# LTM4627EV
# High Efficiency PolyPhase Step-Down Power Supply

## DESCRIPTION

Demonstration circuit 1668B-A is a PolyPhase® power supply featuring two LTM®4627 high efficiency synchronous buck µModule® regulators. The DC1668B-A input voltage range is between 4.5V to 20V with a jumper programmable output voltage from 0.6V to 3.3V. The demo circuit can deliver up to 30A of load with excellent current-sharing. Current derating may be necessary under certain operating conditions.

The LTM4627 can be synchronized to an external clock between 250kHz to 770kHz. The default switching frequency for the DC1668B-A is set to 500kHz through the onboard LTC6902 clock generator. The external clock interleaves the paralleled phases to minimize input and output ripple.

DC1668B-A demonstrates that paralleling LTM4627 modules is easy and reliable. These features and the availability of the LTM4627 in a compact thermally enhanced 15mm × 15mm × 4.32mm LGA package make the circuit ideal for use in high density point of load regulation applications.

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

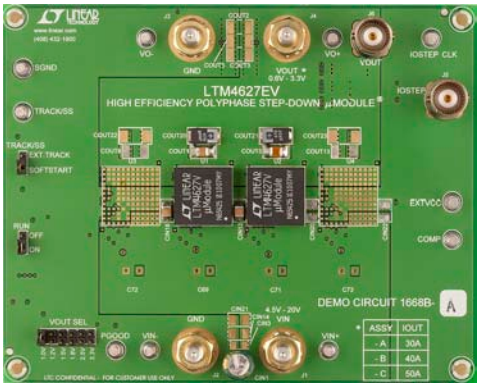


## PERFORMANCE SUMMARY

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

| PARAMETER | CONDITIONS/NOTES | VALUE |
|---|---|---|
| Maximum Input Voltage | | 20V |
| Minimum Input Voltage | | 4.5V |
| Output Voltage $V_{OUT}$ | Remove $V_{OUT}$ SEL Jumper for $V_{OUT}$ = 0.6$V_{DC}$ | 0.6$V_{DC}$, 1$V_{DC}$, 1.2$V_{DC}$, 1.5$V_{DC}$ 1.8$V_{DC}$, 2.5$V_{DC}$, 3.3$V_{DC}$ |
| Maximum Continuous Output Current $I_{OUT(MAX)}$ | Current Derating May Be Necessary for Certain $V_{IN}$, $V_{OUT}$, Frequency and Thermal Conditions | 30$A_{DC}$ |
| Default Operating Frequency | | 500kHz |
| External Clock Synchronous Frequency Range | | 250kHz to 770kHz |
| Output Voltage Ripple (Typical) | $V_{IN}$ = 12V, $V_{OUT}$ = 1.8V, 500kHz (20MHz BW) | < 30m$V_{P-P}$ at $I_{OUT}$ = 30A, See Figure 6 |
| Efficiency | $V_{IN}$ = 12V, $V_{OUT}$ = 1.8V, 500kHz | 86.6% at $I_{OUT}$ = 30A, See Figure 3 |
| Load Transient | $V_{IN}$ = 12V, $V_{OUT}$ = 1.8V | See Figure 5 |

## BOARD PHOTO




DC1668ba F01

**Figure 1. LTM4627/DC1668B-A Demo Board**

## QUICK START PROCEDURE

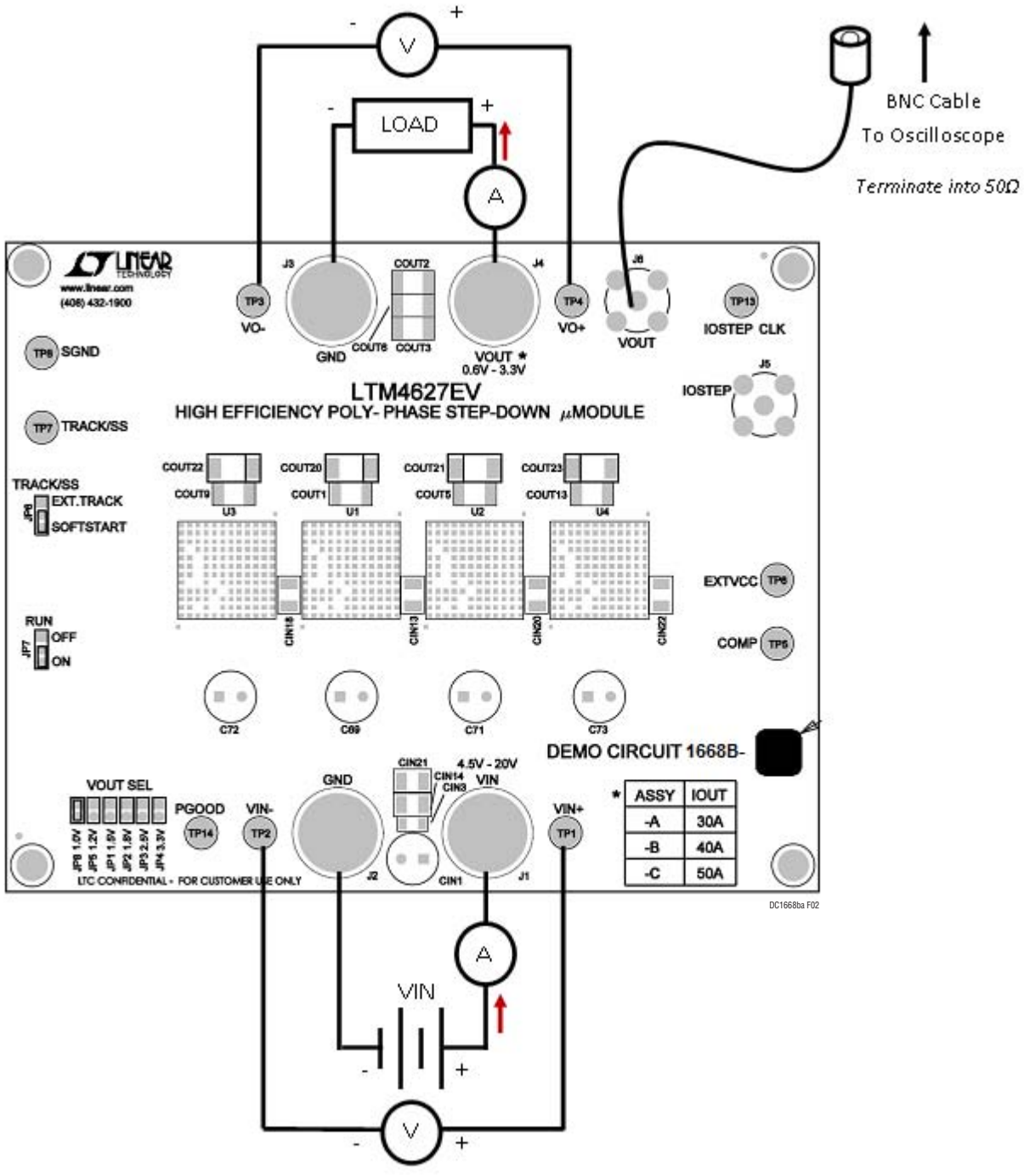
Demonstration circuit 1668B-A is an easy way to evaluate the performance of paralleled LTM4627 modules. Please refer to Figure 2 for proper measurement equipment setup and follow the procedure below:

1. With power off, connect the input power supply, load, meters, and $V_{OUT}$ BNC cable as shown in Figure 2. Preset the load to 0A and $V_{IN}$ supply to be 0V. Place jumpers in the following positions for a typical 1.8$V_{OUT}$ application:

| JP2 | JP7 | JP6 |
|---|---|---|
| $V_{OUT}$ Select | RUN | TRACK/SS |
| 1.8V | OFF | SOFT-START |

2. Turn on the power at the input. Increase $V_{IN}$ to 12V (Do not hot-plug the input supply or apply more than the rated maximum voltage of 20V to the board or the modules may be damaged).
3. Set the run pin jumper (JP7) to the ON position. The output voltage should be regulated. The output voltage meter should read 1.8V ±2% (1.76V to 1.84V).
4. Vary the input voltage from 5V to 20V and adjust the load current from 0A to 30A. $V_{OUT}$ should remain regulated at 1.8V ±2%. Observe the load regulation, output voltage ripple, efficiency and other parameters. Output voltage ripple should be measured at J6 with a BNC cable and oscilloscope. The probe channel for $V_{OUT}$ should be set at 50Ω termination resistance to match the BNC cable.
5. 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 (5mV/A).

## QUICK START PROCEDURE




| ★ | ASSY | IOUT |
|---|---|---|
| | -A | 30A |
| | -B | 40A |
| | -C | 50A |

## QUICK START PROCEDURE

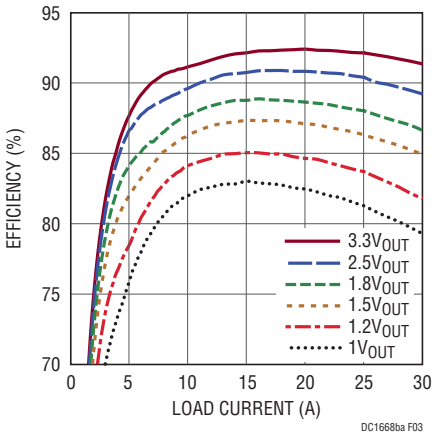



**Figure 3. Measured Efficiency at $12V_{IN}$, 500kHz**

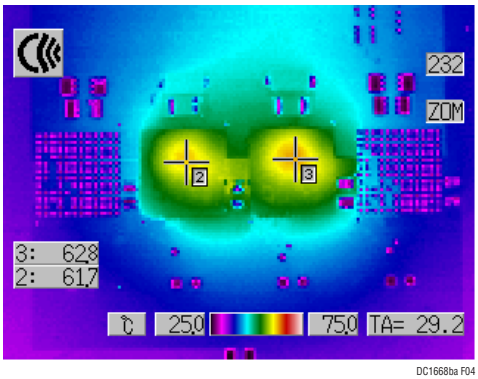
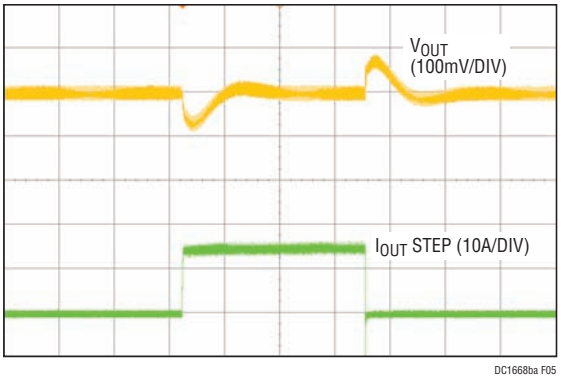
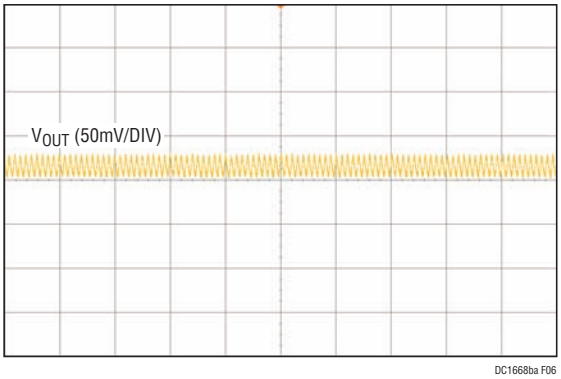



**Figure 4. Thermal Capture at $12V_{IN}$, $1.8V_{OUT}$, 30A, 500kHz No Forced Airflow (Convection). $T_A$ = 29°C.**




$V_{OUT}$ = 1.8V
$I_{OUT}$ DC = 15A
$I_{OUT}$ STEP = 15A
$f_{SW}$ = 500kHz

**Figure 5. Measured Load Step Response**




$V_{OUT}$ = 1.8V
$I_{OUT}$ = 30A
$f_{SW}$ = 500kHz

**Figure 6. Measured Output Voltage Ripple (20MHz BW)**

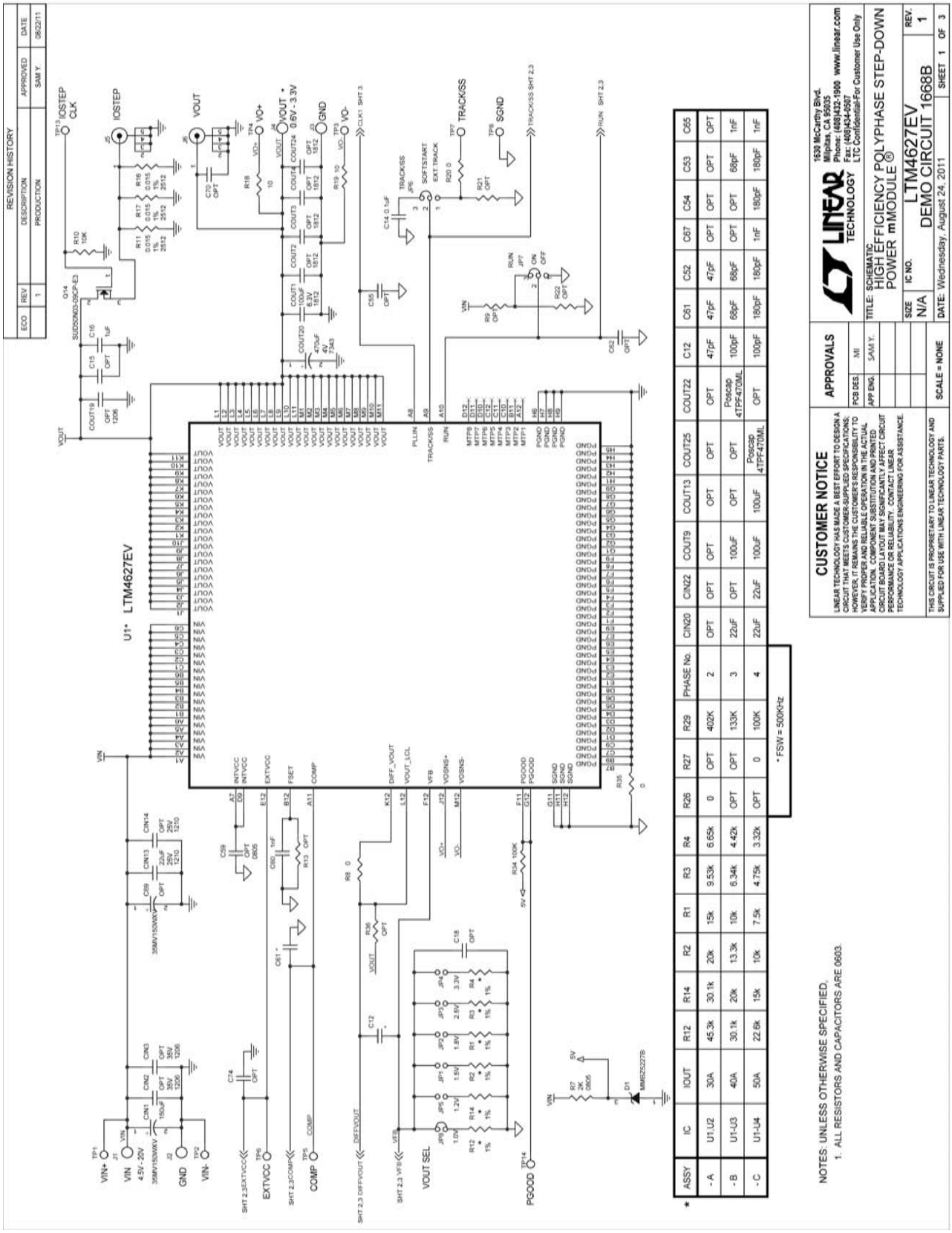
## PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|---|---|---|---|---|
| **Required Circuit Components** | | | | |
| 1 | 1 | CIN1 | CAP, 150µF 20% 35V ALUM | SANYO 35MV150WXV |
| 2 | 2 | CIN13, CIN18 | CAP, 1210 22µF 20% 25V X5R | AVX 12103D226MAT2A |
| 3 | 2 | COUT1, COUT5 | CAP, 1812 100µF 20% 6.3V X5R | TDK C4532X5R0J107MZ |
| 4 | 2 | COUT20, COUT21 | CAP, 470µF 20% 4V POSCAP | SANYO POSCAP 4TPF470ML |
| 5 | 2 | R8 | RES, 0603 0Ω JUMPER | VISHAY CRCW06030000Z0EA |
| 6 | 2 | R18, R19 | RES, 0603 10Ω 5% 1/10W | AAC CR16-100JM |
| 7 | 4 | R30, R31, R32, R33 | RES, 0603 100Ω 5% 1/10W | KOA RK73B1JTTD101J |
| 8 | 1 | R34 | RES, 0603 100k 5% 1/10W | VISHAY CRCW0603100KJNEA |
| 9 | 1 | R35 | RES, 0805 0Ω JUMPER | VISHAY CRCW08050000Z0EA |
| 10 | 1 | U5 | IC, LTC6902CMS | LINEAR TECHNOLOGY LTC6902CMS |
| 11 | 3 | C12, C52, C61 | CAP, 0603 47pF 10% 50V NP0 | AVX 06035A470KAT |
| 12 | 1 | R1 | RES, 0603 15k 1% 1/10W | VISHAY CRCW060315K0FKEA |
| 13 | 1 | R2 | RES, 0603 20k 1% 1/10W | VISHAY CRCW060320K0FKEA |
| 14 | 1 | R3 | RES, 0603 9.53k 1% 1/10W | VISHAY CRCW06034K53FKEA |
| 15 | 1 | R4 | RES, 0603 6.65k 1% 1/10W | VISHAY CRCW06036K65FKEA |
| 16 | 1 | R12 | RES, 0603 45.3k 1% 1/10W | VISHAY CRCW060345K3FKEA |
| 17 | 1 | R14 | RES, 0603 30.1k 1% 1/10W | VISHAY CRCW060330K1FKEA |
| 18 | 1 | R26 | RES, 0603 0Ω JUMPER | VISHAY CRCW06030000Z0EA |
| 19 | 1 | R29 | RES, 0603 402k 1% 1/10W | PANASONIC ERJ-3EKF4023 |
| 20 | 2 | U1, U2 | IC, MICRO MODULE | LINEAR TECHNOLOGY LTM4627EV |
| **Additional Demo Board Circuit Components** | | | | |
| 1 | 2 | C14, C38 | CAP, 0603 0.1µF 20% 16V X7R | TAIYO YUDEN EMK107BJ104MA-T |
| 2 | 1 | C16 | CAP, 0603 1µF 20% 10V X5R | TAIYO YUDEN LMK107BJ105MA-T |
| 3 | 1 | C60 | CAP, 0603 1000pF 10% 50V NP0 | AVX 06035A102KAT2A |
| 4 | 1 | D1 | DIODE, ZENER 350mW | DIODES INC. MMBZ5227B |
| 5 | 1 | R7 | RES, 0805 2k 5% 1/10W | AAC CR10-202JM |
| 6 | 1 | Q14 | XSTR, SUD50N03-10CP MOSFET | SILICONIX SUD50N03-10CP |
| 7 | 1 | R10 | RES, 0603 10k 5% 1/10W | AAC CR16-103JM |
| 8 | 2 | R20 | RES, 0603 0Ω JUMPER | VISHAY CRCW06030000Z0EA |
| 9 | 3 | R11, R16, R17 | RES, 2512 0.015Ω 1% 1W | PANASONIC ERJM1WSF15MU |
| 10 | 0 | CIN2, CIN3 | CAP, 1206 10µF 20% 35V X5R OPTION | TAIYO YUDEN GMK316BJ106ML-T OPTION |
| 11 | 0 | CIN14, CIN19, CIN21, CIN23 | CAP, 1210 22µF 20% 25V X5R OPTION | AVX 12103D226MAT2A OPTION |
| 12 | 0 | COUT2, COUT3, COUT6 | CAP, 1812 100µF 20% 6.3V X5R OPTION | TDK C4532X5R0J107MZ OPTION |
| 13 | 0 | COUT4, COUT7, COUT11, COUT15 | CAP, 1812 OPTION | TAIYO YUDEN JMK432BJ107MU-T OPTION |
| 14 | 0 | COUT10, COUT14 | CAP, 1812 100µF 20% 6.3V X5R OPTION | TDK C4532X5R0J107MZ OPTION |
| 15 | 0 | COUT19 | CAP, 1206 OPTION | TAIYO YUDEN EMK316BJ475ML-T OPTION |
| 16 | 0 | COUT23, COUT26, COUT27 | CAP, 470µF 20% 4V POSCAP OPTION | SANYO POSCAP 4TPF470ML OPTION |

## PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|---|---|---|---|---|
| 17 | 0 | COUT24 | CAP, 1812 OPTION | TAIYO YUDEN JMK316BJ226ML-T |
| 18 | 0 | C15 | CAP, 0603 1µF 20% 10V X5R OPTION | TAIYO YUDEN LMK107BJ105MA-T OPTION |
| 19 | 0 | C18, C55, C56, C57, C58, C62, C74 TO C77 | CAP, 0603 OPTION | OPTION |
| 20 | 0 | C59, C63, C66, C68 | CAP, 0805 OPTION | OPTION |
| 21 | 0 | C64 | CAP, 0603 1000pF 10% 50V NP0 OPTION | AVX 06035A102KAT2A OPTION |
| 22 | 0 | C69, C71, C72, C73 | CAP, 150µF 20% 35V ALUM OPTION | SANYO 35MV150WXV OPTION |
| 23 | 1 | C70 | CAP, 0603 0.22µF 20% 10V X5R OPTION | TAIYO YUDEN LMK107BJ224MA-T OPTION |
| 24 | 0 | R9, R13, R15, R23, R24 | RES, 0603 51k 5% 1/10W OPTION | AAC CR16-513JM OPTION |
| 25 | 0 | R21, R22, R36 | RES, 0603 OPTION | OPTION |
| 26 | 0 | CIN20 | CAP, 1210 22µF 20% 25V X5R OPTION | AVX 12103D226MAT2A OPTION |
| 27 | 0 | CIN22, | CAP, 1210 22µF 20% 25V X5R OPTION | AVX 12103D226MAT2A OPTION |
| 28 | 0 | COUT9 | CAP, 1812 100µF 20% 6.3V X5R OPTION | TDK C4532X5R0J107MZ OPTION |
| 29 | 0 | COUT13 | CAP, 1812 100µF 20% 6.3V X5R OPTION | TDK C4532X5R0J107MZ OPTION |
| 30 | 0 | COUT22 | CAP, 470µF 20% 4V POSCAP OPTION | SANYO POSCAP 4TPF470ML OPTION |
| 31 | 0 | COUT25 | CAP, 470µF 20% 4V POSCAP OPTION | SANYO POSCAP 4TPF470ML OPTION |
| 32 | 0 | C53, C54, C65, C67 | CAP, 0603 OPTION | OPTION |
| 33 | 0 | R27 | RES, 0603 OPTION | OPTION |
| **Hardware** | | | | |
| 1 | 6 | JP1, JP2, JP3, JP4, JP5, JP8 | HEADER, 2PIN, 2mm | SAMTEC TMM 102-02-L-S |
| 2 | 2 | JP6, JP7 | HEADER, 3PIN, 2mm | SAMTEC TMM-103-02-L-S |
| 3 | 4 | J1, J2, J3, J4 | STUD, PRESS-FIT | PEM KFH-032-10 |
| 4 | 2 | J5, J6 | CONN, BNC, 5 PINS | CONNEX 112404 |
| 5 | 10 | TP1 TO TP8, TP13, TP14 | TURRET | MILL MAX 2501-2-00-80-00-00-07-0 |
| 6 | 3 | JP1, JP6, JP7 | SHUNT, 2mm | SAMTEC 2SN-BK-G |
| 7 | 4 | | STANDOFF, SNAP ON | KEYSTONE_8834 |
| 8 | 8 | J1, J2, J3, J4 | NUT, BRASS #10-32 | ANY |
| 9 | 4 | J1, J2, J3, J4 | WASHER, BRASS #10 | ANY |
| 10 | 4 | J1, J2, J3, J4 | LUG, RING | KEYSTONE 310 PbF |

## SCHEMATIC DIAGRAM




| * ASSY | IC | IOUT | R12 | R14 | R2 | R1 | R3 | R4 | R26 | R27 | R29 | PHASE No. | CIN20 | CIN22 | COUT9 | COUT13 | COUT25 | COUT22 | C12 | C61 | C52 | C67 | C54 | C53 | C65 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| - A | U1,U2 | 30A | 45.3k | 30.1k | 20k | 15k | 9.53k | 6.65k | 0 | OPT | 402K | 2 | OPT | OPT | OPT | OPT | OPT | OPT | 47pF | 47pF | 47pF | OPT | OPT | OPT | OPT |
| - B | U1-U3 | 40A | 30.1k | 20k | 13.3k | 10k | 6.34k | 4.42k | OPT | OPT | 133K | 3 | 22uF | OPT | 100uF | OPT | Poscap 4TPF470ML | 100pF | 68pF | 68pF | 68pF | OPT | 68pF | 68pF | 1nF |
| - C | U1-U4 | 50A | 22.6k | 15k | 10k | 7.5k | 4.75k | 3.32k | OPT | 0 | 100K | 4 | 22uF | 22uF | 100uF | 100uF | Poscap 4TPF470ML | OPT | 100pF | 180pF | 180pF | 1nF | 180pF | 180pF | 1nF |

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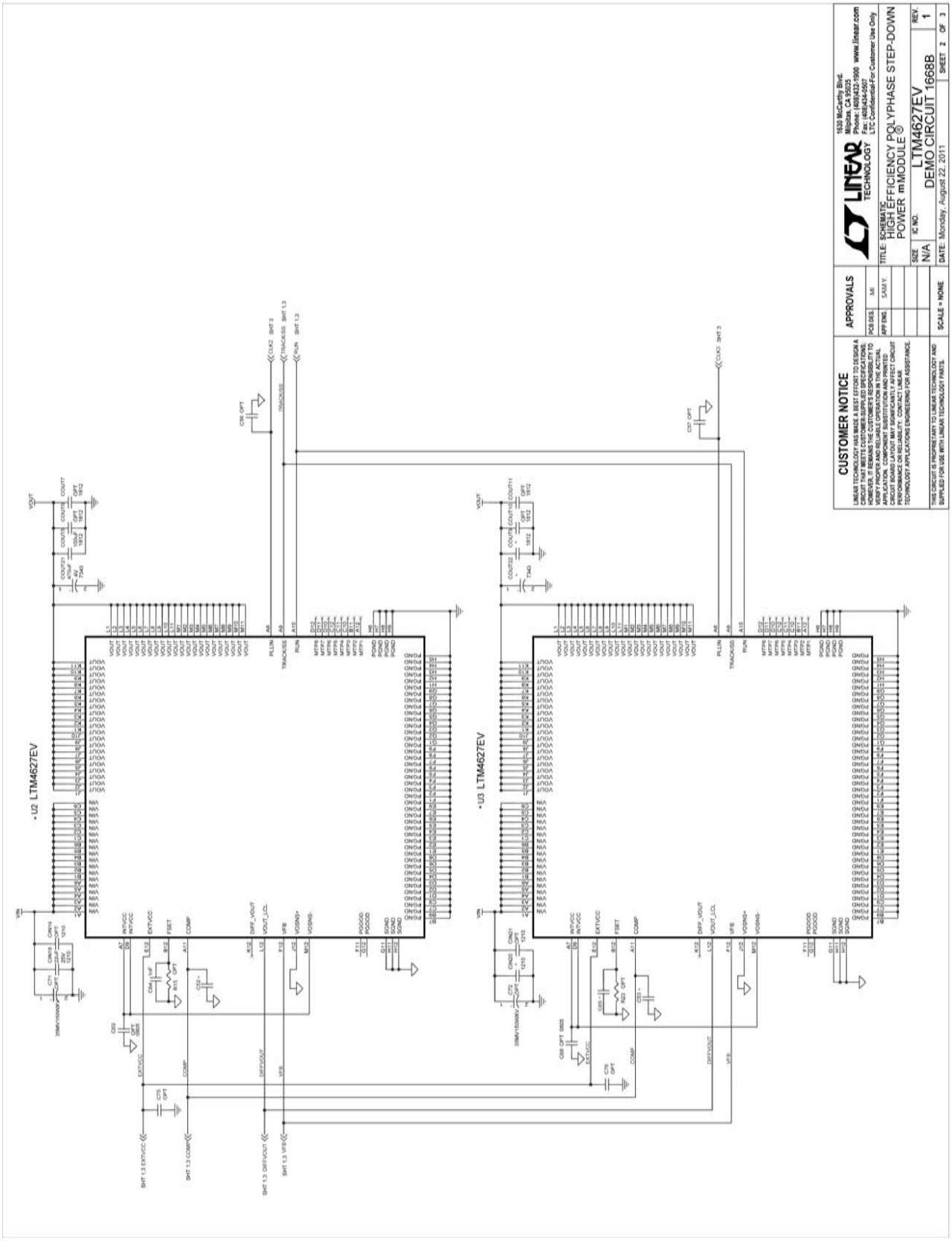

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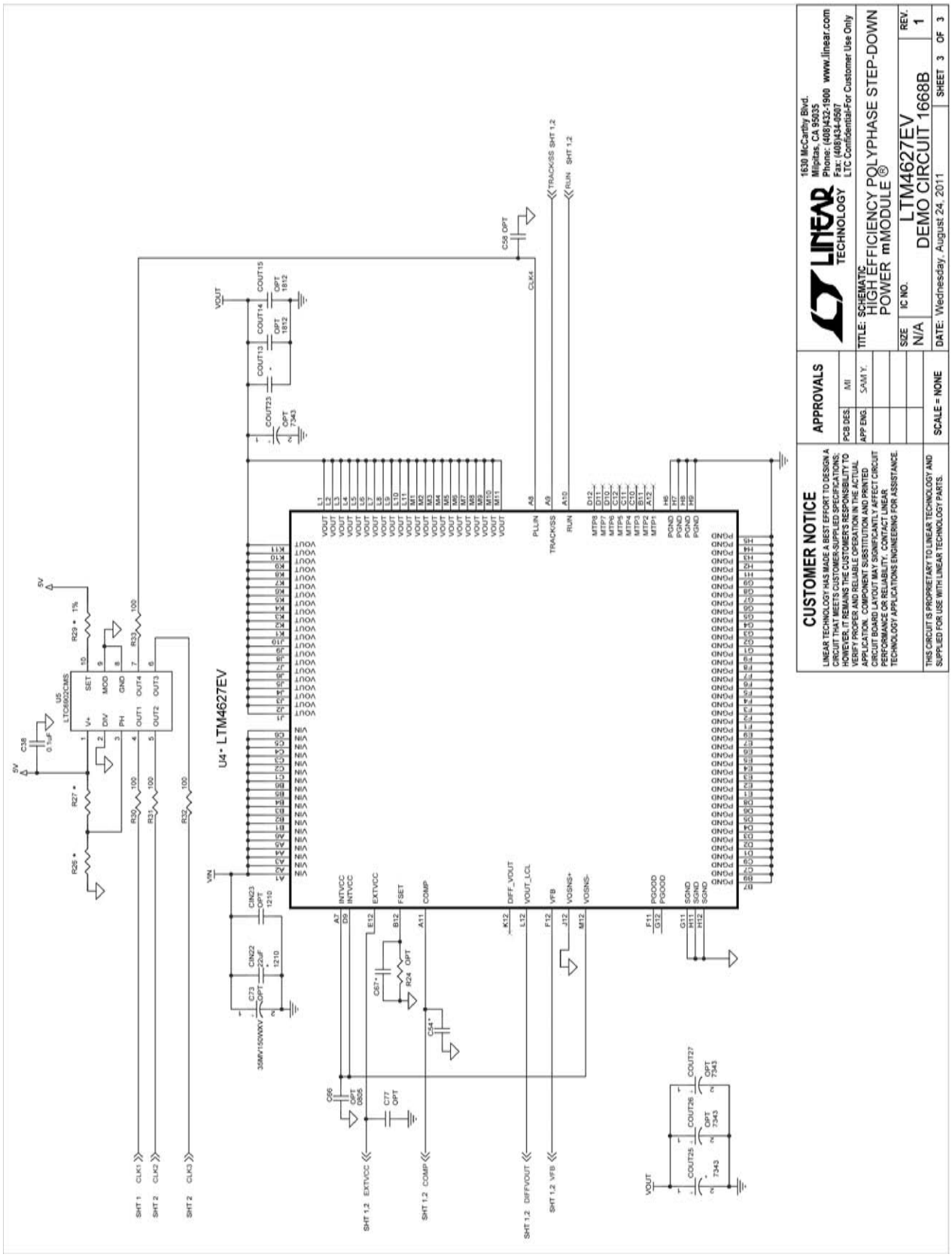

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