

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 μ Module® 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 \times 15mm \times 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>

LT, LT, LTC, LTM, Linear Technology, PolyPhase, μ Module and the Linear logo are registered trademarks of Linear Technology Corporation. All other trademarks are the property of their respective owners.

PERFORMANCE SUMMARY Specifications are at $T_A = 25^\circ\text{C}$

PARAMETER	CONDITIONS/NOTES	VALUE
Maximum Input Voltage		20V
Minimum Input Voltage		4.5V
Output Voltage V_{OUT}	Remove V_{OUT} SEL Jumper for $V_{OUT} = 0.6V_{DC}$	0.6V _{DC} , 1V _{DC} , 1.2V _{DC} , 1.5V _{DC} , 1.8V _{DC} , 2.5V _{DC} , 3.3V _{DC}
Maximum Continuous Output Current $I_{OUT(MAX)}$	Current Derating May Be Necessary for Certain V_{IN} , V_{OUT} , Frequency and Thermal Conditions	30A _{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)	< 30mV _{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

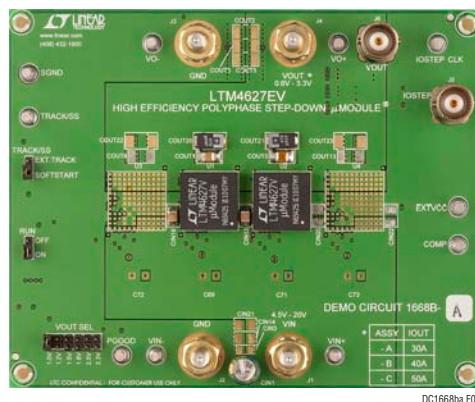


Figure 1. LTM4627/DC1668B-A Demo Board

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:

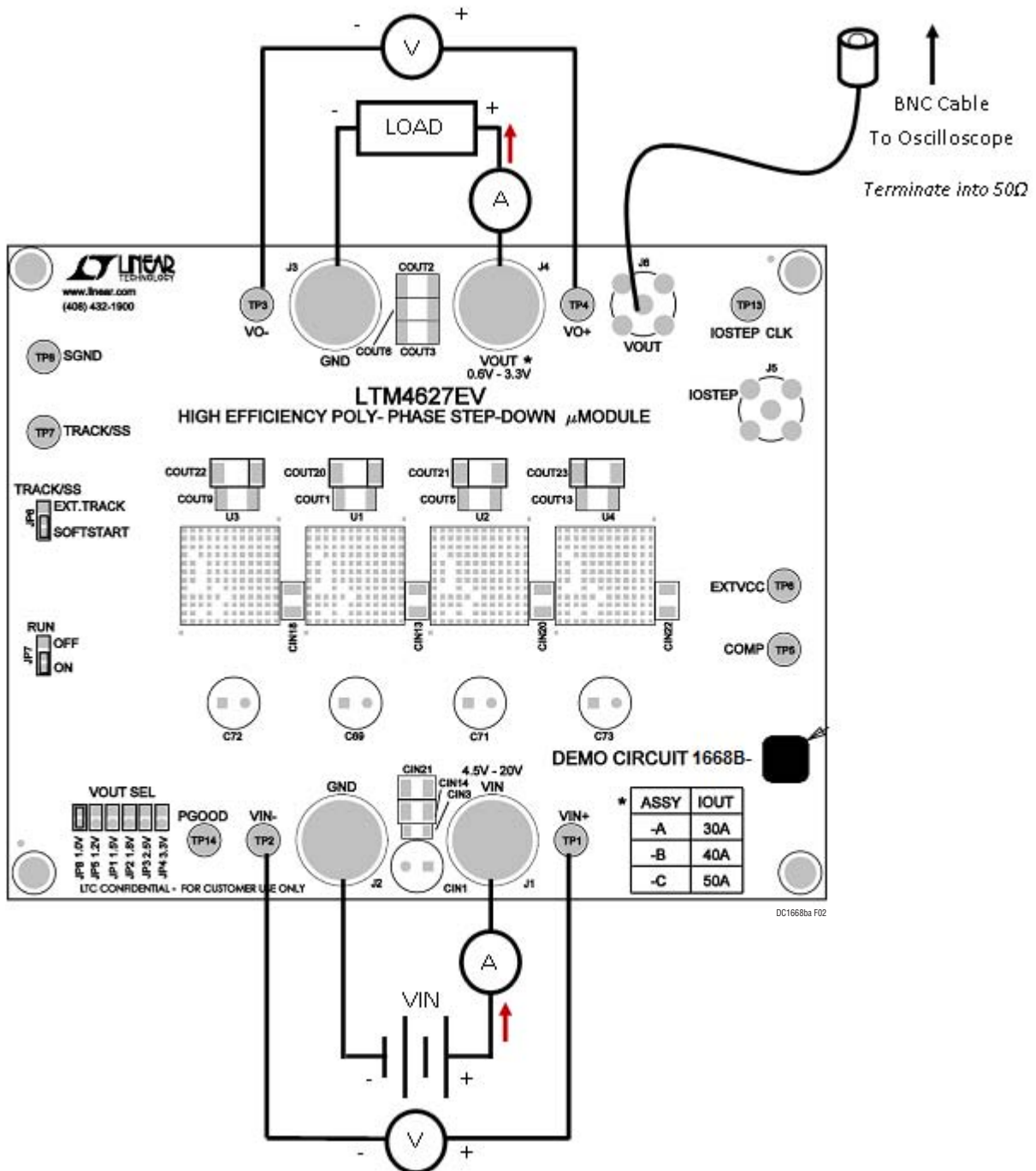
1. With power off, connect the input power supply, load, meters, and V_{OUT} BNC cable as shown in Figure 2. Preset the load to 0A and V_{IN} supply to be 0V. Place jumpers in the following positions for a typical 1.8V $_{OUT}$ application:

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 \pm 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 \pm 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 50 Ω 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



QUICK START PROCEDURE

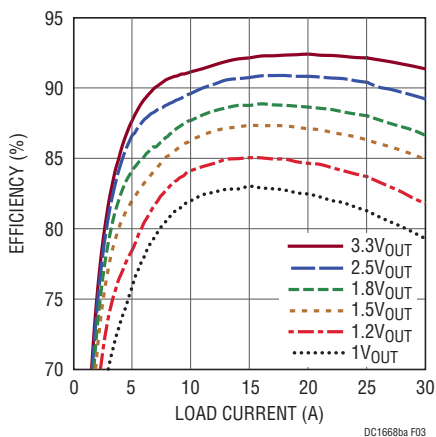


Figure 3. Measured Efficiency at 12VIN, 500kHz

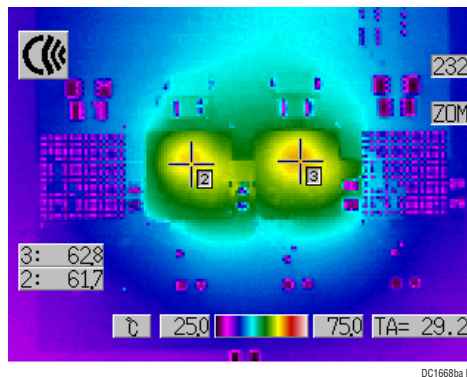
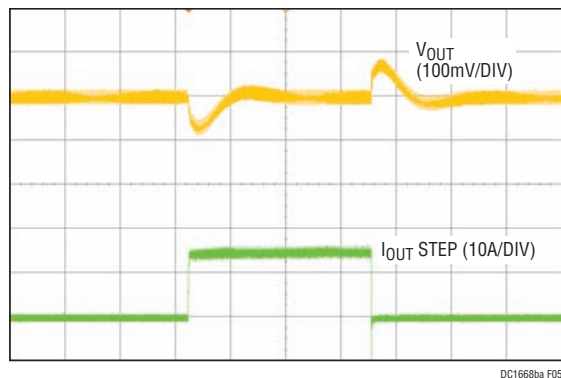
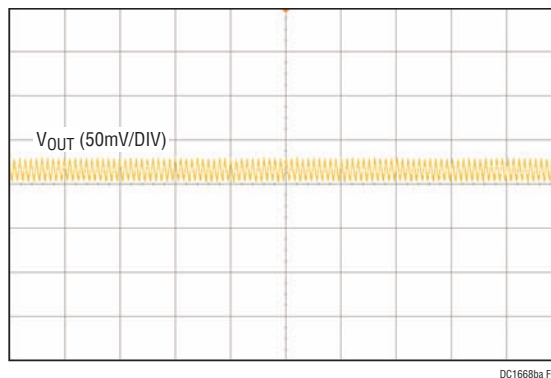


Figure 4. Thermal Capture at 12VIN, 1.8VOUT, 30A, 500kHz No Forced Airflow (Convection). $T_A = 29^\circ\text{C}$.



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

Figure 5. Measured Load Step Response



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

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 RK73B1JTDD101J
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 NPO	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 NPO	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

DEMO MANUAL DC1688B-A

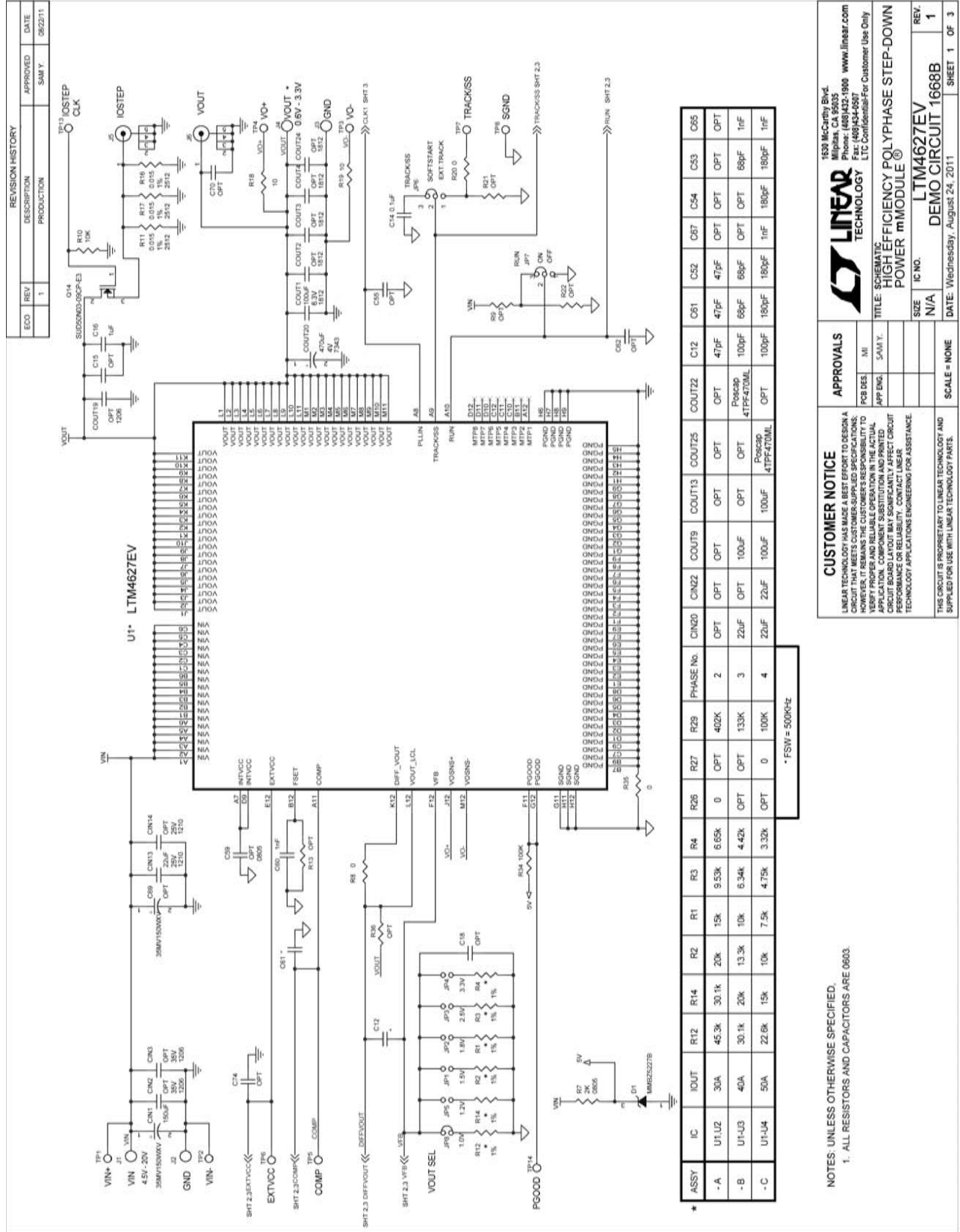
PARTS LIST

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



1630 McCarthy Blvd.
 Milpitas, CA 95035
 Phone: (408)323-1900 www.linear.com
 Fax: (408)323-1901
 LTC Confidential For Customer Use Only

LINEAR TECHNOLOGY
 HIGH EFFICIENCY POLYPHASE STEP-DOWN POWER mMODULE

CUSTOMER NOTICE
 LINEAR TECHNOLOGY MAKES A BEST EFFORT TO DESIGN A PRODUCT THAT MEETS THE CUSTOMER'S REQUIREMENTS. HOWEVER, IT REMAINS THE CUSTOMER'S RESPONSIBILITY TO VERIFY PROPER AND RELIABLE OPERATION IN THE ACTUAL APPLICATION. COMPONENT SUBSTITUTION AND PRINTED CIRCUIT BOARD MANUFACTURING VARIATIONS MAY AFFECT CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE.

APPROVALS

ROB DES	MI	APP ENG	SALES Y

SCALE = NONE

IC NO. LTM4627EV
REV. 1
DEMO CIRCUIT 1668B
 SHEET 1 OF 3

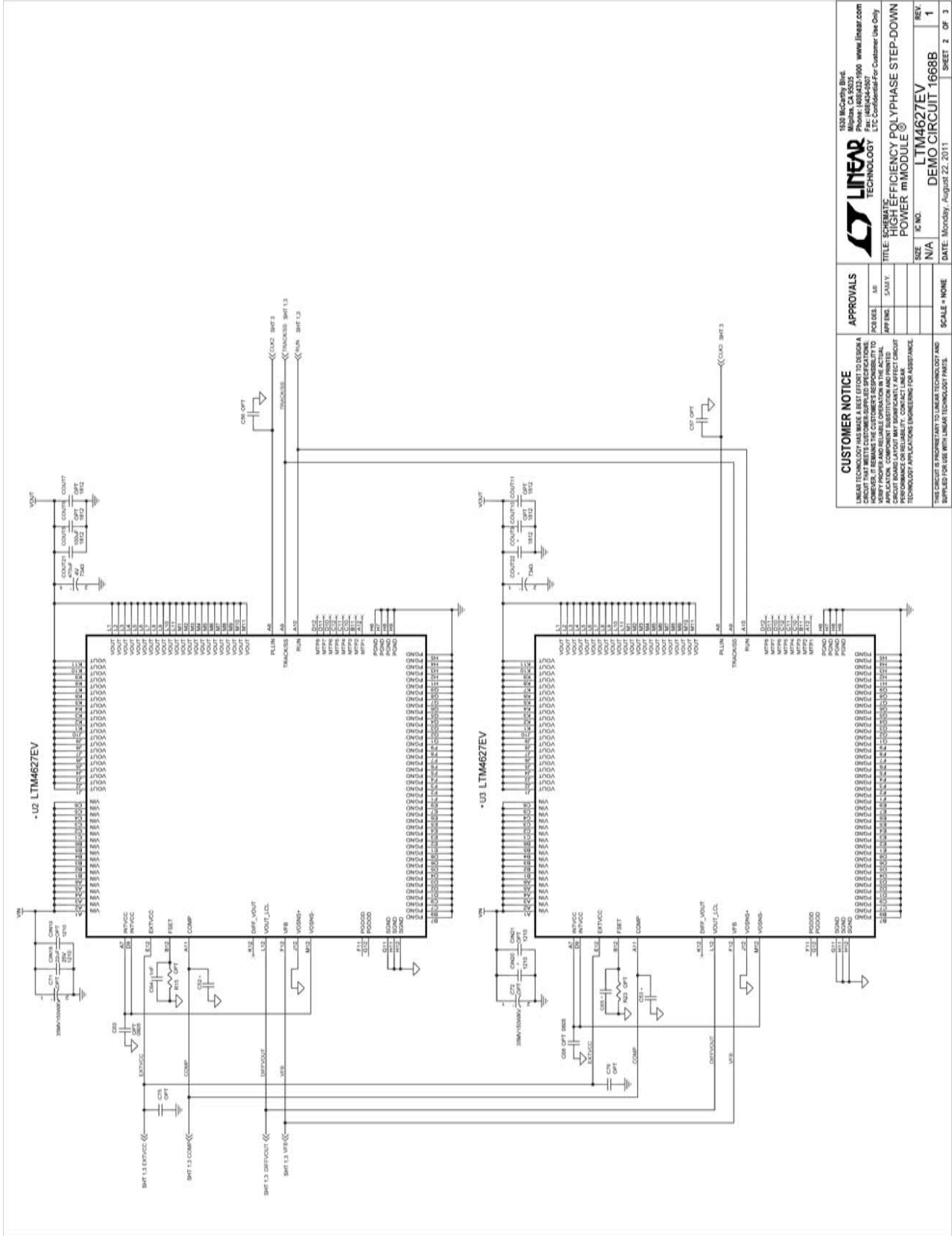
**NOTES: UNLESS OTHERWISE SPECIFIED,
 1. ALL RESISTORS AND CAPACITORS ARE 0603.**

PHASE No. * FSW = 500KHz

ASSY	IC	IOUT	R14	R12	R11	R3	R4	R26	R27	R29	PHASE No.	CIN20	CIN22	COU13	COU19	COU25	COU22	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	22uF	100uF	100uF	100uF	47pF	47pF	OPT	OPT	OPT	OPT	OPT
-B	U1-U3	40A	30.1k	20k	13.3k	10k	6.34k	4.42k	OPT	OPT	133K	3	OPT	100uF	100uF	100uF	100uF	56pF	89pF	OPT	OPT	OPT	OPT	
-C	U1-U4	50A	22.6k	15k	10k	7.5k	4.75k	3.32k	OPT	OPT	100K	4	OPT	22uF	22uF	22uF	22uF	180pF	180pF	OPT	OPT	OPT	OPT	

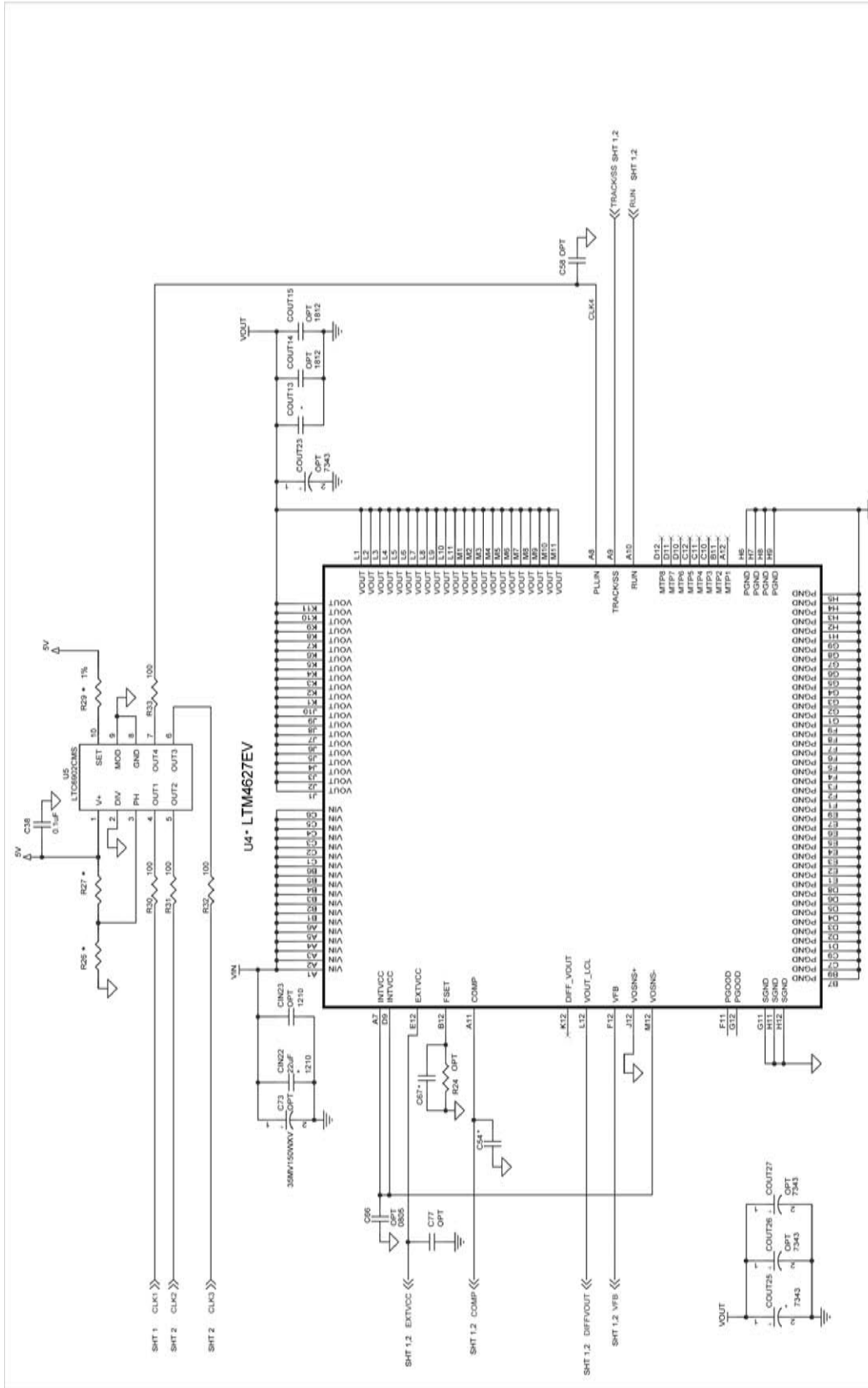
DEMO MANUAL DC1688B-A

SCHEMATIC DIAGRAM



CUSTOMER NOTICE LINEAR TECHNOLOGY HAS MADE A BEST EFFORT TO DESIGN A BOARD FOR PROTOTYPING AND EVALUATION. THE CUSTOMER IS RESPONSIBLE FOR THE DESIGN OF THE FINAL PRODUCT. THE CUSTOMER SHALL BE RESPONSIBLE FOR THE DESIGN OF THE FINAL PRODUCT. THE CUSTOMER SHALL BE RESPONSIBLE FOR THE DESIGN OF THE FINAL PRODUCT.		APPROVALS DESIGNED BY: ME CHECKED BY: JAWY DATE:	1130 McCarty Blvd Milpitas, CA 95035 Phone: (408)432-5900 www.linear.com Fax: (408)432-5909 E-Mail: customer@linear.com
TITLE: SCHEMATIC HIGH EFFICIENCY POLYPHASE STEP-DOWN POWER mMODULE		SIZE: N/A IC NO.: LTM4627EV	REV. 1
DATE: Monday, August 22, 2011		DEMO CIRCUIT 1668B	SHEET 2 OF 3

SCHEMATIC DIAGRAM



CUSTOMER NOTICE		APPROVALS	
LINEAR TECHNOLOGY HAS MADE A BEST EFFORT TO DESIGN A CIRCUIT THAT MEETS CUSTOMER-SUPPLIED SPECIFICATIONS; HOWEVER, IT REMAINS THE CUSTOMER'S RESPONSIBILITY TO MAKE SURE THE CIRCUIT MEETS THE SPECIFICATIONS FOR THE APPLICATION. COMPONENT SUBSTITUTION AND PRINTED CIRCUIT BOARD LAYOUT MAY SIGNIFICANTLY AFFECT CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE.		PCB DES: MI	DATE: Wednesday, August 24, 2011
THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.		APP ENG: SAM Y.	SCALE = NONE
		TITLE: SCHEMATIC HIGH EFFICIENCY POLYPHASE STEP-DOWN POWER mMODULE	
IC NO.	LTM4627EV	REV.	1
SIZE	N/A	DEMO CIRCUIT	1668B
		SHEET 3 OF 3	



Information furnished by Linear Technology Corporation is believed to be accurate and reliable. However, no responsibility is assumed for its use. Linear Technology Corporation makes no representation that the interconnection of its circuits as described herein will not infringe on existing patent rights.

DEMO MANUAL DC1688B-A

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