

# LTM4632EV

## Ultrathin $\mu$ Module Regulator for DDR-QDR4 Memory VDDQ, VTT and VREF

### DESCRIPTION

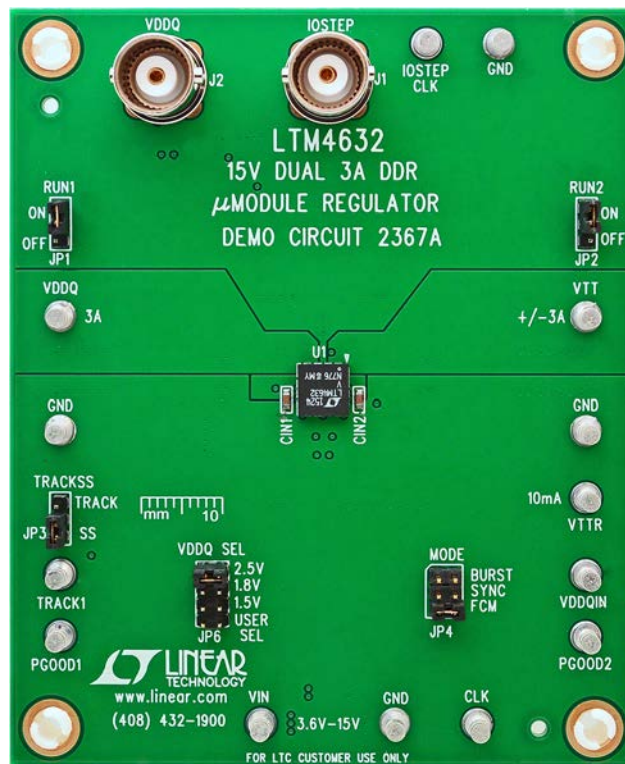
Demonstration circuit DC2367A features the [LTM<sup>®</sup>4632EV](#)  $\mu$ Module<sup>®</sup> regulator, a tiny low-profile high-performance high efficiency dual step-down regulator for DDR power. LTM4632 has an operating input voltage range of 3.6V to 15V. The output voltage of channel 1 (VDDQ) is resistor programmable from 0.6V to 2.5V and is capable of delivering up to 3A of output current. The output voltage of channel 2 (VTT) is set to regulate  $\frac{1}{2}$  of the voltage on the VDDQIN pin which can be provided by either the channel 1 output or an external reference voltage. It can source or sink up to 3A of output current. A 10mA buffered output of VDDQIN/2 is also provided for supplying VREF voltage for DDR memory. DC2367A also provides the option for paralleling channels 1 and 2 together for up to 6A capable VTT rail. LTM4632 is a complete DC/DC DDR dual point

of load regulator in a low-profile thermally enhanced 6.25mm  $\times$  6.25mm  $\times$  1.82mm LGA 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 available through the SYNC/MODE pin. For high efficiency at low load currents the MODE pin jumper (JP4) selects the Burst Mode<sup>®</sup> option for operation in less noise sensitive applications. The LTM4632 data sheet must be read in conjunction with this demo manual for working on or modifying demo circuit 2367A.

**Design files for this circuit board are available at <http://www.linear.com/demo/DC2367A>**

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### BOARD PHOTO



dc2367af

# DEMO MANUAL DC2367A

## PERFORMANCE SUMMARY Specifications are at T<sub>A</sub> = 25°C

| PARAMETER   | CONDITIONS  | MIN | TYP                                       | MAX | UNITS       |
|---|---|-----|---|-----|-------------|
| Input Voltage Range                                 |   | 3.6 |   | 15  | V           |
| Output Voltage V <sub>OUT1</sub> (VDDQ)             | Resistor Programmable, Jumper Selectable  |     | 1.5 (±1.5%)<br>1.8 (±1.5%)<br>2.5 (±1.5%) |     | V<br>V<br>V |
| Maximum Continuous Output Current I <sub>OUT1</sub> | Derating Is Necessary for Certain Operating Conditions. See Data Sheet for Details              |     | 3   |     | A           |
| Output Voltage V <sub>OUT2</sub> (VTT)              | V <sub>OUT1</sub> = 1.5V<br>V <sub>OUT1</sub> = 1.8V<br>V <sub>OUT1</sub> = 2.5V                |     | 0.75<br>0.9<br>1.25                       |     | V<br>V<br>V |
| Maximum Continuous Output Current I <sub>OUT2</sub> | Derating Is Necessary for Certain Operating Conditions. See Data Sheet for Details              |     | ±3  |     | A           |
| Default Operating Frequency                         |   |     | 1   |     | MHz         |
| Efficiency  | V <sub>IN</sub> = 12V, V <sub>OUT1</sub> = 2.5V, I <sub>OUT</sub> = 3A, f <sub>SW</sub> = 1MHz  |     | 83.9<br>(See Figure 2)                    |     | %           |
|   | V <sub>IN</sub> = 12V, V <sub>OUT2</sub> = 1.25V, I <sub>OUT</sub> = 3A, f <sub>SW</sub> = 1MHz |     | 72.3<br>(See Figure 3)                    |     | %           |

## QUICK START PROCEDURE

Demonstration circuit DC2367A is an easy way to evaluate the performance of the LTM4632. 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 application for 2.5V<sub>OUT1</sub> and 1.25V<sub>OUT2</sub> rails:

| JP1  | JP2  | JP3      | JP4  | JP6      |
|------|------|----------|------|----------|
| RUN1 | RUN2 | TRACK/SS | MODE | VDDQ SEL |
| ON   | ON   | SS       | CCM  | 2.5V     |

2. Before powering up the input supply and loads, preset the input voltage supply to be between 3.6V to 15V. Preset the load current for each output rail to 0A.

3. With power off, connect the loads, input voltage supply and meters as shown in Figure 1.
4. Turn on the input power supply. The output voltage meters for each output rail should display the programmed output voltage ±1.5%.
5. Once the proper output voltages are established, adjust the load current on each rail within the 0A to 3A range and observe each output rail's load regulation, efficiency, and other parameters.
6. To observe increased light load efficiency place the mode pin jumper (JP4) in the BURST MODE position.

QUICK START PROCEDURE

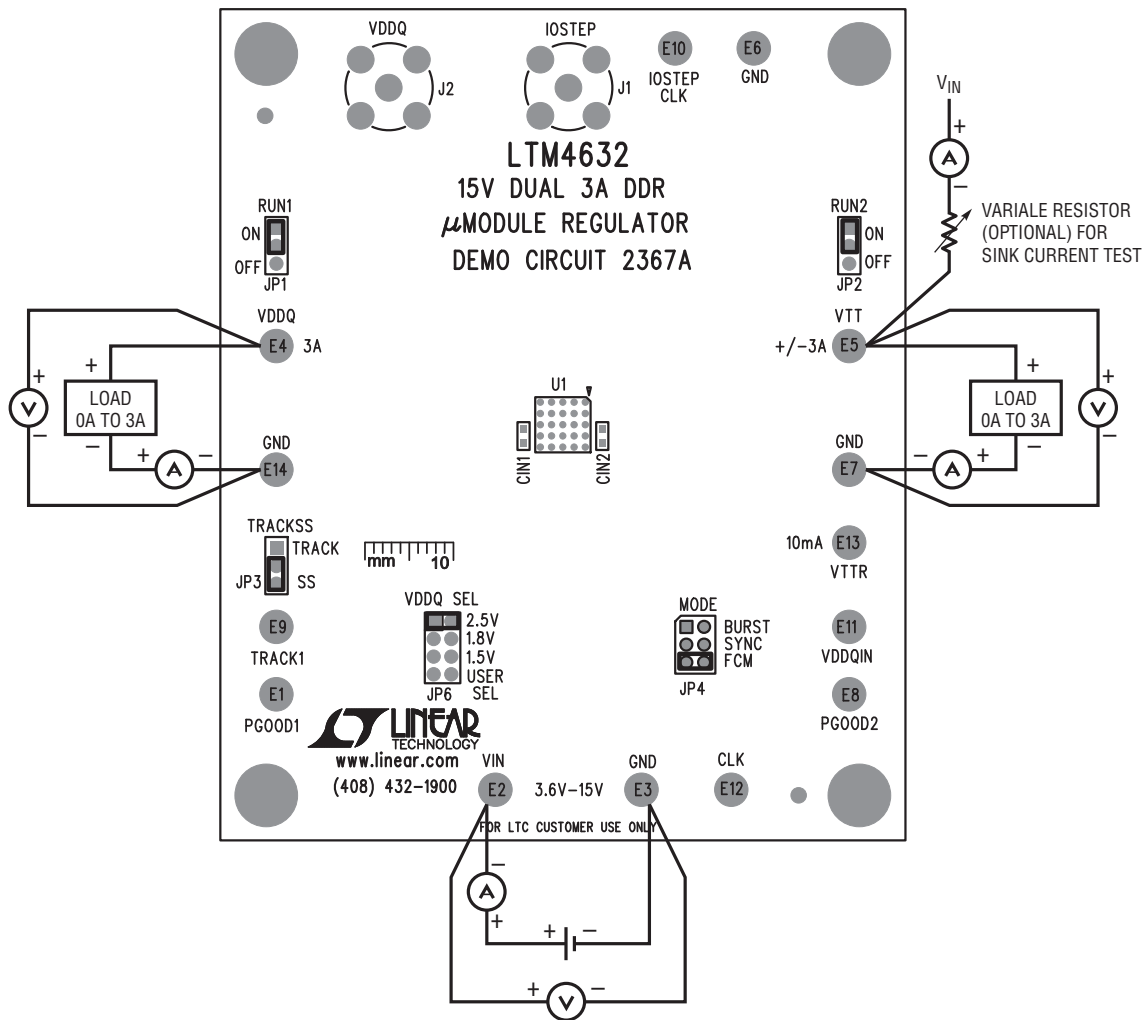


Figure 1. Test Setup

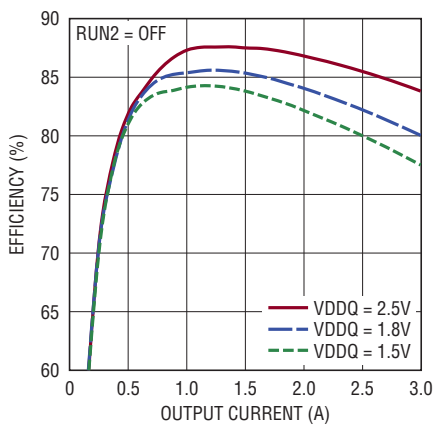


Figure 2. VDDQ 12VIN Efficiency

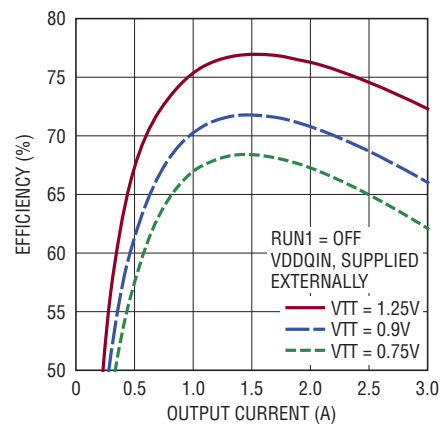


Figure 3. VTT 12VIN Efficiency

## QUICK START PROCEDURE

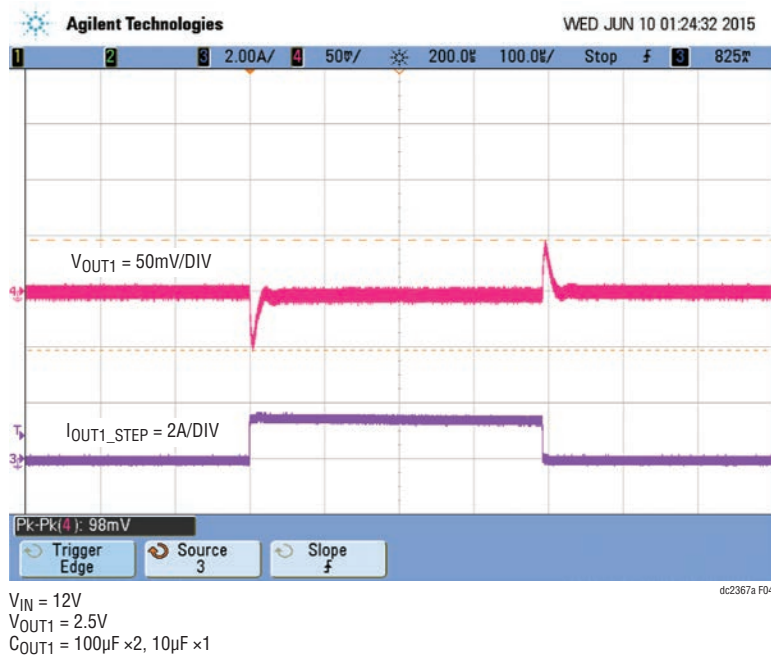


Figure 4. VDDQ Load Transient Response (0A to 1.5A Load Step)

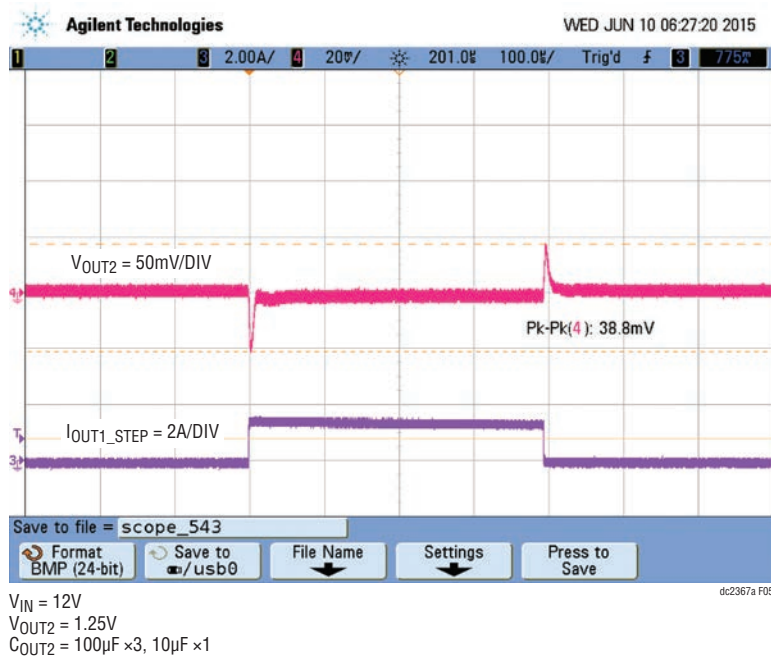
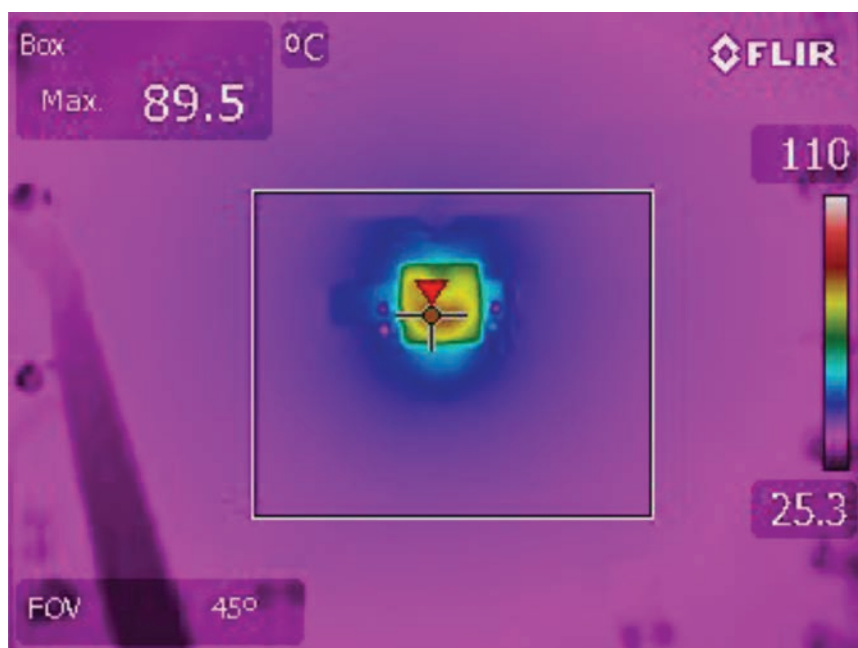


Figure 5. VTT Load Transient Response (0A to 1.5A Load Step)

## QUICK START PROCEDURE



$V_{IN} = 12V$   
 $V_{OUT1} = 2.5V$   
 $I_{OUT1} = 3A$   
 $V_{OUT2} = 1.25V$   
 $I_{OUT2} = 3A$   
 $f_{SW} = 1MHz$   
 $T_A = 25^{\circ}C$ , NO FORCED AIRFLOW

dc2367a F06

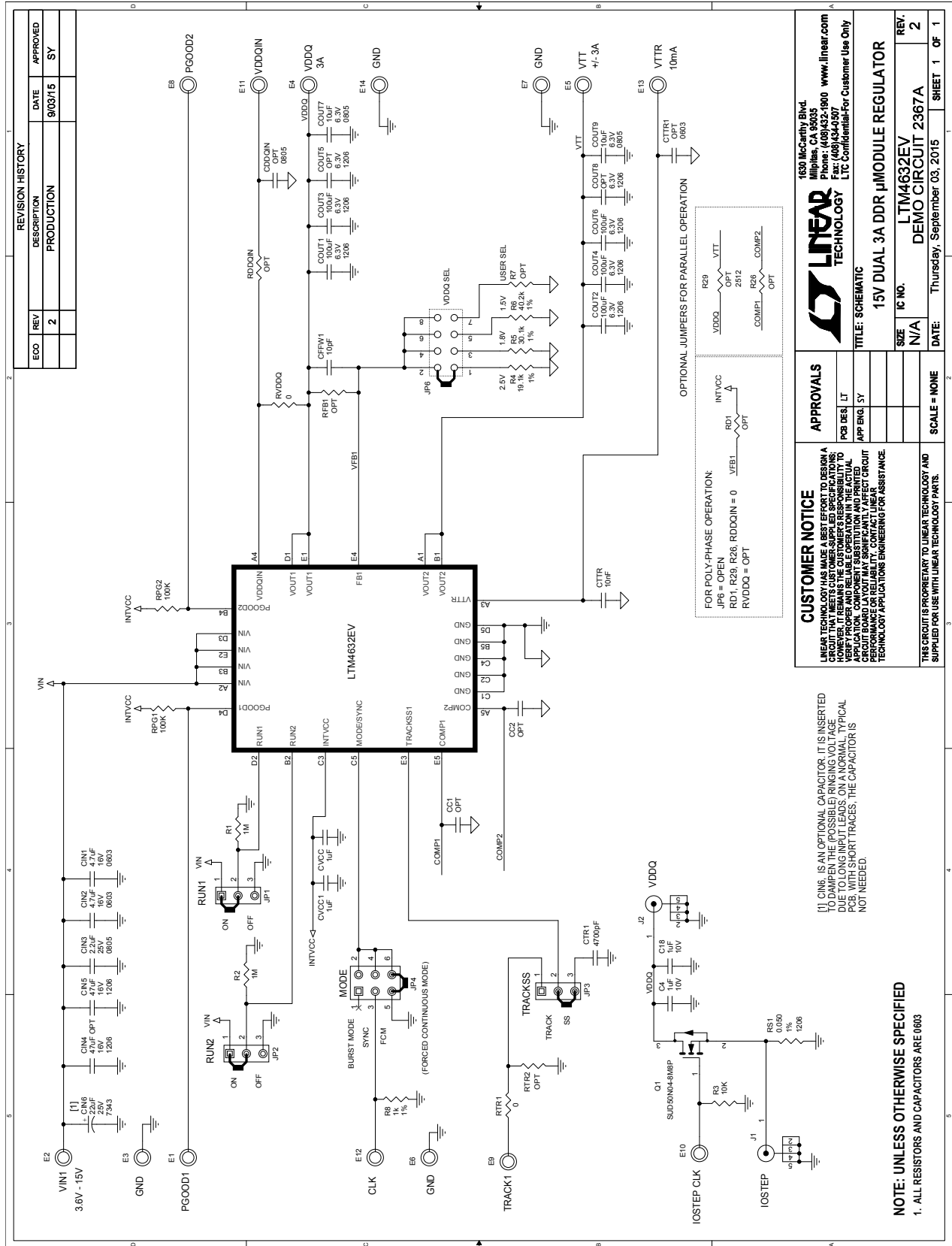
Figure 6. 12V<sub>IN</sub> Full Load Thermal Capture

# DEMO MANUAL DC2367A

## PARTS LIST

| ITEM  | QTY | REFERENCE                        | PART DESCRIPTION                             | MANUFACTURER/PART NUMBER          |
|---|-----|----------------------------------|--|-----------------------------------|
| <b>Required Circuit Components</b>              |     |                                  |  |                                   |
| 1   | 2   | CIN1, CIN2                       | CAP, 4.7 $\mu$ F, X5R, 16V, 10%, 0603        | TDK - C1608X5R1C475K080AC         |
| 2   | 2   | COU7, COU9                       | CAP, 10 $\mu$ F, X5R, 6.3V, 10%, 0805        | MURATA, GRM219R60J106KE19D        |
| 3   | 5   | COU1, COU2, COU3, COU4, COU6     | CAP, 100 $\mu$ F, X5R, 6.3V, 20%, 1206       | MURATA, GRM31CR60J107ME39L        |
| 4   | 1   | R4                               | RES., 19.1k, 1/10W, 1%, 0603                 | VISHAY, CRCW060319K1FKEA          |
| 5   | 1   | U1                               | I.C., LTM4632EV, LGA 25-6.25X6.25            | LINEAR TECH., LTM4632EV#PBF       |
| <b>Additional Demo Board Circuit Components</b> |     |                                  |  |                                   |
| 1   | 0   | CIN4, COU5, COU8                 | CAP, OPTION, 1206                            | OPT                               |
| 2   | 1   | CIN5                             | CAP, 47 $\mu$ F, X5R, 16V, 20%, 1206         | TDK, C3216X5R1C476M160AB          |
| 3   | 1   | CIN3                             | CAP, 2.2 $\mu$ F, X7R, 25V, 10%, 0805        | TAIYO YUDEN, TMK212B7225KGHT      |
| 4   | 1   | CIN6                             | CAP, POSCAP, 22 $\mu$ F, X5R, 25V, 20%, 7343 | PANASONIC, 25TQC22MV              |
| 5   | 4   | CVCC1, C4, C18, CVCC             | CAP, 1 $\mu$ F, X5R, 10V, 10%, 0603          | MURATA, GRM188R61A105KA61D        |
| 6   | 0   | CDDQIN                           | CAP, OPTION, 0805                            | OPT                               |
| 7   | 1   | CTR1                             | CAP, 4700pF, X7R, 50V, 10%, 0603             | KEMET, C0603C472K5RACTU           |
| 8   | 1   | CTTR                             | CAP, 0.01 $\mu$ F, X7R, 50V, 10%, 0603       | KEMET, C0603C103K5RACTU           |
| 9   | 1   | CFFW1                            | CAP, 10pF, C0G, 50V, 5%, 0603                | MURATA, GRM1885C1H100JA01D        |
| 10  | 0   | CC1, CC2, CTTR1                  | CAP, OPTION, 0603                            | OPT                               |
| 11  | 0   | RFB1, RTR2, R7, R26, RD1, RDDQIN | RES, OPTION, 0603                            | OPT                               |
| 12  | 1   | R5                               | RES., 30.1k, 1/10W, 1%, 0603                 | VISHAY, CRCW060330K1FKEA          |
| 13  | 1   | R6                               | RES., 40.2k, 1/10W, 1%, 0603                 | VISHAY, CRCW060340K2FKEA          |
| 14  | 1   | R3                               | RES., 10k, 1/10W, 1%, 0603                   | VISHAY, CRCW060310K0FKEA          |
| 15  | 2   | RPG1, RPG2                       | RES., 100k, 1/10W, 1%, 0603                  | VISHAY, CRCW0603100KFKEA          |
| 16  | 1   | R8                               | RES., 1k, 1/10W, 1%, 0603                    | VISHAY, CRCW06031K00FKEA          |
| 17  | 2   | R1, R2                           | RES., 1M, 1/10W, 1%, 0603                    | VISHAY, CRCW06031M00FKEA          |
| 18  | 2   | RTR1, RVDDQ                      | RES., 0 $\Omega$ , 1/10W, 0603               | VISHAY, CRCW06030000Z0EA          |
| 19  | 1   | RS1                              | RES., 0.05 $\Omega$ , 1/4W, 1%, 1206         | VISHAY, WSL1206R0500FEA           |
| 20  | 0   | R29                              | RES, OPTION, 2512                            | OPT                               |
| 21  | 1   | Q1                               | XSTR., MOSFET, N-CH, 40V, 14A, TO-252        | VISHAY, SUD50N04-8M8P-4GE3        |
| <b>Hardware: For Demo Board Only</b>            |     |                                  |  |                                   |
| 1   | 14  | E1-E14                           | TESTPOINT, TURRET, 0.094" MTG. HOLE          | MILL-MAX, 2501-2-00-80-00-00-07-0 |
| 2   | 3   | JP1, JP2, JP3                    | CONN., HEADER, 1X3, 2mm                      | SULLINS, NRPNO31PAEN-RC           |
| 3   | 1   | JP4                              | CONN., HEADER, 2X3, 2mm                      | SULLINS, NRPNO32PAEN-RC           |
| 4   | 1   | JP6                              | CONN., HEADER, 2X4, 2mm                      | SULLINS, NRPNO42PAEN-RC           |
| 5   | 5   | XJP1, XJP2, XJP3, XJP4, XJP6     | SHUNT, 2mm                                   | SAMTEC 2SN-BK-G                   |
| 6   | 2   | J1, J2                           | CONN, BNC, 5PINS                             | CONNEX, 112404                    |
| 7   | 4   | STAND OFF                        | STAND OFF, NYLON, SNAP-ON, 0.375"            | KEYSTONE_8832                     |

**SCHEMATIC DIAGRAM**



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# DEMO MANUAL DC2367A

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