DESCRIPTION

Demonstration circuit 1635A features the LTC®4412HV16 and LTC4414EMS8, low loss PowerPath™ controllers. Each controller is capable of automatically switching between primary and auxiliary power sources for a single output. There are two electrically isolated circuits, one for each IC, for independent evaluation. The LTC4412 circuit is intended for lower current loads, while the LTC4414 circuit is capable of driving larger PMOS devices for higher current loads.

The input supply voltage ranges are from 2.5V to 36V for LTC4412 and 5V to 36V for LTC4414. As initially configured with the default MOSFET, the LTC4412 circuit maximum input voltage is 18V. The LTC4412 and LTC4414 circuit current limits are 2A and 8A respectively.

PERFORMANCE SUMMARY

Specifications are at \( T_A = 25\degree C \)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>CONDITIONS</th>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum LTC4412 Input Voltage</td>
<td>( V_{\text{IN1}} )</td>
<td>2.5</td>
<td>V</td>
</tr>
<tr>
<td>Maximum LTC4412 Input Voltage</td>
<td>( V_{\text{IN1}} ) and ( V_{\text{AUX1}} )</td>
<td>18</td>
<td>V</td>
</tr>
<tr>
<td>LTC4412 Maximum Current</td>
<td>MOSFET Limited</td>
<td>2</td>
<td>A</td>
</tr>
<tr>
<td>Minimum LTC4414 Input Voltage</td>
<td>( V_{\text{IN2}} ) and ( V_{\text{AUX2}} )</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>Maximum LTC4414 Input Voltage</td>
<td>( V_{\text{IN2}} ) and ( V_{\text{AUX2}} )</td>
<td>36</td>
<td>V</td>
</tr>
<tr>
<td>LTC4414 Maximum Current</td>
<td>MOSFET Limited</td>
<td>8</td>
<td>A</td>
</tr>
</tbody>
</table>
QUICK START PROCEDURE

Demonstration circuit 1635A is easy to set up to evaluate the performance of LTC4412 and LTC4414. Refer to Figure 1 for proper measurement equipment setup of both circuits and follow the procedures below.

LTC4412 Circuit
1. With all power off, connect auxiliary (VAUX1) and primary (VIN1) power supplies capable of 2A each, the system load and meters as shown in Figure 1.
2. Preset the system load to 0A and the input supplies to 0V, 0A current limit.
3. Connect the system load to the output terminals, VOUT1 and GND1.
4. Turn on the supplies, setting the current limit up to 2A. Adjust the voltages to the desired value, up to 18V. The higher voltage of the two supplies should appear at the output.
5. Turn the load on and adjust as necessary.
6. Adjust the supplies and observe how the output switches over to follow the higher voltage of the two sources.

LTC4414 Circuit
1. With all power off, connect auxiliary (VAUX2) and primary (VIN2) power supplies capable of 8A each, the system load, and meters as shown in Figure 1.
2. Preset the system load to 0A and the input supplies to 0V, 0A current limit.
3. Connect the system load to the output terminals, VOUT2 and GND2.
4. Turn on the supplies, setting the current limit up to 8A. Adjust the voltages to the desired value, up to 36V. The higher voltage of the two supplies should appear at the output.
5. Turn the load on and adjust as necessary.
6. Adjust the supplies and observe how the output switches over to follow the higher voltage of the two sources.

Optional
7. For improved current handling, install additional MOSFETs, select from different package footprints, or shunt the two circuits at VIN, VOUT and GND.
8. For source-load back-to-back isolation, remove jumpers JMP1 and JMP2, and/or JMP3 and JMP4, then install additional MOSFETs back-to-back as shown in Figure 2.
9. For external control of the primary source power path, remove the 0Ω jumper on the CTL1 or CTL2 pin, R2 or R5 respectively. Apply the logic-control signal on CTL1 or CTL2 as necessary.
QUICK START PROCEDURE

Figure 1. Test Setup of DC1635A
Diodes shown are body diodes of their respective MOSFETs. Do not install extra diodes or the operation of the power paths may be compromised.
QUICK START PROCEDURE

Figure 2c. Optional, High Side Switch with Logic Control and Status Output (Requires 0Ω Jumper Across Drain-Source Pins of Q7)

Figure 2d. Optional, High Current Dual Battery Load Sharing with Automatic Switchover and Status Output

Figure 2e. Optional, Dual Battery Charging with Logic Select and Status Output
NOTE FOR THIS PAGE:

TOP LAYER CIRCUITS FOR U1 AND U2 ARE ELECTRICALLY ISOLATED FROM EACH OTHER. THEY DO NOT SHARE GND, VIN, VAUX, OR VOUT. JUMPERS CAN BE USED TO PARALLEL THE TWO CIRCUITS AS NECESSARY.

*CLARIFICATION: SHOWN HERE AS CONNECTED FOR TOP LAYER CIRCUIT, BUT STUFFED ON BOTTOM LAYER.

NOTE: UNLESS OTHERWISE SPECIFIED SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS. SCALE = NONE

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 CONTINUOUS OPERATIONS. IF THE CTL PIN OF THE LTC4412 AND/OR LTC4414 IS NOT CONNECTED TO THE GROUND RETURN, THE CIRCUIT MAY AFFECT CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE.

APPROVALS

PCB DES. AK

TITLE: SCHEMATIC

DEMO CIRCUIT 1635A

IC NO. REV.

N/A LTC4412HVIS6 & LTC4414EMS8

SIZE

PCB DES. AK

DATE:

Thursday, March 17, 2016

SHEET OF

2

NOTE: UNLESS OTHERWISE SPECIFIED

IC NO. REV.

N/A LTC4412HVIS6 & LTC4414EMS8

SIZE

PCB DES. AK

DATE:

Thursday, March 17, 2016

SHEET OF

2

LINEAR TECHNOLOGY

www.linear.com

Phone: (408)432-1900

www.linear.com

Phone: (408)432-1900

www.linear.com

Phone: (408)432-1900

LTC Confidential—For Customer Use Only
NOTE FOR ALL CIRCUITS:
The Demo Board as shipped shows the most common functions for two electrically isolated circuits. This Demo Board was designed to show case the maximum number of Evaluation Options that correspond to the circuits in the Data Sheets. Both ICs are necessary for proper back-to-back isolation.

1. Never install U1 (top layer) and U3 (bottom layer) at the same time. Install one or the other, but not both.
2. Never install U2 (top layer) and U4 (bottom layer) at the same time. Same as 1.
3. JMP1-4 are meant for simple diode-or operation. They must be removed for proper back-to-back isolation.

There are more guidelines specifically for certain circuits. Please see the quick start guide for more applications and information.

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. Contact Linear Technology Applications Engineering for assistance.

This circuit is proprietary to Linear Technology and schematic supplied for use with Linear Technology parts. Scale = none.

www.linear.com
## PARTS LIST

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QTY</th>
<th>REFERENCE</th>
<th>PART DESCRIPTION</th>
<th>MANUFACTURER/PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Required Circuit Components</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>C\text{OUT1}, C\text{IN1}, C\text{OUT2}, C\text{IN2}</td>
<td>CAP, X7R, 0.1\mu F, 50V, 10% 0805</td>
<td>AVX, 0805S104KAT2A</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Q1</td>
<td>DUAL P-CHAN., 20V/4.5A</td>
<td>VISHAY, SI921EDJ-T1-GE3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>Q2, Q3</td>
<td>MOSFET P-CHAN., 40V/10A</td>
<td>VISHAY, SI7463DP-T1-GE3</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>R1</td>
<td>RES., CHIP, 690k, 1%, 0603</td>
<td>VISHAY, CRCW0603690KFKEA</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>R3</td>
<td>RES., CHIP, 100k, 1%, 0603</td>
<td>VISHAY, CRCW0603100KFKEA</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>R5, R6</td>
<td>RES., CHIP, 0Ω, 0603</td>
<td>VISHAY, CRCW06030000Z0EA</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>U1</td>
<td>I.C., LTC4412HVIS6</td>
<td>LINEAR TECH., LTC4412HVIS6#PBF</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>U2</td>
<td>I.C., LTC4414EMS8</td>
<td>LINEAR TECH., LTC4414EMS8#PBF</td>
</tr>
<tr>
<td><strong>Additional Circuit Components</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>Q6, Q12, Q13</td>
<td>OPT</td>
<td>VISHAY, SI921EDJ-T1-GE3</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>Q4, Q5, Q7, Q8, Q14, Q15</td>
<td>OPT</td>
<td>VISHAY, SI7463DP-T1-GE3</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>Q16, Q17, Q18, Q19</td>
<td>OPT</td>
<td>VISHAY, SI7905DN-T1-E3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>JMP1, JMP2, JMP3, JMP4</td>
<td>JUMPER, 1206</td>
<td>TEPRO, RN6087</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>R2, R4</td>
<td>RES., CHIP, 560k, 1%, 0603</td>
<td>VISHAY, CRCW0603560KFKEA</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>JMP5, JMP6, JMP7, JMP8</td>
<td>RES., 0603 OPT</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>U3</td>
<td>I.C., LTC4414EMS8 OPT</td>
<td>LINEAR TECH., LTC4414EMS8#PBF</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>U4</td>
<td>I.C., LTC4412HVIS6 OPT</td>
<td>LINEAR TECH., LTC4412HVIS6#PBF</td>
</tr>
<tr>
<td><strong>Hardware-For Demo Board Only</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>18</td>
<td>E1, E2, E3, E4, E5, E6, E7, E8, E9, E10</td>
<td>TEST POINT, TURRET, 0.095&quot;</td>
<td>MILL-MAX, 2501-2-00-80-00-00-07-0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E11, E12, E13, E14, E15, E16, E17, E18</td>
<td>TEST POINT, TURRET, 0.095&quot;</td>
<td>MILL-MAX, 2501-2-00-80-00-00-07-0</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>J1, J2, J3, J4, J5, J6, J7, J8, J10, J11, J12</td>
<td>BANANA JACK</td>
<td>KEYSTONE, 575-4</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>(STAND OFF)</td>
<td>STAND OFF NYLON 0.25&quot;</td>
<td>KEYSTONE, 8831 (SNAP ON)</td>
</tr>
</tbody>
</table>
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