# LTM4649EY
# 10A Step-Down µModule Regulator

## DESCRIPTION

Demonstration circuit 1856A-B features the LTM®4649EY µModule® 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 5V 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 × 9mm × 5.01mm 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 data sheet must be read in conjunction with this demo manual prior to working on or modifying demo circuit 1856A-B.

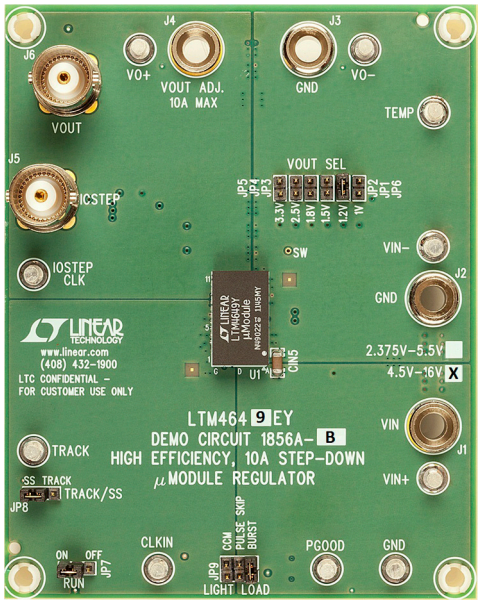
**Design files for this circuit board are available at http://www.linear.com/demo**



## PERFORMANCE SUMMARY ($T_A$ = 25°C)

| PARAMETER | CONDITIONS/NOTES | VALUE |
|---|---|---|
| Input Voltage Range | | 4.5V to 16V |
| Output Voltage $V_{OUT}$ | Jumper Selectable | 1.0VDC, 1.2VDC, 1.5VDC, 1.8VDC, 2.5VDC, 3.3VDC |
| Maximum Continuous Output Current | Derating is Necessary for Certain Operating Conditions. See Data Sheet for Details | 10ADC |
| Default Operating Frequency | | 450kHz |
| External Clock Synchronous Frequency Range | | 250kHz to 780kHz |
| Efficiency | $V_{IN}$ = 12V, $V_{OUT}$ = 1.8V, $I_{OUT}$ = 10A | 89% See Figure 2 |

## BOARD PHOTO




dc1856a-bf

## QUICK START PROCEDURE

Demonstration circuit 1856A-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 1.8$V_{OUT}$ 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, preset the input voltage supply to be between 4.5V to 16V. Preset 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 ±2%.
5. Once the proper output voltage is established, adjust the load current within the 0A to 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 operation place the Mode pin jumper in the pulse-skipping 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 (<1ms) 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).

Note: To evaluate PGOOD pin operation for the LTM4649, insert a 100k resistor between PGOOD and INTVCC. Do not stuff R15.

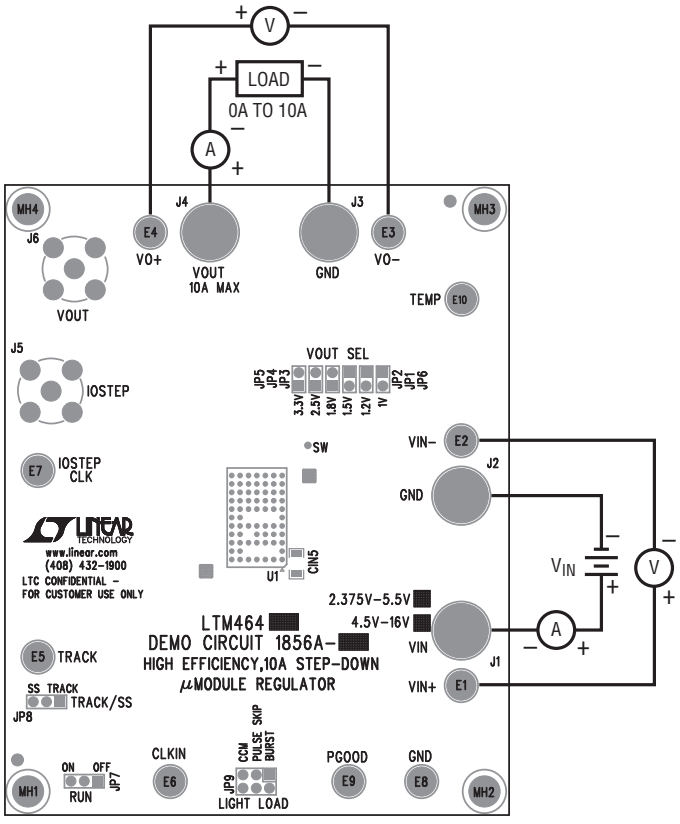



**Figure 1. Test Setup of DC1856A-B**

## QUICK START PROCEDURE

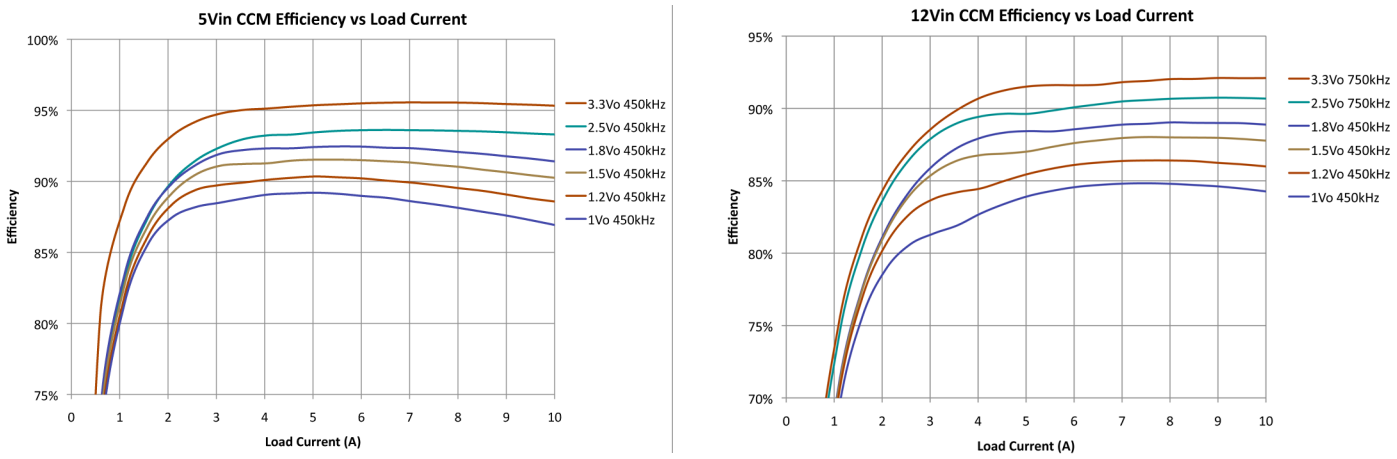
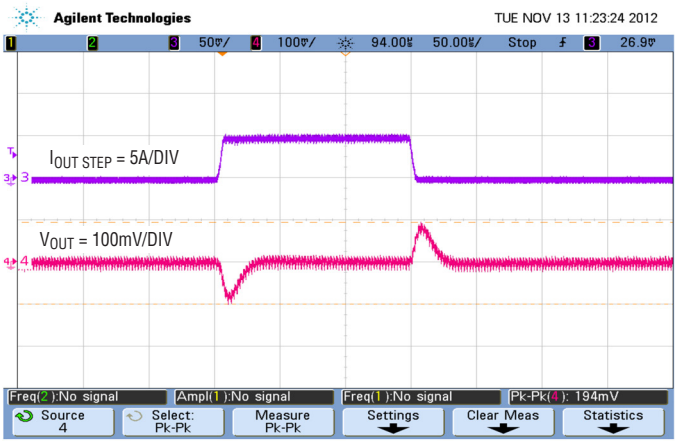
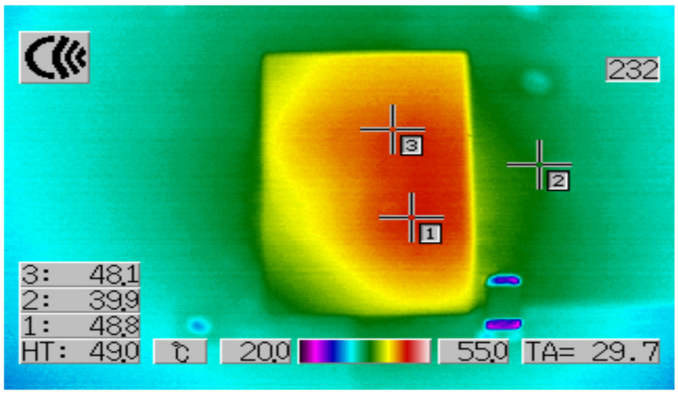



**Figure 2. Measured Supply Efficiency at$5V_{IN}$ and $12V_{IN}$**




| $V_{IN}$ (V) | $V_{OUT}$ (V) | $C_{OUT}$ CERAMIC |
|---|---|---|
| 12 | 1.5 | 2 × 220µF/4V Ceramic |

**Figure 3. Measured Load Transient Response (5A to 10A Load Step)**



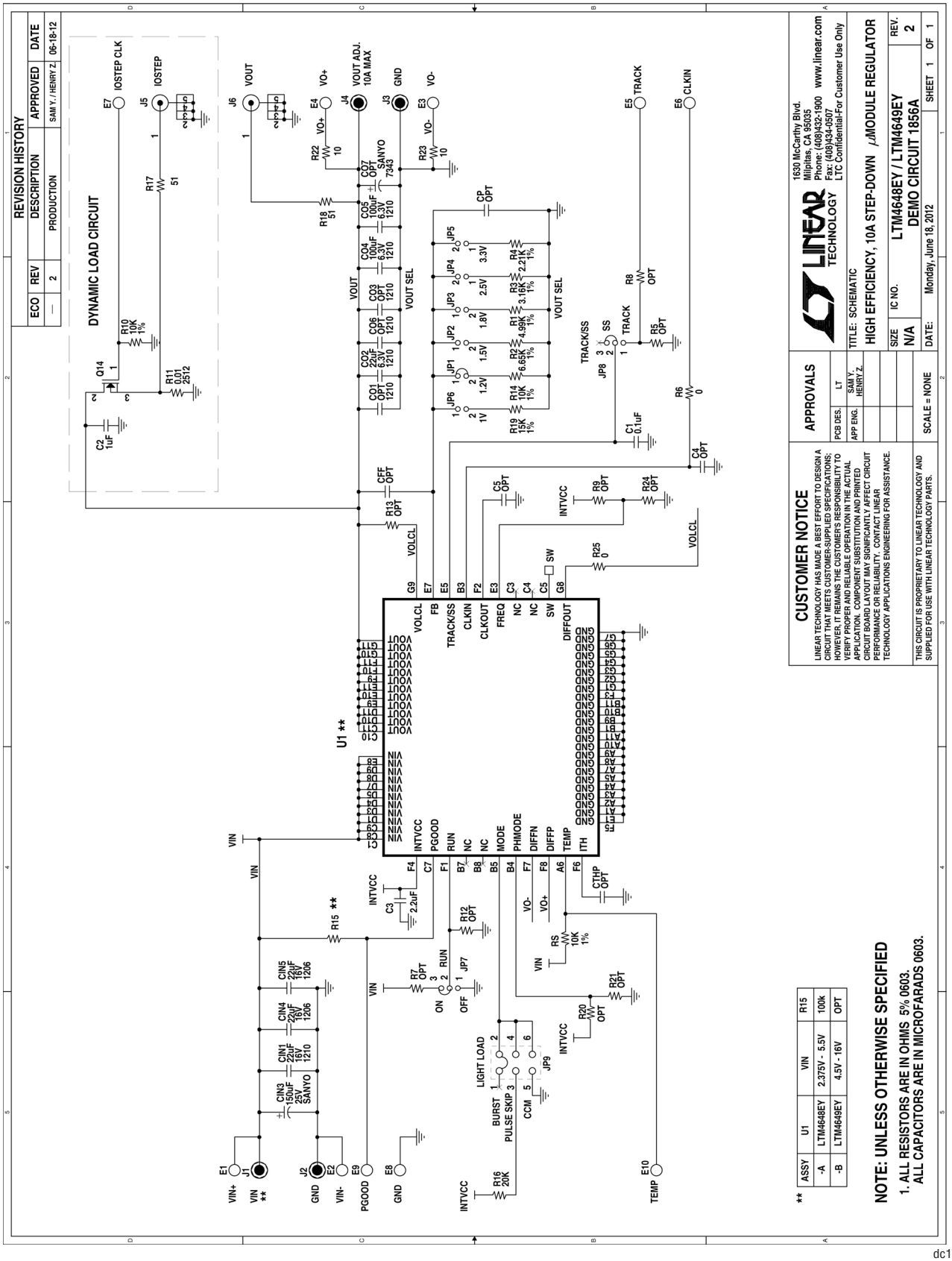

| $V_{IN}$ (V) | $V_{OUT}$ (V) | $I_{OUT}$ (A) | AIRFLOW | AMBIENT (°C) |
|---|---|---|---|---|
| 12 | 1.5 | 10 | Natural Convection | 29.7 |

**Figure 4. Measured Thermal Capture**

## PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|---|---|---|---|---|
| **Required Circuit Components** | | | | |
| 1 | 2 | CO4, CO5 | CAP, 100µF 20% 6.3V X5R 1210 | AVX 12106D107MAT2A |
| 2 | 1 | CO2 | CAP, 22µF 20% 6.3V X5R 1210 | AVX 12106D226MAT2A |
| 3 | 1 | CIN1 | CAP, 22µF 20% 16V X7R 1210 | MURATA, GRM32ER71C226KE18L |
| 4 | 1 | CIN3 | CAP, 150µF 10% 25V OS-CON | SANYO, 25HVH150MT |
| 5 | 2 | CIN4, CIN5 | CAP, 22µF 20% 16V X5R 1206 | TAIYO YUDEN, EMK316BJ226ML-T |
| 6 | 2 | R22, R23 | RES, 0603 10Ω 5% 1/10W | VISHAY CRCW060310R0JNEA |
| 7 | 1 | R19 | RES, 0603 1% 1/10W | OPTION |
| 8 | 1 | C1 | CAP, 0.1µF 20% 25V X7R 0603 | AVX 06033C104MAT2A |
| 9 | 1 | C3 | CAP, 2.2µF 20% 10V X5R 0603 | TAIYO YUDEN LMK107BJ225MA-T |
| 10 | 1 | U1 | I.C., LOW VOLTAGE POWER MODULE | LINEAR TECH. LTM4649 |
| **Additional Demo Board Circuit Components** | | | | |
| 1 | 0 | CO7 | CAP, OPTION POSCAP 7343 | OPTION |
| 2 | 0 | CO1, CO3, CO6 | CAP, OPTION 1210 | OPTION |
| 3 | 1 | C2 | CAP, 1µF 20% 10V X5R 0603 | TAIYO YUDEN LMK107BJ105MA-T |
| 4 | 0 | C4, C5, CTHP, CP, CFF | CAP, OPTION 0603 | OPTION |
| 5 | 1 | R11 | RES, 2512 0.01Ω 5% 1W | PANASONIC ERJ-M1WSF10MU |
| 6 | 2 | R10, RS, R14 | RES, 0603 10k 1% 1/10W | VISHAY CRCW060310K0FKEA |
| 7 | 1 | R16 | RES, 0603 20k 5% 1/10W | VISHAY CRCW060320K0JNEA |
| 8 | 2 | R17, R18 | RES, 0603 51Ω 5% 1/10W | VISHAY CRCW060351R0JNEA |
| 9 | 1 | R15 | RES, 0603 OPTION | OPTION |
| 10 | 1 | R1 | RES, 0603 4.99k 1% 1/10W | VISHAY CRCW06034K99FKEA |
| 11 | 1 | R2 | RES, 0603 6.65k 1% 1/10W | VISHAY CRCW06036K65FKEA |
| 12 | 1 | R3 | RES, 0603 3.16k 1% 1/10W | VISHAY CRCW06033K16FKEA |
| 13 | 1 | R4 | RES, 0603 2.21k 1% 1/10W | VISHAY CRCW06032K21FKEA |
| 14 | 0 | R5, R7, R8, R9, R12, R13, R20, R21, R24 | RES, 0603 OPTION | OPTION |
| 15 | 2 | R6,R25 | RES, 0603 0Ω JUMPER | VISHAY CRCW06030000Z0EA |
| 16 | 1 | Q14 | XSTR, SUD50N03-09P MOSFET | SILICONIX SUD50N03-09P-GE3 |
| **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, 2-PIN, 2mm | SAMTEC TMM 102-02-L-S |
| 3 | 2 | JP7, JP8 | HEADER, 3-PIN, 2mm | SAMTEC TMM-103-02-L-S |
| 4 | 1 | JP9 | HEADER, 3X2 2mm | SAMTEC TMM-103-02-L-D |
| 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 |

## SCHEMATIC DIAGRAM

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