LTM4607EV: High Density Buck-Boost Power Module

DESCRIPTION

Demonstration circuit DC1198B-B features the LTM®4607EV, a high efficiency, high density switch mode buck-boost power module. The LTM4607EV can regulate its output voltage from input voltage both above and below the output. The board accepts an input voltage from 6V to 36V and is set for an output voltage of 12V. The rated load current is 5A in boost mode and 12A in step-down operation. Derating is necessary for certain V_{IN}, V_{OUT} and thermal conditions. The switching frequency can be synchronized to external clock operating from 200kHz to 400kHz. This clock input can be used to reduce undesirable frequency harmonics and reduce input and output ripple when paralleling LTM4607 modules for even higher output current. The LTM4607 data sheet must be read in conjunction with this demo manual for working on or modifying the demo circuit DC1198B-B.

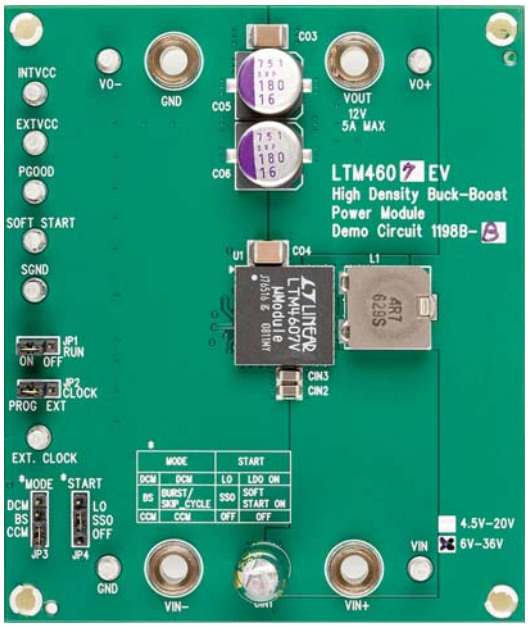
Design files for this circuit board are available at http://www.linear.com/demo

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITION	VALUE
Input Voltage Range		6V to 36V
Output Voltage V_{OUT}	DC Voltage, V_{IN} = 12V, I_{OUT} = 5A	12V, ±2%
Maximum Continuous Output Current	Step-Up Step-Down Derating Is Necessary for Certain V_{IN}, V_{OUT} and Thermal Conditions	$5A_{DC}$ ($6V_{IN}$) $12A_{DC}$ (V_{IN} > 12V)
Default Operating Frequency		300kHz
Efficiency	V_{IN} = 12V, V_{OUT} = 12V, I_{OUT} = 5A	97.4%, See Figure 3 for More Information

BOARD PHOTO



QUICK START PROCEDURE

Demonstration circuit DC1198B-B provides a simple way to evaluate the performance of the LTM4607EV. Please refer to Figure 1 for the proper measurement equipment set-up, and follow the procedure below:

1. Place jumpers in the following positions for a typical $12V_{OUT}$ application:

RUN	CLOCK	MODE	START
On	Prog	CCM	SSO

2. With the power off, preset the load to 0A and the V_{IN} supply to less than 36V. Next, connect the input power supply, load and meters, as shown in Figure 1.
3. Turn on the power at the input. The output voltage should be 12V, ±2%.
4. Once the proper output voltage is established, adjust the load within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other parameters. The cooling fan and lower current sensing resistor are necessary for V_{IN} < 6V and I_{OUT} = 5A.
5. To measure the input and output ripple, please refer to Figure 2 for the proper set-up.
6. The voltage at PLLFLTR determines the switching frequency. Modify R6 and R7 to adjust the switching frequency. Do not allow the voltage at pin PLLFLTR to exceed 2.4V.
7. Inductor and R_{SENSE} should be modified to accommodate certain input and output conditions. Please refer to Table 1 for recommended inductors.

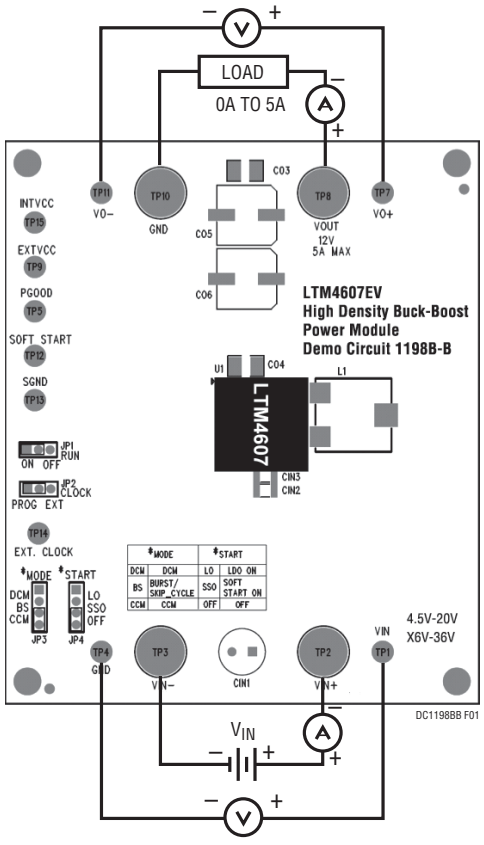


Figure 1. Test Set-Up of the DC1198B-B

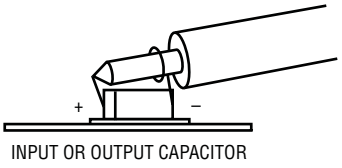


Figure 2. Proper Scope Probe Placement for Measuring Input or Output Ripple

QUICK START PROCEDURE

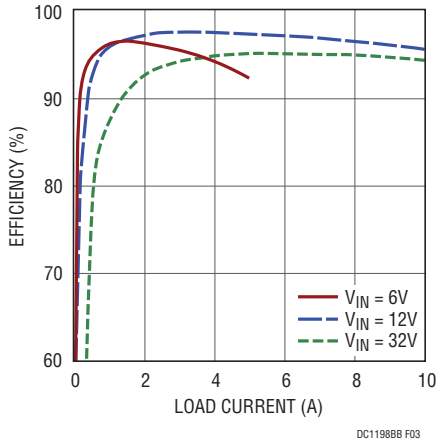


Figure 3. Measured Supply Efficiency with Different V_{IN}

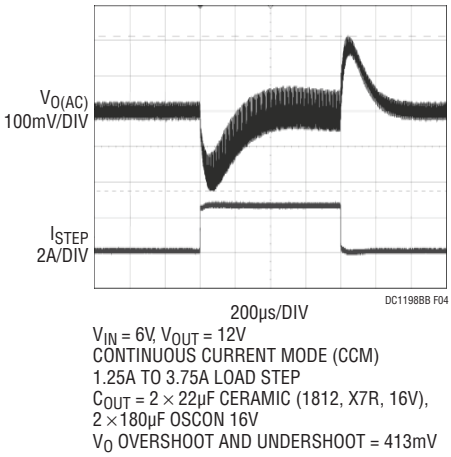


Figure 4. Measured Load Transient Response (2.5A Step, 25% to 75%)

Table 1. Recommended Inductors for Different Input and Output Conditions: f_{SW} = 400kHz

V_{IN} (V)	V_{OUT} (V)	R_{SENSE} (0.5W RATING)	INDUCTOR (µH)	$I_{OUT(MAX)}$* (A)	INDUCTOR	
12	8	2 × 18mΩ, 0.5W	2.2	12	FDA1254-2R2M Toko	CDEP134-2R5 Sumida
20	8	2 × 18mΩ, 0.5W	3.3	12	FDA1254-3R3M Toko	CDEP145-3R5 Sumida
5	10	2 × 14mΩ, 0.5W	1.5	6	FDA1254-1R2M Toko	CDEP134-1R6 Sumida
15	10	2 × 18mΩ, 0.5W	2.2	12	FDA1254-2R2M Toko	CDEP134-2R5 Sumida
20	10	2 × 18mΩ, 0.5W	3.3	12	FDA1254-3R3M Toko	CDEP145-3R5 Sumida
6	12	2 × 14mΩ, 0.5W	2.2	6	FDA1254-2R2M Toko	CDEP134-2R5 Sumida
16	12	2 × 18mΩ, 0.5W	2.2	12	FDA1254-2R2M Toko	CDEP134-2R5 Sumida
20	12	2 × 18mΩ, 0.5W	3.3	12	FDA1254-3R3M Toko	CDEP145-3R5 Sumida
5	16	2 × 14mΩ, 0.5W	2.2	4	FDA1254-2R2M Toko	CDEP134-2R5 Sumida
8	16	2 × 18mΩ, 0.5W	3.3	5	FDA1254-3R3M Toko	CDEP145-3R5 Sumida
12	16	2 × 22mΩ, 0.5W	3.3	6	FDA1254-3R3M Toko	CDEP145-3R5 Sumida
20	16	2 × 22mΩ, 0.5W	2.5	10	FDA1254-2R2M Toko	CDEP134-2R5 Sumida

* Note: Per the manufacturer's specification sheet, Toko FDA1254 inductors are not recommended for V_{IN} > 30V. Please visit Toko's website for more information.

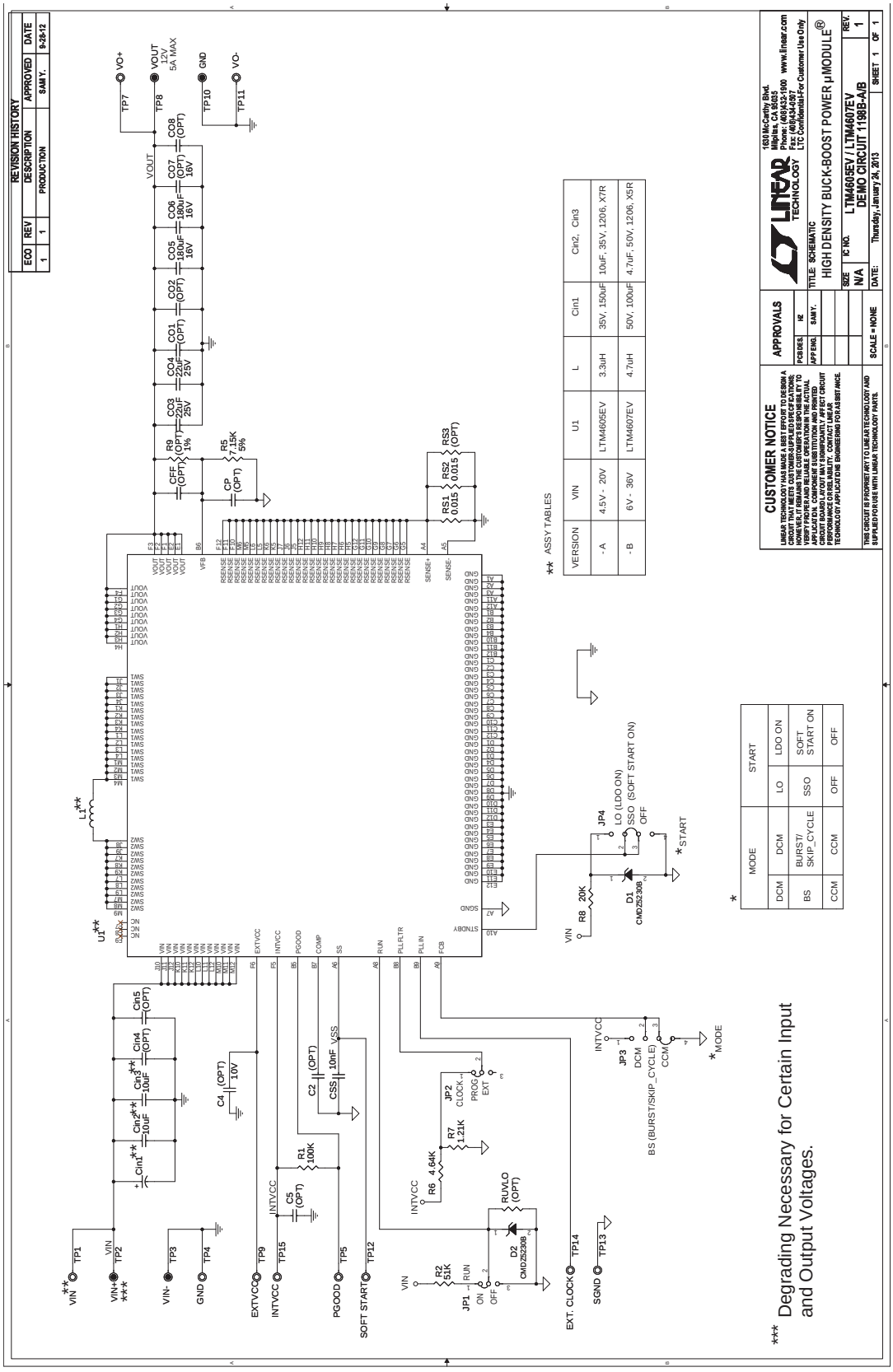
Table 2. R_{SENSE} Vendors

R_{SENSE} VENDOR	PART NUMBER
Vishay	Power Metal Strip Resistors WSL1206, 0.5W
Panasonic	Thick Film Chip Resistors ERJ12, 0.5W

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	C_{IN1}	Cap., Alum, 100µF, 20%, 50V	Sanyo 50ME100WXV+TS
2	2	C_{IN2}, C_{IN3}	Cap., X5R, 4.7µF, 10%, 50V, 1206	Taiyo Yuden UMK316BJ475KL-T
3	1	C_{SS}	Cap., X7R, 0.01µF, 25V, 10%, 0603	AVX 06033C103KAT4A
4	2	CO3, CO4	Cap., X7R, 22µF, 16V, 20%, 1812	TDK C4532X7R1C226M
5	2	CO5, CO6	Cap., OS-CON, 180µF, 16V	Sanyo 16SVP180MX
6	1	L1	Ind. Iron Power Smt Fixed, 4.7µH	Toko FD1254-4R7M
7	1	R5	Res., Chip, 7.15k, 1/16W, 1%, 0603	Vishay CRCW06037K15FKEA
8	1	R6	Res., Chip, 4.64k, 1/16W, 1%, 0603	Vishay CRCW06034K64FKEA
9	1	R7	Res., Chip, 1.21k, 1/16W, 1%, 0603	Vishay CRCW06031K21FKEA
10	2	RS1, RS2	Res., Chip, 0.015 1/2W, 1%, 1206	Vishay WSL1206R0150FEA
11	1	U1	IC, LTM4607EV#PBF, 15mm × 9mm × 2.3mm LGA	Linear Technology Corporation, LTM4607EV#PBF
Additional Demo Board Circuit Components				
1	0	C_{IN4}, C_{IN5} (Opt)	Cap., 1206	
2	0	C2, C4, C5, C_P, C_{FF} (Opt)	Cap., 0603	
3	0	CO1, CO2 (Opt)	Cap., SVP, 100µF, D3L	
4	0	CO7 (Opt)	Cap., 1206, 16V	
5	0	CO8 (Opt)	POSCAP, D3L	
6	2	D1, D2	Zener Diode, 4.7V	Central Semi., CMDZ5230B-7-F
7	1	R1	Res., Chip, 100k, 1/16W, 5%, 0603	Vishay, CRCW0603100KJNEA
8	1	R2	Res., Chip, 51k, 1/16W, 5%, 0603	Vishay, CRCW060351K0JNEA
9	1	R8	Res., Chip, 20k, 1/16W, 1%, 0603	Vishay, CRCW060320K0FKEA
10	1	RS3 (Opt)	Res.,1206	
11	1	R9, R_{UVLO} (Opt)	Res., 0603	
Hardware, for Demo Board Only				
1	2	JP1, JP2	2mm Single Row Header, 3 Pin	Samtec, TMM-103-02-L-S
2	2	JP3, JP4	2mm Single Row Header,, 4 Pin	Samtec, TMM-104-02-L-S
3	4	JP1, JP2, JP3, JP4	Shunt	Samtec, 2SN-BK-G
4	10	TP1, TP4, TP5, TP7, TP9, TP11-TP15	Testpoint, Turret, 0.095"	Mill-Max, 2501-2-00-80-00-00-07-0
5	4	TP2, TP3, TP8, TP10	Banana Jack	Keystone, 575-4
6	4	Stand-Off	Stand-Off, Nylon, 0.50" Tall	Keystone, 8833 (Snap On)

SCHEMATIC DIAGRAM



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This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

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