LT8697
USB 5V 2.5A Output, 42V Input Synchronous Buck with Cable Drop Compensation

DESCRIPTION

Demonstration circuit 1973A is a USB 5V 2.5A output, 42V input synchronous buck with cable drop compensation featuring the LT®8697. The LT8697 is a compact, high efficiency, high speed synchronous monolithic step-down switching regulator designed to power 5V USB applications. Top and bottom power switches, compensation components and other necessary circuits are inside of the LT8697 to minimize external components and simplify design. A precise output voltage and programmable cable drop compensation maintain accurate 5V regulation at the USB socket at the end of a long cable.

The circuit runs at 2MHz to minimize external components size and to avoid AM band. The demo board has an EMI filter installed. The conducted EMI performance of the board is shown on Figure 2. The figure shows the circuit passes the EN55022 Class B with a wide margin.

When the load current is being drawn from VCABLE, the load current is limited by the current limit of the LT8697 or by 5.8V limit at VOUT, whichever comes first. The rated load current of the demonstration circuit is set at 2.1A, enough for all USB applications. If higher voltage or higher current is needed at VCABLE, refer to application examples on the data sheet. If VCABLE is not connected to any load, VOUT can be used to power up a load. VSYS can also be used to supply a small load.

When probing the board, pay attention to GND and C_GND. On the demonstration board, they are connected together by default through R13 so a user can connect the ground clip of a probe to C_GND. However, if a user wants to evaluate an actual cable, the cable will replace R4 and R13. The copper between pads of R13 should be cut open. In this case, C_GND is no longer the same as GND. A differential measurement is needed to probe across the point of load.

The demonstration board also includes a USB socket. With the proper configuration of jumpers X1, X2, X3 and X4, the USB can be configured for different applications. See Table 1 for configurations.

A 500mA onboard step load can also be activated to evaluate the load transient response of the circuit. To active the step load, simply set jumper X5 to V+.

The LT8697 data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this quick start guide for demo circuit 1973A.

Design files for this circuit board are available at http://www.linear.com/demo/DC1973A

DESCRIPTION

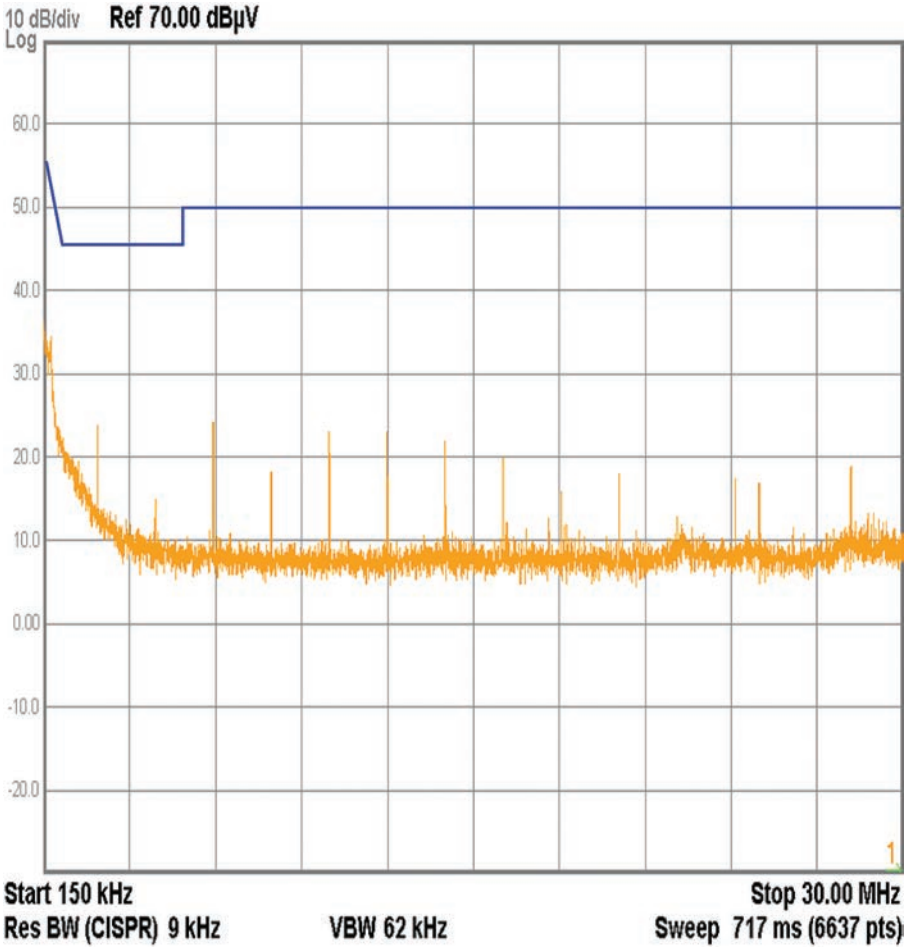


Figure 1. LT8697 Demo Circuit EMI Performance, Switching Frequency = 2MHz

Table 1. Configure X1 – X4 for Different USB Applications

X1	X2	X3	X4	J3
Do Not Care	Do Not Care	Do Not Care	OPEN	Not in USE
OPEN	OPEN	SHORT	SET	USB - DCP
D+	D-	OPEN	SET	USB - APPLE 2.1A

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	Input Supply Range		6		42	V
V_{OUT}	Output Voltage		4.8	5	5.2	V
Max I_{OUT}	Maximum Output Current		2.1			A
f_{SW}	Switching Frequency		1.9	2	2.05	MHz
EFE	Efficiency at DC	I_{OUT} = 2.1A, Measured at V_{OUT}		91		%

QUICK START PROCEDURE

Demonstration circuit 1973A is easy to set up to evaluate the performance of the LT8697. Refer to Figure 2 and Figure 3 for proper measurement equipment setup and follow the procedure below:

1. With power off, connect the input power supply to V_{IN} and GND.
2. With power off, connect the load to VCABLE and C_GND.
3. Set X1 to X5 to OPEN positions.
4. Turn on the power at the input.
5. Carefully evaluate other design parameters as needed.
6. If a USB device is to be connected to J3, use Table 1 as a guide to set X1 to X4 for different USB applications. The total current provided at J3 and VCABLE should not exceed 2.1A.
7. Set X5 to V+ if a quick transient test is desirable. The load step applied to VCABLE is 500mA. Again, make sure the total load current does not exceed 2.1A during the test.

QUICK START PROCEDURE

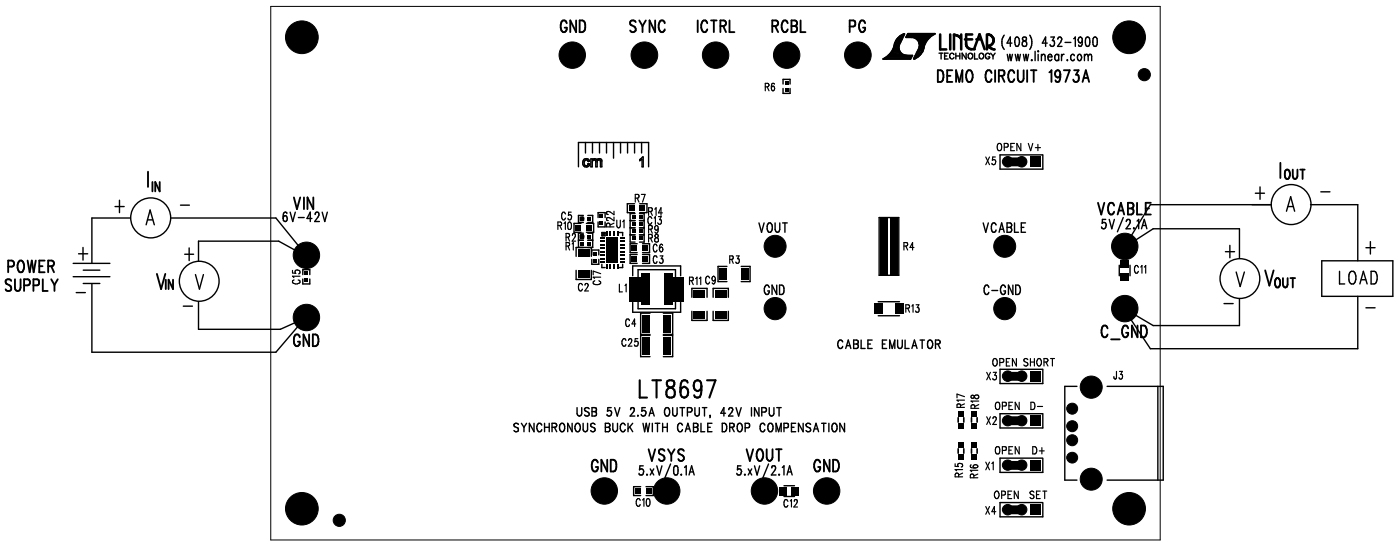


Figure 2. Proper Measurement Equipment Setup

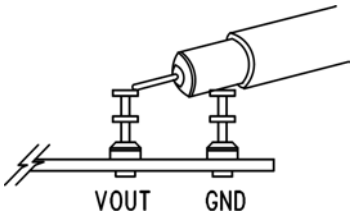


Figure 2. Measure Output Ripple

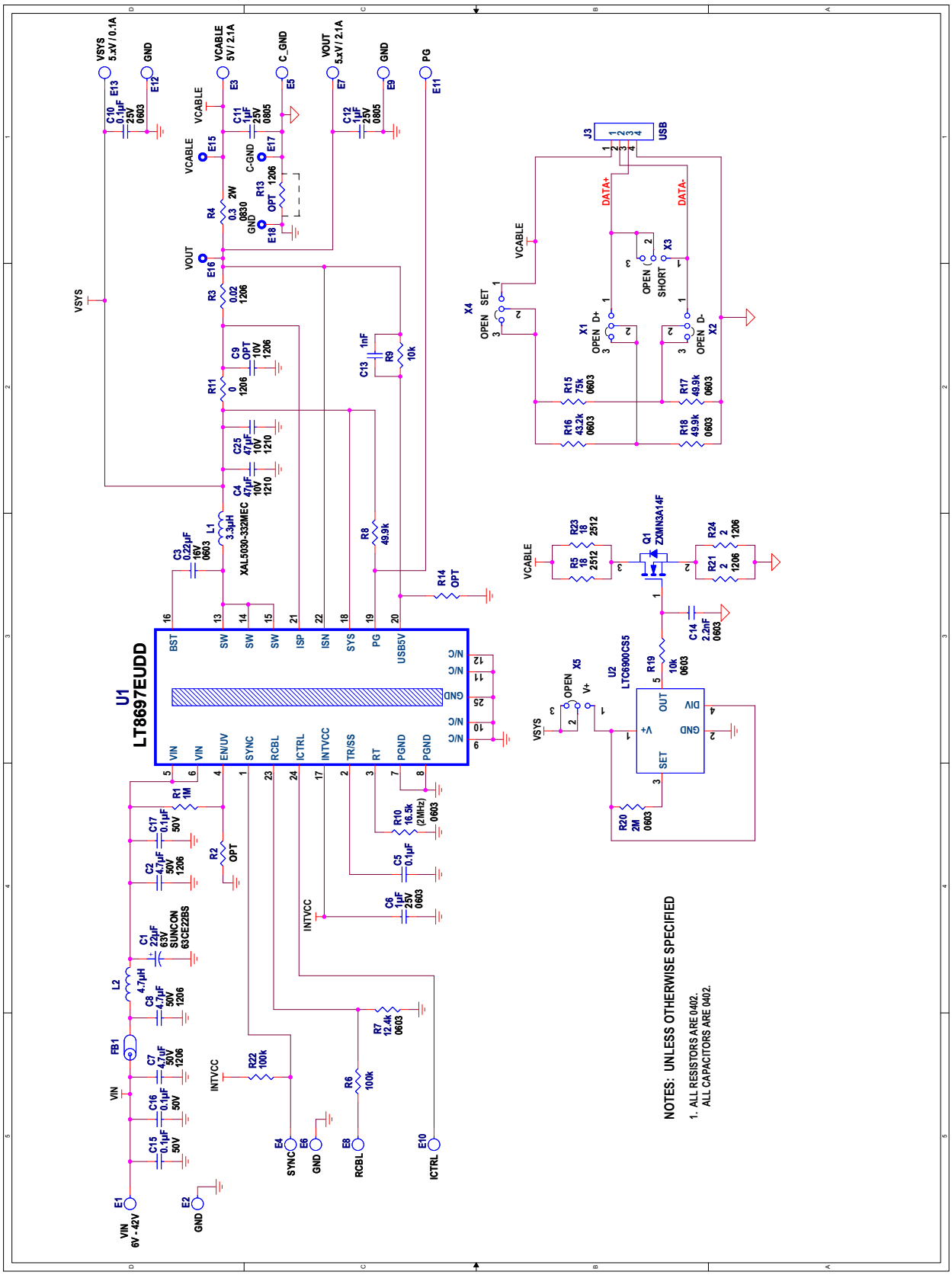
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	C2	Cap., X7R 4.7µF 50V 10% 1206	TAIYO YUDEN, UMK316BJ475KL-T
2	1	C3	Cap., X5R 0.22µF 16V 10% 0603	TAIYO YUDEN, EMK107BJ224KA-T
3	2	C4, C25	Cap., X7R 47µF 10V 10% 1210	MURATA, GRM32ER71A476KE15L
4	1	C5	Cap., X5R 0.1µF 16V 10% 0402	AVX, 0402YD104KAT2A
5	1	C6	Cap., X7R 1µF 25V 10% 0603	MURATA, GRM188R71E105KA12L
6	1	C13	Cap., X7R 1nF 25V 10% 0402	TDK, C1005X7R1E102K
7	1	R1	Res., Chip 1M 0.06W 1% 0402	VISHAY, CRCW04021M00FKED
8	1	R3	Res., 0.02Ω 0.25W 1% 1206	VISHAY, WSL1206R0200FEA
9	1	R4	Res., Sense, 0.3Ω 2W 1% 0830	SUSUMU, RL7520WT-R30-F
10	2	R6, R22	Res., Chip 100k 0.06W 5% 0402	VISHAY, CRCW0402100KJNED
11	1	R7	Res., Chip 12.4k 0.1W 1% 0603	VISHAY, CRCW060312K4FKEA
12	1	R8	Res., Chip 49.9k 0.06W 1% 0402	VISHAY, CRCW040249K9FKED
13	1	R9	Res., Chip 10k 0.06W 5% 0402	VISHAY, CRCW040210K0JNED
14	1	R10	Res., Chip 16.5k 0.1W 1% 0603	VISHAY, CRCW060316K5FKEA
15	1	U1	I.C., Switching Reg. QFN(24) (UDD) 3MMX5MM	LINEAR TECH., LT8697EUDD#PBF
Additional Demo Board Circuit Components				
1	1	C1	Cap., Alum 22µF 63V 25%	SUN ELECT., 63CE22BS
2	1	C7	Cap., X7R 4.7µF 50V 10% 1206	MURATA, GRM31CR71H475KA12L
3	1	C8	Cap., X7R 4.7µF 50V 10% 1206	TAIYO YUDEN, UMK316BJ475KL-T
4	0	C9 (OPT)	Cap., 1206	
5	1	C10	Cap., X7R 0.1µF 25V 10% 0603	TDK, C1608X7R1E104K
6	2	C11, C12	Cap., X7R 1µF 25V 10% 0805	TDK, C2012X7R1E105K
7	1	C14	Cap., X7R 2.2nF 10V 10% 0603	AVX 0603ZC222KAT2A
8	3	C15-C17	Cap., X7R 0.1µF 50V 10% 0402	TDK, C1005X7R1H104K
9	1	FB1	Ferrite Bead, 0805	TDK, MPZ2012S221AT
10	1	L1	Inductor, 3.3µH	COILCRAFT, XAL5030-332MEC
11	1	L2	Inductor, 4.7µH	VISHAY, IHLP2020BZER4R7M01
12	1	Q1	Power Mosfet, SOT23	DIODES INC., ZXMN3A14FTA
13	0	R2, R14 (OPT)	Res., 0402	
14	2	R5, R23	Res., Power, 18Ω, 1W, 1% 2512	SUSUMU, CPA2512Q18R0FS-T10

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
15	1	R11	Res., Chip, 0Ω, 0.25W, 1206	VISHAY, CRCW12060000Z0EA
16	0	R13	Res., Chip, 1206	
17	1	R15	Res., Chip, 75k, 0.1W, 1% 0603	VISHAY, CRCW060375K0FKEA
18	1	R16	Res., Chip, 43.2k, 0.1W, 1% 0603	VISHAY, CRCW060343K2FKEA
19	2	R17, R18	Res., Chip, 49.9k, 0.1W, 1% 0603	VISHAY, CRCW060349K9FKEA
20	1	R19	Res., Chip, 10k, 0.1W, 5% 0603	VISHAY, CRCW060310K0JNEA
21	1	R20	Res., Chip, 2M, 0.1W, 1% 0603	VISHAY, CRCW06032M00FKEA
22	2	R21, R24	Res., Chip, 2Ω, 0.25W, 5% 1206	VISHAY, CRCW12062R00JNEA
23	1	U2	I.C., Oscillator, TSOT-23-S5	LINEAR TECH., LT6900CS5#PBF
Hardware: For Demo Board Only				
1	13	E1-E13	Turret, Testpoint	MILL-MAX, 2501-2-00-80-00-00-07-0
2	4	E15-E18	Testpoint, Turret, 0.061"	MILL-MAX, 2308-2-00-80-00-00-07-0
3	5	X1-X5	Headers, Sgl. Row 3 Pins 2mm Ctrs.	SULLINS, NRPN031PAEN-RC
4	5	xX1-xX5	Shunt, 2mm Ctrs.	SAMTEC, 2SN-BK-G
5	1	J3	USB, Right Angle, Receptacle	CnC TECH LLC, 1002-001-01000
6	4	MH1-MH4	Stand-Off, Nylon 0.375"	KEYSTONE, 8832(SNAP ON)

SCHEMATIC DIAGRAM



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