

LTM8054 36V_{IN}, 5.4A Buck-Boost μModule Regulator

DESCRIPTION

Demonstration circuit 2016A features the [LTM8054](#), a synchronous buck-boost μModule regulator that accepts input voltages lower, higher or the same as the output, but is also highly efficient due to its four-switch architecture. The output for DC2016A is 12V and the input voltage range is 6V to 35V – see the LTM8054 data sheet for application circuits with input voltages up to 36V. The maximum output current of DC2016A is 3A and the switching frequency is 600kHz.

DC2016A supports the adjustable and controllable features of the LTM8054 including output voltage and current regulation, switching frequency, RUN threshold, soft-start period, synchronization and reverse inductor current inhibit. In most cases, adjustment is made by modifying the appropriate resistor or capacitor component(s).

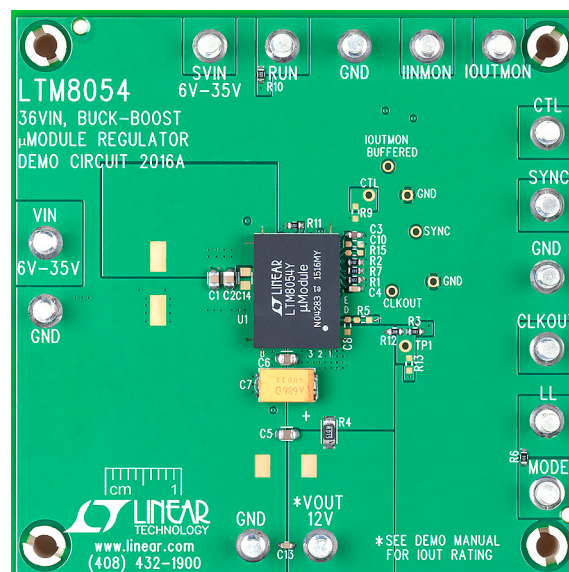
DC2016A provides output current monitoring and a clock output. Input current monitoring and regulation requires the installation of a current sense resistor. The SV_{IN} input for controller power can be made a diode-OR of power V_{IN} and the output voltage to extend the operating range of power V_{IN} to lower voltages. There are places to mount optional components that add an LC input filter and also a unity gain buffer to operate multiple DC2016As in parallel.

The LTM8054 data sheet must be read in conjunction with this demo manual to properly use or modify DC2016A.

Design files for this circuit board are available at <http://www.linear.com/demo/DC2016A>

LT, LTC, LTM, Linear Technology and the Linear logo are registered trademarks of Linear Technology Corporation. All other trademarks are the property of their respective owners.

BOARD PHOTO



DEMO MANUAL DC2016A

PERFORMANCE SUMMARY

Specifications are at $T_A = 25^\circ\text{C}$

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Minimum Input Voltage, V_{IN}				6	V
Maximum Input Voltage, V_{IN}		35			V
Maximum Output Current, I_{OUT}	$12\text{V} < V_{IN} < 35\text{V}$, CTL = OPEN $V_{IN} = 6\text{V}$, CTL = OPEN	3	1.8		A A
Input Turn-On Voltage, V_{IN}	R10 = 332k, R11 = 121k, V_{IN} Rising		5.5		V
Input Turn-Off Voltage, V_{IN}	R10 = 332k, R11 = 121k, V_{IN} Falling		4.5		V
Output Voltage, V_{OUT}	$100\text{mA} < I_{OUT} < 3\text{A}$ (See Figure 2), R2 = 11k 1%, R3 = 100k 1%, R4 = 0.015 Ω	11.7		12.5	V
Efficiency	$V_{IN} = 24\text{V}$, $I_{OUT} = 3\text{A}$		92		%
Switching Frequency	R1 = 36.5k		600		kHz
Output Current Limit	R4 = 0.015 Ω		3.6		A

QUICK START PROCEDURE

To use DC2016A to evaluate the performance of the LTM8054, refer to Figure 1 for the proper measurement equipment setup, Figure 2 for the maximum output current versus input voltage and then follow the procedure below:

NOTE: Do not hot-plug the V_{IN} terminal at high input voltages. The absolute maximum voltage rating for V_{IN} of the LTM8054 is 40V and hot-plugging a power supply through wire leads to the demonstration circuit can cause the voltage on the extremely low ESR ceramic input capacitor to ring to twice its DC value. In order to protect the LTM8054, an aluminum electrolytic capacitor with higher ESR is placed at the input terminals. This may protect against some, but not all, input transients due to a hot-plugged power supply. See Application Note 88 for more details.

NOTE: when measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly to terminals across

the V_{IN} or V_{OUT} capacitors. See Figure 3 for proper scope probe technique. Solder terminals near the input or output capacitors, if necessary.

1. Connect the RUN terminal to ground with a clip-on lead. Connect the power supply (with power off), load, and meters as shown in Figure 1.
2. After all connections are made, turn on the input power and verify that the input voltage is between 6V and 35V
3. Remove the clip-on lead from RUN. Verify that V_{OUT} is 12V.

NOTE: If V_{OUT} is too low, temporarily disconnect the load to make sure that the load is not set too high.

Once the proper output voltage is established, adjust the input voltage and load within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other parameters.

QUICK START PROCEDURE

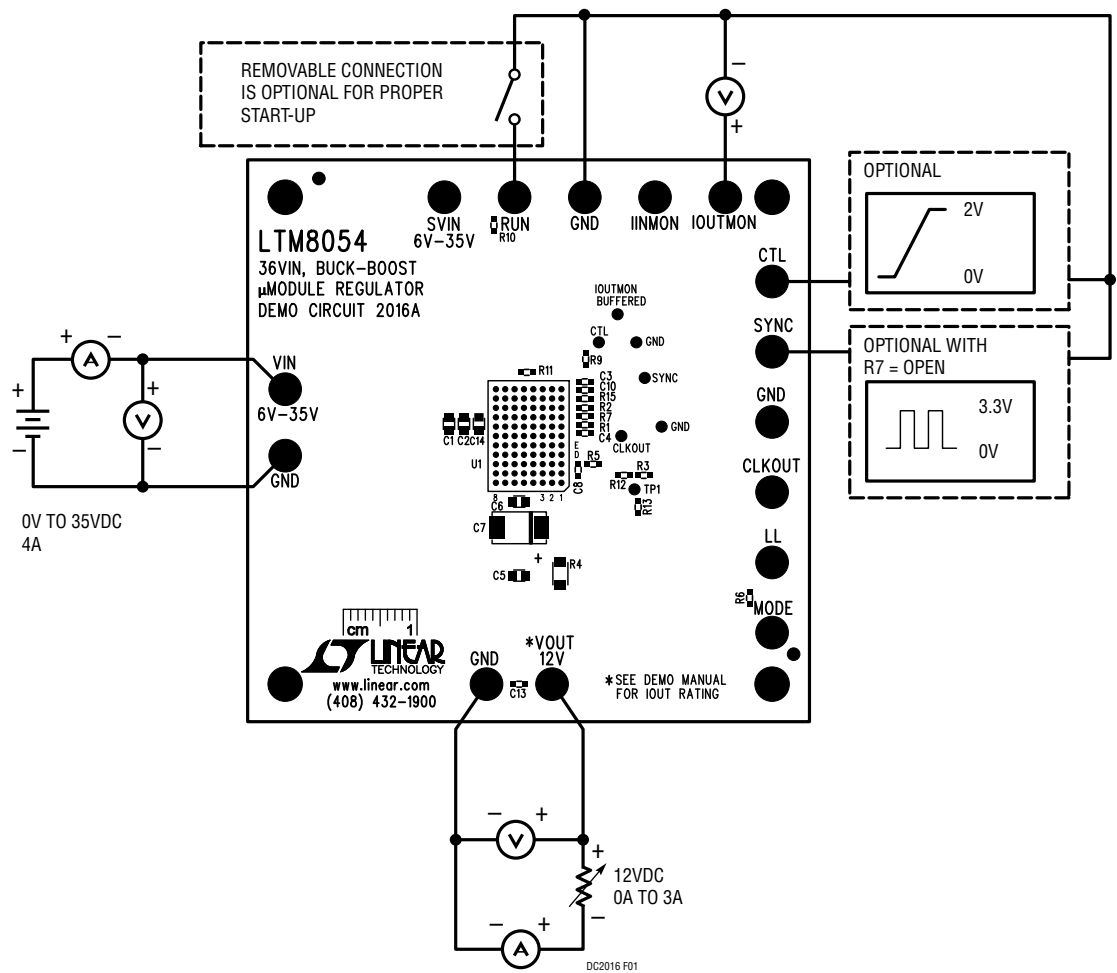


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

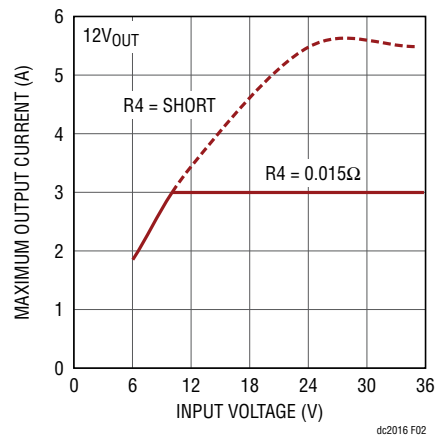


Figure 2. Maximum Output Current vs Input Voltage for $V_{OUT} = 12V$

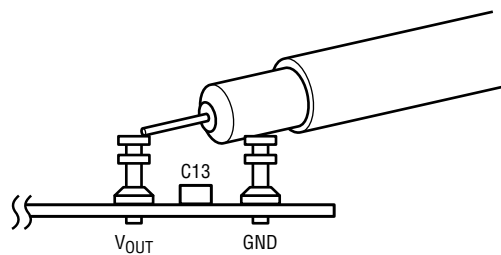


Figure 3. Proper Scope Probe Technique

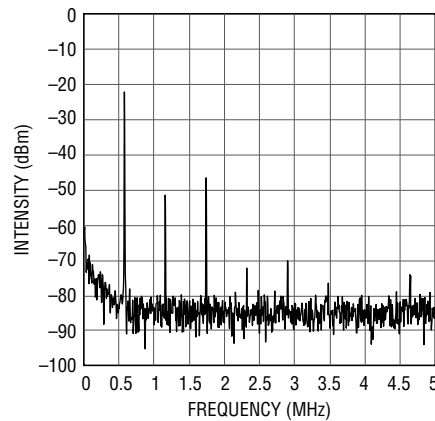


Figure 4. Conducted V_{OUT} Noise Spectrum Using HP 4395A Spectrum Analyzer and 41800A Active Probe. $V_{IN} = 24V$ and $V_{OUT} = 12V$ at 3A

DEMO MANUAL DC2016A

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	C1, C2	CAP., 4.7 μ F, X5R, 50V, 10%, 0805	SAMSUNG, CL21A475KBQNNNE
2	1	C3	CAP., 0.22 μ F, X7R, 16V, 10%, 0603	TDK, C1608X7R1C224K080AC
3	1	C4	CAP., 0.01 μ F, X7R, 16V, 10%, 0603	MURATA, GRM188R71C103KA01D
4	2	C5, C6	CAP., 22 μ F, X5R, 25V, 20%, 0805	SAMSUNG, CL21A226MAQNNNE
5	1	C7	CAP., TANT. POLYMER, 68 μ F, 20V, 20%, 7343	AVX, TCJD686M020R0055
6	1	R1	RES., 36.5k, 1%, 1/10W, 0603	VISHAY, CRCW060336K5FKEA
7	1	R2	RES., 11k, 1%, 1/10W, 0603	VISHAY, CRCW060311K0FKEA
8	1	R3	RES., 100k, 1%, 1/10W, 0603	VISHAY, CRCW0603100KFKEA
9	1	R4	RES., SENSE, 0.015 Ω , 1%, 1/2W, 1206	VISHAY, WSL1206R0150FEA
10	1	U1	IC, 36V _{IN} Buck-Boost μ Module Regulator	LINEAR TECH., LTM8054EY#PBF
Optional Demo Board Circuit Components				
1	0	C8, C10, C15, C16(OPT)	CAP., 0603	
2	1	C9	CAP., ALUM. ELECT., 100 μ F, 50V, 20%, 8mm x 10.2mm	SUN ELECT., 50CE100LX
3	0	C11, C12(OPT)	CAP., 1210	
4	1	C13	CAP., 0.1 μ F, X7R, 16V, 10%, 0603	MURATA, GRM188R71C104KA01D
5	0	C14(OPT)	CAP., 0805	
6	0	D1, D2(OPT)	DIODE, OPTION, SOD-123	
7	0	L1, L2(OPT)	INDUCTOR, 8mm DIA.	
8	0	R5, R9, R13, R14, R15(OPT)	RES., CHIP, 0603	
9	2	R6, R7	RES., 0 Ω , 1/10W, 0603	VISHAY, CRCW0603000Z0EA
10	0	R8(OPT)	RES., OPTION, 1206	
11	1	R10	RES., 332k, 1%, 1/10W, 0603	VISHAY, CRCW0603332KFKEA
12	1	R11	RES., 121k, 1%, 1/10W, 0603	VISHAY, CRCW0603121KFKEA
13	1	R12	RES., 20 Ω , 5%, 1/10W, 0603	VISHAY, CRCW060320R0JNEA
14	0	U2(OPT)	IC, R-R I/O OP AMP, MSOP-8	LINEAR TECH., LT1636CMS8#PBF
Hardware				
1	15	E1-E15	TESTPOINT, TURRET, .094" MTG. HOLE	MILL-MAX, 2501-2-00-80-00-00-07-0
2	4	MH1-MH4	STANDOFF, NYLON, SNAP-ON, 0.500"	KEystone, 8833



DEMO MANUAL DC2016A

DEMONSTRATION BOARD IMPORTANT NOTICE

Linear Technology Corporation (LTC) provides the enclosed product(s) under the following **AS IS** conditions:

This demonstration board (DEMO BOARD) kit being sold or provided by Linear Technology is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not provided by LTC for commercial use. As such, the DEMO BOARD herein may not be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including but not limited to product safety measures typically found in finished commercial goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may or may not meet the technical requirements of the directive, or other regulations.

If this evaluation kit does not meet the specifications recited in the DEMO BOARD manual the kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY THE SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THIS INDEMNITY, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user releases LTC from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge. Also be aware that the products herein may not be regulatory compliant or agency certified (FCC, UL, CE, etc.).

No License is granted under any patent right or other intellectual property whatsoever. **LTC assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or any other intellectual property rights of any kind.**

LTC currently services a variety of customers for products around the world, and therefore this transaction **is not exclusive**.

Please read the DEMO BOARD manual prior to handling the product. Persons handling this product must have electronics training and observe good laboratory practice standards. **Common sense is encouraged.**

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

Mailing Address:

Linear Technology
1630 McCarthy Blvd.
Milpitas, CA 95035

Copyright © 2004, Linear Technology Corporation

dc2016af