Evaluation Board User Guide

EVAL-LT3964-1-AZ

36V Synchronous Dual LED Driver with I²C

General Description

The EVAL-LT3964-1-AZ evaluation circuit is a 36V synchronous dual Light-emitting diode (LED) driver with I²C featuring the LT®3964-1. It drives two channels of LEDs at 1A when V_{IN} is between 9V and 36V. EVAL-LT3964-1-AZ runs at 2MHz switching frequency. Its two channels can drive separate LED strings, which can have different currents, voltages, or dimming ratios. It can be controlled with I²C communications, or it can be run in non-I²C mode with proper ADDR pin settings. It is protected against both open and short LED conditions and reports the faults. In I²C mode, faults can be enabled or disabled. Up to 8 different EVAL-LT3964-1-AZ can be placed on the same I²C bus with unique addresses. A serial interface is available when connected to a DC2026C Linduino® One demo circuit.

The LT3964-1 has an input voltage range from 4V to 36V. It has two independent 1.8A, 40V bucks with internal, synchronous 40V switches for high efficiency and small size. It has an adjustable switching frequency between 200kHz and 2MHz. It can be synchronized to an external source or programmed with a clock output (CLKOUT). The PWMTG high-side PWM MOSFET drivers assist with short-circuit protection and versatility. Although the evaluation circuit is optimized for just two LEDs per channel, it can be altered to be buck regulators with as high as 33V of LEDs if V_{IN} is high enough and circuit components are changed appropriately.

In non-I²C mode, each channel can separately be PWM- and analog-dimmed by placing a PWM signal or CTRL voltage on the provided turrets. In I²C mode, each channel can be dimmed to up to 8192:1, and analog dimmed to a high ratio using serial communications.

Small ceramic input and output capacitors are used to save space and cost. The open LED overvoltage protection uses the IC's constant voltage regulation loop to regulate the output to approximately 8.1V if the LED string is opened.

Undervoltage lockout can be adjusted on the circuit with a few simple resistor choices. The output voltage (overvoltage protection) can be adjusted by changing the feedback resistors for higher string voltages. Other components may also need to be changed to accommodate higher voltages.

The LT3964-1 data sheet gives a complete description of the device, operation, and applications information. The data sheet must be read in conjunction with this user guide for EVAL-LT3964-1-AZ. The LT3964RUHE-1#PBF is assembled in a 36-lead plastic 5mm × 6mm QFN package with a thermally enhanced ground pad. A proper board layout is essential for maximum thermal performance. Refer to the datasheet Layout Considerations section.

Design files for this circuit board are available at https://www.analog.com.

Performance Summary (T_A = 25°C)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage PV_{IN} Range	Operating	9		36	V
Switching Frequency	R8 = 27.4kΩ		2.0		MHz
I_{LED1}, I_{LED2}	R12 = R16 = 0.1Ω		1.0		A
Open LED Voltage V_{OUT} (V C_{OUT})	R10 = R14 = 1MΩ R11 = R15 = 169kΩ		8.16		V
V_{LED} Range	R10 = R14 = 1MΩ R11 = R15 = 169kΩ	2.5		7.7	V
PV_{IN} Undervoltage Lockout (Falling)	R1 = 332kΩ, R2 = 51.1kΩ		8.8		V
PV_{IN} Turn-On Voltage (Rising)	R1 = 332kΩ, R2 = 51.1kΩ		10.6		V

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Quick Start Procedure

How to Operate in Non-I²C Mode

The EVAL-LT3964-1-AZ is easy to set up to evaluate the performance of the LT3964-1 in non-I²C mode. Follow the procedure below:

1. With power off, connect a string of LEDs between LED1+ and LED1– terminals and the same for LED2+ and LED2–. Connect the EN/UVLO terminal to GND to keep the circuit shut down. With power off, connect the input power supply to the PVIN and GND terminals. Make sure that the input voltage does not exceed 36V.
2. For non-I²C mode operation, set both JP1 and JP2 (ADDR1 and ADDR2) to 0. The 00 address pins setting is for non-I²C mode, but all other settings are for I²C serial communication mode.
3. Turn the input power supply on and make sure the voltage is between 11V and 36V to start the operation.
4. Release the EN/UVLO-to-GND connection.
5. Observe the LED string running at the programmed LED current.
6. To change the brightness with analog dimming in non-I²C mode, simply attach a voltage source to the CTRL1 and/or CTRL2 terminals and set the voltage between 0V and 1.5V. See datasheet for details.
7. To change the brightness with external PWM dimming in non-I²C mode, simply attach a rectangular waveform with varying duty cycles to the PWM1 and/or PWM2 terminals.

How to Operate with Serial Interface – I²C Serial Communication Mode

1. With power off, connect a string of LEDs between LED1+ and LED1– terminals and the same for LED2+ and LED2–. Connect the EN/UVLO terminal to GND to keep the circuit shut down. With power off, connect the input power supply to the PVIN and GND terminals. Make sure that the input voltage does not exceed 36V.
2. For I²C serial communication operation, set JP1 (ADDR1) to FLOAT and JP2 (ADDR2) to 0. FLOAT and 0 are the default address settings of the EVAL-LT3964-1-AZ serial interface example code offered by Analog Devices, Inc. However, they can be easily adjusted to send to any address. In general, serial communication can be used with the LT3964-1 as long as the ADDR1 and ADDR2 settings are anything other than 00. There are three states to each ADDRX pin, 0, 1, or float. There are eight unique I²C address settings.
3. Connect a ribbon cable between the J1 serial communication connection and a Linduino One (DC2026C) demo circuit.
4. Connect a USB cable between a PC and the DC2026C.
5. Download the latest Linduino Sketchbook, QuikEval Program, and Arduino IDE.
6. Refer to the DC2026C Demo Manual for detailed instructions on installing and configuring the above software.
7. Download the Linduino code and library files, EVAL_LT3964_1_AZ_FIRMWARE.zip, from the EVAL-LT3964-1-AZ web page. Unzip the files and store them in your working directory.
8. Launch Arduino IDE.
9. Open the code, EVAL_LT3964_1_AZ.ino, in Arduino IDE, compile, and upload to the Linduino.
10. Open the serial monitor inside Arduino IDE.
11. Turn the input power supply on between PVIN and GND terminals and make sure the voltage is between 11V and 36V to start operation.
12. Release the EN/UVLO-to-GND connection.
13. Use the command line interface in the serial monitor to evaluate the performance of EVAL-LT3964-1-AZ.

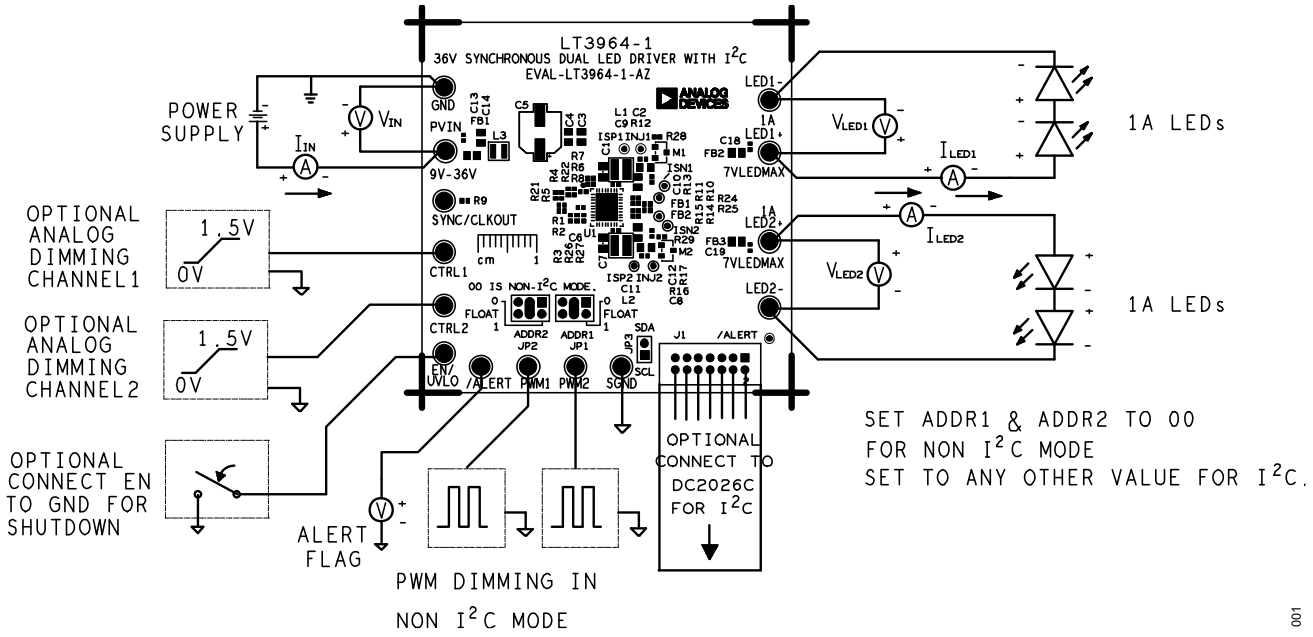


Figure 1. EVAL-LT3964-1-AZ Board Connections

Table 1. I²C ADDR Jumpers (JP1 and JP2) Setting

SHUNT POSITION		MODE
ADDR1 JP1	ADDR2 JP2	
0*	0*	Non I²C
Any other combination		I²C

**Default position*

Performance

(PVIN = 24V, V_{LED1} = V_{LED2} = 6V, I_{LED1} = I_{LED2} = 1A, f_{SW} = 2MHz, T_A = +25°C unless otherwise noted.)

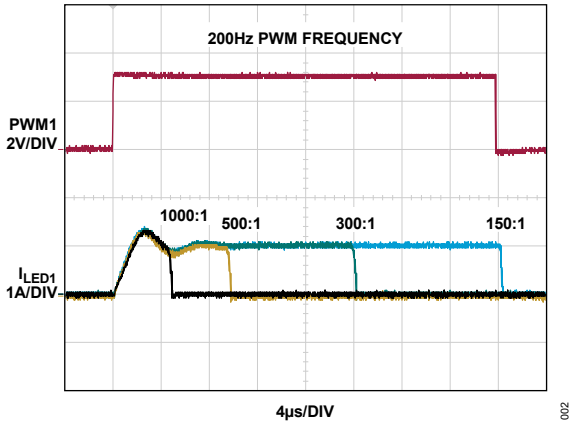


Figure 2. EVAL-LT3964-1-AZ External PWM Dimming with dimming ratios 1000:1, 500:1, 300:1, and 150:1

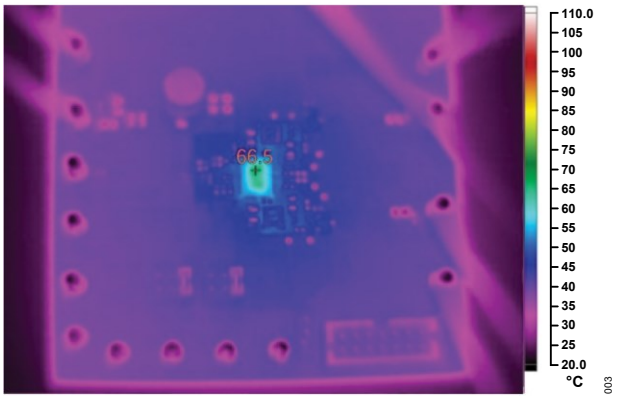


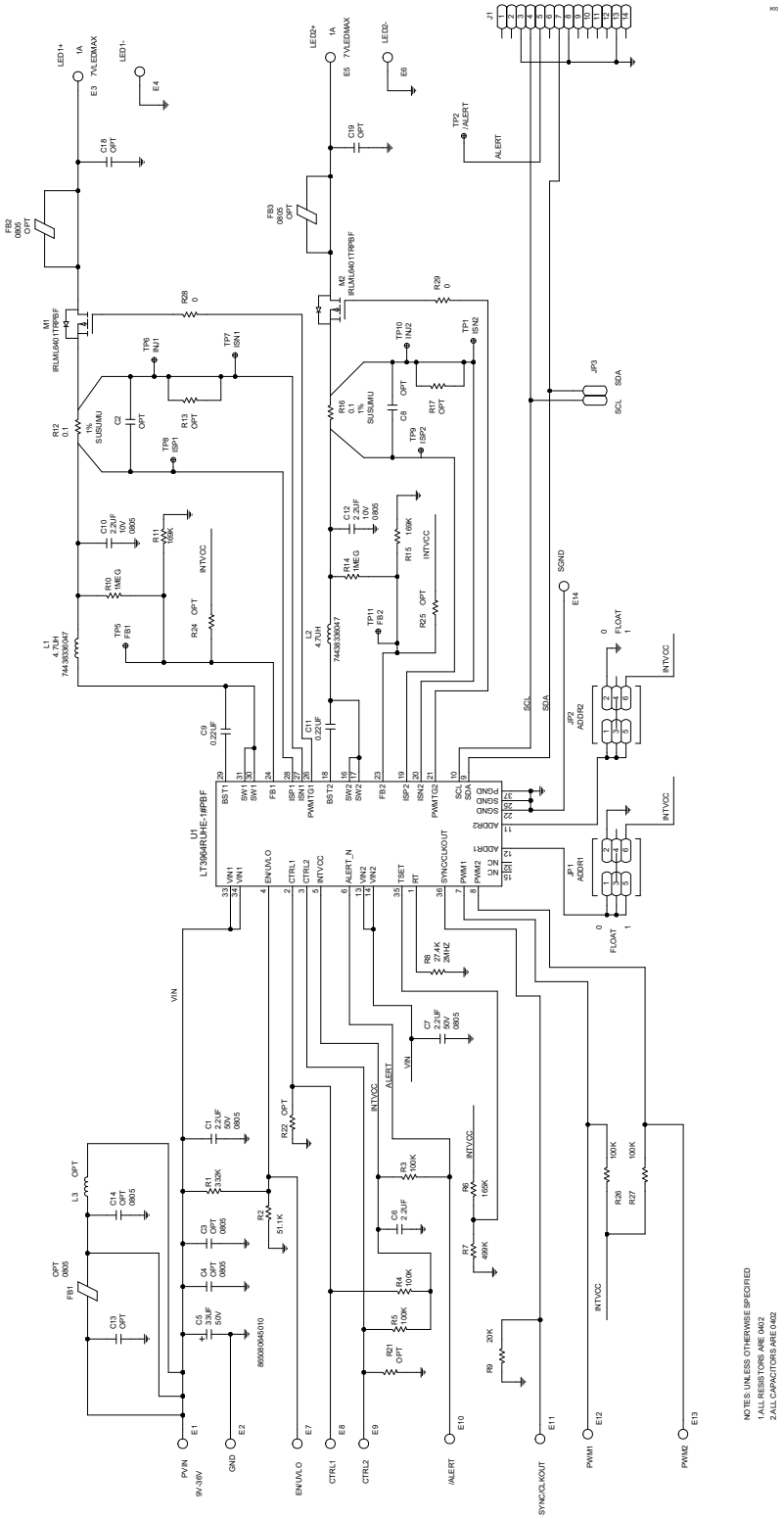
Figure 3. EVAL-LT3964-1-AZ Thermal Image

Bill of Materials

ITEM	QTY	DESIGNATOR	DESCRIPTION	MANUFACTURER PART NUMBER
REQUIRED CIRCUIT COMPONENTS				
1	2	C1,C7	CAP CER 2.2uF 50V 10% X7R 0805	TAIYO YUDEN, UMK212BB7225KG-T
2	2	C10,C12	CAP CER 2.2uF 10V 10% X5R 0805	TAIYO YUDEN, LMK212BJ225KD-T
3	2	C9,C11	CAP CER 0.22uF 50V 10% X5R 0402	TAIYO YUDEN, UMK105BJ224KV-F
4	1	C5	CAP ALUM 33UF 20% 50V 6.6X6.6MM	WURTH, 865080645010
5	1	C6	CAP CER 2.2UF 25V 10% X5R 0402 AEC-Q200	MURATA, GRT155R61E225KE13D
6	14	E1,E2,E3,E4,E5,E6, E7,E8,E9,E10,E11, E12,E13,E14	CONN-PCB SOLDER TERMINAL TEST POINT TURRET 0.094" MTG. HOLE PCB 0.062 INCH THK	MILL-MAX, 2501-2-00-80-00-00-07-0
7	1	J1	CONN-PCB SHROUDED HDR ST 14P MALE	MOLEX, 87831-1420
8	2	JP1,JP2	CONN-PCB 6POS UNSHROUDED HEADER VERT 2MM PITCH	SAMTEC INC., TMM-103-02-L-D
9	1	JP3	CONN-PCB SINGLE ROW HDR 2MM PITCH	SAMTEC, TMM-102-01-G-S
10	2	L1,L2	IND SHIELDED POWER 1.9A 0.158OHM DCR	WURTH, 74438336047
11	2	M1,M2	TRAN P-CH POWER MOSFET	INFINEON TECHNOLOGIES AG, IRLML6401TRPBF
12	1	R1	RES SMD 332K Ohm 1% 1/10W 0402 AEC-Q200	PANASONIC, ERJ-2RKF3323X
13	2	R10,R14	RES SMD 1MEG Ohm 1% 1/10W 0402 AEC-Q200	PANASONIC, ERJ-2RKF1004X
14	2	R11,R15	RES SMD 169K Ohm 1% 1/10W 0402 AEC-Q200	PANASONIC, ERJ-2RKF1693X
15	2	R12,R16	RES SMD 0.1 Ohm 1% 1/2W 0805 AEC-Q200	SUSUMU, KRL1220E-M-R100-F-T5

16	1	R2	RES SMD 51.1K Ohm 0.1% 1/16W 0402 AEC-Q200 HIGH RELIABILITY	PANASONIC, ERA-2AEB5112X
17	5	R3,R4,R5,R26,R27	RES 100K OHM 1% 1/16W 0402	YAGEO, AC0402FR-13100KL
18	2	R28,R29	RES SMD 0 Ohm JUMPER 1/10W 0402 AEC-Q200	PANASONIC, ERJ-2GE0R00X
19	1	R6	RES SMD 165K Ohm 1% 1/16W 0402	YAGEO, RC0402FR-07165KL
20	1	R7	RES SMD 499K Ohm 1% 1/10W 0402 AEC-Q200	PANASONIC, ERJ-2RKF4993X
21	1	R8	RES SMD 27.4K Ohm 1% 1/10W 0402 AEC-Q200	PANASONIC, ERJ-2RKF2742X
22	1	R9	RES SMD 20K Ohm 1% 1/10W 0402 AEC-Q200	PANASONIC, ERJ-2RKF2002X
23	1	U1	IC-ADI DUAL 36V SYNCHRONOUS 2A BUCK LED DRIVER WITH I2C	ANALOG DEVICES, LT3964RUHE-1#PBF
OPTIONAL CIRCUIT COMPONENTS				
1	5	C2,C8,C13,C18,C19	CAP., OPTION, 0402	
2	3	C3,C4,C14	CAP., OPTION, 0805	
3	1	FB1	IND CHIP FERRITE BEAD 100OHM 25% 100MHZ 4A 0.02OHM DCR 0805	TDK, MPZ2012S101AT000
4	2	FB2,FB3	IND CHIP FERRITE BEAD 0805	MURATA, BLM21BD152SN1D
5	1	L3	IND POWER SHIELDED WIREWOUND 2.2UH 20% 100KHZ 1.3A 0.176 OHM DCR 1008, AEC-Q200	WURTH, 74438323022
6	6	R13,R17,R21,R22, R24,R25	RES., OPTION, 0402	
HARDWARE – FOR DEMO BOARD ONLY				
1	2		SHUNT, 2POS, 2MM PITCH, BLACK	SAMTEC INC., 2SN-BK-G

Schematic



Revision History

Revision Number	Revision Date	Nature of Change	Page Number
Rev 0	9/23	Initial Release	—

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