# LTM4649EY
# High Efficiency 10A
# Step-Down µModule Regulator

## DESCRIPTION

Demonstration circuit 1856B-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 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 × 9mm × 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 data sheet 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 http://www.linear.com/demo/DC1856B-B**

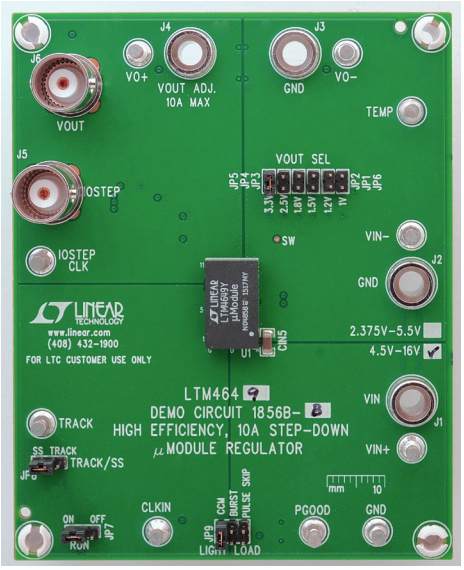


## PERFORMANCE SUMMARY

**Specifications are at $T_A$ = 25°C**

| PARAMETER | CONDITIONS | VALUE |
|---|---|---|
| Input Voltage Range | | 4.5V TO 16V |
| Output Voltage $V_{OUT}$ | Jumper Selectable | $1V_{DC}$, $1.2V_{DC}$, $1.5V_{DC}$, $1.8V_{DC}$, $2.5V_{DC}$, $3.3V_{DC}$ |
| Maximum Continuous Output Current | Derating is Necessary for Certain Operating Conditions. See Data Sheet for Details | $10A_{DC}$ |
| Default Operating Frequency | | 450kHz |
| External Clock Sync. Frequency Range | | 250kHz TO 800kHz |
| Efficiency | $V_{IN}$ = 12V, $V_{OUT}$ = 1.8V, $I_{OUT}$ = 10A | 89% See Figure 2 |

## 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 1.8$V_{OUT}$ 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® operation 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).

## QUICK START PROCEDURE

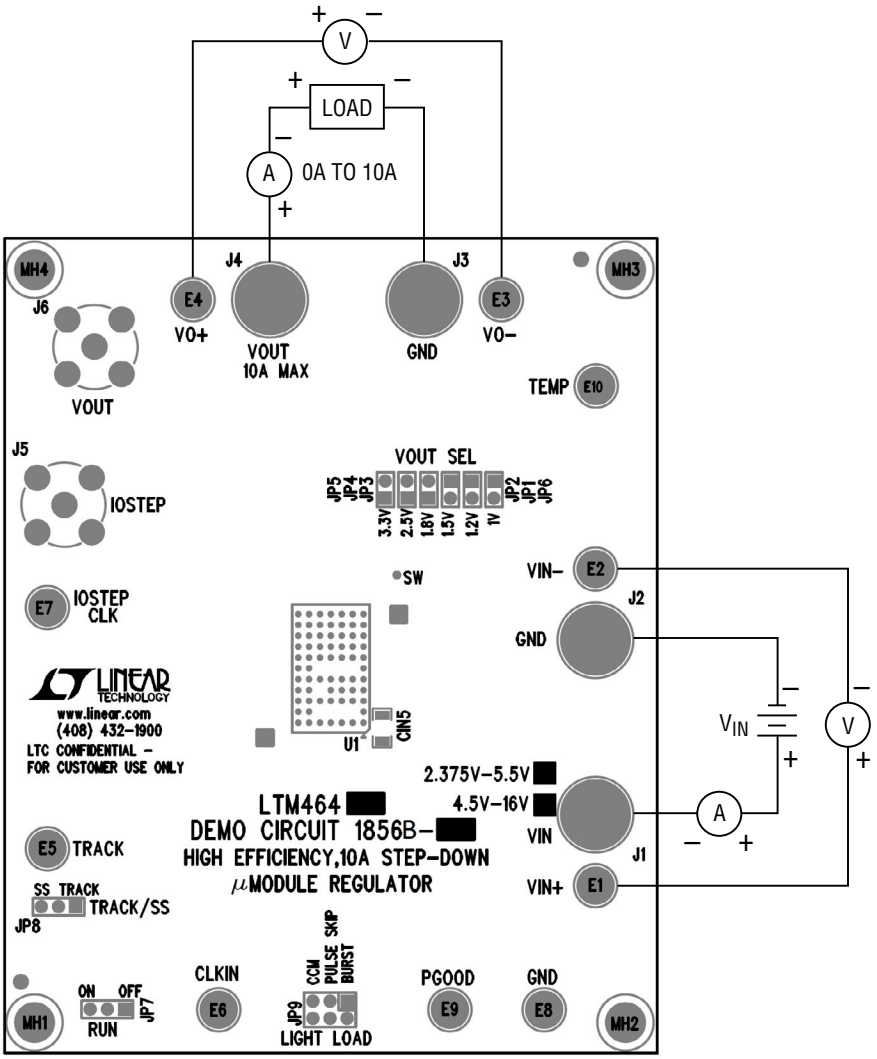



**Figure 1. Test Setup of DC1856B-B**

## QUICK START PROCEDURE

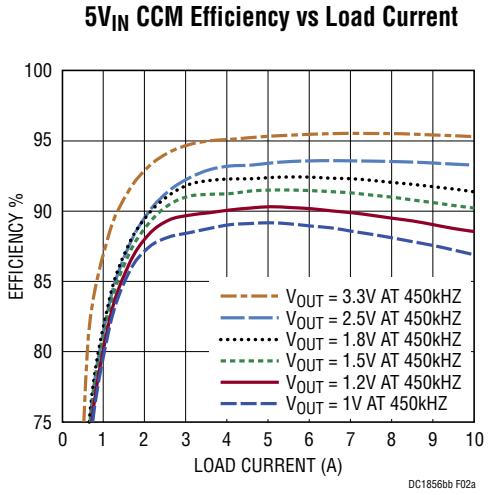
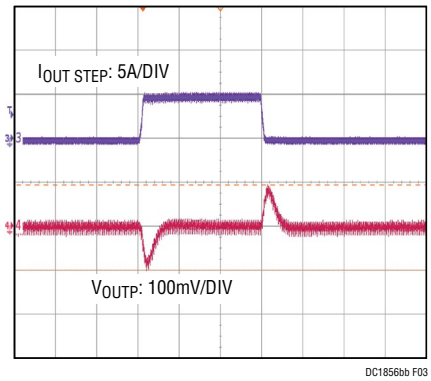


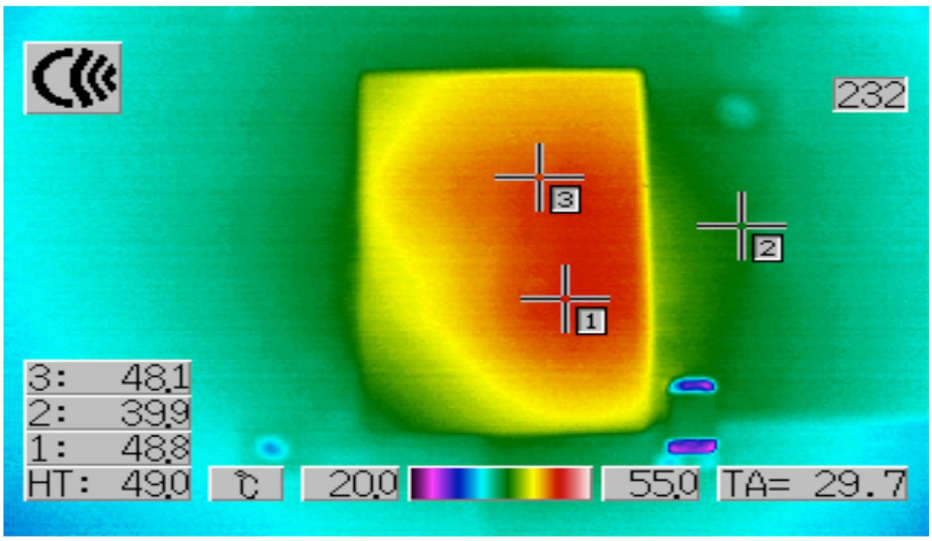

**Figure 2. Measured Supply Efficiency at $5V_{IN}$ and $12V_{IN}$**

## QUICK START PROCEDURE




| $V_{IN}$ (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)**



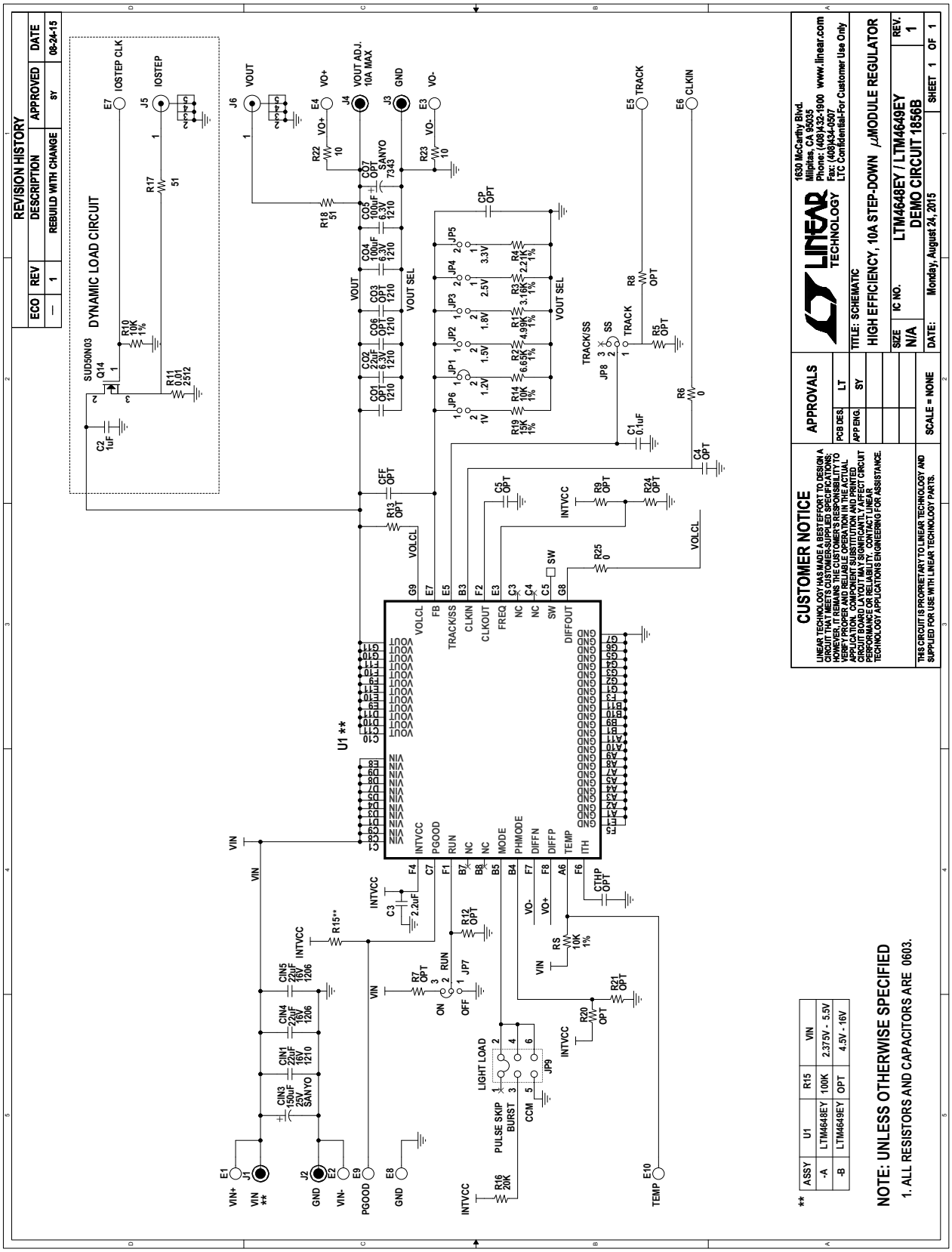

| $V_{IN}$ (V) | $V_{OUT}$ (V) | $I_{OUT}$ (A) | AIRFLOW | AMBIENT (°C) |
|---|---|---|---|---|
| 1.2 | 1.5 | 10 | Natural Convection | 29.7 |

**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 | SUN ELECT, 25HVH150MT |
| 5 | 2 | CIN4, CIN5 | CAP, 22µF, 20%, 16V, X5R, 1206 | TAIYO YUDEN, EMK316BJ226ML-T |
| 6 | 2 | R22, R23 | RES, 10Ω, 5%, 1/10W, 0603 | VISHAY, CRCW060310R0JNEA |
| 7 | 1 | R19 | RES, 15kΩ, 1%, 1/10W, 0603 | VISHAY, CRCW060315K0FKEA |
| 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 | IC, POWER MODULE | LINEAR TECHNOLOGY, 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, 1µF, 20%, 10V, X5R, 0603 | TAIYO YUDEN, LMK107BJ105MA-T |
| 4 | 0 | C4, C5, CTHP, CP, CFF | CAP, OPTION, 0603 | OPTION |
| 5 | 1 | R11 | RES, 0.01Ω, 5%, 1W, 2512 | PANASONIC, ERJ-M1WSF10MU |
| 6 | 3 | R10, R14, RS | RES, 10kΩ, 1%, 1/10W, 0603 | VISHAY, CRCW060310K0FKEA |
| 7 | 1 | R16 | RES, 20kΩ, 5%, 1/10W, 0603 | VISHAY, CRCW060320K0JNEA |
| 8 | 2 | R17, R18 | RES, 51Ω, 5%, 1/10W, 0603 | VISHAY, CRCW060351R0JNEA |
| 9 | 1 | R15 | RES, OPTION, 0603 | OPTION |
| 10 | 1 | R1 | RES, 4.99kΩ, 1%, 1/10W, 0603 | VISHAY, CRCW06034K99FKEA |
| 11 | 1 | R2 | RES, 6.65kΩ, 1%, 1/10W, 0603 | VISHAY, CRCW06036K65FKEA |
| 12 | 1 | R3 | RES, 3.16kΩ, 1%, 1/10W, 0603 | VISHAY, CRCW06033K16FKEA |
| 13 | 1 | R4 | RES, 2.21kΩ, 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, 0Ω, JUMPER, 0603 | VISHAY, CRCW06030000Z0EA |
| 16 | 1 | Q14 | XSTR, MOSFET, N-CHANNEL, 30V | VISHAY, SUD50N04-8M8P-4GE3 |
| **Hardware** | | | | |
| 1 | 10 | E1 TO 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, NRPN021PAEN-RC |
| 3 | 2 | JP7, JP8 | HEADER, 3PIN, 2mm | SULLIN, NRPN031PAEN-RC |
| 4 | 1 | JP9 | HEADER, 3X2 2mm | SULLIN, NRPN032PAEN-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 |

# SCHEMATIC DIAGRAM

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