AN-1742 LM3554 Evaluation Board

1   Introduction

The Texas Instruments LM3554 Evaluation Board is designed to fully evaluate the LM3554 Synchronous Boost Converter with Dual 600 mA High Side Flash LED Drivers and I^{2}C-Compatible Interface. For a detailed description of the LM3554, see *LM3554 Synchronous Boost Converter with 1.2A Dual High Side LED Drivers and I^{2}C-Compatible Interface* (SNVS549).

The board comes equipped with two LXCL-PWF4 Flash LEDs from Lumiled and an additional LED (LEDI) is an Indicator LED. The Flash Button demonstrates the Hardware Flash feature of the LM3554 and when pushed, turns on both Flash LEDs at the programmed Flash current. There are two 10-kΩ pull-up resistors on the board for the I^{2}C clock and data lines (SDA and SCL). Additionally, there is a 10-kΩ pull-up (R_RESET) that pulls the HWEN/GPIO1 pin high during startup. Each input and/or output from the LM3554 has its own separate header to serve as a test-point. Figure 2 shows the Evaluation Board schematic.

2   Operation

To operate the evaluation board, connect a 2.5V to 5.5V supply between the VL banana jack and the GND banana jack. Make sure that a jumper is installed from the VI/O pin to the IN pin (3-pin header at bottom left of board). This connects the logic level pull-ups to the VIN supply. Next, connect a jumper from the IN header and VL. This will short the IN pin and the power supply connected to the VL banana jack. This jumper is designed to remove the input bypass capacitor from the input of the inductor in order to measure the inductor current. If a supply is connected at VL, make sure that the VIN/VUSB jumper (upper right of board) is removed. This jumper takes the power from the Texas Instruments USB Interface Board and connects it to VL. With this jumper in place and a supply connected to VL, the power source from the USB Interface Board will conflict with the supply connected to VL.

Control of the LM3554 can be done via two ways. At the top left corner of the board are two 2-pin headers. Each header has its left most pin connected to either the SCL or the SDA pin of the LM3554 and to the on-board pull-up resistor. The right-most pin connects to GND. To control the LM3554 using a data generator or an external I^{2}C device, connect the I^{2}C lines directly to the left pins of these headers (SCL and SDA). Alternatively, you can use Texas Instruments USB board.

2.1   Jumper/Header Descriptions

SCL, GND Header:— SCL pin connects to SCL of the LM3554 and to the SCL line coming from the USBL connector. The on-board pull-up for SCL is 10 kΩ. The right side of this header connects to GND.

SDA, GND Header:— SDA pin connects to SDA of the LM3554 and to the SDA line coming from the USBL connector. The on-board pull-up for SDA is 10 kΩ. The right side of this header connects to GND.

VI/O, ENVM/TX2 Jumper:— The VI/O pin connects to the middle pin of the bottom left jumper on the board (VUSB, VI/O, IN). The right pin of this jumper connects to ENVM/TX2/GPIO2 of the LM3554. ENVM/TX2/GPIO2 has an internal 300-kΩ pull-down.

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VBIAS, GND Header:—The left pin of this header (VBIAS) connects to R3 and C4. If a thermistor is installed at RTH, connect the bias supply for the thermistor resistive divider at VBIAS. The right side of this pin connects to GND.

VI/O, TX Jumper:—The left pin of this jumper (VI/O) connects to the middle pin of the bottom left jumper on the board (VUSB, VI/O, IN). The right pin (TX) connects directly to the TX1/TORCH input of the LM3554. There is an internal 300-kΩ pull-down resistor on TX1/TORCH.

VIN/VUSB Jumper:—Left pin of this jumper connects to VL (input side of the inductor). The right pin of this jumper connects to the USB interface board's power supply.

A2 Header:—The A2 header connects across a 0.1Ω current sense resistor (R2) in series with LED2.

A1 Header:—The A1 header connects across a 0.1Ω current sense resistor (R1) in series with LED1.

SW, GND Header:—The top pin of this header (SW) connects to the SW pin of the LM3554. The bottom pin connects to GND.

IN, VL Jumper:—The left pin of this jumper connects to IN . The right pin connets to VL (input side of the inductor). This jumper connects the VL supply to CIN.

VUSB, VI/O, IN Jumper:—Three-pin jumper. The left pin connects to the 3.3V supplied from the USB Interface Board. The middle pin connects to the LM3554 Evaluation Boards pull-ups. The right pin connects to IN of the LM3554.

RESET, GND Jumper:—The left pin (RESET) connects to HWEN/GPIO1 of the LM3554 and to the R_RESET pull-up resistor (10 kΩ). The right pin connects to GND. Connecting a jumper here will force the LM3554 into shutdown.

VI/O, STROBE Jumper:—Left pin of this jumper connects to the middle pin of the bottom left jumper on the board (VUSB, VI/O, IN). The right pin connects to the STROBE input on the LM3554. Connecting a jumper here will force the LM3554 into hardware flash mode.

OUT Header:—This header connects to the OUT pin of the LM3554.

2.2 Operation with the Texas Instruments USB Interface Board

The USBL and USBR connectors (16-pin bottom mounted connectors on each side of the board) plug directly into the Texas Instruments USB Interface Board. The connectors are keyed so the boards will fit together only one way. The 3-position header at the bottom left of the board (VUSB, VI/O, IN) connects the logic voltages to IN or to the 3.3V regulator (VUSB) coming from the USB board. Connecting a jumper across VIN/VUSB at the top right of the board allows for power (at the VL pin) to come from the Texas Instruments USB Interface Board. This is useful for demonstrating the device without an external power supply. This can only be used for low-current Torch and Flash currents which keep the input current below 500 mA. This is due to the 500-mA current limit available from the USB port. This input voltage from the USB Board can be 3.3V or 5V, depending on the (J1) jumper setting on Texas Instruments USB Interface Board (See *USB Interface Module for Applications* (SNOU007) for details). High current requirements such as the higher Flash and Torch currents require an external supply at VL. Also, ensure the VIN/VUSB jumper is left open when connecting an external supply to the VL pin when operating with Texas Instruments USB Interface Board as this will cause a conflict with the power supply from the Interface Board and the external supply connected to VL.

3   LM3554 Graphical User Interface

The LM3554.exe graphical user interface program works together with the Texas Instruments USB Interface Board to provide control of the LM3554 Evaluation Board via the PC. The LM3554.exe graphical user interface program features all the registers that are programmable within the LM3554 over the I^{2}C-compatible interface. When the LM3554.exe program is executed, and any button or slider is activated, the program will update the LM3554 with all the settings that are currently set on the LM3554.exe screen. The following sections describe the LM3554.exe program; see Figure 1.
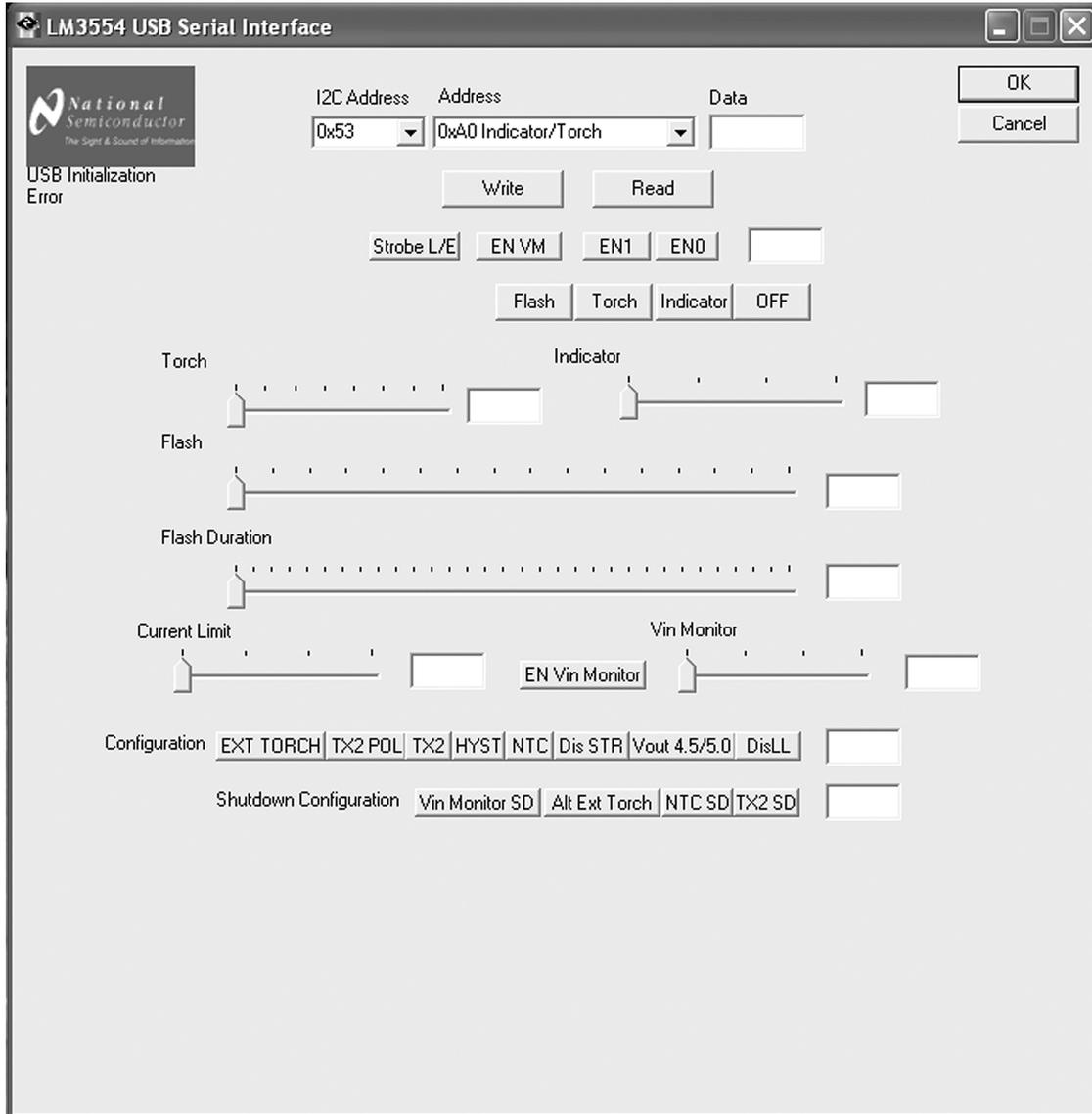
Figure 1. LM3554 Graphical User Interface Program

3.1 *Address and Data Pulldown Menus*

The top 2 pull-down menus show the chip address (0x53) and select the internal register addresses. The Data field to the right of the Address pull-down menu is for the hexadecimal register data. The two buttons directly below the Address pull-down menu allow for the Writing or Reading of data from the specified register in the Address pull-down menu.

3.1.1 Flash, Torch, Voltage Mode, and Indicator Enable Buttons

Strobe L/E Button:— This sets the STR bit (bit 7) in the Flash Brightness Register to a '1' (pushed in) or a '0' not pushed.

ENVM Button:— This programs the VM bit (bit 2) of the Flash Brightness Register and the Torch Brightness Register with a '1' (button pushed) or a '0' button not pushed. The resulting code in the Flash Brightness Register and the Torch Brightness Register is shown in the field to the right.

EN1 Button:— This programs the EN1 bit (bit 1) of the Flash Brightness Register and the Torch Brightness Register with a '1' (button pushed) or a '0' button not pushed. The resulting code in the Flash Brightness Register and the Torch Brightness Register is shown in the field to the right.

EN0 Button:— This programs the EN0 (bit 0) of the Flash Brightness Register and the Torch Brightness Register with a '1' (button pushed) or a '0' button not pushed. The resulting code in the Flash Brightness Register and the Torch Brightness Register is shown in the field to the right.

Flash Button:— This causes a Flash event. This is the same as pushing EN1 and EN0 button.

Torch Button:— This places the LM3554 in torch mode. This is the same as pushing the EN1 button with the EN0 button not pushed.

Indicator Button:— This turns on the indicator current source. This is the same as pushing the EN0 button with the EN1 button not pushed.

OFF Button:— This turns off the ENVM, EN1, and EN0 buttons and programs bits [2:0] of the Flash Brightness Register and the Torch Brightness Register with 0.

4 Sliders

4.1 *Torch Slider*

This slider bar selects the Torch Current Level and writes the corresponding Torch Current setting shown in Table 1 to the Torch Current Select Bits (bits [5:3] of the Torch Brightness Register). The field to the right of the Torch slider is updated with the current Hexadecimal equivalent of the Torch Current Select bits.

Table 1. Torch Current Levels

Torch Current Setting	I_{LED1} or I_{LED2} (mA)	I_{LED1} +I_{LED2} (mA)
0	18.75	37.5
1	37.5	75
2	56.25 **(Default)**	112.5 **(Default)**
3	75	150
4	93.75	187.5
5	112.5	225
6	131.25	262.5
7	150	300

4.2 Indicator Slider

This slider bar selects the Indicator Current Level and writes the corresponding Indicator Current setting shown in Table 2 to the Indicator Current Select Bits (bits [7:6] of the Torch Brightness Register). The field to the right of the Indicator Slider is updated with the Hexadecimal equivalent of the Indicator Current Select Bits.

Table 2. Indicator LED Current Levels

Indicator Current Setting	I_{LEDI} (mA)
0	2.5
1	5 **(Default)**
2	7.5
3	10

4.3 Flash Slider

This slider bar selects the Flash Current Level and writes the corresponding Flash Current shown in Table 3 to the Flash Current Select Bits (bits [6:3] of the Flash Brightness Register). The field to the right of the Flash slider is updated with the Hexadecimal equivalent of the Flash Current Select Bits.

Table 3. Flash Current Level

Flash Current Setting	I_{LED1} or I_{LED2} (mA)	I_{LED1} + I_{LED2} (mA)
0	37.5	75
1	75	150
2	112.5	225
3	150	300
4	187.5	375
5	225	450
6	262.5	525
7	300	600
8	337.5	675
9	375	750
A	412.5	825
B	450	900
C	487.5	975
D	525 **(Default)**	1050 **(Default)**
E	562.5	1125
F	600	1200

4.4 Flash Duration Slider

This slider bar selects the Flash Duration and writes the corresponding Flash Duration setting shown in Table 4 to the Flash Timeout Select Bits (bits [4:0] of the Flash Duration Register). The field to the right of the Flash Duration slider is updated with the Hexadecimal equivalent of the Flash Timeout Select Bits.

Table 4. Flash Duration

Flash Duration Setting (0-15)	t_{FLASH} (ms)	Flash Duration Setting (15-31)	t_{FLASH} (ms)
0	32	10	544
1	64	11	576
2	96	12	608
3	128	13	640
4	160	14	672
5	192	15	704
6	224	16	736
7	256	17	768
8	288	18	800
9	320	19	832
A	352	1A	864
B	384	1B	896
C	416	1C	928
D	448	1D	960
E	480	1E	992
F	512 **(Default)**	1F	1024

4.5 Current Limit Slider

This slider bar selects the Current Limit and writes the corresponding Current Limit Setting shown in Table 5 to the Current Limit Select Bits (bits [6:5] of the Flash Duration Register). The field to the right is updated with the Hexadecimal equivalent of the Current Limit Select bits.

Table 5. Switch Current Limit Levels

Current Limit Setting	Switch Current Limit (A)
0	1
1	1.5
2	2 **(Default)**
3	2.5

4.6 VIN Monitor

The VIN MONITOR button controls the on/off state of the VIN MONITOR function. When this button is pushed, bit 0 in the VIN Monitor Register is set to '1', and the VIN Monitor feature in the LM3554 is enabled. When the button is not pushed, bit 0 in the VIN Monitor Register is programmed with a '0', and the VIN Monitor feature is disabled.

The VIN Monitor Slider selects the 4 different VIN Monitor Thresholds shown in Table 6 and programs the VIN Threshold Bits (bits [2:1] of VIN Monitor Register). The box to the right of the slider shows the Hexadecimal equivalent of the VIN Threshold bits.

Table 6. VIN Monitor Thresholds

UVLO Slider Setting	Under Voltage Lockout Threshold
0	3.1V **(Default)**
1	3.2V
2	3.3V
3	3.4V

4.7 Configuration Buttons

The following buttons correspond to bits in the Configuration Register 1 (0xD0):

4.7.1 EXT TORCH

When pushed, the EXT TORCH Button writes a '1' to bit 7 (Hardware Torch Mode Enable) of Configuration Register 1. This makes the TX1/TORCH input a hardware Torch enable. When not pushed, the bit is written with a '1', and the TX1/TORCH input is a transmit interrupt flash inhibit.

4.7.2 TX2 POL

When pushed, the TX2 POL button writes a '1' to bit 6 (TX2 Polarity bit) of Configuration Register 1. This makes the ENVM/TX2 input (when in TX2 mode) an active high flash inhibit. When not pushed, the bit is written with a '0', and the ENVM/TX2 (when in TX2 mode) an active low flash inhibit.

4.7.3 TX2

When pushed, the TX2 button writes a '1' to bit 5 (ENVM/TX2 bit) of Configuration Register 1. This makes the ENVM/TX2 input a transmit interrupt flash inhibit with adjustable polarity. When not pushed, the bit is written with a '0', and the ENVM/TX2 input is a hardware Voltage mode enable.

4.7.4 HYST

When pushed the HYST button writes a '1' to bit 4 (HYST bit) of Configuration Register 1 and selects 100 mV hysteresis for the thermistor comparator. When not pushed, the bit is written with a '0', and 200 mV of hysteresis is selected.

4.7.5 NTC

When pushed, the NTC button writes a '1' to bit 3 (LEDI/NTC bit) of Configuration Register 1 and makes the LEDI/NTC pin an input to the thermistor comparator. In this mode, when the voltage at LEDI/NTC falls below 1.05V (typical), the flash event is terminated. When not pushed, the bit is written with a zero, and the LEDI/NTC pin is an indicator current source output.

4.7.6 Dis STR

When the Dis STR button is pushed, a '1' is written to Bit 2 of Configuration Register 1. This disables the STROBE input. When not pushed, the STROBE input is an active high Flash mode enable.

4.7.7 V~OUT~ 4.5/5.0

The V_{OUT} 4.5/5.0 button programs bit 1 in Configuration Register 1. This changes the output voltage in Voltage Output Mode to 5V when pushed or 4.5V when not pushed.

4.7.8 DisLL

The DisLL button gives the option of disabling the light load comparator of the LM3554 when pushed or enabling the light load comparator when not pushed. When the light load comparator is disabled, the LM3554 will not switch over to pulse skip mode at light load currents (typically I_{OUT} = 100 mA with VIN = 3.6V). The light load comparator only applies when the LM3554 is operating in Voltage Out mode. In LED mode the light load comparator is always disabled.

4.8 Shutdown Configuration Buttons

The following buttons correspond to Configuration Register 2, address (0xF0):

4.8.1 VIN Monitor SD

The VIN MONITOR SD button programs bit 3 of Configuration Register 2 with a '1' when pushed, or a '0' when not pushed. When this bit is a '1', the LM3554 will be forced into shutdown when the VIN Monitor feature is enabled (VIN Monitor Register bit [0] = 1), and the input voltage falls below the programmed VIN Threshold. When this bit is a '0', and the VIN Monitor feature is enabled, the LEDs are forced into Torch mode when the input voltage falls below the programmed VIN Threshold.

4.8.2 Alt Ext Torch

When the Alt Ext Torch (Alternative External Torch) button is pushed, Configuration Register 2 bit 2 is programmed with '1'. This sets the LM3554 up for Alternative External Torch mode (AET mode). In AET mode the timeout counter is disabled when TX1 goes high before STROBE goes high. For example, in AET mode a high on TX1, followed by a high on STROBE, forces the LEDs into Torch mode without a timeout. If TX1 is then brought low with STROBE still high, the LEDs are forced into Flash mode, and the timeout counter is re-enabled. When STROBE is brought low, or when the timeout counter expires, the LEDs are turned off. When the Alt Ext Torch button is left un-pushed, this bit is programmed with a '0', and the LM3554's timeout function operates normally.

4.8.3 NTC SD

When the NTC SD button is pushed, bit 1 of Configuration Register 2 is programmed with a '1', and the LM3554 is placed in NTC Shutdown mode. When the button is not pushed, bit 1 of Configuration Register 1 is programmed with '0', and the LM3554 is placed into NTC force Torch mode. When the LM3554 is placed in NTC mode (Configuration Register 1 bit 3 = 1), and NTC force shutdown mode, the LM3554 will go into shutdown when the NTC voltage falls below 1.05V. When the LM3554 is placed in NTC mode (Configuration Register 1 bit 3 = 1) and NTC force Torch mode, the LM3554 will reduce the active Flash current to the programmed Torch level if the NTC voltage falls below 1.05V.

4.8.4 TX2 SD

When the TX2 SD button is pushed, Configuration Register 2 bit 0 is programmed with a '1', and the LM3554 is placed in TX2 Force Shutdown mode. If the LM3554 is placed into TX2 Force Shutdown mode, and the ENVM/TX2 pin is configured as a TX2 input (Configuration Register 1, bit 5 = 1), a TX2 event causes the LM3554's LED current to turn off. If the LM3554 is placed into TX2 force Torch mode, and the ENVM/TX2 pin is configured as a TX2 input (Configuration Register 1, bit 5 = 1), a TX2 event causes the LM3554's LED current to go from Flash mode to Torch mode.

A TX2 event is considered as a low-to-high transition at TX2 when the TX2 polarity bit is set for active high (Configuration Register 1 bit 5 = 1) or a high-to-low transition on TX2 when the TX2 polarity bit is set for active low (Configuration Register 1 bit 5 = 0).

## 5   Evaluation Board Schematic and Bill of Materials
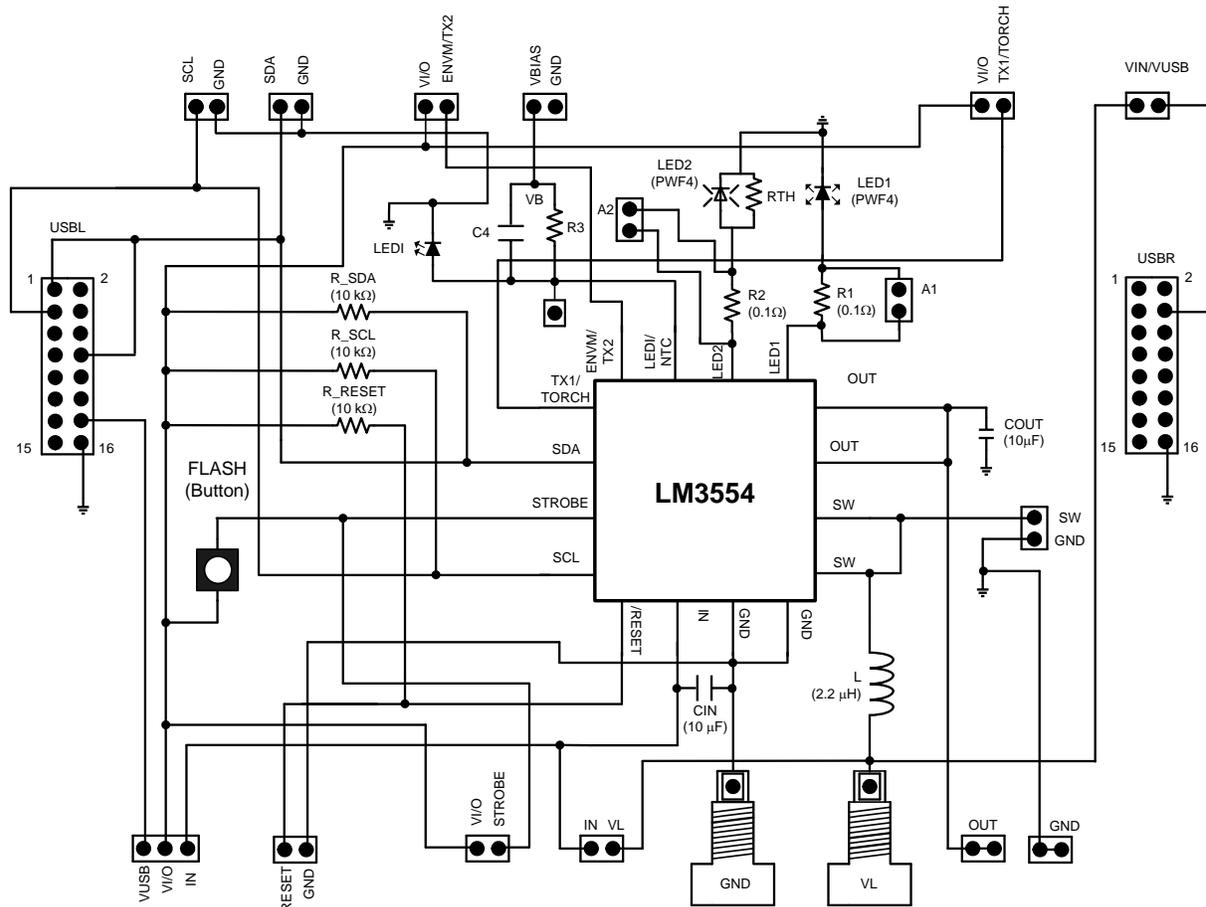
Figure 2. LM3554 Evaluation Board Schematic

Table 7. Bill of Materials

Component	Manufacturer	Value	Part Number	Size (mm)	Description
L	TOKO	2.2 µH	FDSE0312-2R2M	(3 × 3 × 1.2)	I_{SAT} = 2.3A (0.2Ω)
COUT, CIN	Murata	10 µF	GRM188R60J106ME470	0603 (1.6 × 0.8)	6.3V, X5R
LED1, LED2	Lumiled	Flash LED	LXCL-PWF4	(2.04 × 1.64 × 0.7)	145 lm (1A), V_F = 3.6V, @1A
LEDI	Stanley Electric or equivalent	Red LED	HKR1105W-TR	1206 (3.2 × 1.6)	Indicator LED
R1, R2	Panasonic	100 mΩ	ERJ-L06KF10CV	0805 (2 × 1.2)	1/8W, 1%
R_{TH}		Not Populated			Thermistor Pad
R_RESET, RSDA, RSCL	Vishay	10 kΩ	CRCW06031002F	0603 (1.6 × 0.8)	Open Drain Pull-up Resistors
R3		Not Populated			Series Resistor for Thermistor Divider
Flash Button	Panasonic		EVQP1		Momentary Push-button for Hardware Flash
USBL, USBR					USB Interface Board Connector

6   Evaluation Board Layout

The LM3554 evaluation board layout is shown in the following figures.
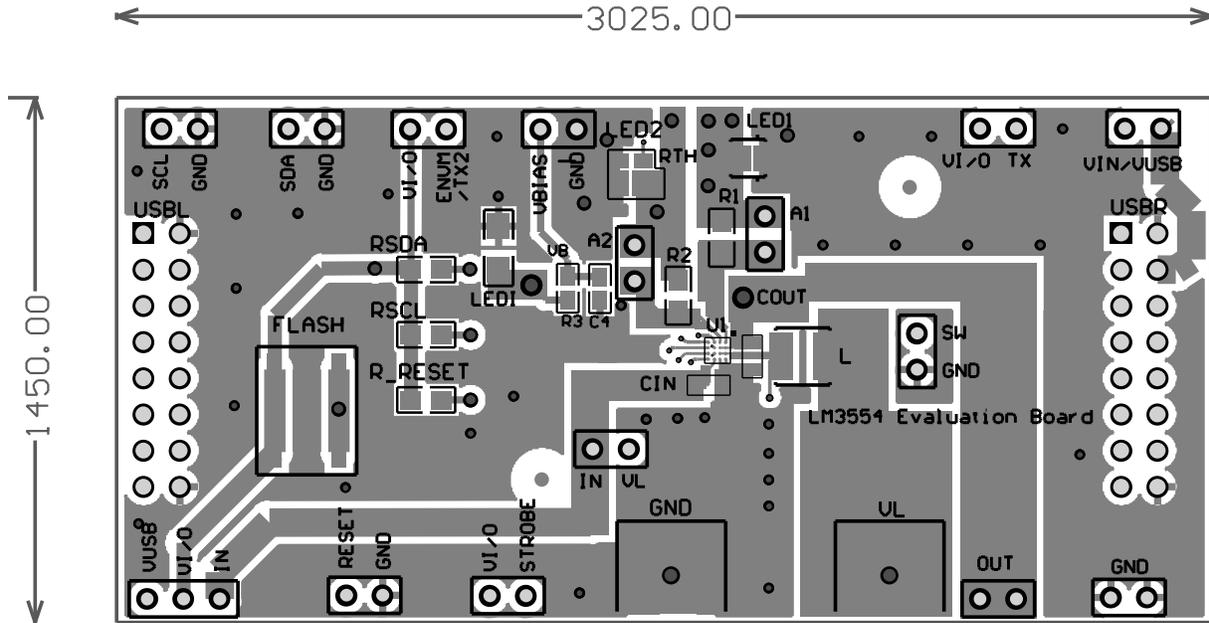
Figure 3. LM3554 Evaluation Board Layout (Top Layer)
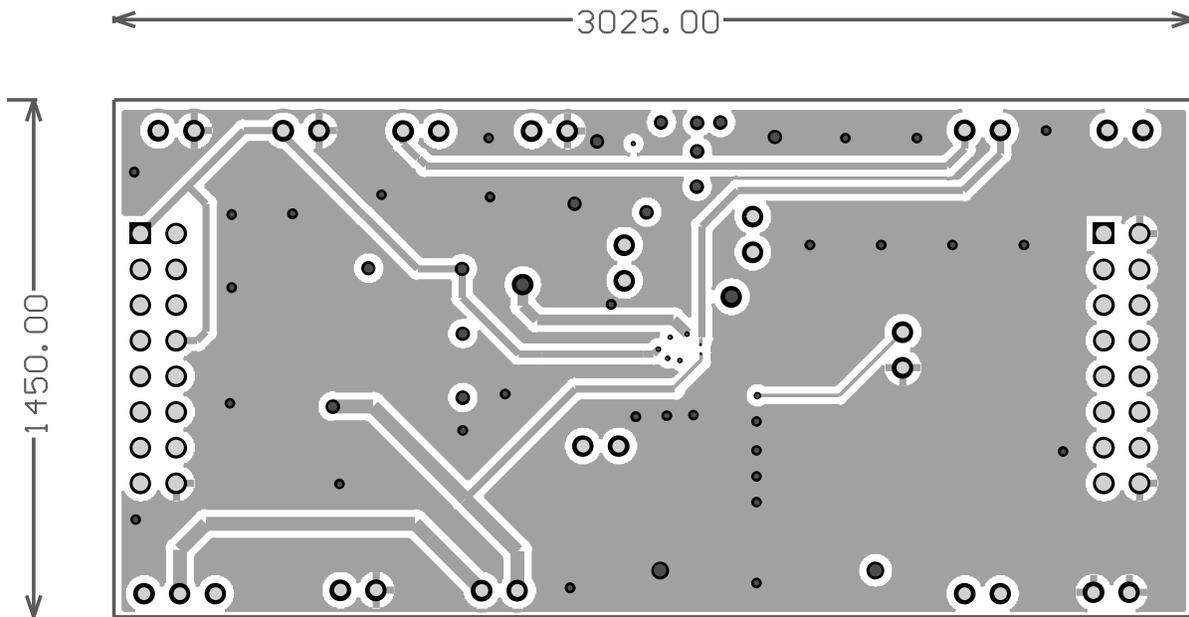
Figure 4. LM3554 Evaluation Board Layout (Mid Layer 1)
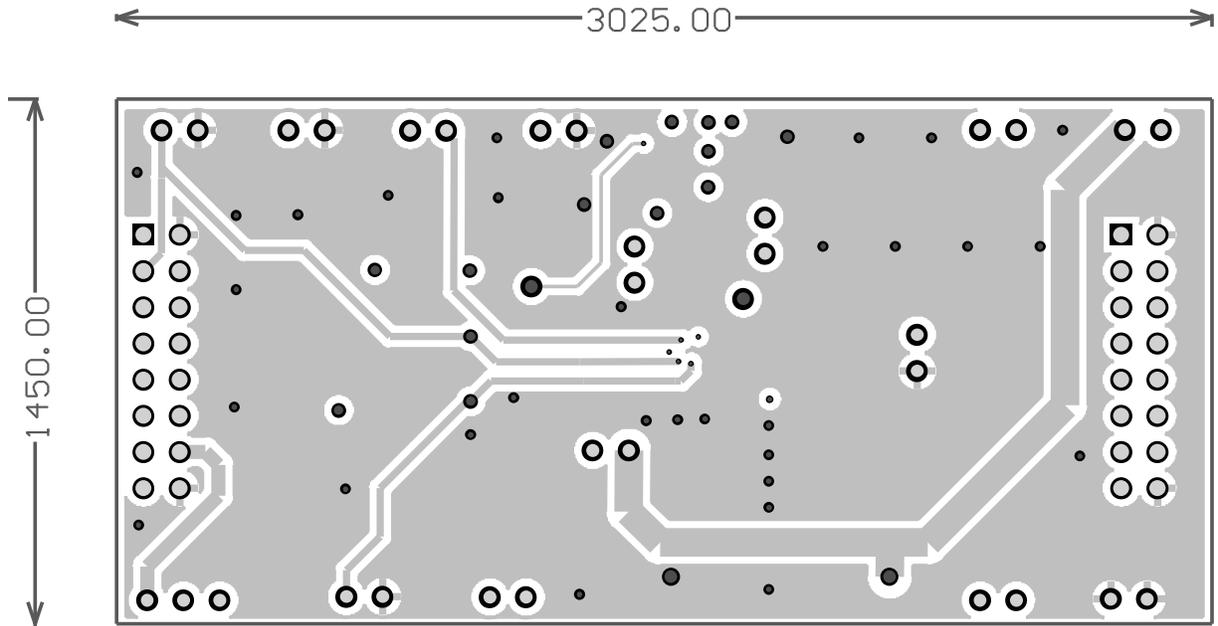
Figure 5. LM3554 Evaluation Board Layout (Mid Layer 2)
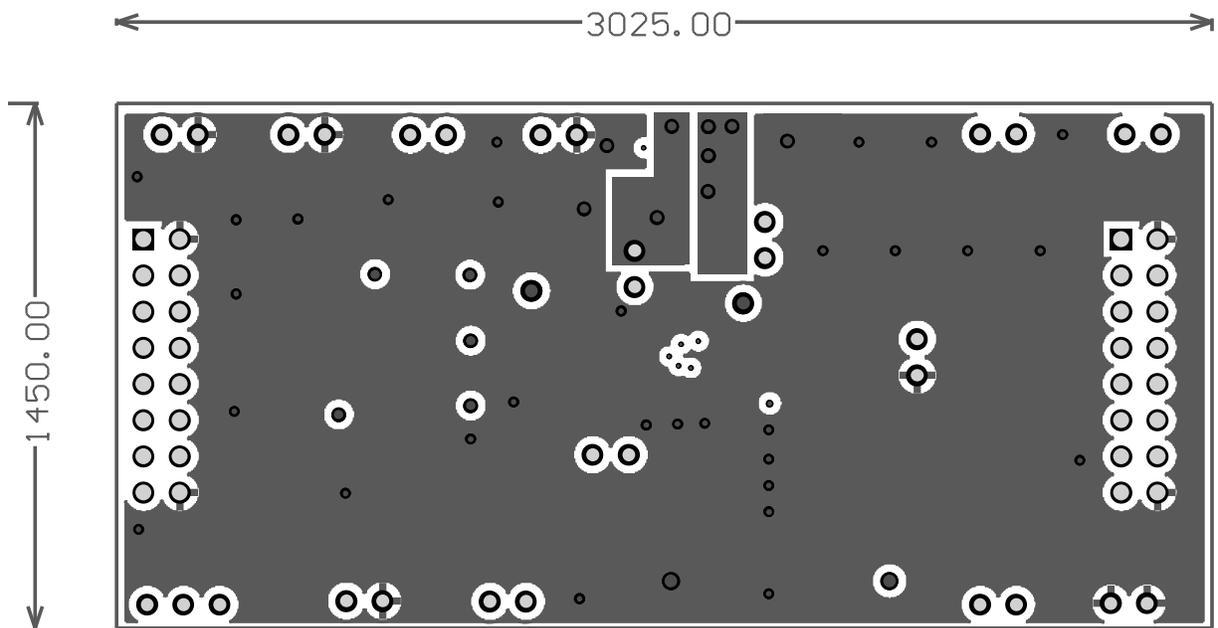
Figure 6. LM3554 Evaluation Board Layout (Bottom Layer)

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

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

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

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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 EVMs for RF Products 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.

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【無線電波を送信する製品の開発キットをお使いになる際の注意事項】

本開発キットは技術基準適合証明を受けておりません。

本製品のご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

　　　上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。

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EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

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. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. 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.

IMPORTANT NOTICE

Products		Applications	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
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DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
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