# Microsemi Power Management Solution
# for
# A2F-EVAL-KIT-2

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## Scope

This document presents data covering proposed AMSG power management ICs targeted to replace competitor's parts used in Microsemi SOC's A2F Smart Fusion Evaluation Kit. Power requirements are addressed via a comparison list between targeted power management ICs for retrofitting, as compared to Microsemi power management ICs determined to fit the requirements. Note that these are not all of the power management ICs on the A2F-EVAL-KIT-2 circuit card; only PM chips which can be retrofitted are addressed here.

Test images and data of the competitor's solution vs. the AMSG solution follow the comparison for each selected part. Lastly, schematic diagrams and suggested PCB layouts of the proposed AMSG devices are at the end of this document.

## Power Requirements

Parts targeted for retrofit are referenced to their respective schematic page. Please reference the A2F-EVAL-Kit Schematic, document number: SCH-SMFSNEVK-0940-B1B, Rev F, for details.

**Schematic Pg 2**

1) U66 –NX4108
    a. AMSG part - No Change
2) U67 – NX4108
    a. AMSG part - No Change
3) U42 – Linear Tech LT1615ES5
    a. 5V to 10V Boost
    b. 350mA Current Limit
    c. $VCE_{SAT}$ = 250mV at 300mA
    d. ICC (no load) = 20uA
    e. ICC (shutdown) = 500nA
    f. 400ns Constant Off Time Control – Operates in Burst Mode
    g. Shutdown Pin – Chip is enabled high
    h. SOT23 – 5pin

    **Suggested AMSG replacement: LX1742**

    a. 5V to 10V Boost capable
    b. Peak Current Limit is Adjustable to 500mA.
    c. $VCE_{SAT}$ not specified – $RDS_{ON}$ of FET specified at 1.1Ω at 10mA
    d. ICC (no load) = 80uA

e. ICC (shutdown) = 500nA (typ)

f. 300ns Constant Off Time Control – Operates in Burst Mode

g. Shutdown Pin – Chip is enabled high

h. MSOP – 8pin

Differences/Risks:

a. Additional component (1 resistor) required

b. Burst Frequency Will Be Higher.

c. Bigger Package Size – requires more PCB area

d. Higher Quiescent Current – 60uA larger draw on USB.

**Schematic Pg 14**

1) U62 – Texas Instruments LP3985

a. 5V to 3.3V Fixed Voltage LDO

b. 150mA Output Current

c. 200us Turn-On Time From Enable

d. 100mV Dropout at 150mA

e. 2% Initial Voltage Accuracy

f. 130uA Ground Current at 100mA Load Current and 25°C

g. 30uVrms Noise 10Hz to 100kHz

h. 50dB PSRR at 1kHz

i. VOUT Change Less Than 0.4% 0 to 100°C

j. 1uF Minimum Output Capacitor

k. Junction Temperature Rated -40°C to 125°C

l. Enable Pin – Chip is enabled high

m. SOT23 – 5pin

**Suggested AMSG Replacement: LX8213**

a. 5V to 3.3 Fixed Voltage LDO

b. 300mA Output Current

c. 30us Turn-on Time From Enable

d. 80mV Dropout at 150mA



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e. 2% Initial Voltage Accuracy

f. 80uA Ground Current at 100mA Load Current and 25°C

g. 60uVrms Noise 10Hz to 100Khz

h. 68dB PSRR at 1kHz

i. Reference Change Less Than 4% 0 to 100°C.

j. 1uF Minimum Output Capacitor

k. Ambient Temperature Rated -40°C to +85°C

l. SHDN Pin – Chip is enabled high

m. SOT23 – 5pin; not pin compatible with LP3985

Differences/Risks:

a. Faster Turn On Time – this may be a misinterpretation of the two datasheets and as such may not be an issue. Soft start times are ~30us for both the LP part and the Microsemi part with $C_{BYPASS}$ = 0

b. Output Noise Level is 2X Greater – any system level issues due to this difference would only be apparent under actual evaluation circuit tests, which should be performed by someone at SOC familiar with the requirements. For the tests covered in this document, no difference is noted in functionality between the Texas Instruments and Microsemi part.

2) U63 – Texas Instruments LP3985

a. 5V to 2.5V Fixed Voltage LDO

b. 150mA Output Current

c. 200us Turn-On Time From Enable

d. 100mV Dropout at 150mA

e. 2% Initial Voltage Accuracy

f. 130uA Ground Current at 100mA Load Current and 25°C

g. 30uVrms Noise 10Hz to 100kHz

h. 50dB PSRR at 1kHz

i. VOUT Change Less Than 0.4% 0 to 100°C

j. 1uF Minimum Output Capacitor

k. Junction Temperature Rated -40°C to 125°C

l. Enable Pin – Chip is enabled high.

m. SOT23 – 5pin

**Suggested AMSG Replacement: LX8213**

a. 5V Adjustable Voltage LDO – will require 2 programming resistors.

b. 300mA Output Current

c. 30us Turn-on Time From Enable

d. 80mV Dropout at 150mA

e. + 2%, -6% Initial Voltage Accuracy*

f. 80uA Ground Current at 100mA Load Current and 25°C

g. 60uVrms Noise 10Hz to 100Khz

h. 68dB PSRR at 1kHz

i. Reference Change Less Than 4% 0 to 100°C.

j. 1uF Minimum Output Capacitor

k. Ambient Temperature Rated -40°C to +85°C

l. SHDN Pin – Chip is enabled high

m. SOT23 – 5pin; not pin compatible with LP3985

Differences/Risks:

a. Faster Turn On Time – this may be a misinterpretation of the two datasheets and as such may not be an issue. Soft start times are ~30us for both the LP part and the Microsemi part with $C_{BYPASS}$ = 0

b. Output Noise Level is Greater – any system level issues due to this difference would only be apparent under actual evaluation circuit tests, which should be performed by someone at SOC familiar with the requirements. For the tests covered in this document, no difference is noted in functionality between the Texas Instruments and Microsemi part.

*Regarding Initial Voltage Accuracy: The variation stated above is based on the min, typical, and max values of the internal reference used in the adjustable version. Presently the LX8213 does not have a 2.5V fixed output version; however, providing a fixed version with 2% output accuracy would require only a trim program change to ATE, and could be considered if Marketing determines it is worth the investment to qualify a 2.5V version of this part for release. The part used for this evaluation was *not* hand-picked, and has an off-the-shelf reference value that is less than ½% of the typical value.

## Test Data

### <u>U42 – 5V to 10V Boost</u>

**Old Device Steady State:**

Output Voltage: 10.01V

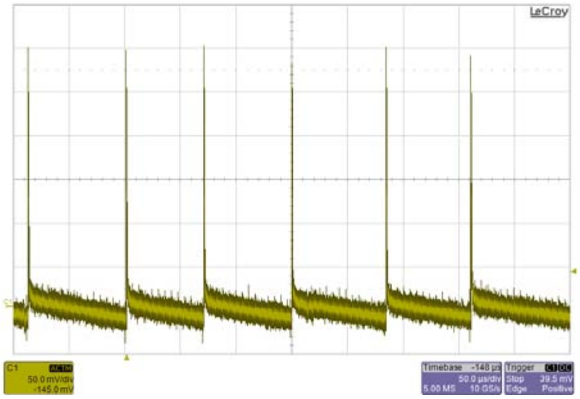
Enable: 3.276V

**New Device Steady State:**

Output: 10.16V

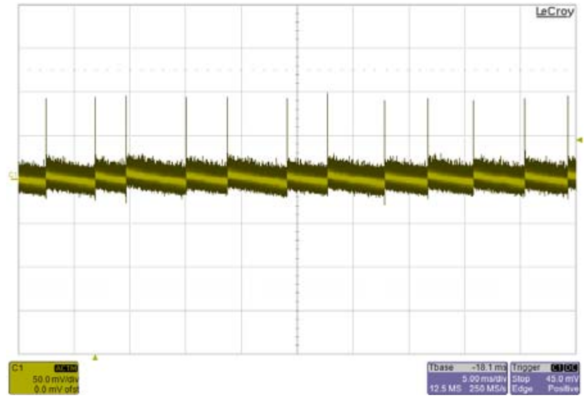
Enable: 3.276V

**Images:**



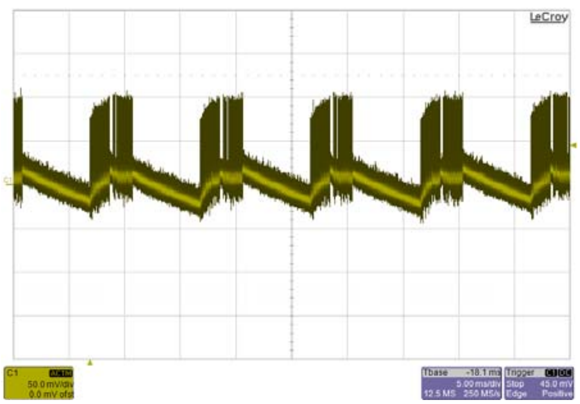
LT Part – Static Display

Output Ripple



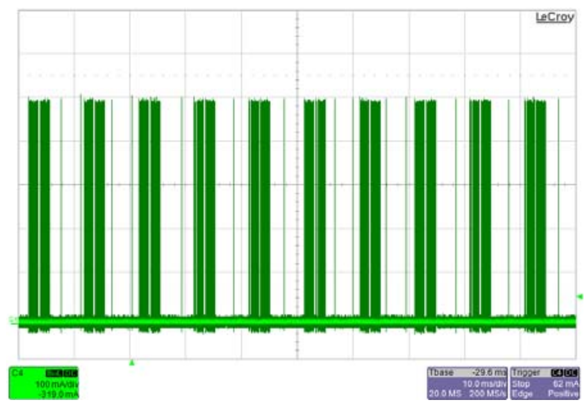
Microsemi Part – Static Display

Output Ripple

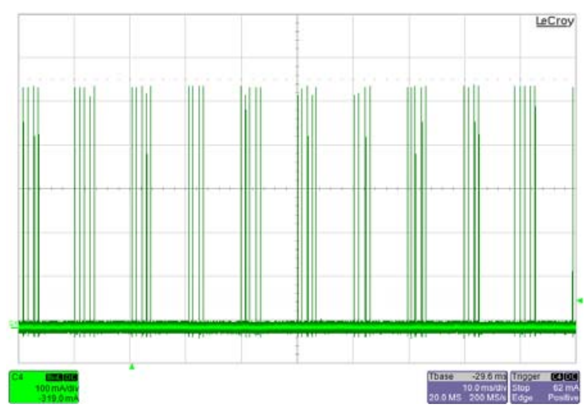


Microsemi Part Display Scrolling

Output Ripple



LT Part – Peak Ripple Current



Microsemi Part Peak Ripple Current

**Summary of Observations:** U42 is used to power the OLED circuit. The OLED was exercised with the Microsemi part installed by running both the Demo Program (all tests were run except the Webpage test), and the Manufacturer's Test Program ( all tests ran except for the Ethernet test). Demo mode was run both with the Hyper Terminal and without (OLED indicator continuously scrolls in multimeter mode without Hyper Terminal) No functionality issues were observed; the OLED display functions correctly with no indication of brightness degrading or flickering.

## U62 – 3.3V LDO to FPGA; U63 – 2.5V LDO to FPGA

### U62 Old Device Steady State:

Output (FPGA programmed): 3.290V

Enable: 3.276V

### U62 New Device Steady State:

Output (FPGA programmed): 3.306V

Enable: 3.276V

### U63 Old Device Steady State:

Output (FPGA not programmed): 2.493V

Output (FPGA programmed): 2.493V

Enable: 3.276V

### U63 New Device Steady State:

Output (FPGA not programmed): 2.507V

Output (FPGA programmed): 2.507V

Enable: 3.276V

**Summary of Observations:** The Functionality of the LDOs were verified by running the FPGA programming routines for both the Demo Program and the Manufacturing Test Program. Several Erase – Program – Verify cycles were performed using the Flash Pro Programming Software. No programming errors were observed, and both the Demo Program and the Manufacturer's Test program ran all routines (except Ethernet) without incident. The Flash Program's "Inspect Device" tool was used to compare the FPGA with both the Texas Instrument Part and the Microsemi part. The results of the comparison were saved in Text Format and are shown here:

**Texas Instruments LP3985 with Erased FPGA:**

Device Status:

IDCode (read from the device) (HEX): 55a131cf

User Information:

UROW data (HEX): ffff007fffffffffffffffff26fe409f

Programming Method: STAPL

Programmer: FlashPro3

Programmer Software: FlashPro vX.X

Design Name:

Design Check Sum: FFFF

Algorithm Version: 19

Array Prog. Cycle Count: 1

Device State:

IRCapture Register (HEX): 51

FPGA Array Status: Not enabled

Factory Data:

Factory Serial Number (HEX): 114ab346054

Security:

Device has no security enforced.

Analog Block:

| | |
|---|---|
| OABTR Register (HEX): | 0bae210 |
| 3.3V (vdd33): | PASS |
| 1.5V (vdd15): | PASS |
| Bandgap: | PASS |
| -3.3V (vddn33): | FAIL |
| ADC Reference: | PASS |
| FPGA_Good: | FAIL |

Status: Analog Block is non-operational

**Texas Instruments LP3985 with Programmed FPGA (Manufacturer's Test Program):**

Device Status:

IDCode (read from the device) (HEX): 55a131cf

User Information:

| | |
|---|---|
| UROW data (HEX): | 977d00410205672e5fa5fd8726fe409f |
| Programming Method: | STAPL |
| Programmer: | FlashPro3 |
| Programmer Software: | FlashPro vX.X |

| | |
|---|---|
| Design Name: | MSS_top |
| Design Check Sum: | 977D |
| Algorithm Version: | 19 |
| Array Prog. Cycle Count: | 1 |

Device State:

| | |
|---|---|
| IRCapture Register (HEX): | 55 |
| FPGA Array Status: | Programmed and enabled |

Factory Data:

| | |
|---|---|
| Factory Serial Number (HEX): | 114ab346054 |

Security:

Device has no security enforced.

Analog Block:

| | |
|---|---|
| OABTR Register (HEX): | 0fae210 |
| 3.3V (vdd33): | PASS |
| 1.5V (vdd15): | PASS |
| Bandgap: | PASS |
| -3.3V (vddn33): | FAIL |
| ADC Reference: | PASS |
| FPGA_Good: | PASS |

Status: Analog Block is operational

**Microsemi LX8213 (U62 and U63) with Erased FPGA:**

Device Status:

IDCode (read from the device) (HEX): 55a131cf

User Information:

UROW data (HEX): ffff00bfffffffffffffffff26fe409f

Programming Method: STAPL

Programmer: FlashPro3

Programmer Software: FlashPro vX.X

Design Name:

Design Check Sum: FFFF

Algorithm Version: 19

Array Prog. Cycle Count: 2

Device State:

IRCapture Register (HEX): 51

FPGA Array Status: Not enabled

Factory Data:

Factory Serial Number (HEX): 114ab346054

Security:

Device has no security enforced.



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Analog Block:

OABTR Register (HEX): 09be211

3.3V (vdd33): PASS

1.5V (vdd15): PASS

Bandgap: PASS

-3.3V (vddn33): PASS

ADC Reference: PASS

FPGA_Good: FAIL

Status: Analog Block is non-operational

**Microsemi LX8213 (U62 and U63) with Programmed FPGA (Manufacturer's Test Program):**

Device Status:

IDCode (read from the device) (HEX): 55a131cf

User Information:

UROW data (HEX): 977d00810205672e5fa5fd8726fe409f

Programming Method: STAPL

Programmer: FlashPro3

Programmer Software: FlashPro vX.X

Design Name: MSS_top

Design Check Sum: 977D

Algorithm Version: 19

Array Prog. Cycle Count: 2

Device State:

IRCapture Register (HEX): 55

FPGA Array Status: Programmed and enabled

Factory Data:

Factory Serial Number (HEX): 114ab346054

Security:

Device has no security enforced.

Analog Block:

| | |
|---|---|
| OABTR Register (HEX): | 0fae210 |
| 3.3V (vdd33): | PASS |
| 1.5V (vdd15): | PASS |
| Bandgap: | PASS |
| -3.3V (vddn33): | FAIL |
| ADC Reference: | PASS |
| FPGA_Good: | PASS |

Status: Analog Block is operational

Note: the "FAIL" indication in the Analog Block after programming is present with both the Texas Instruments and Microsemi parts.



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## Schematics and BOM

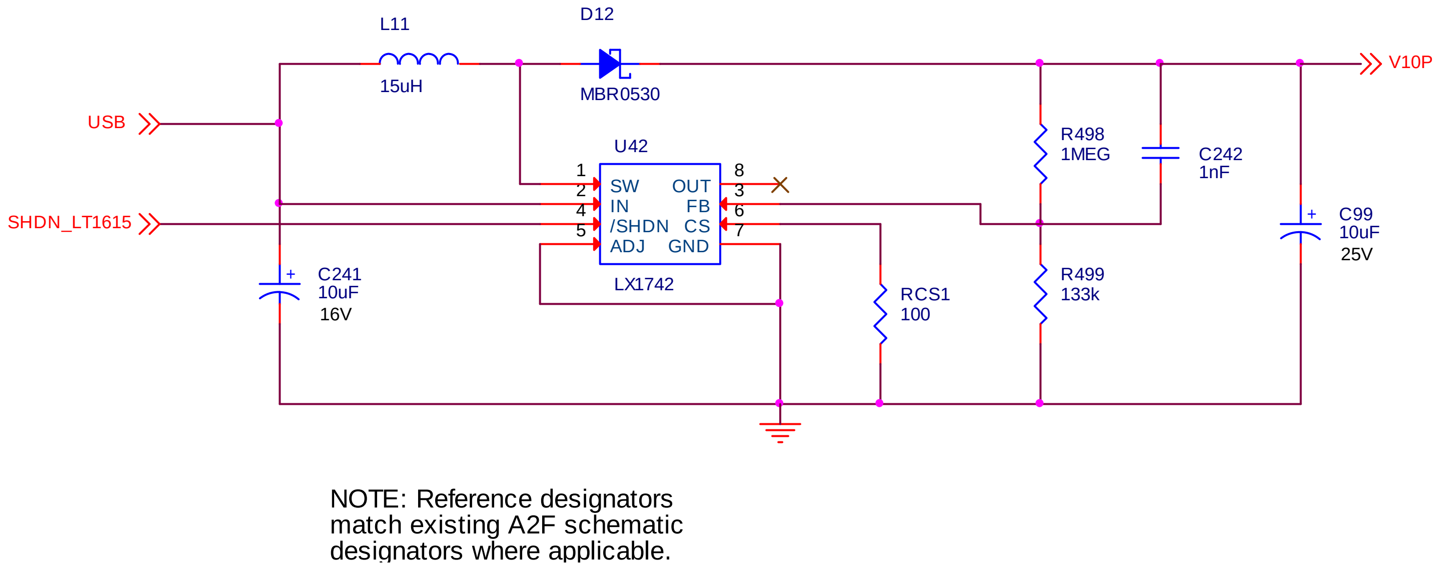


**Figure 1. U42 Boost Circuit**

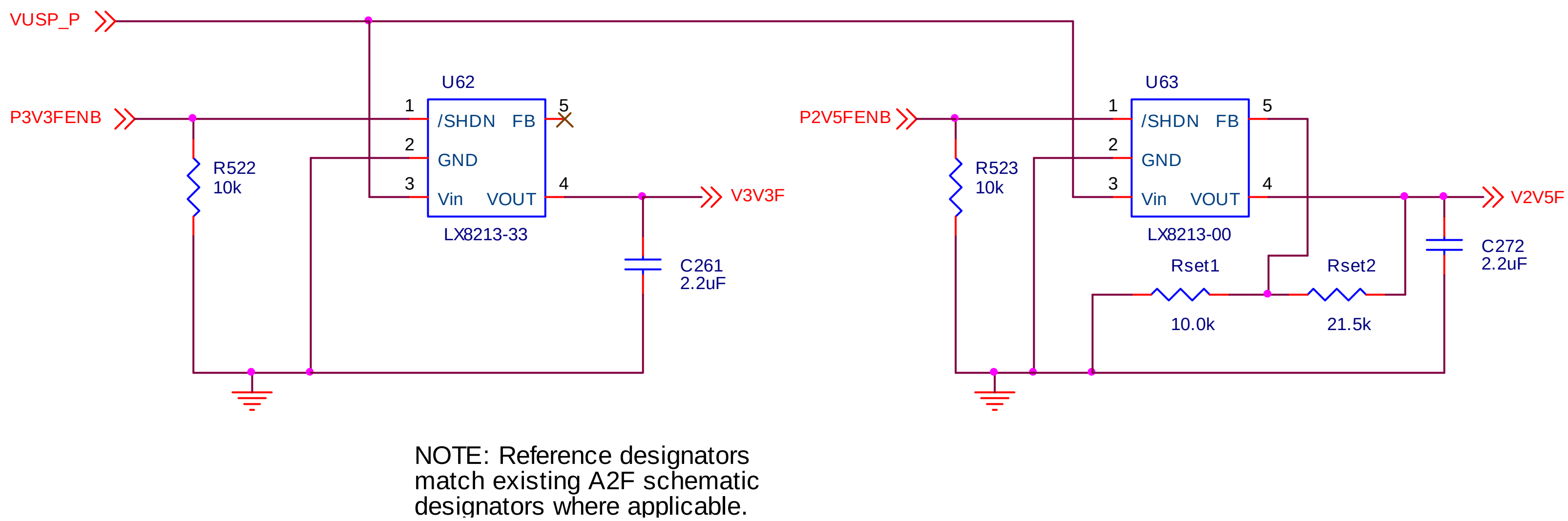


**Figure 2. U62 and U63 LDO Circuits**

**U42 Boost Circuit BOM:**

| Item Number | Quantity | Part Reference | Description | Manufacturer | Manufacturer Part Number |
|---|---|---|---|---|---|
| 1 | 1 | C99 | CAP TANT 10UF 25V 10% SMD | Vishay/Sprague | TR3B106K025C1100 |
| 2 | 1 | C241 | CAP TANT 10UF 16V 10% SMD | Vishay/Sprague | 293D106X9016A2TE3 |
| 3 | 1 | C242 | Capacitor, Ceramic, 1nF, 25v, 0603 SMD | Any | Any |
| 4 | 1 | D12 | DIODE SCHOTTKY 30V 0.5A SOD123 | On Semiconductor | MBR0530T1G |
| 5 | 1 | L11 | Inductor, 15uH, 1812 SMD | Murata | LQH43CN150K03 |
| 6 | 1 | RCS1 | Resistor, 100, 5%, 0603 SMD | Any | Any |
| 7 | 1 | R498 | Resistor, 1.00M, 1%, 0603 SMD | Any | Any |
| 8 | 1 | R499 | Resistor, 133k, 1%, 0603 SMD | Any | Any |
| 9 | 1 | U42 | IC, High Voltage Boost Controller, MSOP 8 | Microsemi | LX1742CDU |

**U62 and U63 LDO Circuit BOM:**

| Item Number | Quantity | Part Reference | Description | Manufacturer | Manufacturer Part Number |
|---|---|---|---|---|---|
| 1 | 2 | C261,C272 | CAP CERM 2.2UF 10V X7R 0805 | Taiyo Yuden | LMK212B7225MG-T |
| 2 | 1 | Rset1 | Resistor, 10.0k, 1%, 0603 SMD | Any | Any |
| 3 | 1 | Rset2 | Resistor, 21.5k, 1%, 0603 SMD | Any | Any |
| 4 | 2 | R522,R523 | Resistor, 10k, 5%, 0603 SMD | Any | Any |
| 5 | 1 | U62 | IC, 300mA Low Noise LDO, 3.3V Out, SOT23-5 | Microsemi | LX8213-33ISE |
| 6 | 1 | U63 | IC, 300mA Low Noise LDO, Adjustable, SOT23-5 | Microsemi | LX8213-00ISE |



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Note: Highlighted items are items already in the existing A2F design.

## PCB Layouts

The two circuit schematics (reference Figures 1 and 2) were respectively assembled on a small two-sided PCB for testing. The following PCB Layouts can be used as a reference to retrofit the Microsemi parts onto the existing PCB:

**U42 Boost Circuit**

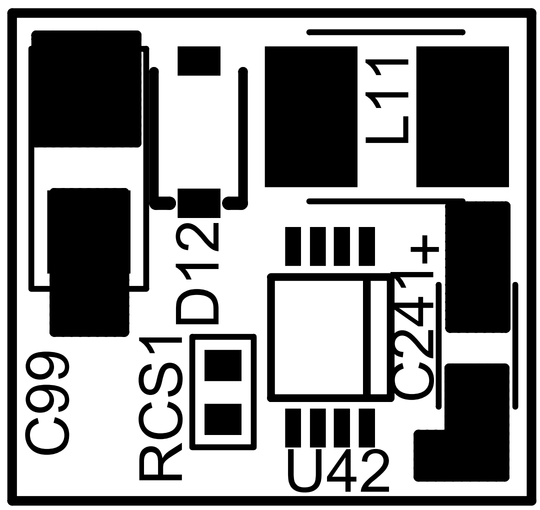


**Figure 3. Boost Circuit Top Assembly**

Finished Board Size = 0.542 (W) X 0.508 (H)

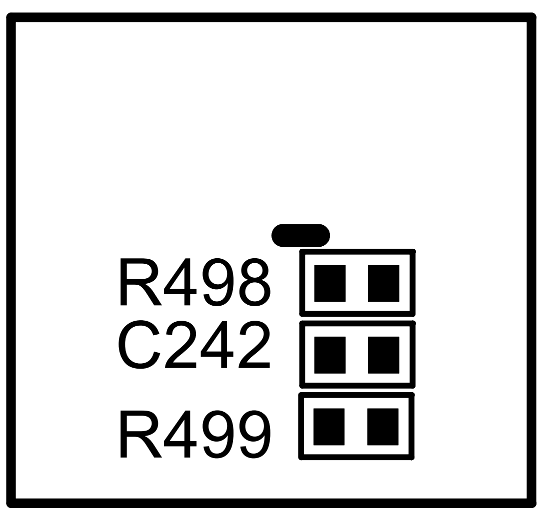

**Figure 4. Boost Circuit Bottom Assembly**

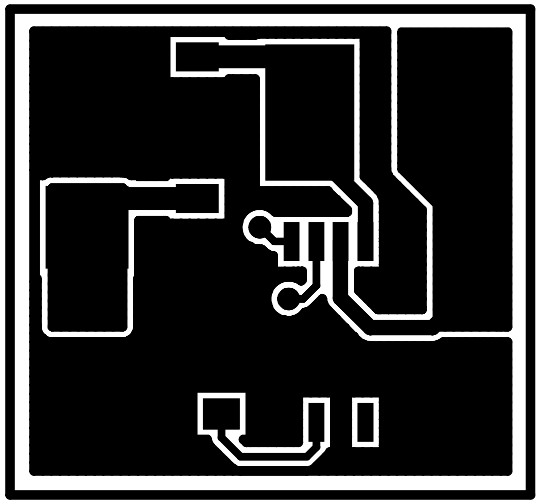

**Figure 5. Boost Circuit Top Layer**

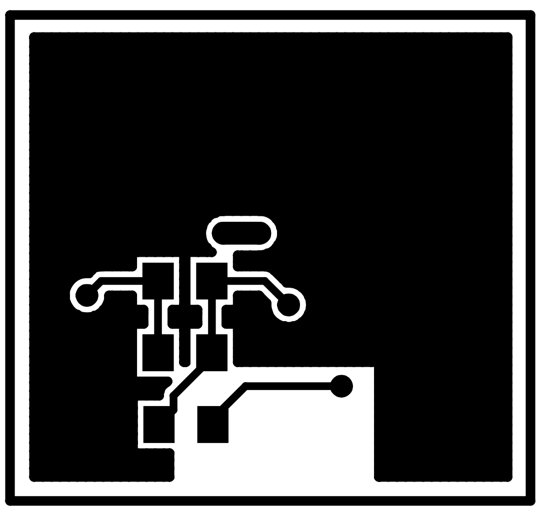

**Figure 6. Boost Circuit Bot Layer**

### U62 and U63 LDO Circuits

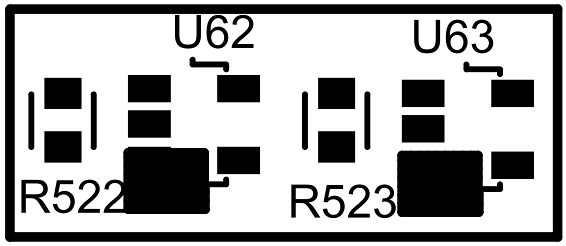


**Figure 7. LDO Circuits Top Assembly**

Finished Board Size = 0.570 (W) X 0.238 (H)

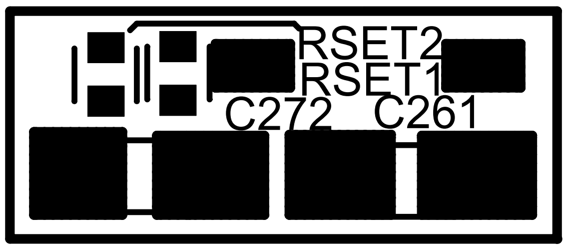


**Figure 8. LDO Circuits Bottom Assembly**

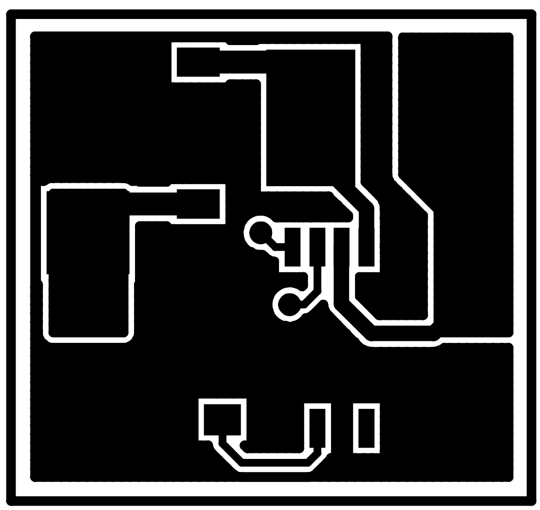

**Figure 9. LDO Circuits Top Layer**

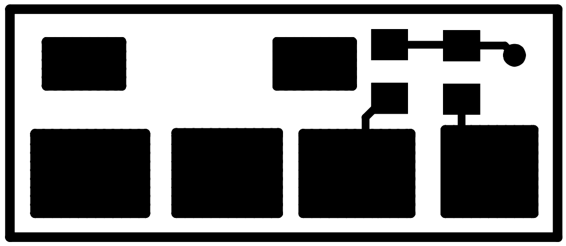

**Figure 10. LDO Circuits Bottom Layer**