pin PWM2 can be configured as ON, OFF, time-adjustable voltage pulse or continuous voltage pulses of adjustable frequency and duty cycle via the General User Interface software provided.

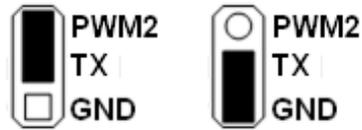


Figure 5. TX Jumper Settings

SDA / SCL - These connections allow the user to externally control the I²C lines. For independent control of the I²C lines, do not connect the VIO jumper to either the 3.3V or the VIN pin.

VOUT / VLED - These provide access to the regulated output of the driver and the output of the LED current source. The user can measure VOUT with reference to GND, VLED with reference to GND and current source headroom directly between VOUT and VLED.

2.2 Setup

The input voltage range for the flash driver is 2.7 volts to 5.5 volts. The on-board LEDs or an LED module should be connected for proper operation.

2.3 Operation

For proper operation of the LM3565, the jumpers should be properly configured. The recommended setting, using shorting blocks.

VIO to VIN

HWEN to VIO

STROBE to PWM0 or external signal

TORCH to PWM1 or external signal

TX to PWM2 or external signal

LEDs (J5) shorted

In this configuration, the device will power up when power is applied.

3 Board Layout

[Figure 6](#), [Figure 7](#), [Figure 8](#), [Figure 9](#), [Figure 10](#) and [Figure 11](#) show the board layout for the LM3565EVM. The EVM offers resistors, capacitors and jumpers to Enable the device and to configure it as desired.

The LM3565 will dissipate power, especially during high current and long duration flash events. Power will also be dissipated on the flash 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.

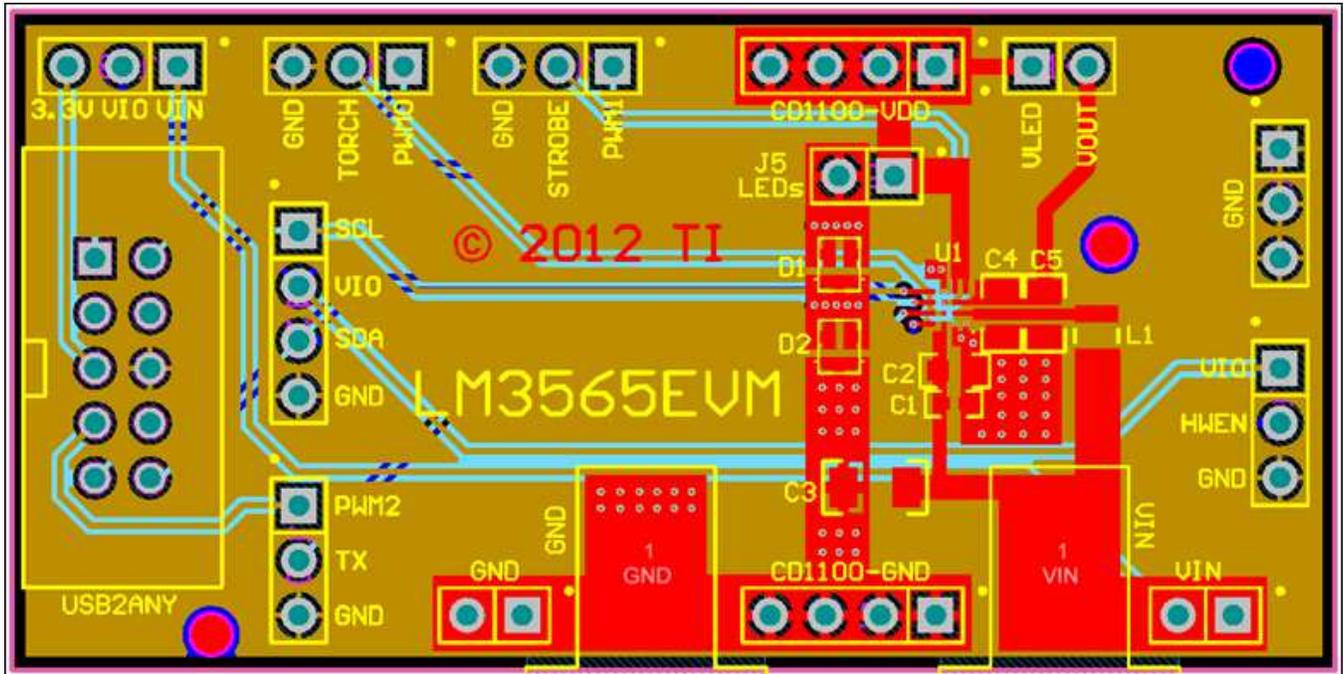


Figure 6. Top Assembly Layer

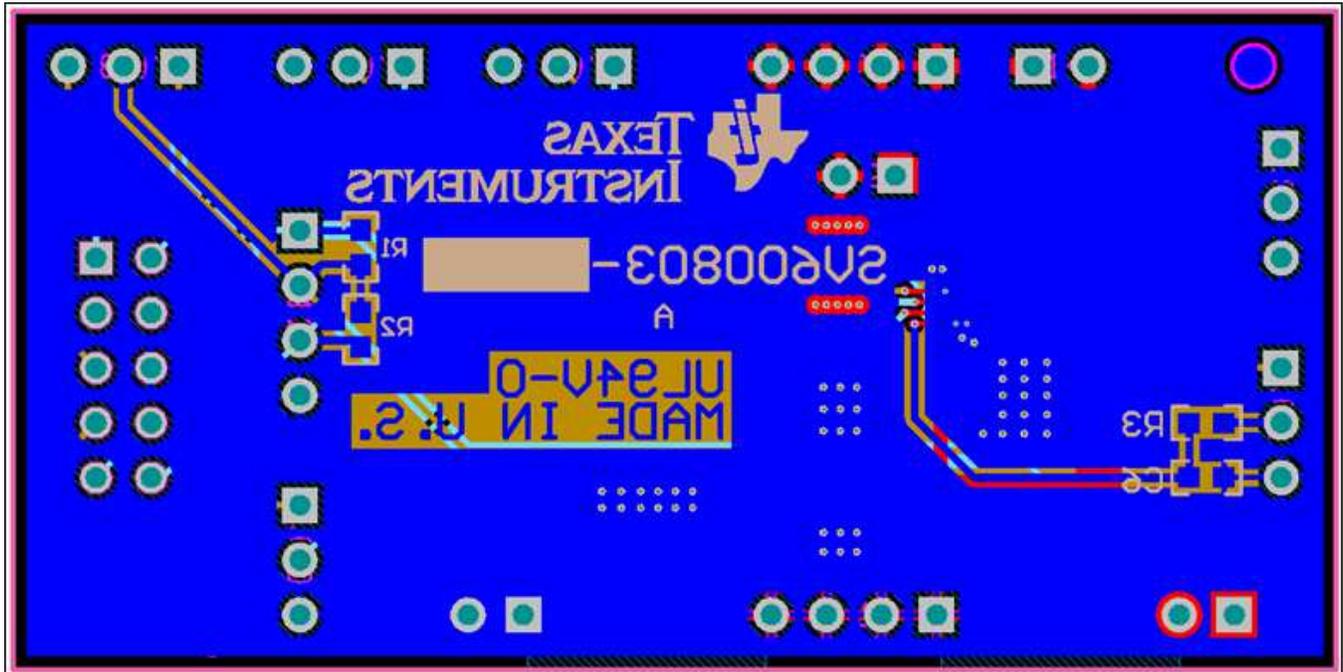


Figure 7. Bottom Assembly Layer

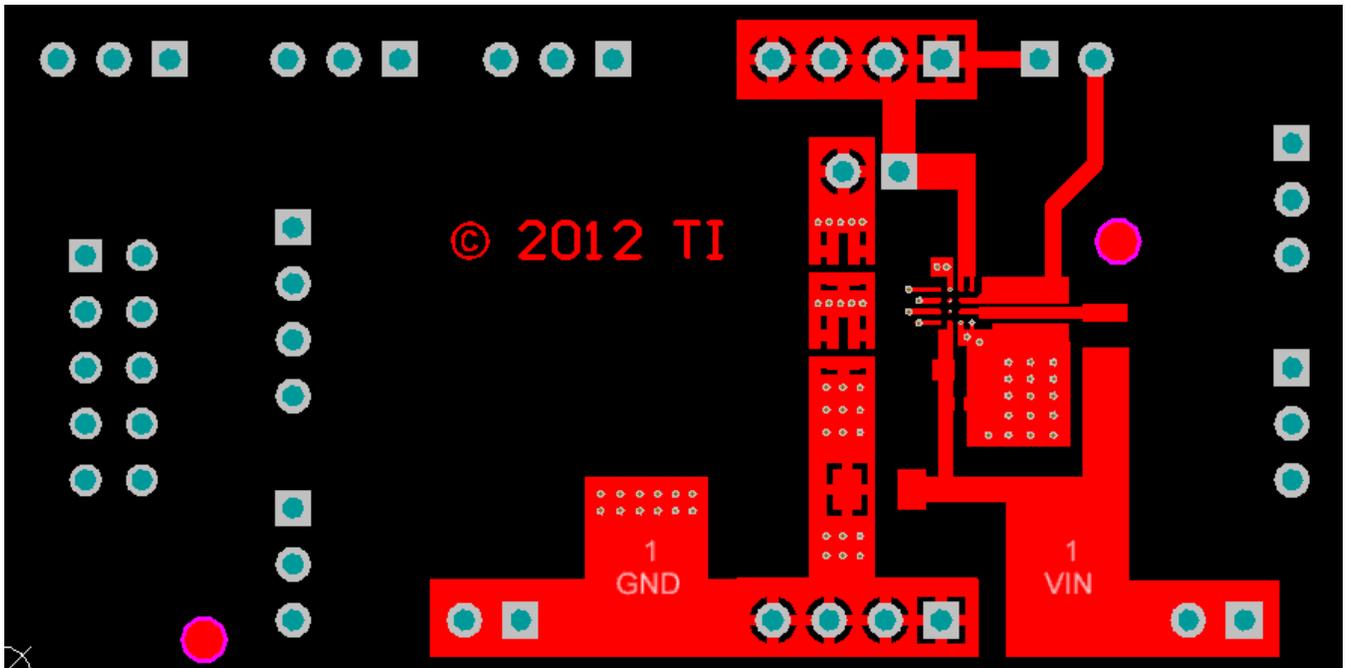


Figure 8. Top Layer Routing

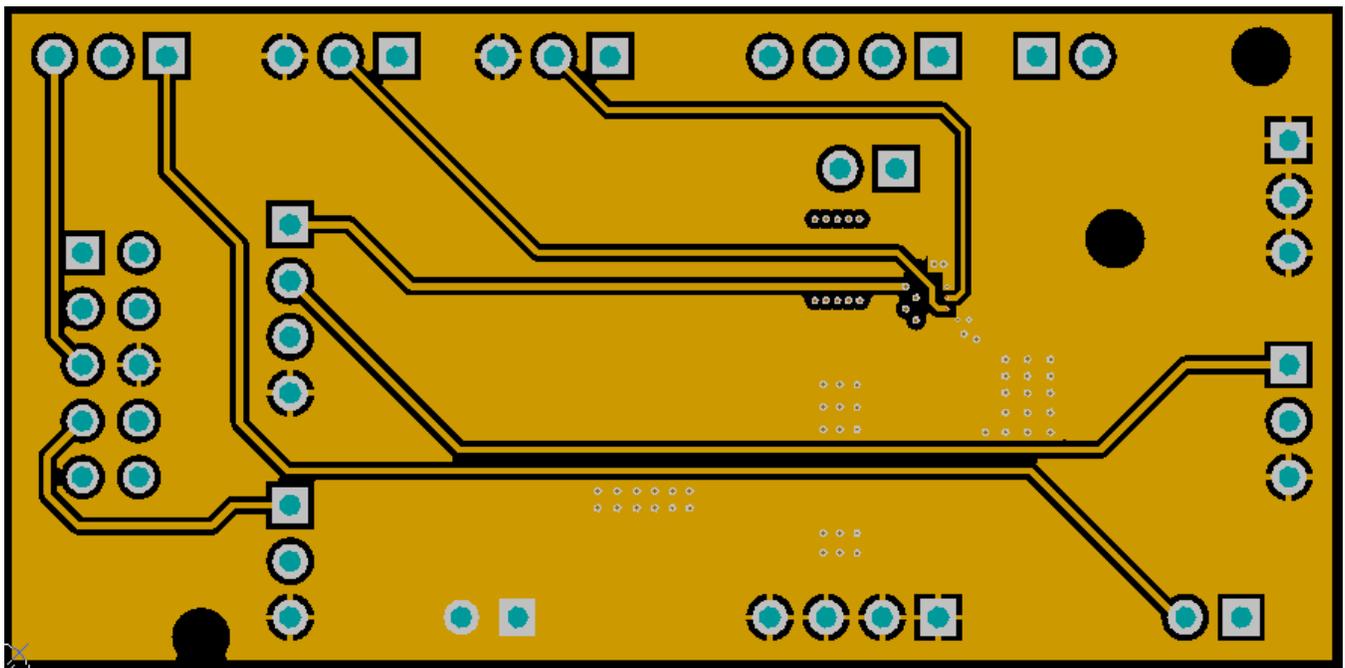


Figure 9. Middle Layer 1 Routing

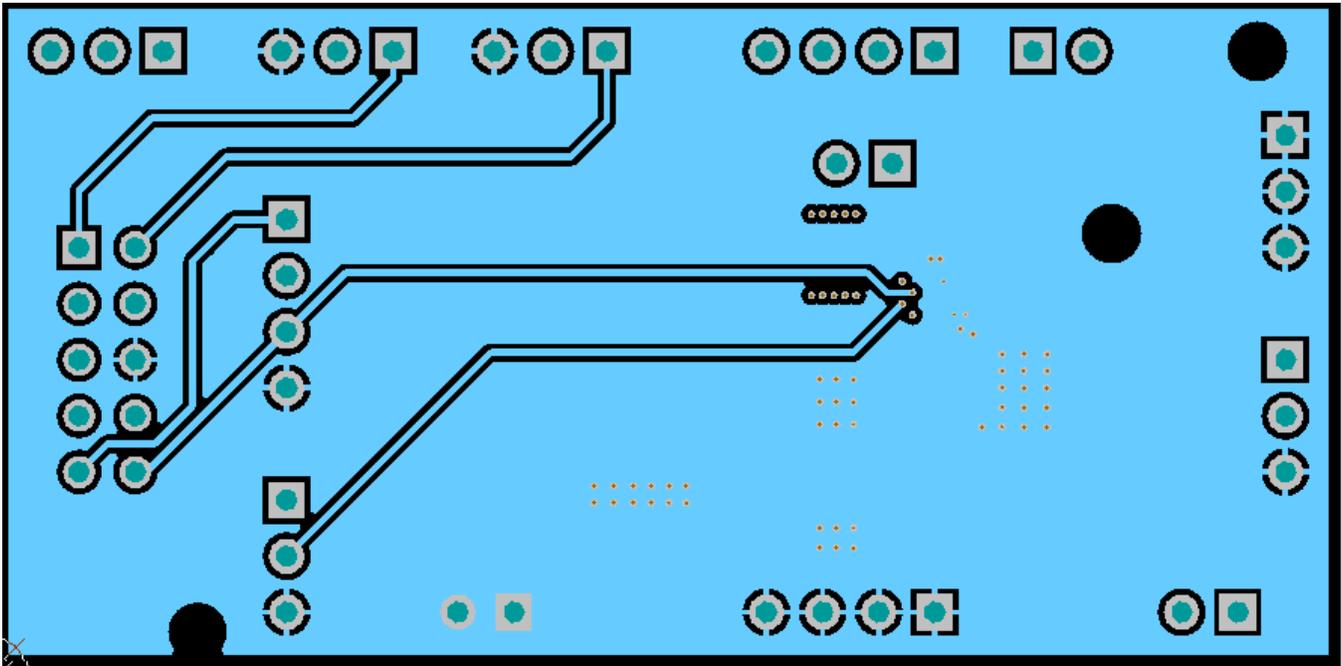


Figure 10. Middle Layer 2 Routing

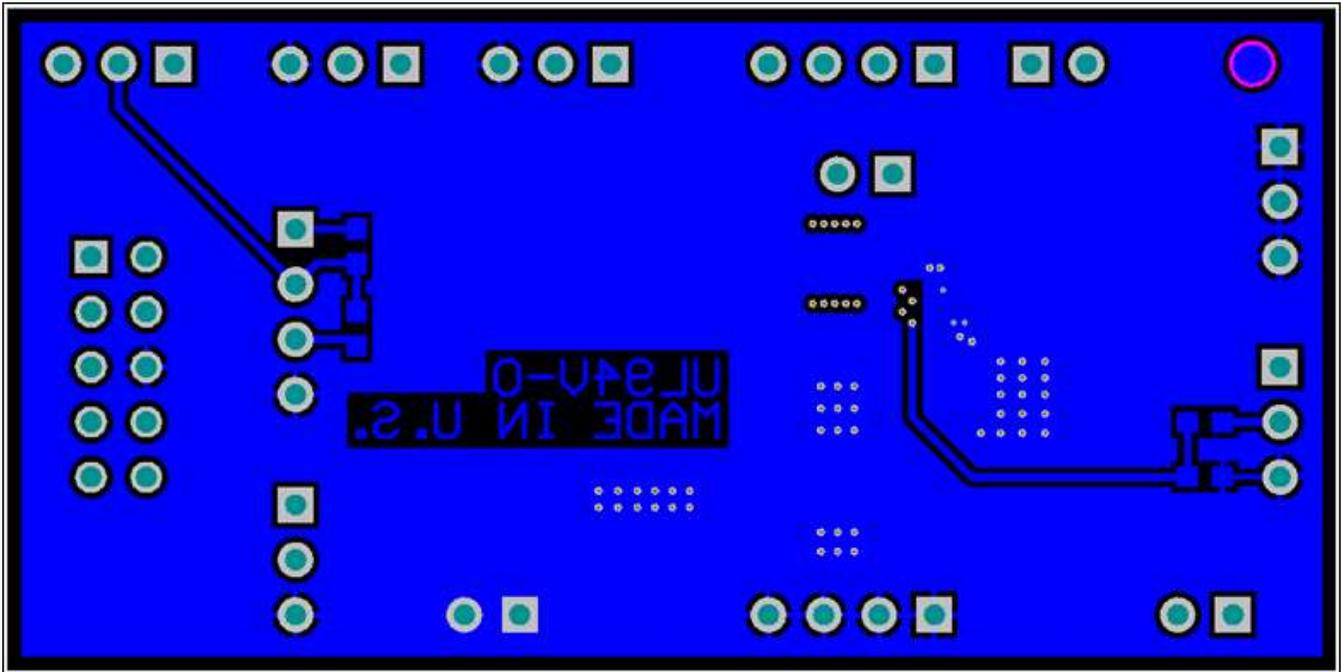


Figure 11. Bottom Layer Routing

4 Schematic

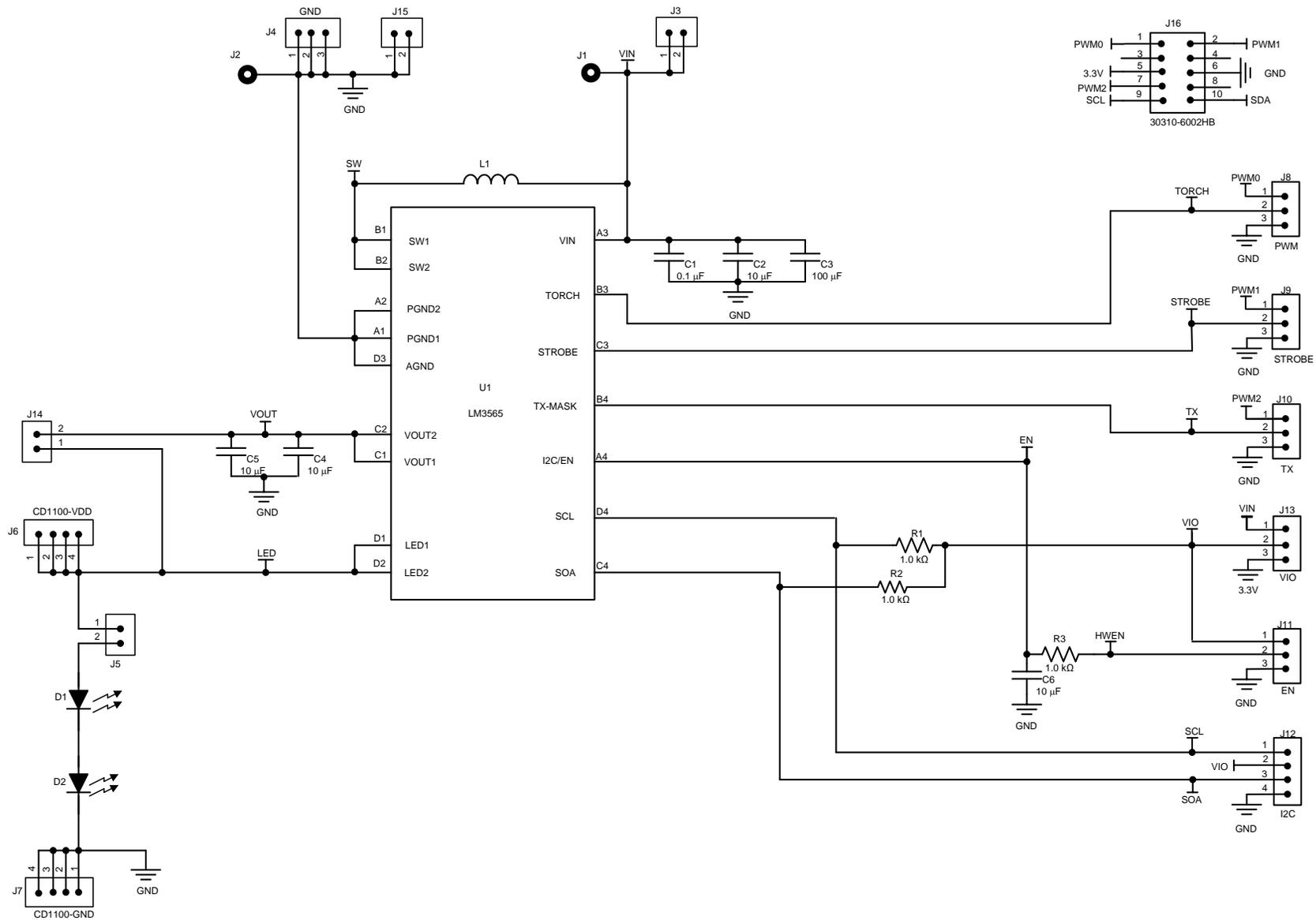


Figure 12. LM3565EVM Schematic

Table 2. Bill of Materials

Item	Designator	Description	Manufacturer	Part Number	Quantity
1	AA1	Printed Circuit Board	TBD by TI	551600803-001 REV A	1
2	C1	CAP, CERM, 0.1 μ F, 16V, X7R 10%, 0402	Murata	GRM155R71C104KA88D	1
3	C2	CAP, CERM, 10 μ F, 6.3V, X5R 20%, 0603	Murata Electronics	GRM188R60J106ME47D	1
4	C3	CAP, CERM, 100 μ F, 6.3V, \pm 20%, X5R, 1206	Murata	GRM31CR60J107ME39L	1
5	C4	CAP, CERM, 10 μ F, 16V, X5R 10%, 0805	Murata	GRM155R60J106ME44D	1
6	C5	CAP, CERM, 10 μ F, 16V, X5R 10%, 0805	Murata	GRM155R60J106ME44D	1
7	C6	CAP, CERM, 10 μ F, 6.3V, \pm 20%, X5R, 0603	TDK	C1608X5R0J106M	1
8	D1	LED, White SMT	Philips Lumileds	LXCL-EYW4	1
9	D2	LED, White SMT	Philips Lumileds	LXCL-EYW4	1
10	FID1	Fiducial mark. There is nothing to buy or mount.	N/A	N/A	1
11	FID2	Fiducial mark. There is nothing to buy or mount.	N/A	N/A	1
12	FID3	Fiducial mark. There is nothing to buy or mount.	N/A	N/A	1
13	J1	Standard Banana Jack, Insulated, Red	Keystone	6091	1
14	J2	Standard Banana Jack, Insulated, Black	Keystone	6092	1
15	J3	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S	1
16	J4	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-103-07-G-S	1
17	J5	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S	1
18	J6	Header, TH, 100mil, 4x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-104-07-G-S	1
19	J7	Header, TH, 100mil, 4x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-104-07-G-S	1
20	J8	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-103-07-G-S	1
21	J9	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-103-07-G-S	1
22	J10	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-103-07-G-S	1
23	J11	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-103-07-G-S	1
24	J12	Header, TH, 100mil, 4x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-104-07-G-S	1
25	J13	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-103-07-G-S	1
26	J14	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S	1

Table 2. Bill of Materials (continued)

Item	Designator	Description	Manufacturer	Part Number	Quantity
27	J15	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S	1
28	J16	CONN HEADER 10POS DL STR GOLD	3M	30310-6002HB	1
29	L1	Inductor, Metal Alloy, 1.0 μ H, 3A, 0.059 Ω , SMT	TOKO	252012C	1
30	R1	RES, 1.0 k Ω , 5%, 0.1W, 0603	Vishay-Dale	CRCW06031K00JNEA	1
31	R2	RES, 1.0 k Ω , 5%, 0.1W, 0603	Vishay-Dale	CRCW06031K00JNEA	1
32	R3	RES, 1.0 k Ω , 5%, 0.1W, 0603	Vishay-Dale	CRCW06031K00JNEA	1
33	U1	LM3565	Texas Instruments	LM3565	1

5 USB Interface Board and I²C-Compatible Interface Program

Texas Instruments has created an I²C-compatible program and USB docking board that can help exercise the part in a simple way. Contained in this document is a description of how to use the USB docking board and interface software.

The LM3565EVM 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 LM3565 part 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.

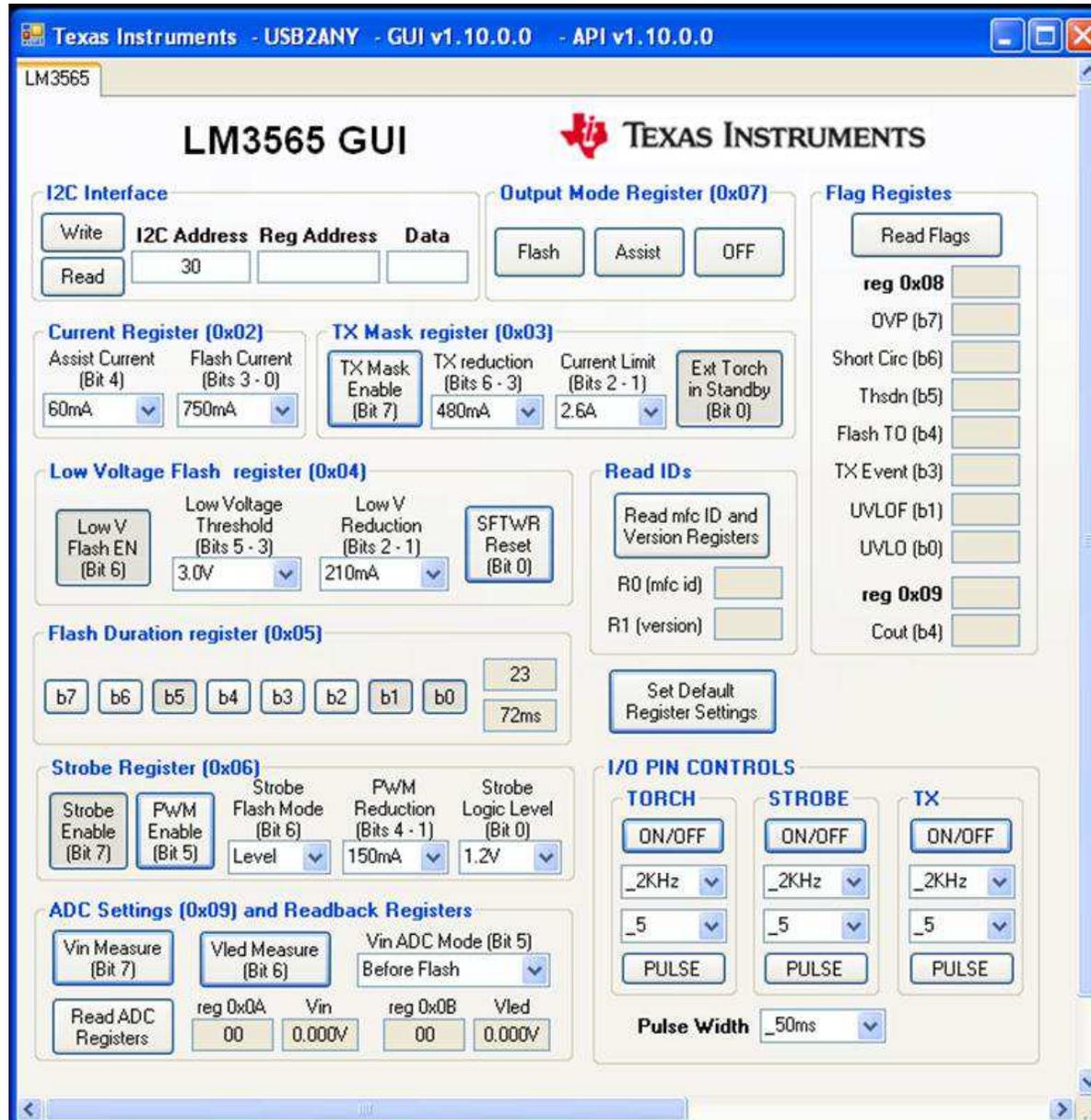


Figure 13. LM3565 General User Interface

The above image shows the default settings. “Strobe Enable” (bit7 in register 0x06) is set, so only STROBE operations are allowed in the default settings. The “Simple I²C Interface” fields may be used to write or read any LM3565 register.



Figure 14. Simple I²C interface Fields

5.1 Current Set Register (0x02)

Use the dropdown menus to select the desirable flash current and torch current.

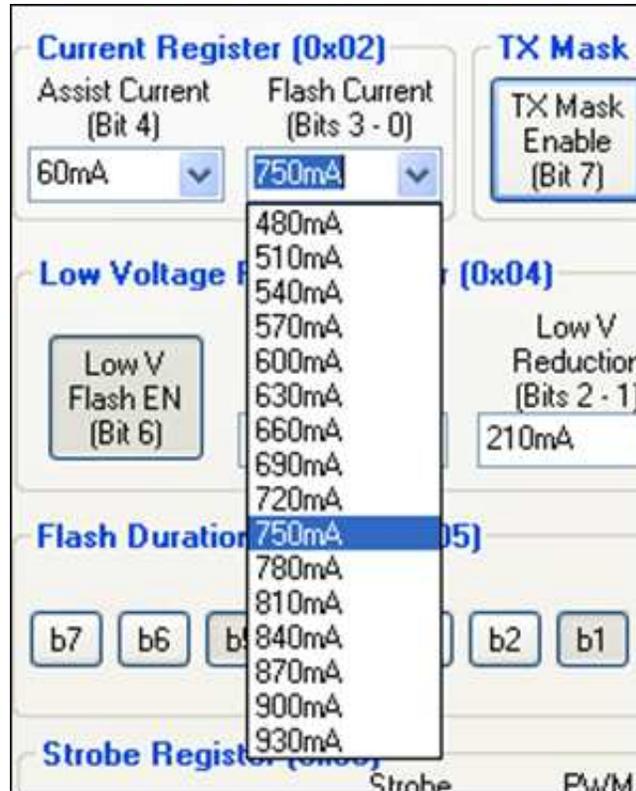


Figure 15. Current Set Register

5.2 TX Mask Register (0x02)

If the “TX Mask Enable” bit is set, the programmed flash current will be reduced by the amount selected in the “TX reduction” drop-down menu, if the voltage on the TX pin is logic high.

Use the “Current limit” drop-down menu to select among the 4 available current limit settings.

If the “Ext Torch” bit is set (default), the Torch pin can be used to turn on the part in torch mode by setting it to logic high. I²C assist mode can be entered with this bit set to either “0” or “1”.

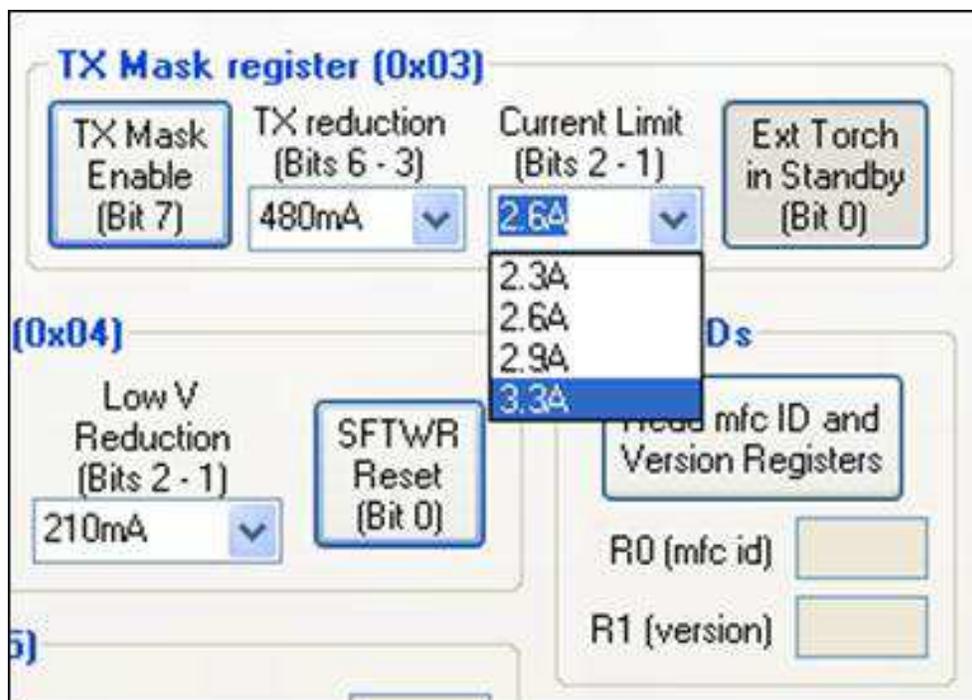


Figure 16. TX Mask Register

5.3 Low-Voltage Register (0x03)

If the “Low V Flash Enable” bit is set, the programmed LED current will be reduced by the amount selected in the “Flash reduction” dropdown menu, if the battery voltage drops below the threshold selected in the “Low V Threshold” menu.

The “Sftwr Reset” bit can be used to reset all LM3565 registers to their default values. Note that you need to deselect the button for normal operation to resume (bit does not auto-clear).

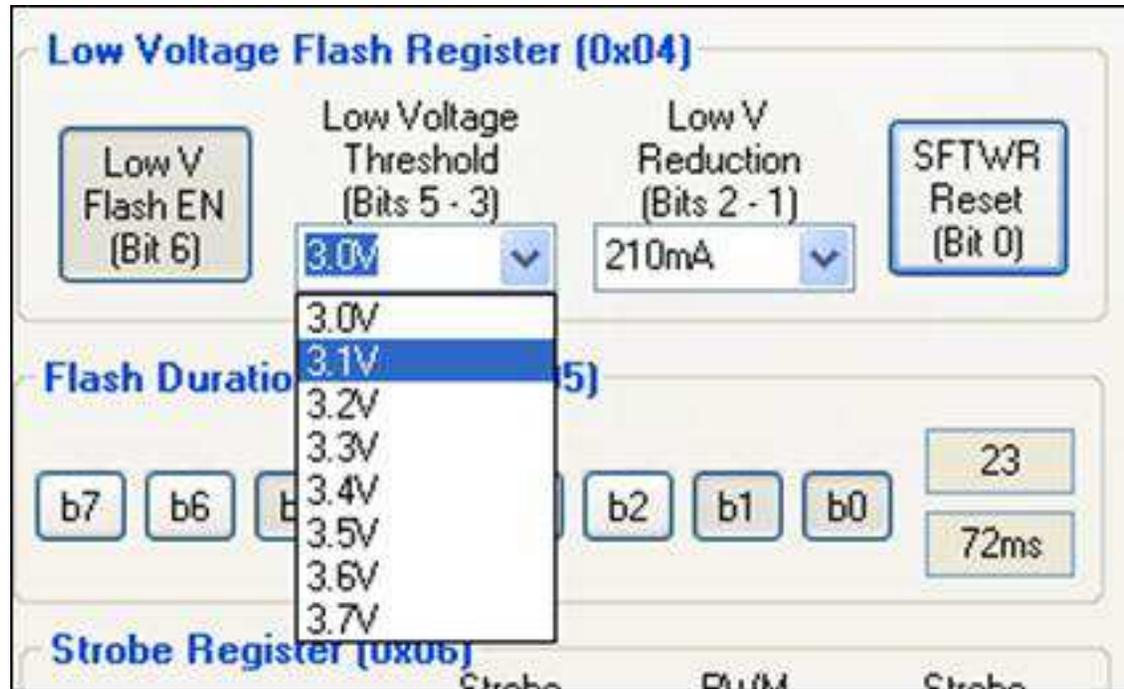


Figure 17. Low-Voltage Register

5.4 Flash Duration Register (0x04)

This register sets the LM3565's flash duration. The register value and the corresponding time setting are displayed.

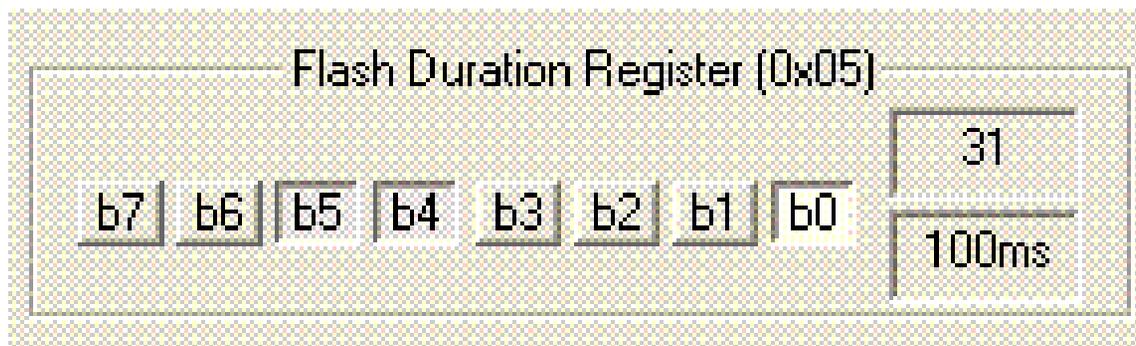


Figure 18. Flash Duration Register

5.5 Strobe Register (0x05)

If “Strobe Enable” is selected, only STROBE operations are allowed. Deselect this button to turn the part on/off using only I²C commands.

If the “PWM Enable” bit is set, the programmed flash current will be reduced by the amount selected in the “PWM reduction” dropdown menu, when the voltage on the STROBE pin is logic low. The full programmed value is resumed when STROBE is high.

Strobe mode can be set to Level (default) or Edge.

“Strobe Logic Level” sets the STROBE pin input logic threshold to either 1.2V or 1.8V.

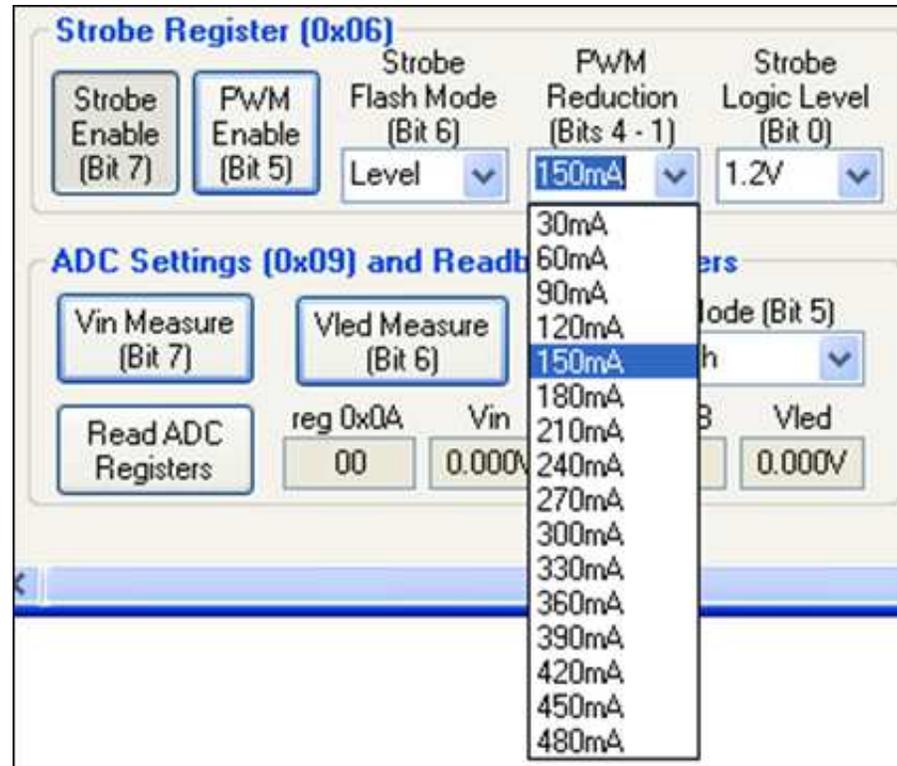


Figure 19. Strobe Register

5.6 Output Mode Register (0x07)

Use these buttons to enable the LM3565 in Flash, Assist or Memory Interface mode. The mode buttons can also be used to independently select modes and enable the part. Use the OFF button to clear the register.

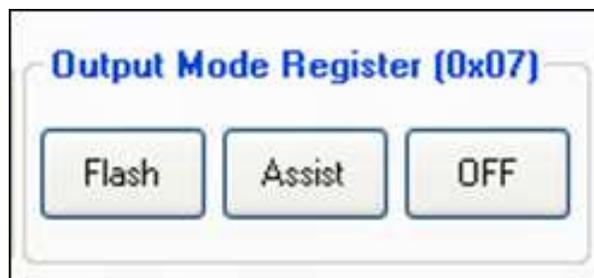


Figure 20. Output Mode Register

5.7 Fault Register (0x08)

The contents of the LM3565 fault register are read upon clicking the “Read Flags” button. The register is cleared upon read back.



Figure 21. Fault Register

5.8 ADC Register

The LM3565 ADC will read and store battery voltage and LED voltage information during a flash or assist event, if the “Vin measure” and “Vled measure” buttons are selected, respectively. The contents of these readings are stored in registers 0x0A and 0x0B. Click on “Read ADC” button to display the readings.

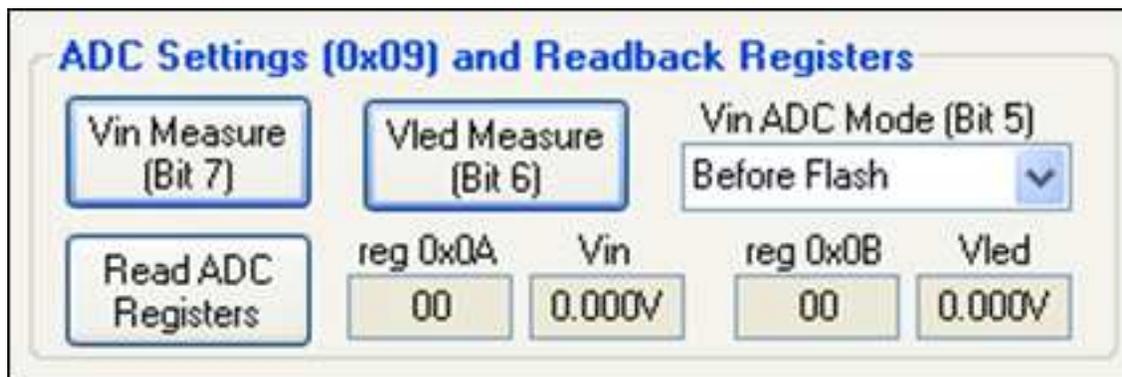


Figure 22. ADC Registers

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Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

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Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

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As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

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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Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
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.

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