AN-2252 LM3561 Evaluation Kit

1 Introduction

The LM3561 is a 2-MHz fixed-frequency current-mode synchronous boost converter. The device is designed to operate as a single 600-mA constant current driver for high-current white LEDs. The high-side current source allows for grounded cathode LED operation while the 250-mV regulated headroom voltage ensures that the LED current is well regulated and efficiency remains high.

The LM3561EVM is designed to fully evaluate the LM3561 Boost Converter + White LED Camera Flash LED driver. The board comes populated with a single Flash LED (LXCL-EYW4 from Lumileds), and an indicator LED (LEDI). For each input/output of the LM3561 there is a dedicated header pin for testing purposes. The LM3561EVM is included with a USB2ANY Module which interfaces the LM3561EVM with the downloadable Graphical User Interface (LM3561.exe GUI) available at (www.ti.com).

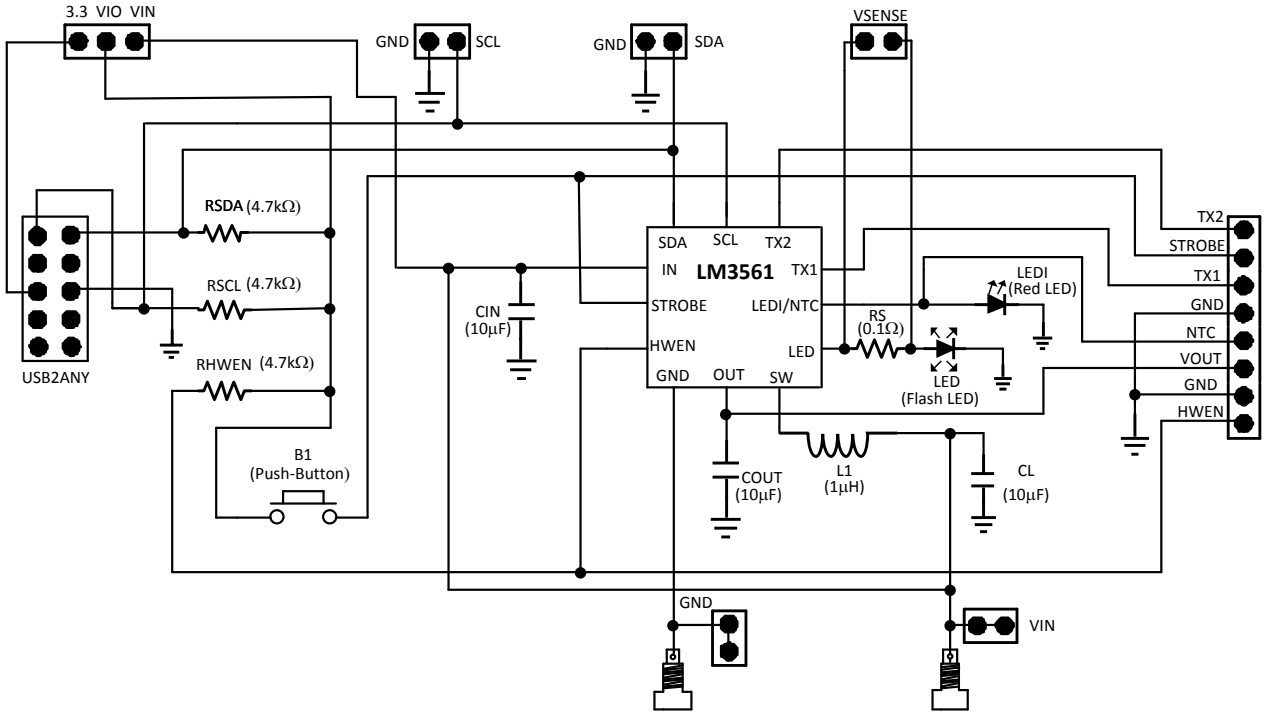

Figure 1. LM3561 Evaluation Board Schematic

2 LM3561 Evaluation Board Bill of Materials

Component Symbol	Value	Manufacturer	Part #	Size
LM3561	LED Driver	TI	LM3561	(0.4 mm × 1.215 mm × 1.615 mm)
L1	1 µH, I_{DC_MAX} = 2.15A, R_L = 80mΩ	TOKO	MDT2012-CR1R0N	(2 mm x 1.25 mm x 0.9 mm)
CIN	10 µF, 6.3V	TDK	C1005X5R0J106M	0402 (1mm x 0.5 mm x 0.5 mm)
COUT	10 µF, 6.3V	TDK	C1005X5R0J106M	0402
CL	10 µF, 6.3V	TDK	C1608X5R1A106M	0603 (1.6 mm x 0.8 mm x 0.8 mm)
RHWEN	4.7 kΩ	Vishay-Dale	CRCW04024K70JNED	0603
RSDA	4.7 kΩ	Vishay-Dale	CRCW04024K70JNED	0603
RSCL	4.7 kΩ	Vishay-Dale	CRCW04024K70JNED	0603
RS	0.1Ω	Panasonic	ERJ-L03KF10CV	0603
LED	Flash LED	Lumileds	LXCL-EYW4	
LEDI	Red Indicator LED	Lite-On	LTST-C170KRKT	

3 LM3561 Evaluation Board Layout

Figure 2, Figure 3, Figure 4, and Figure 5 show the board layout for the LM3561 Evaluation Board. This represents an ultra compact design which can deliver a 600 mA flash LED current with VIN down to 2.7V.

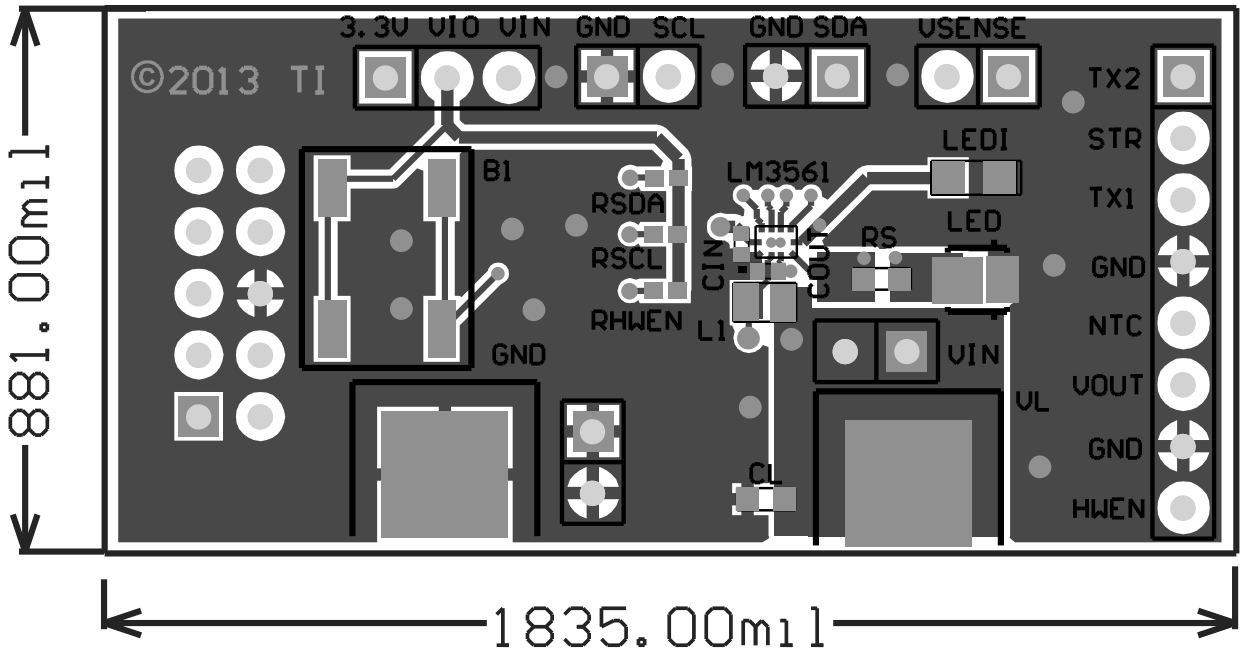

Figure 2. Top Layer

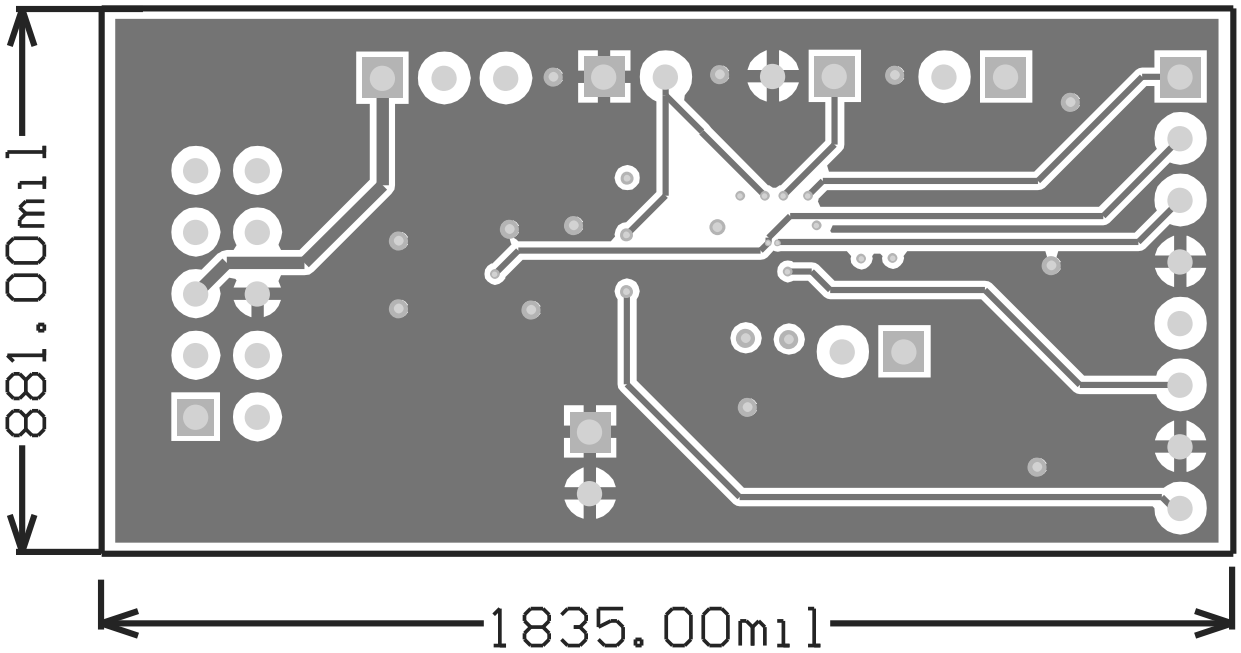

Figure 3. Mid Layer 1

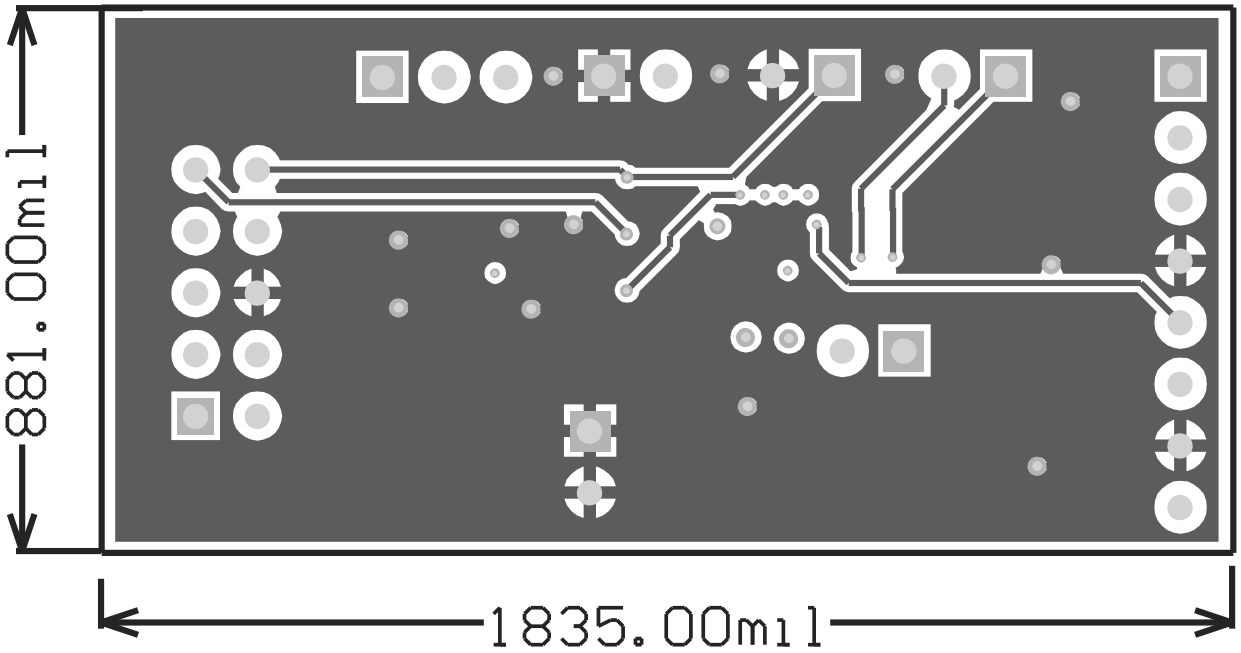

Figure 4. Mid Layer 2

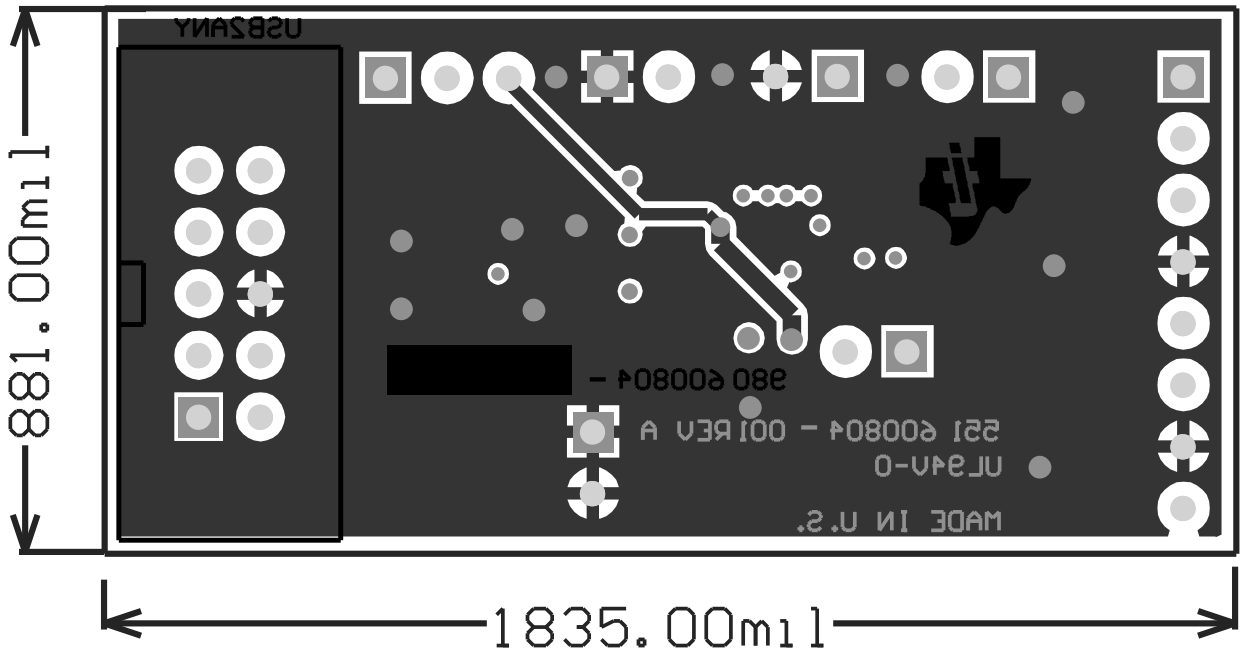

Figure 5. Bottom Layer

4 LM3561EVM Set-Up

To operate the LM3561EVM the following steps must be taken:

1. Download the LM3561 Graphical User Interface (GUI) from www.ti.com. The downloaded .zip folder consists of 2 files: the LM3561.exe and the USB2ANY.dll. The .zip file must be copied and the files extracted to a folder on a PC. Both files must reside in the same folder.
2. Ensure there is a jumper connected from VIO to VIN or from VIO to 3.3V. This is the jumper at the top left of the board. This will connect the I2C pull-ups, the HWEN pull-up, and the STROBE button (B1) to a logic voltage.
3. Connect a (2.7V to 5.5V) power supply across the red and black banana plugs. Red (+) and Black (GND).
4. Connect the USB2ANY, USB Interface module with the supplied 10-pin cable to the LM3561 evaluation board.
5. Connect the USB2ANY, USB Interface module to the PC with the LM3561.exe installed.
6. Launch the LM3561.exe

5 LM3561.exe Graphical User Interface (GUI) Instructions

The GUI for the LM3561 is designed to fully demonstrate all the features of the LM3561 Flash LED Driver. The GUI provides the interface between the PC and the Texas Instruments USB2ANY, USB Interface Module. A picture of the interface program (LM3561.exe) is shown in Figure 6. The GUI is broken up into different sections that correspond to the available registers within the LM3561. Operation of the GUI is fairly basic. When any button is pushed/un-pushed or pull-down menu is selected, the appropriate I2C command will be automatically written to the LM3561. The following section lists the register descriptions for the LM3561.

6 LM3561 GUI

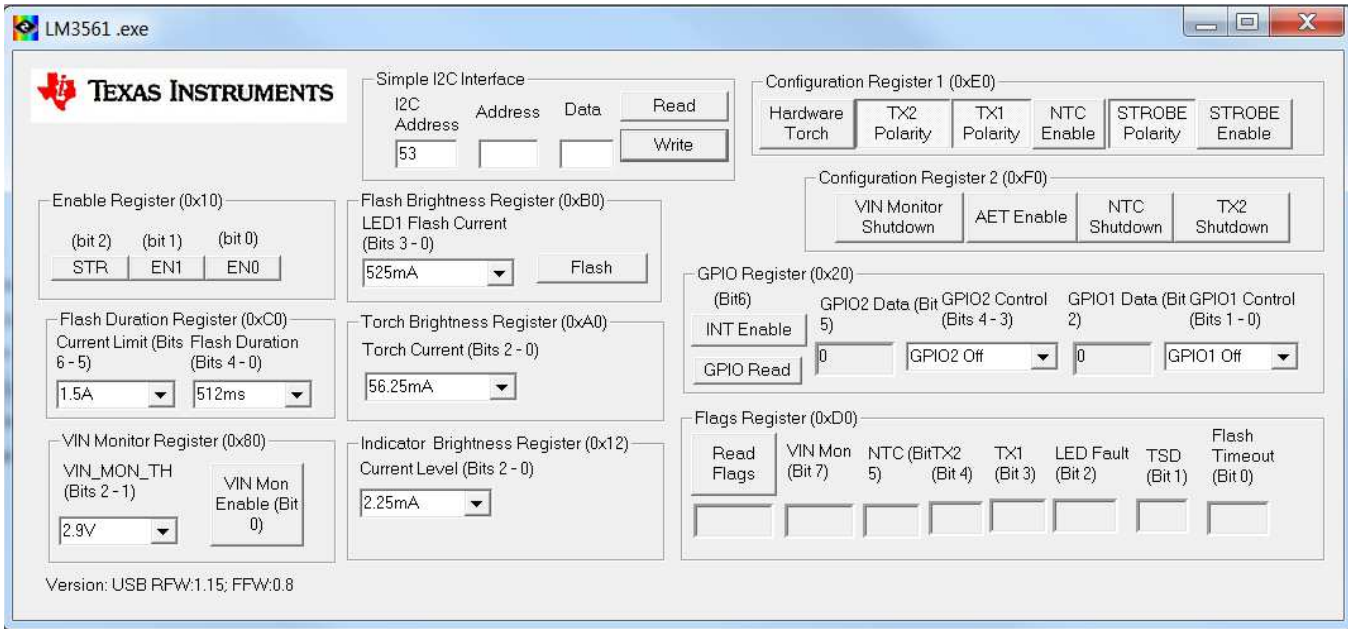

Figure 6. LM3561.exe GUI

7 LM3561 Register Descriptions

Table 1. Enable Register Bit Settings

Bits[7:3] Not Used	**Bit 2** (Strobe Level or Edge, STR bit)	**Bits [1:0]** Enable Bits
N/A	0 = STROBE Input set for Level. Flash current turns on when STROBE input is high and turns off when STROBE either goes low or the Timeout Duration expires (**default**) 1 = STROBE Input set for edge triggered. Flash current turns on when STROBE sees a rising edge. Flash pulse turns off when timeout duration expires	Enable Bits 00 = Shutdown (**default**) 01 = Indicator Mode 10 = Torch Mode 11 = Flash Mode (bits reset at timeout)

Table 2. Indicator Brightness Register Bit Settings

Bits [7:3] Not Used	**Bits [2:0]** Indicate Current Settings
N/A	**000 = 2.25 mA (default)** 001 = 4.5 mA 010 = 6.75 mA 011 = 9 mA 100 = 11.25 mA 101 = 13.5 mA 110 = 15.75 mA 111 = 18 mA

Table 3. GPIO Register Bit Settings

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Not Used	TX2/GPIO2/INT Interrupt Output	TX2/GPIO2 data	TX2/GPIO2 data direction	TX2/GPIO2 Control	TX1/GPIO1 data	TX1/GPIO1 data direction	TX1/GPIO1 Control
N/A	0 = INT mode is disabled (**default**) 1 = When TX2/GPIO2 is configured as a GPIO output TX2/GPIO2/INT is set for INT mode and will pull low when either the LED Thermal Fault Flag is set or the VIN Monitor Flag is set	This bit is the read or write data for TX2/GPIO2 in GPIO mode (**default is 0**)	0 = TX2/GPIO2 is a GPIO Input (**default**) 1 = TX2/GPIO2 is a GPIO Output	0 = TX2/GPIO2 is a flash interrupt input (**default**) 1 = TX2/GPIO2 is configured as a GPIO	This bit is the read or write data for TX1/GPIO1 in GPIO mode (**default is 0**)	0 = TX1/GPIO1 is a GPIO input (**default**) 1 = TX1/GPIO1 is a GPIO output	0 = TX1/GPIO1 is configured as flash interrupt input(**default**) 1 = TX1/GPIO1 is configured as a GPIO

Table 4. VIN Monitor Register Bit Settings

Bits [7:3]	Bits [2:1]	Bit 0
Not Used	VIN Monitor Threshold Settings	VIN Monitor Enable
N/A	00 = 2.9V threshold (V_{IN} falling) **Default** 01=3.0V threshold (V_{IN} falling) 10 = 3.1V threshold (V_{IN} falling) 11 = 3.2V threshold (V_{IN} falling)	0 = VIN Monitor Comparator is disabled (**default**) 1 = VIN Monitor Comparator is enabled.

Table 5. GPIO Register Bit Settings

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Not Used	TX2/GPIO2/INT Interrupt Output	TX2/GPIO2 data	TX2/GPIO2 data direction	TX2/GPIO2 Control	TX1/GPIO1 data	TX1/GPIO1 data direction	TX1/GPIO1 Control
N/A	0 = INT mode is disabled (**default**) 1 = When TX2/GPIO2 is configured as a GPIO output TX2/GPIO2/INT is set for INT mode and will pull low when either the LED Thermal Fault Flag is set or the VIN Monitor Flag is set	This bit is the read or write data for TX2/GPIO2 in GPIO mode (**default is 0**)	0 = TX2/GPIO2 is a GPIO Input (**default**) 1 = TX2/GPIO2 is a GPIO Output	0 = TX2/GPIO2 is a flash interrupt input (**default**) 1 = TX2/GPIO2 is configured as a GPIO	This bit is the read or write data for TX1/GPIO1 in GPIO mode (**default is 0**)	0 = TX1/GPIO1 is a GPIO input (**default**) 1 = TX1/GPIO1 is a GPIO output	0 = TX1/GPIO1 is configured as flash interrupt input(**default**) 1 = TX1/GPIO1 is configured as a GPIO

Table 6. Flash Brightness Register Bit Settings

Bits [7:4] Not Used	Bits [3:0] Flash Current Settings
N/A	0000 = 36 mA 0001 = 73.6 mA 0010 = 111.2 mA 0011 = 148.8 mA 0100 = 186.4 mA 0101 = 224 mA 0110 = 261.6 mA 0111 = 299.2 mA 1000 = 336.8 mA 1001 = 374.4 mA 1010 = 412 mA 1011 = 449.6 mA 1100 = 487.2 mA **1101 = 524.8 mA (default)** 1110 = 562.4 mA 1111 = 600 mA

Table 7. Flash Timeout Duration Register Bit Settings

Bit [7:6] Not Used	Bit 5 Current Limit Select	Bits [4:0] Flash Timeout Duration Settings
N/A	0 = 1A Peak Current Limit 1 = 1.5A Peak Current Limit **(default)**	00000 = 32 ms timeout 00001 = 64 ms timeout 00010 = 96 ms timeout 00011 = 128 ms timeout 00100 = 160 ms timeout 00101 = 192 ms timeout 00110 = 224 ms timeout 00111 = 256 ms timeout 01000 = 288 ms timeout 01001 = 320 ms timeout 01010 = 352 ms timeout 01011 = 384 ms timeout 01100 = 416 ms timeout 01101 = 448 ms timeout 01110 = 480 ms timeout **01111 = 512 ms timeout (default)** 10000 = 544 ms timeout 10001 = 576 ms timeout 10010 = 608 ms timeout 10011 = 640 ms timeout 10100 = 672 ms timeout 10101 = 704 ms timeout 10110 = 736 ms timeout 10111 = 768 ms timeout 11000 = 800 ms timeout 11001 = 832 ms timeout 11010 = 864 ms timeout 11011 = 896 ms timeout 11100 = 928 ms timeout 11101 = 960 ms timeout 11110 = 992 ms timeout 11111 = 1024 ms timeout

Table 8. Flags Register Bit Settings

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
VIN Monitor Flag	Not Used	LED Thermal Fault (NTC)	TX2 Interrupt	TX1 Interrupt	Led Fault (LEDF)	Thermal Shutdown (TSD)	Flash Timeout (TO)
0 = No Fault at VIN (**default**) 1 = Input Voltage Monitor is enabled and VIN has fallen below (V_{IN_TH})	N/A	0 =LEDI/NTC pin is above V_{TRIP} (**default**) 1=LEDI/NTC has fallen below V_{TRIP}(NTC mode only)	0=TX2 has not changed state (**default**) 1=TX2 has changed state (TX2 mode only)	0=TX1/TORCH has not changed state (**default**) 1=TX1/TORCH pin has changed state (TX1 mode only)	0 = Proper LED Operation (**default**) 1 = LED Failed (Open or Short)	0 = Die Temperature below Thermal Shutdown Limit (**default**) 1 = Die Temperature has crossed the Thermal Shutdown Threshold of +150°C	0 = Flash timeout did not expire (**default**) 1 = Flash timeout Expired

Table 9. Configuration Register 1 Bit Settings

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Hardware Torch Mode Enable	TX2 Polarity	TX1 Polarity	NTC Mode Enable	STROBE Polarity	STROBE Input Enable	Not Used	Not Used
0 = TX1/TORCH is a TX1 flash interrupt input **(default)** 1 = TX1/TORCH pin is a hardware TORCH enable. This bit is reset to 0 after a flash event.	0 = TX2 is set for active low polarity 1 = TX2 is set for active high polarity **(default)**	0 = TX1 is set for active low polarity 1 = TX1 is set for active high polarity **(default)**	0 = LEDI/NTC is a Indicator Current Source Output **(default)** 1 = LEDI/NTC is a Comparator Input for LED Temperature Sensing	0 = STROBE set for active low polarity 1 = STROBE set for active high polarity **(default)**	0 = STROBE Input Disabled **(default)** 1 = STROBE Input Enabled	N/A	N/A

Table 10. Configuration Register 2 Bit Settings

Bits [7:4]	Bit 3	Bit 2	Bit 1	Bit 0
Not Used	V_{IN} Monitor Shutdown	AET mode	NTC Shutdown	TX2 Shutdown
N/A	0 = If IN drops below V_{IN_TH} and the VIN Monitor feature is enabled, the LEDs are forced into Torch mode (**default**) 1 = If IN drops below V_{IN_TH} and the VIN Monitor feature is enabled, the LEDs turn off	0 = Normal operation for TX1/TORCH high before STROBE (TX1 mode only) **default** 1 = Alternate External Torch Mode. TX1/TORCH high before STROBE forces Torch mode with no timeout (TX1 mode only)	0 = LEDI/NTC pin going below V_{TRIP} forces the LEDs into Torch mode (NTC mode only) **default** 1 = LEDI/NTC pin going below V_{TRIP} forces the LEDs into shutdown (NTC mode only)	0 = TX2 interrupt event forces the flash LED into Torch mode (TX2 mode only) **default** 1 = TX2 interrupt event forces the flash LED into shutdown (TX2 mode only)

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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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