

High Power Constant Current, Constant Voltage Synchronous Buck Controller

DESCRIPTION

Demonstration circuit 1602A is a high power constant current, constant voltage synchronous buck controller featuring the LT[®]3741. The demo board is optimized for 20A output from a 12V input. Being an LED driver, the output current is being regulated until the output voltage reaches a programmed voltage limit. The voltage limit on this demo board is set to around 6V by R11 and R14. The 6V is chosen because of the 10V voltage rating of the output capacitors. Higher output voltage can be easily achieved with higher voltage rated output capacitors. The ideal load to be used with this demo board is a single LED, such as PT120 from Luminus Devices. Smaller LEDs may not be able to handle the high current, even for a short period of time. At 20A, the demo circuit can operate continuously. However, it is necessary to mount the LED load on a proper heat sink and possibly with a fan to avoid exceeding its maximum temperature rating.

The input voltage range of the LT3741 itself is 6V to 36V. However, the demo board utilizes 30V MOSFETs to demonstrate best efficiency, so the maximum recommended input voltage is 24V for the demo board. The typical efficiency of the demo board is 94% from a 12V input to 5V, 20A load. The lower the input voltage, the higher the efficiency tends to be with a given load. At output power level of

100W, a couple of percent of efficiency improvement is a huge advantage in minimizing temperature rise. If an efficiency measurement is needed in an application, the output voltage must be measured at the output capacitors instead of at the LED load. This prevents cable loss from being counted as a loss of the board. Output current can be adjusted by varying the CTRL1 voltage.

R16 can be used to slow down the gate drive. Slower gate drive helps to reduce ringing on the SW node without noticeable effect on the efficiency. A 10 Ω is usually more than enough to completely damp any ringing.

R10, R13 and C14 help filtering out voltage spikes seen on the SENSE⁺ or SENSE⁻ pin. It is critical to have those components on a board.

The LT3741 data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this quick start guide for demo circuit 1602A.

Design files for this circuit board are available at <http://www.linear.com/demo/DC1602A>.

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PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
PV _{IN} *	Input Supply Range. PV _{IN} = V _{IN}	L1 is Optimized for 12V.		12	24	V
V _{OUT} *	Output Voltage	With ONE PT120 LED. 6V Is the Overvoltage Limit		4.5	6	V
I _{OUT}	Output Current	In Current Mode	18.8	20	21.2	A
V _{OUT}	Output Voltage	In Voltage Mode	5.88	6	6.12	V
F _{SW}	Switching Frequency	R3 = 100k	380	420	460	kHz
EFE	Efficiency at DC	V _{IN} = 12V, V _{OUT} = 5V, I _{OUT} = 20A		94		%

* PV_{IN} and V_{IN} of the demo circuit are limited to 24V typical by the selection of MOSFETs. The LT3741 input range is 6V to 36V. V_{OUT} maximum of the demo circuit is limited to 6V due to the selection of the output capacitors.

QUICK START PROCEDURE

Demonstration circuit 1602A is easy to set up to evaluate the performance of the LT3741. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

1. With power off, connect the input power supply to PV_{IN} and GND. The input power supply should have a current limit of 10A or more.
2. With power off, connect a LED between V_{OUT} and GND.
3. Turn on the power at the input. Be careful not to look at a powered LED directly.
4. Carefully evaluate other design parameters as needed.
5. Adjust CTRL1 to change output current.
6. To modify the demo board for other applications, please contact Linear Applications Group for help.

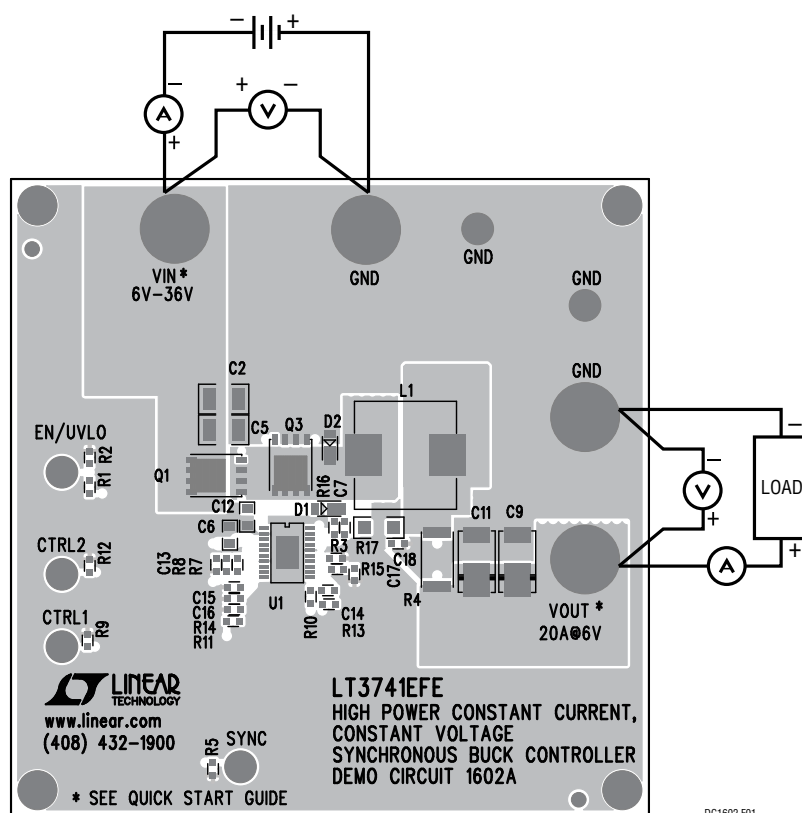


Figure 1. Proper Measurement Equipment Setup

DC1602 F01

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	C1	CAP, ALUM., ELECT., 100 μ F, 50V	SUN ELECT., 50CE100LX
2	4	C2, C3, C4, C5	CAP, X7R, 4.7 μ F, 50V, 10%, 1210	MURATA, GRM32ER71H475KA88L
3	2	C8, C10	CAP, POSCAP, 150 μ F, 10V	SANYO, 10TPF150ML
4	1	C6	CAP, X7R, 1 μ F, 50V, 10%, 0805	MURATA, GRM21BR71H105KA12L
5	1	C7	CAP, X7R, 0.22 μ F, 10V, 10%, 0603	MURATA, GRM188R71A224KA01D
6	2	C9, C11	CAP, X5R, 47 μ F, 16V, 10%, 1210	MURATA, GRM32ER61C476KE15L
7	1	C12	CAP, X5R, 22 μ F, 6.3V, 20%, 0805	MURATA, GRM21BR60J226ME39L
8	1	C13	CAP, COG, 2nF, 50V, 0603	MURATA, GRM1885C1H202JA01D
9	1	C14	CAP, NPO, 33nF, 16V, 0603	MURATA, GRM188R71C333KA01D
10	1	C15	CAP, X7R, 10000pF, 16V, 0603	MURATA, GRM188R71C103KA01D
11	1	C17	CAP, U2J, 5100pF, 50V, 0603	MURATA, GRM1887U1H512JA01D
12	1	D1	1.0A LOW VF SCHOTTKY RECTIFIER	DIODES INC., DFSL140
13	1	D2	2.0A LOW VF SCHOTTKY RECTIFIER	DIODES INC., DFSL240L
14	1	L1	INDUCTOR, 1.3 μ H	WE., 7443551130
15	2	Q1, Q2	MOSFET, N-CHANNEL, PG-TDSON-8	INFINEON, BSC080N03LS G
16	1	Q3	MOSFET, N-CHANNEL, PG-TDSON-8	INFINEON, BSC011N03LSI
17	1	R1	RES., CHIP, 374k, 1%, 0603	VISHAY, CRCW0603374KFKEA
18	1	R2	RES., CHIP, 124k, 1%, 0603	VISHAY, CRCW0603124KFKEA
19	3	R3, R5, R8	RES., CHIP, 100k, 1%, 0603	VISHAY, CRCW0603100KFKEA
20	1	R4	RES., CHIP, 0.0025, 1W, 1%, 2512	VISHAY, WSL25122L500FEA
21	1	R7	RES., CHIP, 45.3k, 1%, 0603	VISHAY, CRCW060345K3FKEA
22	2	R10, R13	RES., CHIP, 10 Ω , 1%, 0603	VISHAY, CRCW060310R0FKEA
23	1	R11	RES., CHIP, 40.2k, 1%, 0603	VISHAY, CRCW060340K2FKEA
24	1	R12	RES., CHIP, 680k, 1%, 0603	VISHAY, CRCW0603680KFKEA
25	1	R14	RES., CHIP, 10k, 1%, 0603	VISHAY, CRCW060310K0JNEA
26	1	R15	RES., CHIP, 66.5k, 1%, 0603	VISHAY, CRCW060366K5FKEA
27	1	U1	I.C. LT3741EFE, 20-PIN TSSOP	LINEAR TECH., LT3741EFE#PBF

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PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Additional Demo Board Circuit Components				
1	0	C16, C18	CAP, 0603, OPT	
2	0	Q4	MOSFET, OPT	
3	1	R16	RES., CHIP, 0 Ω , 0603	VISHAY, CRCW06030000Z0ED
4	0	R9, R17	RES., 1206, OPT	
Hardware: For Demo Board Only				
1	4	E1, E2, E4, E5	JACK, BANANA	KEYSTONE, 575-4
2	6	E3, E6, E7, E8, E9, E10	TURRET, TESTPOINT , 091"	MILL MAX 2501-2-00-80-00-00-07-0
3	4	STAND-OFF	STAND-OFF, NYLON, 0.5" tall	KEYSTONE, 8833(SNAP ON)



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