LTM4609EV: 36V_{IN}, 34V_{OUT} Buck-Boost DC/DC µModule® Regulator

DESCRIPTION

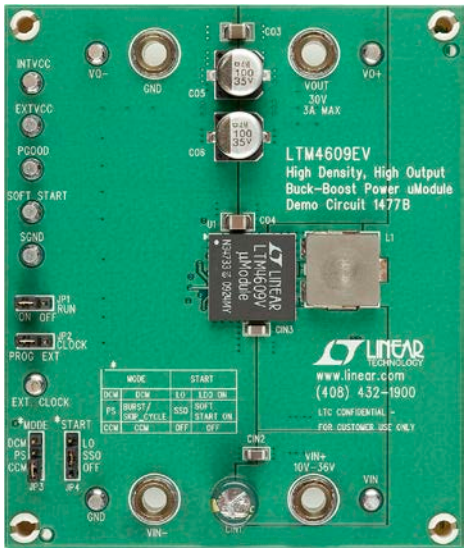
Demonstration circuit DC1477B features the LTM®4609EV, the high voltage, high efficiency, high density switch mode buck-boost power module. The LTM4609EV regulates an output voltage above, below, or equal to the input voltage. DC1477B accepts an input voltage from 10V to 36V with a preset output voltage of 30V at up to 3A. Derating may be necessary for certain V_{IN}, V_{OUT}, and thermal conditions. An optional input π filter is added on the DC1477B to minimize the input ripple. The switching frequency may be synchronized to an external clock from 200kHz to 400kHz to reduce undesirable frequency harmonics and/or parallel multiple modules for even higher output current. The LTM4609 data sheet must be read in conjunction with this demo manual prior to working on or modifying demo circuit DC1477B.

Design files for this circuit board are available at http://www.linear.com/demo/DC1477B

PERFORMANCE SUMMARY (T_A = 25°C)

PARAMETER	CONDITIONS	VALUE
Minimum Input Voltage		10V to 36V
Output Voltage V_{OUT}		30V ± 2%
Maximum Continuous Output Current	Derating is Necessary for Certain V_{IN}, V_{OUT}, and Thermal Conditions	3ADC at 10V_{IN} 8ADC at 24V_{IN} 10ADC at V_{IN} > 30V
Default Operating Frequency		300kHz
Efficiency	V_{IN} = 20V, V_{OUT} = 30V, I_{OUT} = 3A	96.7%, See Figure 3 for More Information

BOARD PHOTO



QUICK START PROCEDURE

Demonstration circuit DC1477B is an easy way to evaluate the performance of the LTM4609EV. Please refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

1. Place jumpers in the following positions for a typical $30V_{OUT}$ application:

RUN	CLOCK	MODE	START
ON	PROG	CCM	SSO

2. With the power supply off, connect the input power supply, load and meters as shown in Figure 1. Preset the load to 0A and V_{IN} supply between 10V to 36V.
3. Turn on the power at the input. The output voltage should be 30V ± 2%.
4. Once the proper output voltage is established, adjust the load within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other parameters. A cooling fan and heat sink are necessary for V_{IN} <10V and I_{OUT} = 3A.
5. To measure input and output ripple, please refer to Figure 2 for proper setup.
6. To adjust the switching frequency turn off the power supply and modify R6 and R7. Do not allow voltage at pin PLLFLTR to exceed 2.4V.
7. Inductor and R_{SENSE} should be modified to accommodate certain input and output condition. Refer to the data sheet for details.
8. The input filter formed by CIN2, L2 and L3, CIN3 and CIN4 is for the purpose of reducing the input voltage ripple. The magnetic beads L2 and L3 are not necessary, but they help to reduce the high frequency ringings on the input supply significantly. See Figure 5 for details.
9. The optional components Rsnb1 and Csnb1, Rsnb2 and Csnb2 can be used to form RC snubber circuits on the switching nodes, which may help to reduce the output ripple. Refer to the data sheet for details.

QUICK START PROCEDURE

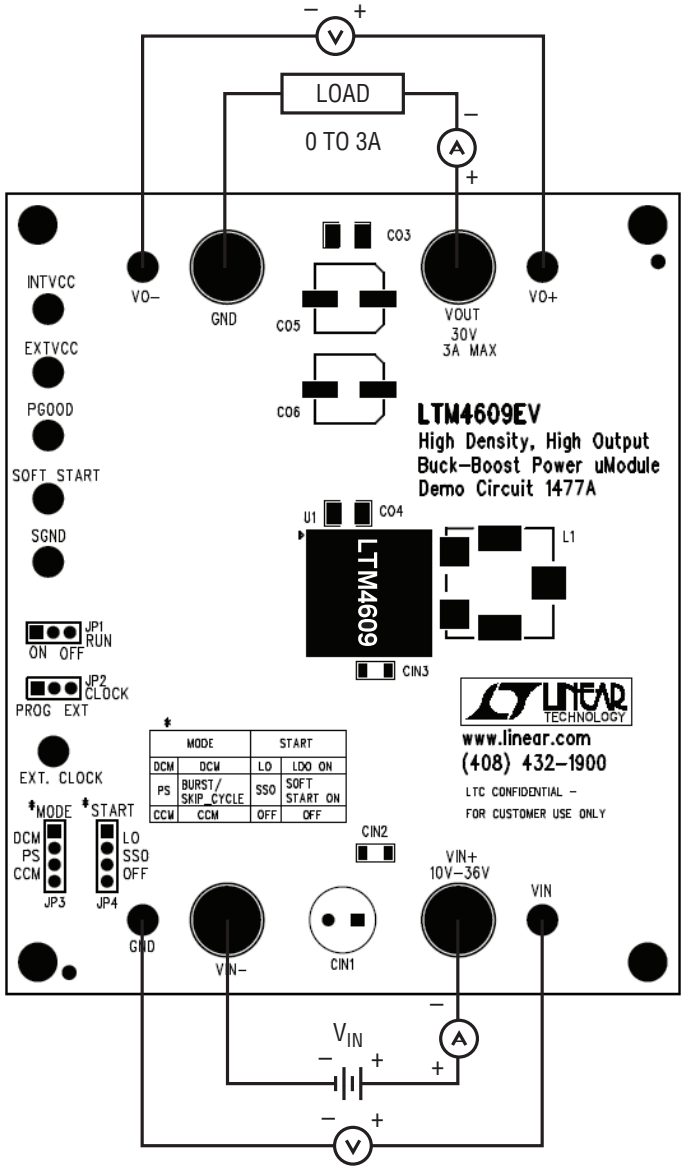


Figure 1. Test Setup of DC1477B

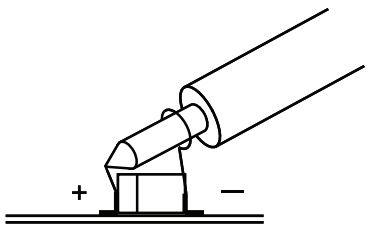


Figure 2. Proper Scope Probe Placement for Measuring Input or Output Ripple

QUICK START PROCEDURE

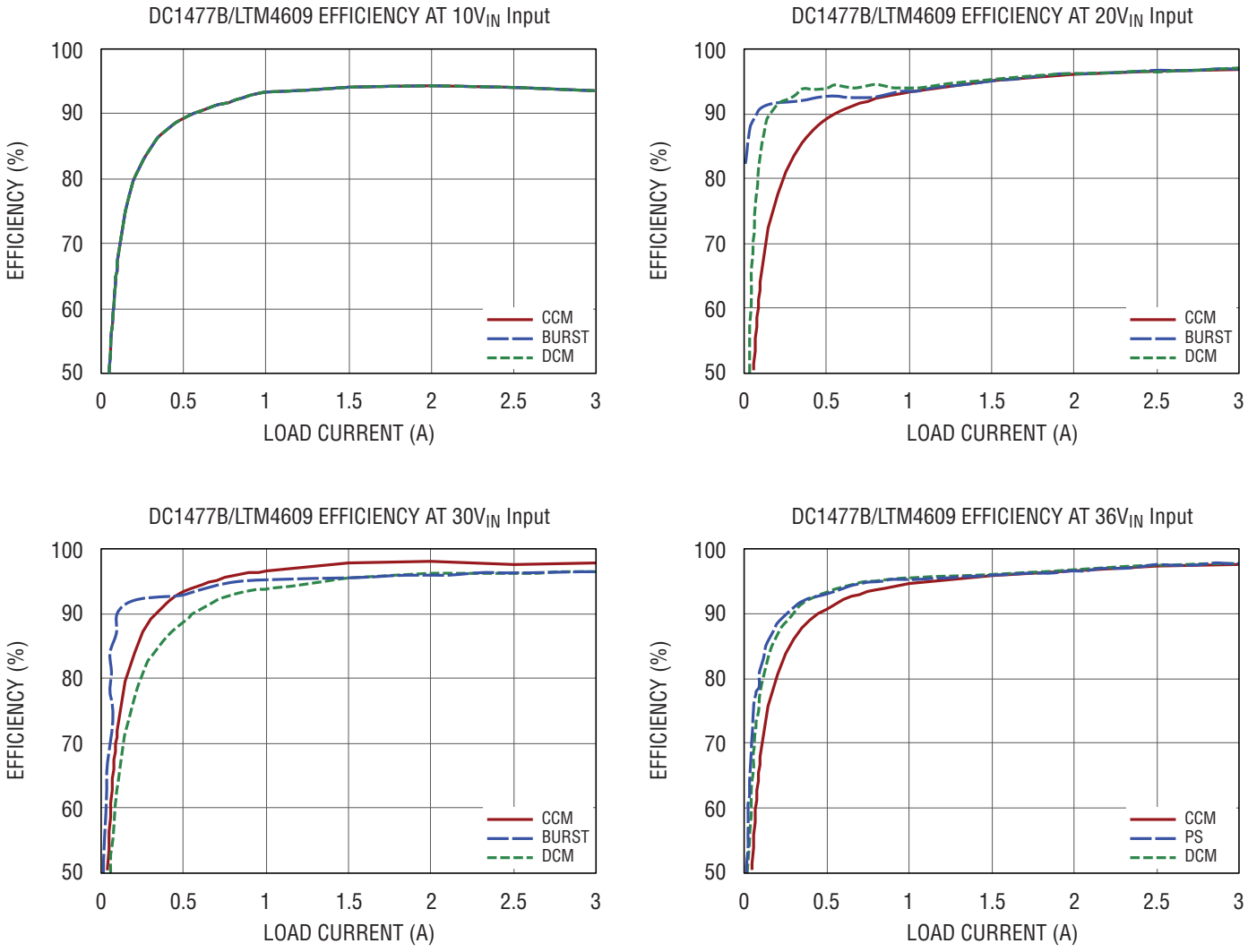
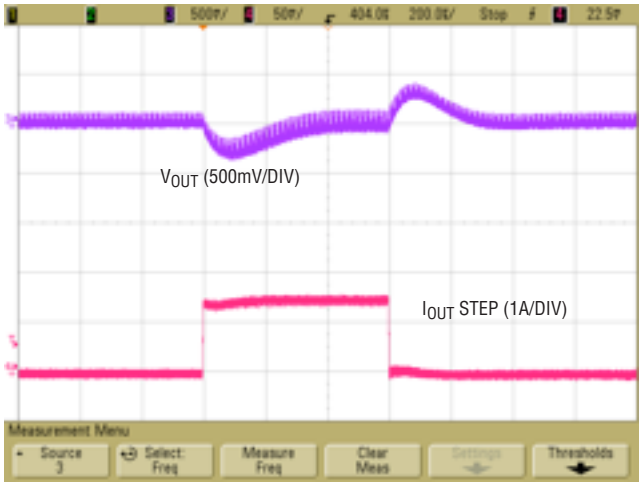
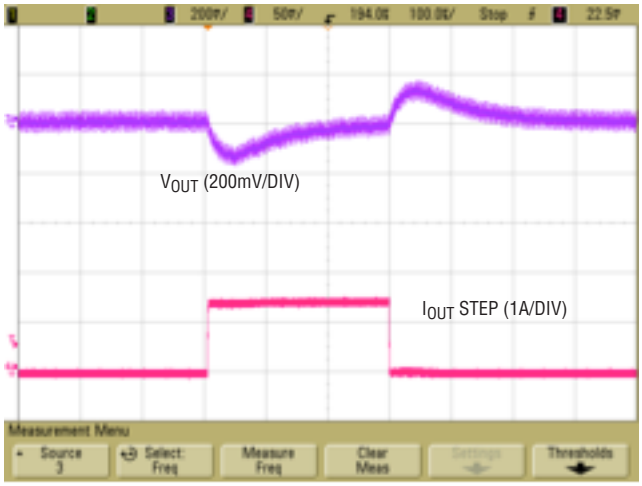


Figure 3. Measured Efficiency at Different V_{IN}

QUICK START PROCEDURE

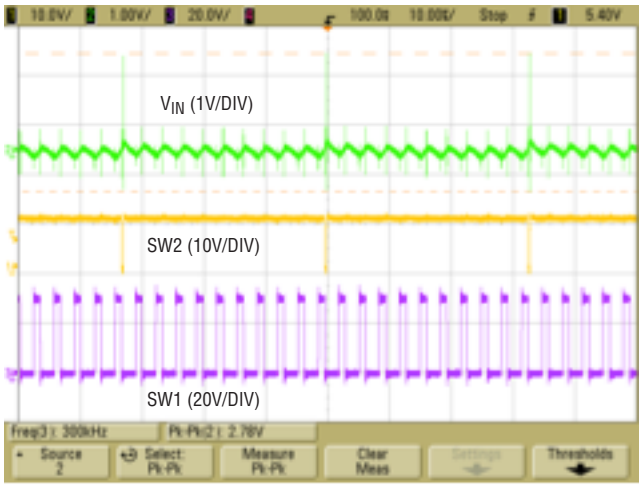


V_{IN} = 10V, V_{OUT} = 30V, CCM MODE
1.5A to 3A LOAD STEP
C_{OUT} = 2 × 10µF CERAMIC + 2 × 100µF ALUM

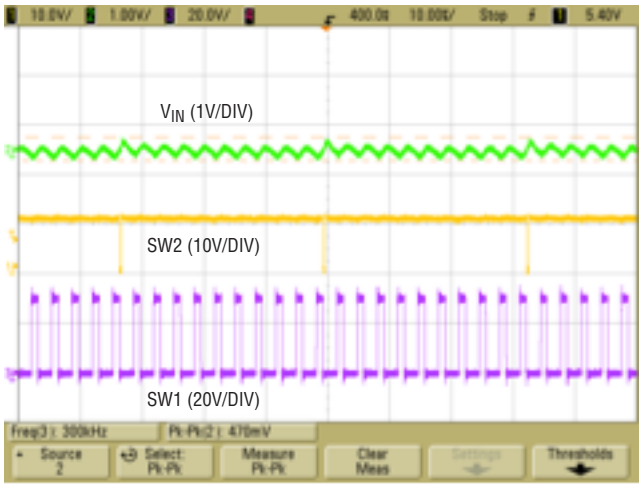


V_{IN} = 36V, V_{OUT} = 30V, CCM MODE
1.5A to 3A LOAD STEP
C_{OUT} = 2 × 10µF CERAMIC + 2 × 100µF ALUM

Figure 4. Measured Load Transient Response (1.5A Step, 50% to 100%)



V_{IN} = 10V, V_{OUT} = 30V, I_{OUT} = 3A
W/O INPUT FILTER: SHORT L2 AND L3, REMOVE C_{IN2}
V_{IN} = PEAK-TO-PEAK RIPPLE = 2.78V



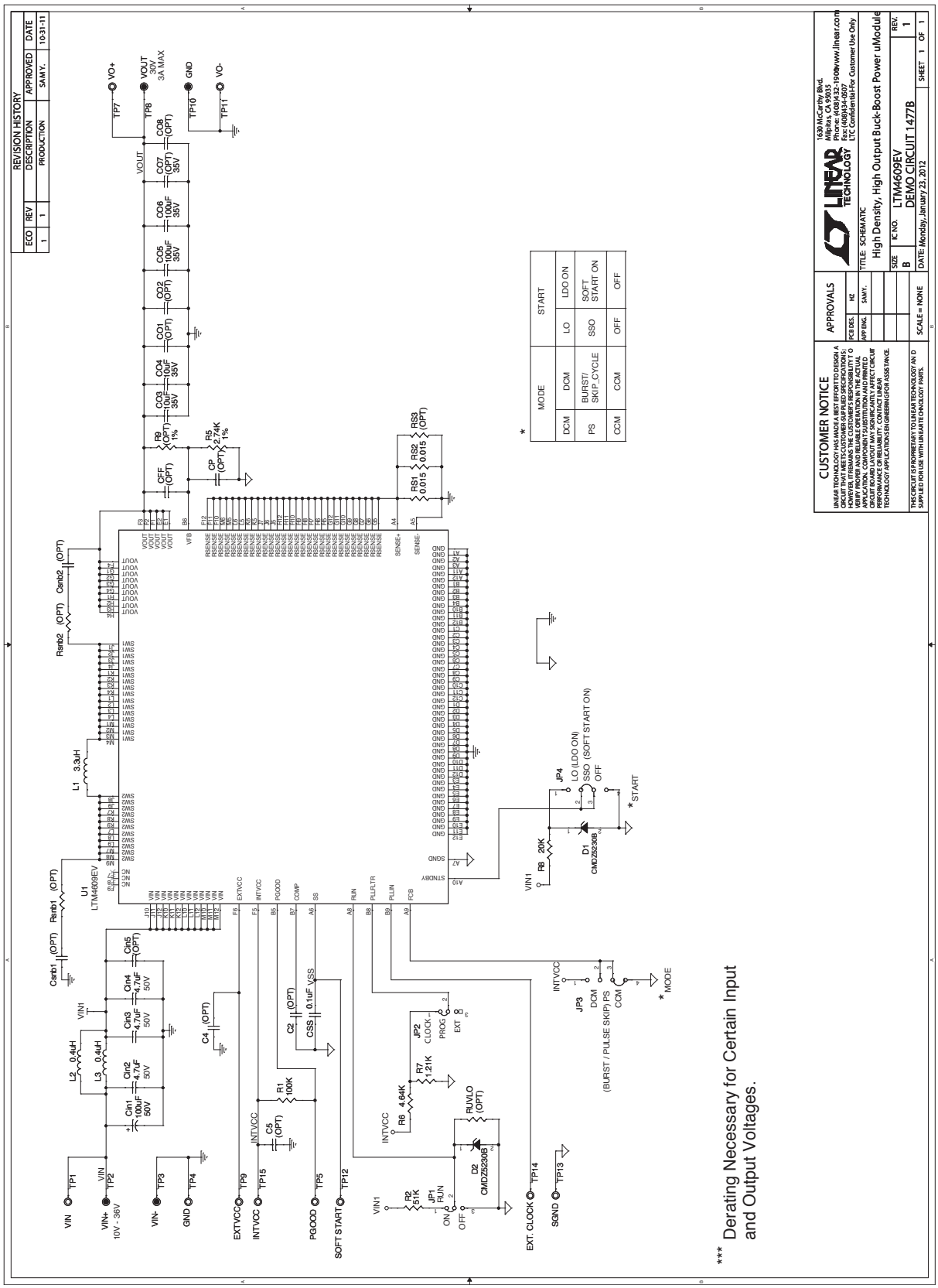
V_{IN} = 10V, V_{OUT} = 30V, I_{OUT} = 3A
W/ INPUT FILTER: STUFF L2, L3, AND C_{IN2}
V_{IN} PEAK-TO-PEAK RIPPLE = 0.47V

Figure 5. Input Voltage Ripple Measured at C_{IN1} with 300MHz BW Probe, with and without the Input Filter

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	CSS	CAP., 0.1µF, X7R, 25V, 10%, 0603	AVX, 06033C104KAT2A
2	1	CIN1	CAP., ALUM. ELECT., 100µF, 50V, 20%, ME -WX SERIES, THROUGH-HOLE, STRAIGHT-PIN	SUN ELECTRONIC INDUSTRIES CORPORATION, 50ME100WX+TS
3	2	CO3, CO4	CAP., 10µF, X7R, 35V, 10%, 1210	MURATA, GRM32ER7YA106KA12L
4	3	CIN2, CIN3, CIN4	CAP., X7R, 4.7µF, 50V, 10%, 1206	TAIYO YUDEN, UMK316BJ475KL-T
5	2	CO5, CO6	CAP., ALUM., 100µF, 35V, 20%, HVH SERIES	SUN ELECTRONIC INDUSTRIES CORPORATION, 35HVH100M
6	1	L1	IND., POWER, 3.3µH, 20%, IHLP-5050FD-01	VISHAY, IHLP5050FDER3R3M01
7	1	R1	RES., 100kΩ, 5%, 1/10W, 0603	VISHAY, CRCW0603100KJNEA
8	1	R5	RES., 2.74kΩ, 1%, 1/10W, 0603	VISHAY, CRCW06032K74FKEA
9	1	R6	RES., 4.64kΩ, 1%, 1/10W, 0603	VISHAY, CRCW06034K64FKEA
10	1	R7	RES., 1.21kΩ, 1%, 1/10W, 0603	VISHAY, CRCW06031K21FKEA
11	2	RS1, RS2	RES., PWR. METAL STRIP, 0.015Ω, 1%, 1/4W, 1206	VISHAY, WSL1206R0150FEA
12	1	U1	I.C., HIGH DENSITY, HIGH OUTPUT BUCK-BOOST µModule, 15mm × 15mm × 2.82mm, LGA	LINEAR TECH., LTM4609EV#PBF
Additional Demo Board Circuit Components				
1	0	CIN5, Csnb1, Csnb2, C07 (OPT)	CAP., OPTION, 1206	OPT.
2	0	C2, C4, C5, CP, CFF (OPT)	CAP., OPTION, 0603	OPT.
3	0	CO1, CO2, CO8 (OPT)	CAP., OPTION, D3L	OPT.
4	2	D1, D2	DIODE, ZENER, 4.7V, 5%, 250mW, SOD-323	CENTRAL SEMI., CMDZ5230B TR LEAD FREE
5	2	L2, L3	IND., HIGH CURRENT, 50Ω, 25%, 6A, 1806	FAIR-RITE PRODUCTS CORP., 2518065007Y6
6	1	R2	RES., 51kΩ, 5%, 1/10W, 0603	VISHAY, CRCW060351K0JNEA
7	1	R8	RES., 20kΩ, 1%, 1/10W, 0603	VISHAY, CRCW060320K0FKEA
8	0	RS3, Rsnb1, Rsnb2 (OPT)	RES., OPTION, 1206	OPT.
9	0	R9, RUVLO (OPT)	RES., OPTION, 0603	OPT.
Hardware-For Demo Board Only				
1	2	JP1, JP2	CONN., HEADER, 1×3, 2mm	SAMTEC, TMM-103-02-L-S
2	2	JP3, JP4	CONN., HEADER, 1×4, 2mm	SAMTEC, TMM-104-02-L-S
3	4	JP1, JP2, JP3, JP4	SHUNT, 2mm	SAMTEC, 2SN-BK-G
4	10	TP1, TP4, TP5, TP7, TP9, TP11-TP15	TEST POINT, TURRET, 0.094" MTG. HOLE	MILL-MAX, 2501-2-00-80-00-00-07-0
5	4	TP2, TP3, TP8, TP10	CONN., JACK, BANANA, NON-INSULATED, 0.218"	KEYSTONE, 575-4
6	4	MH1, MH2, MH3, MH4	STANDOFF, NYLON, SNAP-ON, 0.500"	KEYSTONE, 8833 (SNAP ON)

SCHEMATIC DIAGRAM



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