

DESCRIPTION

Demonstration circuit 621 is a 1.25MHz triple DC/DC switching converter using the LT1941. The LT1941 features fast switching speed, three internal power switches, and a wide input voltage range, making it a versatile and powerful IC that fits easily into space-constrained applications and removes the need for three separate DC/DC converters in triple output applications. The constant 1.1MHz switching frequency allows for the use of tiny, surface mount external components. The current-mode control topology yields fast transient response and good loop stability, requiring a minimum number of external compensation components and allowing the use of ceramic input and output capacitors. The anti-phase switching and single-IC solution reduces the input capacitance requirements from three separate capacitors to only two. The low resistance internal power switches maintain high efficiencies (typically 80% to 85%) over a wide range of input voltages and loads. Its 260 μ A shutdown current (activated by grounding all three of the RUN/SS pins) extends battery life. All three outputs have external adjustable soft-start capacitors to limit inrush current during turn-on. The wide V_{IN} range of the LT1941 allows step-down, SEPIC, and boost configurations with up to 25V input. Power good terminals provide diagnostics for each output voltage (within 10%

of final value) and the input voltage (within 10% of 5V and 12V).

This board is designed for applications that require three outputs (two step-down supplies and a SEPIC or boost) with high load current in a small board space with low cost and low parts count as well as simple circuit design. The high current, on-board, triple monolithic switches eliminate the need for external switches. The use of ceramic capacitors in this circuit not only demonstrates small size and low cost, but the advantage of current-mode control in step-down, SEPIC, and boost applications with a simple compensation network for good stability and transient response.

For optional adjustments in the output voltage, compensation, ripple, power good diagnostics, run/soft-start, and other aspects of LT1941 design, please consult the datasheet. With three outputs and internal power switches, this design can start to heat up under maximum load current and high ambient temperature conditions. Please consult the datasheet for thermal considerations, especially when altering the output voltage for much higher power DC/DC converters.

Design files for this circuit board are available. Call the LTC factory.

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QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 621

1.25MHZ TRIPLE DC/DC CONVERTER

Table 1. Typical Performance Summary ($T_A = 25^\circ\text{C}$)

| Parameter | Conditions | Value |
|-----------------------------|---|-------------------|
| V_{IN} | | 4.7V to 14V |
| VOUT1 | | 1.8V |
| VOUT2 | | 3.3V |
| VOUT3 | | -12V |
| VOUT1 Maximum Load Current | | 2.4A |
| VOUT2 Maximum Load Current | | 1.4A |
| VOUT3 Maximum Load Current | $V_{IN} = 12\text{V}$ | 550mA |
| | $V_{IN} = 5\text{V}$ | 240mA |
| Efficiency | $V_{IN} = 12\text{V}, I_{OUT1} = 1.2\text{A}, I_{OUT2} = 700\text{mA}, I_{OUT3} = 275\text{mA}$ | 79% |
| | $V_{IN} = 5\text{V}, I_{OUT1} = 1.2\text{A}, I_{OUT2} = 700\text{mA}, I_{OUT3} = 120\text{mA}$ | 82.5% |
| VOUT1 ripple | $V_{IN} = 12\text{V}, I_{OUT1} = 2.4\text{A}, I_{OUT2} = 0\text{A}, I_{OUT3} = 0\text{A}$ | 25mV pk-pk |
| VOUT2 ripple | $V_{IN} = 12\text{V}, I_{OUT1} = 0\text{A}, I_{OUT2} = 1.4\text{A}, I_{OUT3} = 0\text{A}$ | 10mV pk-pk |
| VOUT3 ripple | $V_{IN} = 12\text{V}, I_{OUT1} = 0\text{A}, I_{OUT2} = 0\text{A}, I_{OUT3} = 550\text{mA}$ | 15mV pk-pk |
| Zero-Load Quiescent Current | $I_{OUT1} = I_{OUT2} = I_{OUT3} = 0\text{A}, V_{IN} = 12\text{V}$ | 8mA |
| Shutdown Quiescent Current | $RUN/SS1 = RUN/SS2 = RUN/SS3 = \text{GND}, V_{IN} = 12\text{V}$ | 260 μA |

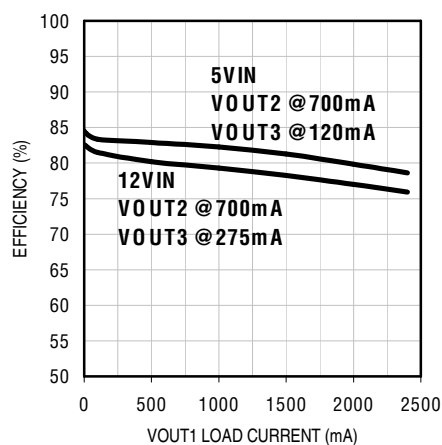


Figure 1. Typical Efficiency of Demo Circuit 621 LT1941 with varying load current on VOUT1

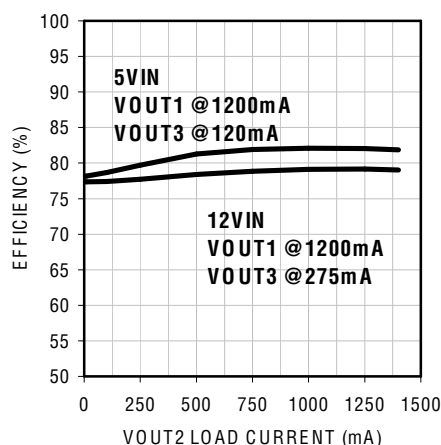


Figure 2. Typical Efficiency of Demo Circuit 621 LT1941 with varying load current on VOUT2

QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 621 1.25MHz TRIPLE DC/DC CONVERTER

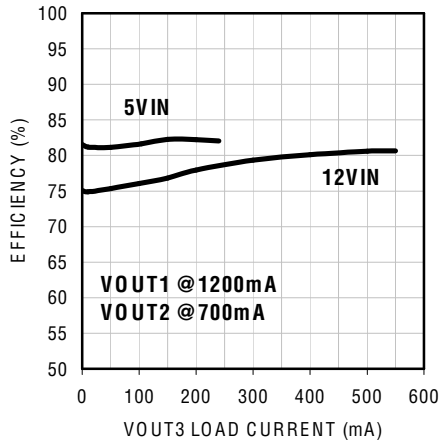


Figure 3. Typical Efficiency of Demo Circuit 621 LT1941 with varying load current on VOUT3

QUICK START PROCEDURE

Demonstration circuit 621 is easy to set up to evaluate the performance of the LT1941. Refer to Figure 5 for proper measurement equipment setup and follow the procedure below:

1. Connect the 4.7V–14V input power supply to the VIN and GND terminals.
2. After all connections are made, turn on input power and verify that the output voltages are 3.3V, 1.8V, and -12V.
3. The RUN/SS and Power Good functions are optional and their terminals can be left floating (disconnected) if their functions are not being used. Connecting a RUN/SS terminal to the GND terminal will disable the corresponding output. Connecting RUN/SS2 to the GND terminal will disable VOUT3 as well as VOUT2.

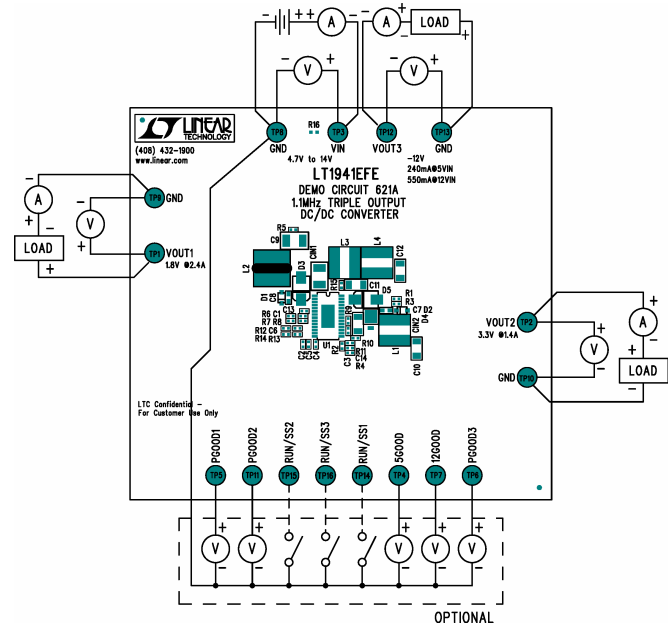


Figure 4. Proper Measurement Equipment Setup

OPTIONS

POWER GOOD TERMINALS

The power good terminals indicate the state of the three outputs and the input voltage. PGOOD1, PGOOD2, and PGOOD3 indicate when VOUT1, VOUT2, and VOUT3 are within 10% of their final values. PGOOD1 is pulled up to VIN and both PGOOD2 and PGOOD3 are pulled up to VOUT2. PGOOD3 is therefore dependent upon the state of VOUT2.

5G00D and 12G00D indicate when the input voltage is within 10% of 5V and 12V. Each has a pull-up resistor to VIN.

The power good terminals are not valid if the input voltage is below 3.5V or if all three of the RUN/SS terminals are pulled low and the LT1941 is in shut-down.

RUN / SOFT-START TERMINALS

The run/soft-start terminals (RUN/SS1, RUN/SS2, RUN/SS3) are used to disable or enable the three outputs and to adjust soft-start for each output. C2, C4,

and C5 (1500pF) provide soft-start to all three outputs and can be easily adjusted.

For normal operation (RUN), the terminals are left floating. In order to disable, or shutdown, an output stage, the RUN/SS terminal for that stage must be pulled to GND. If all three of the RUN/SS terminals are pulled to GND, the LT1941 enters micropower shutdown and the quiescent current drops to only 260 μ A at 12V input.

Table 2. RUN/SS Terminal Logic Table

| RUN/SS1 | RUN/SS2 | RUN/SS3 | VOUT1 | VOUT2 | VOUT3 |
|---------|---------|---------|-------|-------|-------|
| n/c | n/c | n/c | 1.8V | 3.3V | -12V |
| GND | n/c | n/c | 0V | 3.3V | -12V |
| n/c | GND | n/c | 1.8V | 0V | 0V |
| n/c | n/c | GND | 1.8V | 3.3V | 0V |
| GND | GND | n/c | 0V | 0V | 0V |
| n/c | GND | GND | 1.8V | 0V | 0V |
| GND | n/c | GND | 0V | 3.3V | 0V |
| GND | GND | GND | 0V | 0V | 0V |

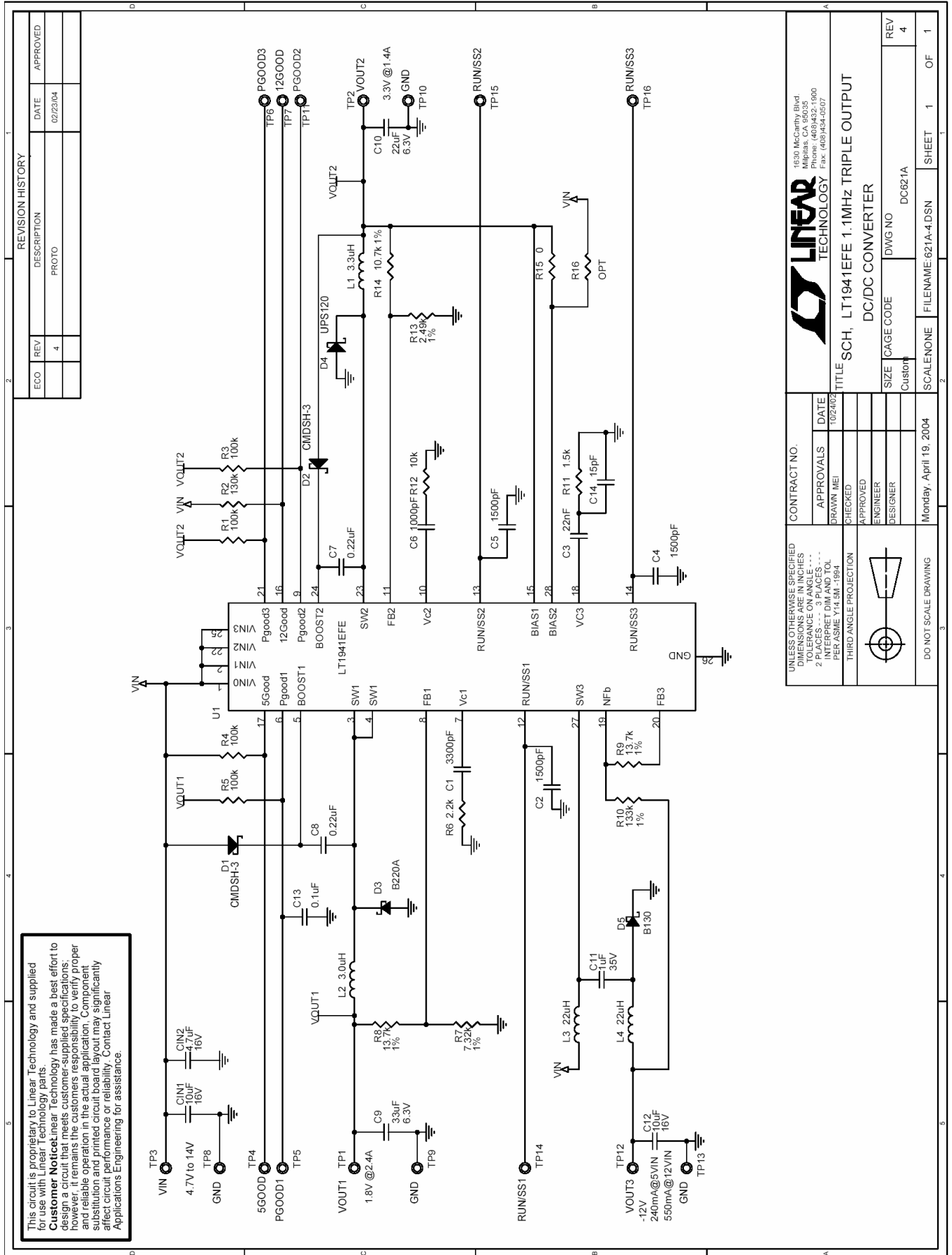
R15 / R16 BIAS2 SOURCE

The BIAS2 pin supplies the current to the driver of SW3. This pin is tied to the lowest available voltage source above 2.5V (VOUT2) for highest efficiency. R15 (0 Ω) provides a direct connection from BIAS2 to VOUT2.

BIAS2 can be tied directly to VIN if VOUT2 is not guaranteed to be available or if VOUT2 can be in shutdown when VOUT3 is required. By removing R15 and installing R16 (0 Ω), BIAS2 is tied directly to VIN. R16 and R15 must never be installed simultaneously. Installing R16 will change the logic in Table 2 to reflect a direct correlation between RUN/SS3 and VOUT3; RUN/SS2 no longer affects VOUT3.

QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 621

1.25MHz TRIPLE DC/DC CONVERTER

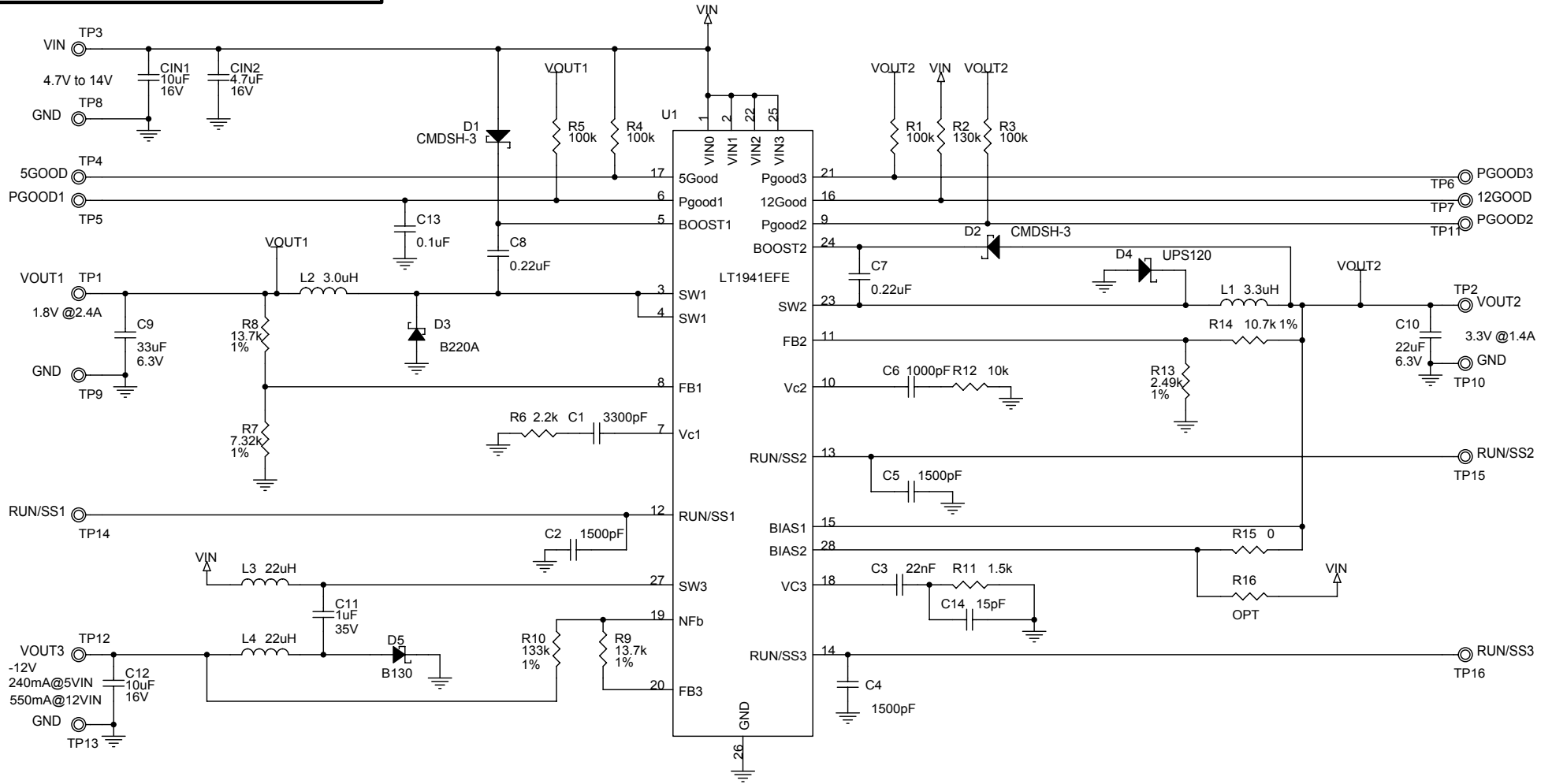


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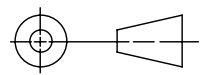
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| REVISION HISTORY | | | | |
|------------------|-----|-------------|----------|----------|
| ECO | REV | DESCRIPTION | DATE | APPROVED |
| | 4 | PROTO | 02/23/04 | |



UNLESS OTHERWISE SPECIFIED
 DIMENSIONS ARE IN INCHES
 TOLERANCE ON ANGLE ---
 2 PLACES --- 3 PLACES ---
 INTERPRET DIM AND TOL
 PER ASME Y14.5M - 1994



DO NOT SCALE DRAWING

CONTRACT NO.

| | |
|-----------|----------|
| APPROVALS | DATE |
| DRAWN MEI | 10/24/02 |
| CHECKED | |
| APPROVED | |
| ENGINEER | |
| DESIGNER | |



1630 McCarthy Blvd.
 Milpitas, CA 95035
 Phone: (408)432-1900
 Fax: (408)434-0507

TITLE
**SCH, LT1941EFE 1.1MHz TRIPLE OUTPUT
 DC/DC CONVERTER**

| | | | |
|------------|----------------------|---------|------|
| SIZE | CAGE CODE | DWG NO | REV |
| Custom | | DC621A | 4 |
| SCALE NONE | FILENAME: 621A-4.DSN | SHEET 1 | OF 1 |

Monday, April 19, 2004

| Item | Qty | Ref | Desc | Manufacturer / Part # |
|------|-----|-------------|-------------------------------------|-----------------------------|
| 1 | 1 | CIN1 | CAP, X5R 10uF 16V 20% 1210 | TAIYO YUDEN EMK325BJ106MN-T |
| 2 | 1 | CIN2 | CAP, X5R 4.7uF 16V 10% 1206 | TAIYO YUDEN EMK316BJ475KL |
| 3 | 1 | C1 | CAP, X7R 3300pF 50V 10% 0402 | AVX 04025C332KAT |
| 4 | 3 | C2,C4,C5 | CAP, X7R 1500pF 50V 5% 0402 | AVX 04025C152JAT |
| 5 | 1 | C3 | CAP, X7R 22nF 25V 10% 0402 | TDK C1005X7R1E223K |
| 6 | 1 | C6 | CAP, X7R 1000pF 10V 10% 0402 | AVX 0402ZC102K |
| 7 | 2 | C8,C7 | CAP, X5R 0.22uF 16V 20% 0603 | AVX 0603YD224MAT |
| 8 | 1 | C9 | CAP, X5R 33uF 6.3V 20% 1210 | TDK C3225X5R0J336ML |
| 9 | 1 | C10 | CAP, X5R 22uF 6.3V 20% 1206 | TAIYO YUDEN JMK316BJ226KL |
| 10 | 1 | C11 | CAP, X7R 1uF 35V 10% 1206 | TAIYO YUDEN GMK316BJ105KL |
| 11 | 1 | C12 | CAP, X7R 10uF 16V 20% 1206 | TDK C3216X7R1C106M |
| 12 | 1 | C13 | CAP, X5R 0.1uF 10V 10% 0402 | AVX 0402ZD104KAT |
| 13 | 1 | C14 | CAP, NPO 15pF 50V 5% 0402 | AVX 04025A150JAT2A |
| 14 | 2 | D2,D1 | DIODE,CMDSH-3 SOD323 | CENTRAL CMDSH-3-LTC |
| 15 | 1 | D3 | DIODE, B220A SCHOTTKY RECTIFIER 2A | DIODES INC. B220A |
| 16 | 1 | D4 | DIODE, SCHOTTKY 20V 1A | MICROSEMI UPS120 |
| 17 | 1 | D5 | DIODE, B130 SCHOTTKY RECTIFIER 1.0A | DIODES INC. B130 |
| 18 | 1 | L1 | IND, 3.3uH | SUMIDA CDRH5D28R-3R3 |
| 19 | 1 | L2 | IND, 3.0uH | SUMIDA CDRH6D28-3R0 |
| 20 | 2 | L3,L4 | IND, 22uH | SUMIDA CDRH5D28-220 |
| 21 | 4 | R1,R3,R4,R5 | RES, 100K OHMS 5% 1/16W 0402 | AAC CR05-104JM |
| 22 | 1 | R2 | RES, 130K OHMS 5% 1/16W 0402 | AAC CR05-134JM |
| 23 | 1 | R6 | RES, 2.2K OHMS 5% 1/16W 0402 | AAC CR05-222JM |
| 24 | 1 | R7 | RES, 7.32K OHMS 1% 1/16W 0402 | KOA RK73H1E7321F |
| 25 | 2 | R9,R8 | RES, 13.7K OHMS 1% 1/16W 0402 | AAC CR05-1372FM |
| 26 | 1 | R10 | RES, 133K OHMS 1% 1/16W 0402 | AAC CR05-1333FM |
| 27 | 1 | R11 | RES, 1.5K OHMS 5% 1/16W 0402 | AAC CR05-152JM |
| 28 | 1 | R12 | RES, 10K OHMS 1% 1/16W 0402 | AAC CR05-1002FM |
| 29 | 1 | R13 | RES, 2.49K OHMS 1% 1/16W 0402 | AAC CR05-2491FM |
| 30 | 1 | R14 | RES, 10.7K OHMS 1% 1/16W 0402 | AAC CR05-1072FM |
| 31 | 1 | R15 | RES, 0 OHM JUMPER 0402 | AAC CJ05-000M |
| 32 | 0 | R16 | OPTION | OPTION |
| 33 | 16 | TP1-TP16 | TURRET | MILL-MAX-2501-2 |
| 34 | 1 | U1 | IC, LT1941EFE | LINEAR TECH LT1941EFE |

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