

LTM4649EY

10A Step-Down μ Module[®] Regulator

DESCRIPTION

Demonstration circuit 1856B-B features the LTM[®]4649EY μ Module regulator, a high-performance high efficiency step-down regulator. The LTM4649EY has an operating input voltage range of 4.5V to 16V and is able to provide an output current of up to 10A. The output voltage is programmable from 0.6V to 3.3V and can be remotely sensed with the internal differential remote sensing amplifier. The LTM4649EY is a complete DC-DC point of load regulator in a thermally enhanced 15mm x 9mm x 4.92mm BGA package requiring

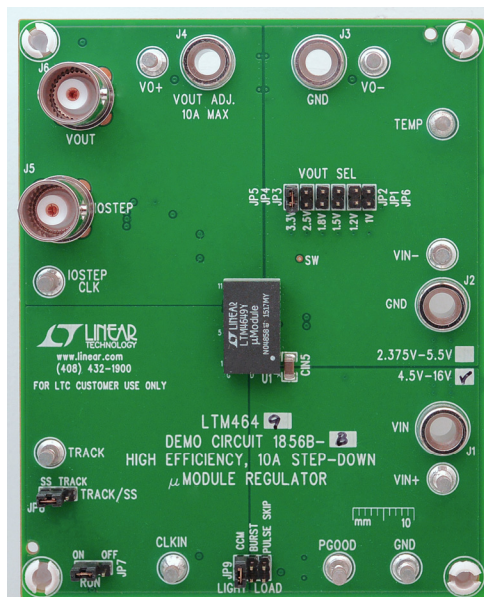
only a few input and output capacitors. Output voltage tracking is available through the TRACK/SS pin for supply rail sequencing. External clock synchronization is also available through the CLKIN pin. The LTM4649 datasheet must be read in conjunction with this demo manual for working on or modifying demo circuit 1856B-B.

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

Table 1. Performance Summary

PARAMETER	CONDITIONS / NOTES	VALUE
Input Voltage Range		4.5V – 16V
Output Voltage V_{OUT}	Jumper selectable	1.0V _{DC} , 1.2V _{DC} , 1.5V _{DC} , 1.8V _{DC} , 2.5V _{DC} , 3.3V _{DC}
Maximum Continuous Output Current	De-rating is necessary for certain operating conditions. See datasheet for details	10A _{DC}
Default Operating Frequency		450kHz
External Clock Sync. frequency range		250kHz – 800kHz
Efficiency	$V_{IN} = 12V, V_{OUT} = 1.8V, I_{OUT} = 10A$	89% See Figure 2

DEMO BOARD PHOTO



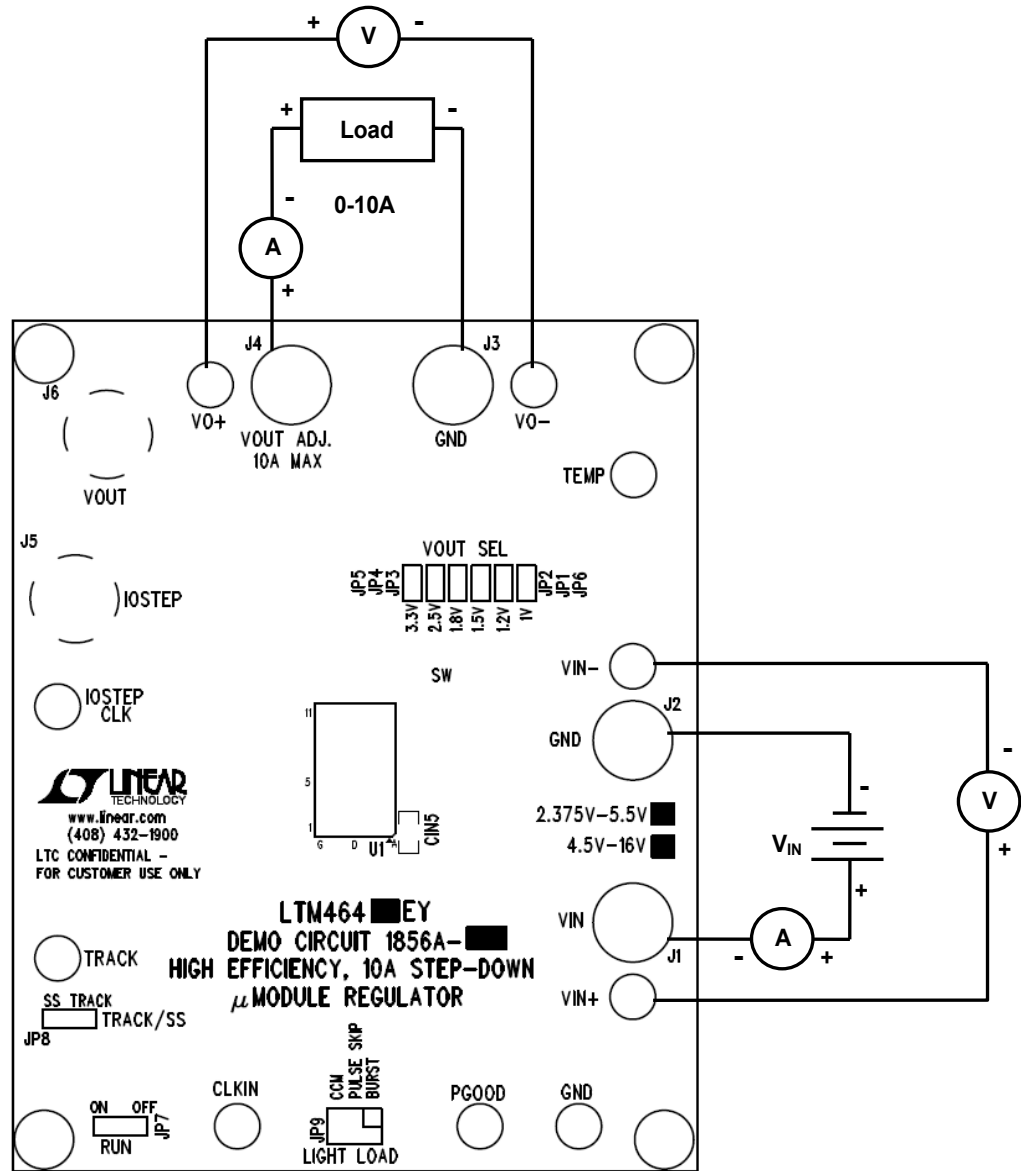
QUICK START PROCEDURE

Demonstration circuit 1856B-B is an easy way to evaluate the performance of the LTM4649EY. Please refer to Figure 1 for test setup connections and follow the procedure below.

1. With power off, place the jumpers in the following positions for a typical 1.8V_{out} application:

JP8	JP7	JP9	JP2
TRACK/SS	RUN	MODE	V_{OUT} Select
SS	ON	CCM	1.8V

2. Before connecting input supply, load and meters, pre-set the input voltage supply to be between 4.5V to 16V. Pre-set the load current to 0A.
3. With power off, connect the load, input voltage supply and meters as shown in Figure 1.
4. Turn on input power supply. The output voltage meter should display the selected output voltage $\pm 2\%$.
5. Once the proper output voltage is established, adjust the load current within the 0-10A range and observe the load regulation, efficiency, and other parameters. Output voltage ripple should be measured at J6 with a BNC cable and oscilloscope.
6. To observe increased light load efficiency place the Mode pin jumper (JP9) in the Burst Mode position. To observe increased light load efficiency with a reduced output ripple as compared to Burst Mode[®] place the Mode pin jumper in the Pulse skip position.
7. For optional load transient testing apply an adjustable positive pulse signal between IOSTEP CLK and GND pins. The pulse amplitude sets the load step current amplitude. The pulse width should be short ($< 1\text{ms}$) and pulse duty cycle should be low ($< 15\%$) to limit the thermal stress on the load transient circuit. The load step current can be monitored with a BNC connected to J5 (10mV/A).



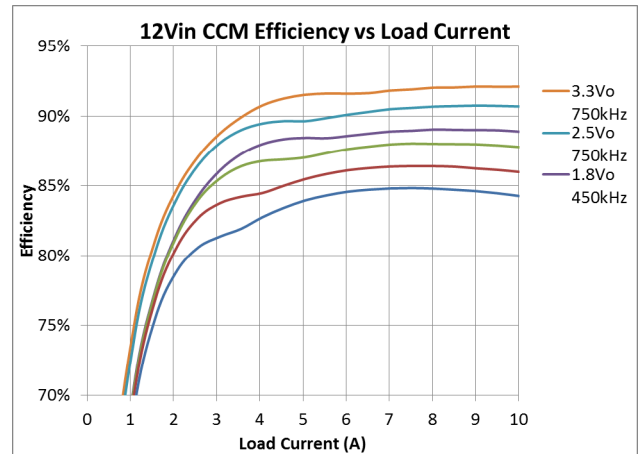
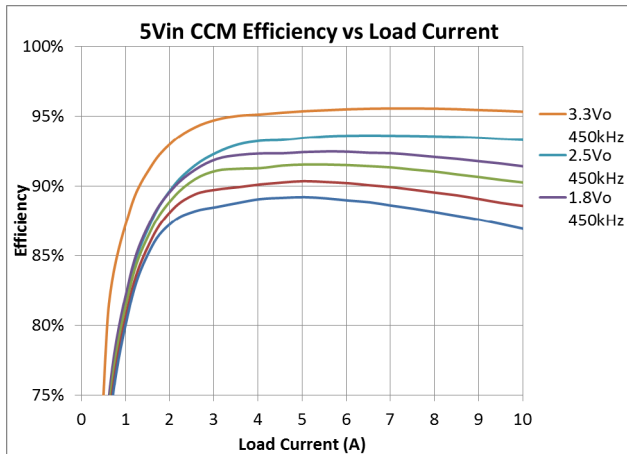
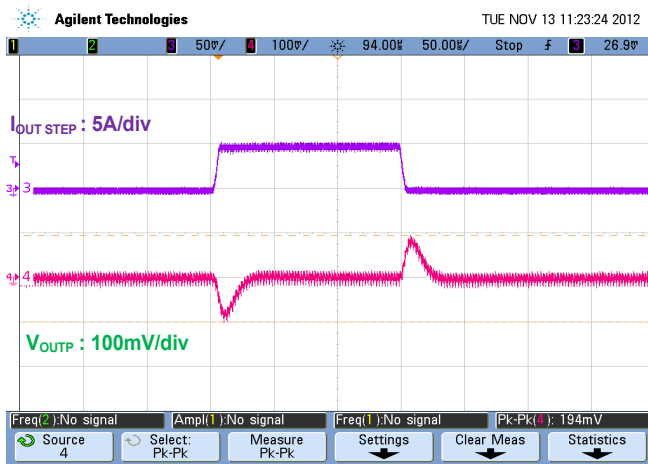
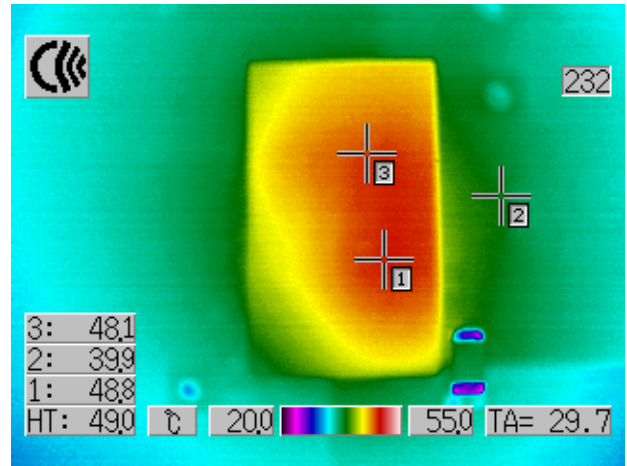


Figure 2. Measured Supply Efficiency at 5Vin & 12Vin



V_{in} (V)	V_{out} (V)	C_{out} Ceramic
12	1.5	2x220uF/4V Ceramic

Figure 3. Measured load transient response (5A-10A load step)



V_{in} (V)	V_{out} (V)	I_{out} (A)	Airflow	Ambient (°C)
12	1.5	10	Natural Convection	29.7

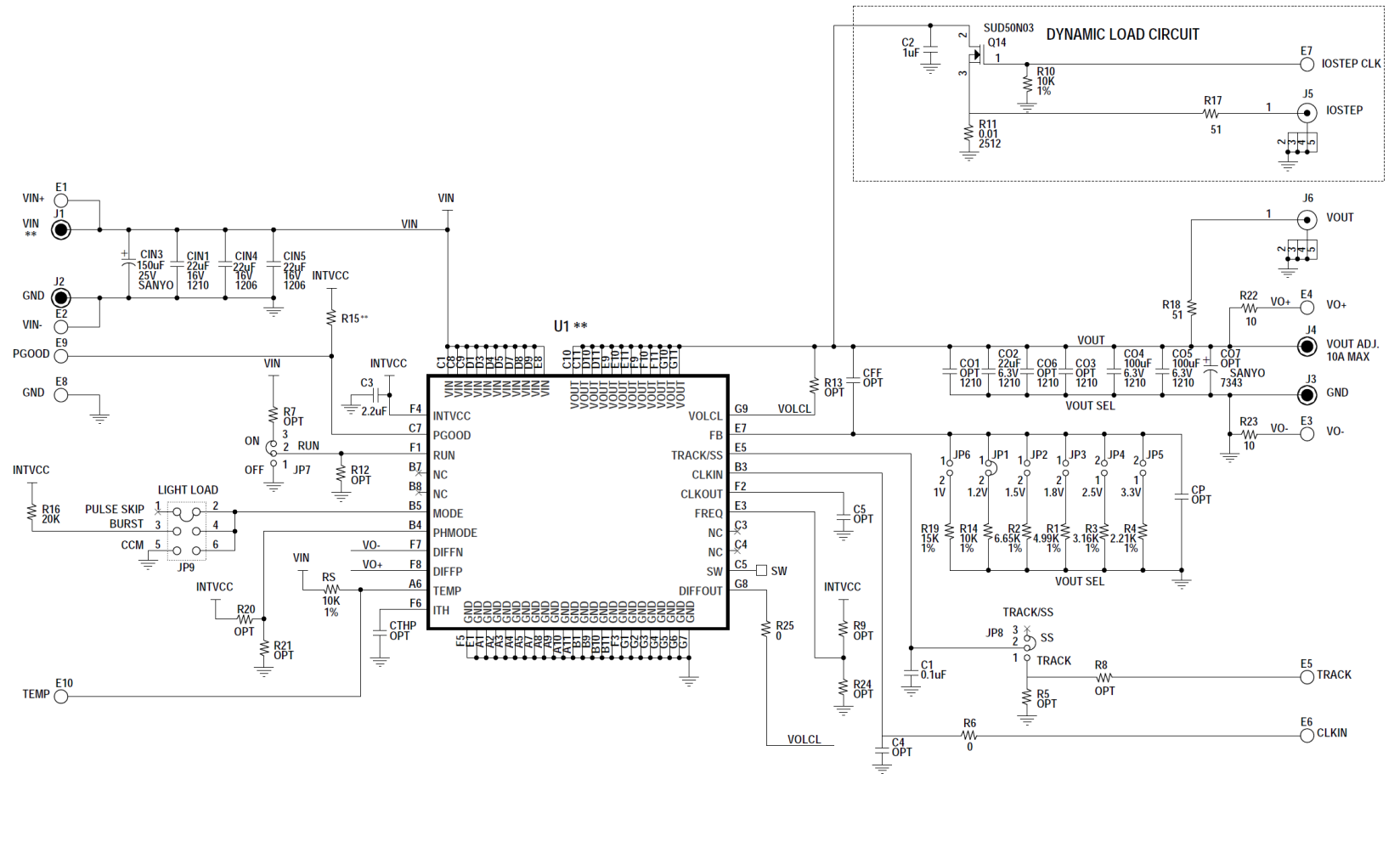
Figure 4. Measured thermal capture

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	CO4,CO5	CAP, 100 μ F, 20%, 6.3V, X5R,1210	AVX, 12106D107MAT2A
2	1	CO2	CAP, 22 μ F, 20%, 6.3V, X5R,1210	AVX, 12106D226MAT2A
3	1	CIN1	CAP, 22 μ F, 20%, 16V, X7R,1210	MURATA, GRM32ER71C226KE18L
4	1	CIN3	CAP, 150 μ F, 10%, 25V, OS-CON	SUN ELECT., 25HVH150MT
5	2	CIN4,CIN5	CAP, 22 μ F, 20%, 16V, X5R,1206	TAIYO YUDEN, EMK316BJ226ML-T
6	2	R22,R23	RES, 10 Ω , 5%, 1/10W, 0603	VISHAY, CRCW060310R0JNEA
7	1	R19	RES, 15k Ω , 1%, 1/10W, 0603	VISHAY, CRCW060315K0FKEA
8	1	C1	CAP, 0.1 μ F, 20%, 25V, X7R, 0603	AVX, 06033C104MAT2A
9	1	C3	CAP, 2.2 μ F, 20%, 10V, X5R, 0603	TAIYO YUDEN, LMK107BJ225MA-T
10	1	U1	I.C., POWER MODULE	LINEAR TECH., LTM4649EY
Additional Demo Board Circuit Components				
1	0	CO7	CAP, OPTION, 7343	OPTION
2	0	CO1,CO3,CO6	CAP, OPTION,1210	OPTION
3	1	C2	CAP, 1 μ F, 20%, 10V, X5R, 0603	TAIYO YUDEN, LMK107BJ105MA-T
4	0	C4,C5,CTHP,CP,CFF	CAP, OPTION, 0603	OPTION
5	1	R11	RES, 0.01 Ω , 5%, 1W, 2512	PANASONIC, ERJ-M1WSF10MU
6	3	R10,R14,RS	RES, 10k Ω , 1%, 1/10W, 0603	VISHAY, CRCW060310K0FKEA
7	1	R16	RES, 20k Ω , 5%, 1/10W, 0603	VISHAY, CRCW060320K0JNEA
8	2	R17,R18	RES, 51 Ω , 5%, 1/10W, 0603	VISHAY, CRCW060351R0JNEA
9	1	R15	RES, OPTION, 0603	OPTION
10	1	R1	RES, 4.99k Ω , 1%, 1/10W, 0603	VISHAY, CRCW06034K99FKEA
11	1	R2	RES, 6.65k Ω , 1%, 1/10W, 0603	VISHAY, CRCW06036K65FKEA
12	1	R3	RES, 3.16k Ω , 1%, 1/10W, 0603	VISHAY, CRCW06033K16FKEA
13	1	R4	RES, 2.21k Ω , 1%, 1/10W, 0603	VISHAY, CRCW06032K21FKEA
14	0	R5,R7,R8,R9,R12,R13,R20,R21,R24	RES, OPTION, 0603	OPTION
15	2	R6,R25	RES, 0 Ω , JUMPER, 0603	VISHAY, CRCW06030000Z0EA
16	1	Q14	XSTR, MOSFET, N-CHANNEL,30V	VISHAY, SUD50N04-8M8P-4GE3
Hardware				
1	10	E1-E10	TESTPOINT, TURRET 0.094"	MILL MAX, 2501-2-00-80-00-00-07-0
2	6	JP1,JP2,JP3,JP4,JP5,JP6	HEADER, 2PIN, 2mm	SULLIN, NRPNO21PAEN-RC
3	2	JP7,JP8	HEADER, 3PIN, 2mm	SULLIN, NRPNO31PAEN-RC
4	1	JP9	HEADER, 3X2 2mm	SULLIN, NRPNO32PAEN-RC
5	4	J1,J2,J3,J4	JACK, BANANA	KEYSTONE, 575-4
6	2	J5,J6	CONN,BNC,5 PINS	CONNEX, 112404
7	4	XJP1,XJP7,XJP8,XJP9	SHUNT, 2mm	SAMTEC, 2SN-BK-G
8	4		STANDOFF, SNAP ON	KEYSTONE_8834

LTM4649EY

REVISION HISTORY				
ECO	REV	DESCRIPTION	APPROVED	DATE
-	1	REBUILD WITH CHANGE	SY	08-24-15



**	ASSY	U1	R15	VIN
-A	LTM4648EY	100K	2.375V - 5.5V	
-B	LTM4649EY	OPT	4.5V - 16V	

NOTE: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS AND CAPACITORS ARE 0603.

CUSTOMER NOTICE
LINEAR TECHNOLOGY HAS MADE A BEST EFFORT TO DESIGN A CIRCUIT THAT MEETS CUSTOMER-SUPPLIED SPECIFICATIONS; HOWEVER, IT REMAINS THE CUSTOMER'S RESPONSIBILITY TO VERIFY PROPER AND RELIABLE OPERATION IN THE ACTUAL APPLICATION. COMPONENT SUBSTITUTION AND PRINTED CIRCUIT BOARD LAYOUT MAY SIGNIFICANTLY AFFECT CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE.

THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.

APPROVALS	
PCB DES.	LT
APP ENG.	SY
SCALE	NONE

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LINEAR TECHNOLOGY

TITLE: SCHEMATIC
HIGH EFFICIENCY, 10A STEP-DOWN μMODULE REGULATOR

SIZE	IC NO.	LTM4648EY / LTM4649EY	REV.
N/A		DEMO CIRCUIT 1856B	1

DATE: Monday, August 24, 2015 SHEET 1 OF 1