LT3762
60V Synchronous Boost LED Controller

DESCRIPTION

Demonstration circuit DC2342A is a 60V synchronous boost LED controller featuring the LT®3762. It drives a single string of LEDs at 2A up to 32V when V_{IN} is between 7V and 28V. It runs down to $4V_{IN}$ with reduced I_{LED} and can withstand V_{IN} transients as high as 30V. DC2342A runs at approximately 300kHz switching frequency. Spread spectrum frequency modulation (SSFM) can be turned on with a simple jumper, reducing EMI. DC2342A is designed for high power step-up LED controller applications that require excellent efficiency across the V_{IN} range. This demonstration circuit is protected against both open and short LED conditions, each having its own flag.

The LT3762 has an input range from 2.5V to 42V. It has an adjustable switching frequency between 100kHz and 1MHz. Enabling SSFM spreads the switching frequency from f_{SW} down to f_{SW} – 30% for reduced EMI. SSFM speed is set by placing a capacitor from the SSFM pin of the LT3762 to ground, and can be disabled by shorting this pin to GND. DC2342A has a simple jumper option to enable/disable spread spectrum frequency modulation.

The LT3762 can be PWM dimmed with an external PWM signal, as well as an internally generated PWM signal. A capacitor from PWM to GND of the LT3762 sets the PWM frequency, while the PWM duty cycle is determined by the voltage on the DIM terminal. Between 0V and 3V, V_{DIM} gives between 0.4% and 97% PWM duty cycle. DC2342A has a jumper that can be set to switch between internally generated PWM signal, externally generated PWM signal, and no PWM signal (100% on). When run with both

PWM dimming and spread spectrum enabled, the spread spectrum aligns itself with the PWM signal for flicker free operation. DC2342A can also be analog dimmed by placing a voltage source at either of its two CTRL turrets.

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 35.5V if the LED string is opened, although it may reach almost 40V peak during the transient caused by an open circuit. There is a protection diode from LED⁺ to GND to prevent negative ringing during a short-circuit.

Undervoltage lockout can be adjusted on the circuit with a few simple resistor choices. Further modifications can be made to DC2342A to reconfigure the circuit from a boost topology to operate as a buck-mode or buck-boost mode LED driver. Please consult the factory for details.

The LT3762 data sheet gives a complete description of the part, operation and applications information. The data sheet must be read in conjunction with this Demo Manual for demonstration circuit DC2342A. The LT3762EUFD is assembled in a 28-lead plastic 4mm × 5mm QFN package with a thermally enhanced ground pad. Proper board layout is essential for maximum thermal performance. See the data sheet section Layout Considerations.

Design files for this circuit board are available at http://www.analog.com/DC2342A

PERFORMANCE SUMMARY Specifications are at $T_A = 25°C$

PARAMETER	CONDITION	MIN	TYP	MAX	UNITS
Input Voltage PV_{IN} Range	$I_{LED} > 0mA$	4		28	V
	$V_{LED} = 32V$, $I_{LED} = 2A$	7		28	V
EN/UVLO Rising Turn On	R2 = 499k, R5 = 226k		5		V
EN/UVLO Falling Turn Off	R2 = 499k, R5 = 226k		4		V
Switching Frequency	R11 = 28.0k, JP1 (SSFM) = OFF		300		kHz
	R11 = 28.0k, JP1 (SSFM) = ON		210 - 300		kHz
I_{LED}	$R_{SNS2} = 0.12\Omega$, $7.0V < PV_{IN} < 28V$, $V_{LED} = 32V$		2.08		A
V_{LED} Range	R4 = 1M, R5 = 36.5k	V_{IN}		32	V
Open LED Voltage V_{OUT}	R4 = 1M, R5 = 36.5k, Open Load		35.5		V
Efficiency (100% PWM DC)	$PV_{IN} = 12V$ $V_{LED} = 32V$ $I_{LED} = 2A$		94.7		%
$INTV_{CC}$	Over Operational PV_{IN} Range	7.3		7.7	V
Internal PWM Dimming Duty Cycle	DIM = 0V	0.22	0.32	0.4	%
	DIM = 1.19V	3.7	5	6.8	%
	DIM = 1.42V	7	10	13	%
	DIM = 1.76V	17	25	33	%
	DIM = 2.1V	37	50	58	%
Internal PWM Dimming Frequency	JP2 = INT, C2 = 470nF, $0V < V_{DIM} < 3V$		140		Hz

QUICK START PROCEDURE

Demonstration circuit 2342A is easy to set up to evaluate the performance of the LT3762. Follow the procedure below:

1. With power off, connect a string of LEDs that will run with forward voltage less than or equal to 32V (at 2A) to the LED+ and LED− banana jacks on the PCB as shown in Figure 1.

2. Connect the EN/UVLO terminal to GND.

3. Set JP1 (SSFM) to OFF to run without SSFM and JP2 (PWM) to ON for 100% always-on operation

4. With power off, connect the input power supply to the PVIN and GND terminals. Make sure that the input voltage will not exceed 28V.

5. Turn the input power supply on and make sure the voltage is between 4V and 28V to start operation.

6. Release the EN/UVLO-to-GND connection.

7. Observe the LED string running at the programmed LED current.

8. To change the brightness with analog dimming, simply attach a voltage source to either CTRL1 or CTRL2 terminal and set the voltage between 0V and 1.5V. See data sheet for details.

9. To change brightness with external PWM dimming, set JP2 (PWM) to EXT and attach a 3V rectangular waveform with varying duty cycle to the PWM terminal.

10. To change brightness with internally generated PWM dimming, set JP2 (PWM) to INT. Attach a DC voltage source between 0V and 3V to the DIM terminal to vary the PWM dimming duty cycle. See data sheet for details

11. To enable spread spectrum frequency modulation, set JP1 (SSFM) to ON.
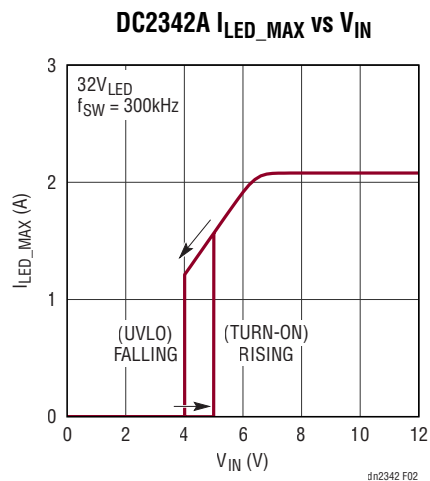
QUICK START PROCEDURE

Figure 1. Test Procedure Setup Drawing for DC2342A

QUICK START PROCEDURE

DC2342A I_{LED_MAX} vs V_{IN}

Figure 2. DC2342A LED Current Versus Input Voltage
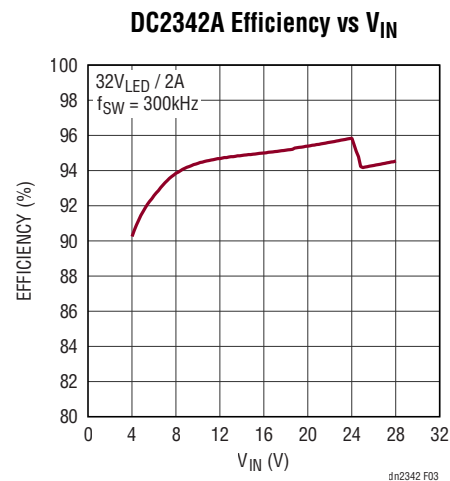
DC2342A Efficiency vs V_{IN}

Figure 3. DC2342A Efficiency Versus Input Voltage for 32V 2A LED Load. Efficiency Remains High through the Range Due to Synchronous Switching, with Asynchronous Switching Starting at 24.5V_{IN}. At Low V_{IN}, I_{LED} Is Reduced Due to Peak Switch Current Limit
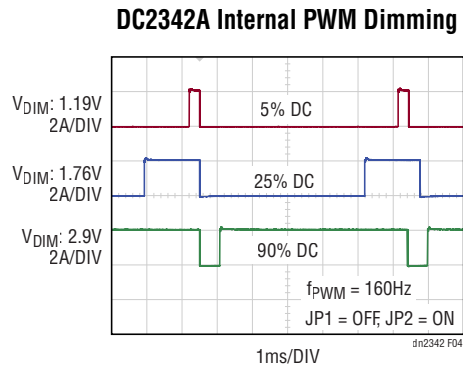
DC2342A Internal PWM Dimming

Figure 4. DC2342A Internally Generated PWM Dimming. A 0V to 3V Source Applied at the DIM Turret of DC2342A Varies the PWM Dimming Duty Cycle to Adjust the Brightness of the LEDs. Please Refer to the Data Sheet for Relation between DIM Voltage and PWM Duty Cycle

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	6	CIN4, CIN5, COUT1, COUT2, COUT3, COUT4	CAP., CER., 10µF, X7R, 50V, 10%, 1210	MURATA, GRM32ER71H106KA12L
2	1	C1	CAP., CER., 1µF, X5R, 50V, 10%, 0603	MURATA, GRM188R61H105KAALD
3	1	C5	CAP., CER., 10nF, X7R, 10V, 10%, 0603	AVX, 0603ZC103KAT2A
4	1	C6	CAP., CER., 0.1µF, X7R, 10V, 10%, 0603	AVX, 0603ZC104KAT2A
5	1	C7	CAP., CER., 10µF, X5R, 10V, 10%, 0603	TDK, C1608X5R1A106K080AC
6	2	C8, C10	CAP., CER., 0.1µF, X7R, 10V, 10%, 0402	MURATA, GRM155R71A104KA01D
7	1	L1	IND., 10µH, 18.30mm	WURTH ELEKTRONIK, 74435561100
8	1	L2	IND., 47µH, 5.0mm	WURTH ELEKTRONIK, 74408942470
9	2	M1, M2	N-MOSFET, PG-TDSON-8	INFINEON, BSC019N04LS
10	1	M5	P-MOSFET, POWERPAK-1212-8-S	VISHAY, SIS443DN-T1-GE3
11	1	RSNS1	RES., SENSE, 0.003Ω, 3W, 1%, 2512 (WIDE)	SUSUMU, KRL6432E-M-R003-F-T1
12	1	RSNS2	RES., SENSE, 0.120Ω, 1W, 1%, 2512	SUSUMU, RL3264R-R120-F
13	1	R2	RES., 499k, 1/10W, 1%, 0603	VISHAY, CRCW0603499KFKEA
14	1	R5	RES., 226k, 1/10W, 1%, 0603	VISHAY, CRCW0603226KFKEA
15	1	R10	RES., 2.2k, 1/10W, 5%, 0603	VISHAY, CRCW06032K20JNEA
16	1	R11	RES., 28.0k, 1/10W, 1%, 0603	VISHAY, CRCW060328K0FKEA
17	1	R16	RES., 1M, 1/10W, 1%, 0603	VISHAY, CRCW06031M00FKEA
18	1	R17	RES., 36.5k, 1/10W, 1%, 0603	VISHAY, CRCW060336K5FKEA
19	1	U1	I.C., LED CONTROLLER, 28QFN-4X5	LINEAR TECH., LT3762EUFD#PBF

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Additional Demo Board Circuit Components				
1	1	CIN1	CAP., ALUM., 100µF, 50V, 20%	SUN ELEC., 50CE100BS
2	0	CIN2, CIN3, C14, C15, C16, COUT5, COUT6(OPT)	CAP, OPTION, 1210	
3	1	C2	CAP., CER., 0.47µF, X7R, 25V, 10%, 0603	MURATA, GRM188R71E474KA12D
4	1	C3	CAP., CER., 6.8nF, X7R, 50V, 10%, 0603	MURATA, GRM188R71H682KA01D
5	0	C4 (OPT)	CAP., 0402	
6	0	C9, C13, C17(OPT)	CAP, OPTION, 0603	
7	0	C9, C13, C17(OPT)	CAP, OPTION, 0603	
8	1	D1	DIODE, SCHOTTKY, 40V, 1A, SOD323F	NEXPERIA, PMEG4010CEJ, 115
9	0	D2(OPT)	DIODE, OPTION, SOD-128	
10	0	M3, M4(OPT)	N-MOSFET, OPTION, PG-TDSON-8	
11	0	Q1 (OPT)	TRANSISTOR, SOT23	
12	0	R1, R12, R13, R19, R20, R21, R22, R23, R24, R25(OPT)	RES., OPTION, 0603	
13	1	R3	RES., 1M, 1/10W, 1%, 0603	VISHAY, CRCW06031M00FKEA
14	1	R4	RES., 205k, 1/10W, 1%, 0603	VISHAY, CRCW0603205KFKEA
15	1	R6	RES., 100k, 1/16W, 5%, 0402	VISHAY, CRCW0402100KJNED
16	0	R7, R14, R15 (OPT)	RES., OPTION, 0402	
17	3	R8, R9, R18	RES., 100k, 1/10W, 5%, 0603	VISHAY, CRCW0603100KJNEA
Hardware: For Demo Board Only				
1	5	E1, E2, E9, E10, E14	TESTPOINT, TURRET, 0.094"	MILL-MAX, 2501-2-00-80-00-00-07-0
2	9	E3, E4, E5, E6, E7, E8, E12, E13, E15	TESTPOINT, TURRET, 0.061"	MILL-MAX, 2308-2-00-80-00-00-07-0
3	1	JP1	HEADER 2X2 0.079" DOUBLE ROW	WURTH ELEKTRONIK, 62000421121
4	1	JP2	HEADER 2X3 0.079" DOUBLE ROW	WURTH ELEKTRONIK, 62000621121
5	2	XJP1, XJP2	SHUNT, 0.079" CENTER	WURTH ELEKTRONIK, 60800213421
6	4	J1-J4	JACK, BANANA	KEYSTONE, 575-4

SCHEMATIC DIAGRAM
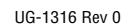
ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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