LTC7813EUH
4V to 56V V_{IN}, Step-Up/Step-Down Power Supply

DESCRIPTION

Demonstration circuit DC2435A is a step-up/down supply featuring the LTC®7813EUH. The LTC7813 is a high performance dual output (buck and boost) synchronous DC/DC switching regulator controller. The board has three different configurations:

DC2435A-A: Regulated output voltage of 24 Volt

DC2435A-B: Narrowed output voltage between 20V and 28V

DC2435A-C: Dual output voltages of 24V (Boost V_{BUS} channel) and 5V (Buck V_{OUT1} channel)

The circuit enables a drop-in layout where the total circuit area is only 1½" by 1½". The LTC7813EUH is in a 32-lead exposed pad QFN package.

The main features of the board include rail tracking (buck channel only), an internal 5V linear regulator for bias, separate RUN pins for each output and a Mode selector that allows the converter to run in CCM, pulse-skipping or Burst Mode operation. Synchronization to an external clock is also possible.

The LTC7813 buck input is supplied from the Boost output for the DC2435A-A and DC2435A-B only. With this boost-then-buck topology, the buck outputs maintain regulation over the entire input range of 4V to 56V, making it suitable for automotive or other battery fed applications where low quiescent current is important.

The DC2435A-B is designed such that V_{OUT} is partially regulated between 20V and 28V for higher efficiency (Figure 5a), reduced power loss, and switching noise. When V_{IN} is between 20V and 28V, it operates in pass-thru mode with the boost synchronous FET fully on and the buck in drop-out with >99% duty cycle. When V_{IN} is below 20V, the boost is activated and when V_{IN} is above 28V, the buck is activated as shown in Figure 5b.

The LTC7813 data sheet gives a complete description of the part, operation and application information and must be read in conjunction with this quick start guide.

Design files for this circuit board are available at http://www.linear.com/demo/DC2435A

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PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

Table 1

SYMBOL	PARAMETER		CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	Input Supply Range			4		56	V
V_{OUT1}	Output1 Voltage Range	-A	V_{IN} = 4V* – 56V, I_{OUT1} = 0A to 5A#	23.5	24	24.5	V
		-B		19		28.6	V
		-C		4.9	5**	5.1	V
V_{BUS}	V_{BUS} Voltage Range (-C only)		V_{IN} < 24V	23.5	24	24.5	V
f_{SW}	Typical Free Running Switching Frequency			200		kHz	
	See Figures 4, 5, 6 and 7 for efficiency curves	-A	V_{IN} = 14V, V_{OUT1} = 24V, I_{OUT1} = 5A V_{IN} = 48V, V_{OUT1} = 24V, I_{OUT1} = 5A		94.6 96.9		% %
		-B	V_{IN} = 14V, V_{OUT1} = 20V, I_{OUT1} = 5A V_{IN} = 24V, V_{OUT1} = 24V, I_{OUT1} = 5A V_{IN} = 48V, V_{OUT1} = 28V, I_{OUT1} = 5A		96.3 98.5 97.3		% % %
		-C	V_{IN} = 14V, V_{BUS} = 24V, I_{BUS} = 3A V_{IN} = 14V, V_{OUT1} = 5V, I_{OUT1} = 8A V_{IN} = 48V, V_{OUT1} = 5V, I_{OUT1} = 8A		97.1 92.8 88.9		% % %

I_{OUT1} starts to de-rate when V_{IN} < 14V. * V_{IN} needs to be > 8V to start up. ** V_{OUT1} follows V_{IN} when V_{IN} < 5V.

DEMO BOARD OPTIONS

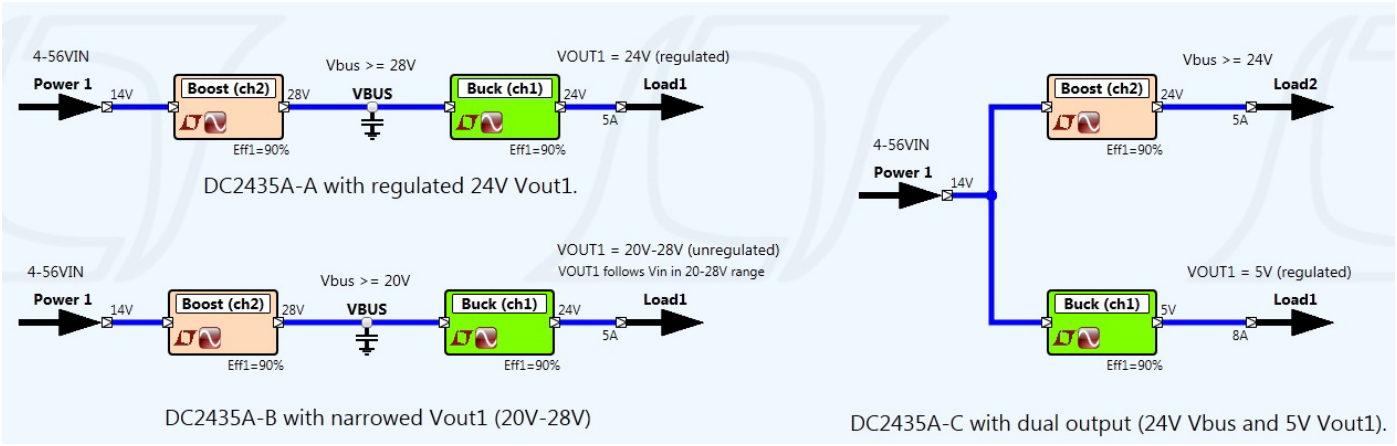


Figure 1. DC2435A/LTC7813 Demo Board Options

QUICK START PROCEDURE

DC2435A is easy to set up to evaluate the performance of the LTC7813EUH. Refer to Figure 2 for proper measurement equipment setup and follow the procedure below:

NOTE: When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across the V_{IN} or V_{OUT} and GND terminals or directly across relevant capacitor. See Figure 3 for proper scope probe technique.

1. Place jumpers in the following positions:

   JP1 ON

   JP2 ON

   JP3 FCM

2. With power off, connect the input power supply to V_{IN} and GND.

3. Turn on the power at the input.

   NOTE: Make sure that the input voltage is higher than 8V and does not exceed 56V.

4. Check for the proper output voltages for different boards.

   -A: V_{OUT1} = 23.5V to 24.5V,

   -B: 19V < V_{OUT1} < 28.6V,

   -C: V_{OUT1} = 4.9V to 5.1V;
   V_{BUS} = 23.5V to 24.5V (V_{IN} < 24V)

   NOTE: If there is no output, temporarily disconnect the load to make sure that the load is not set too high.

5. Once the proper output voltages are established, adjust the loads within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other parameters.

QUICK START PROCEDURE

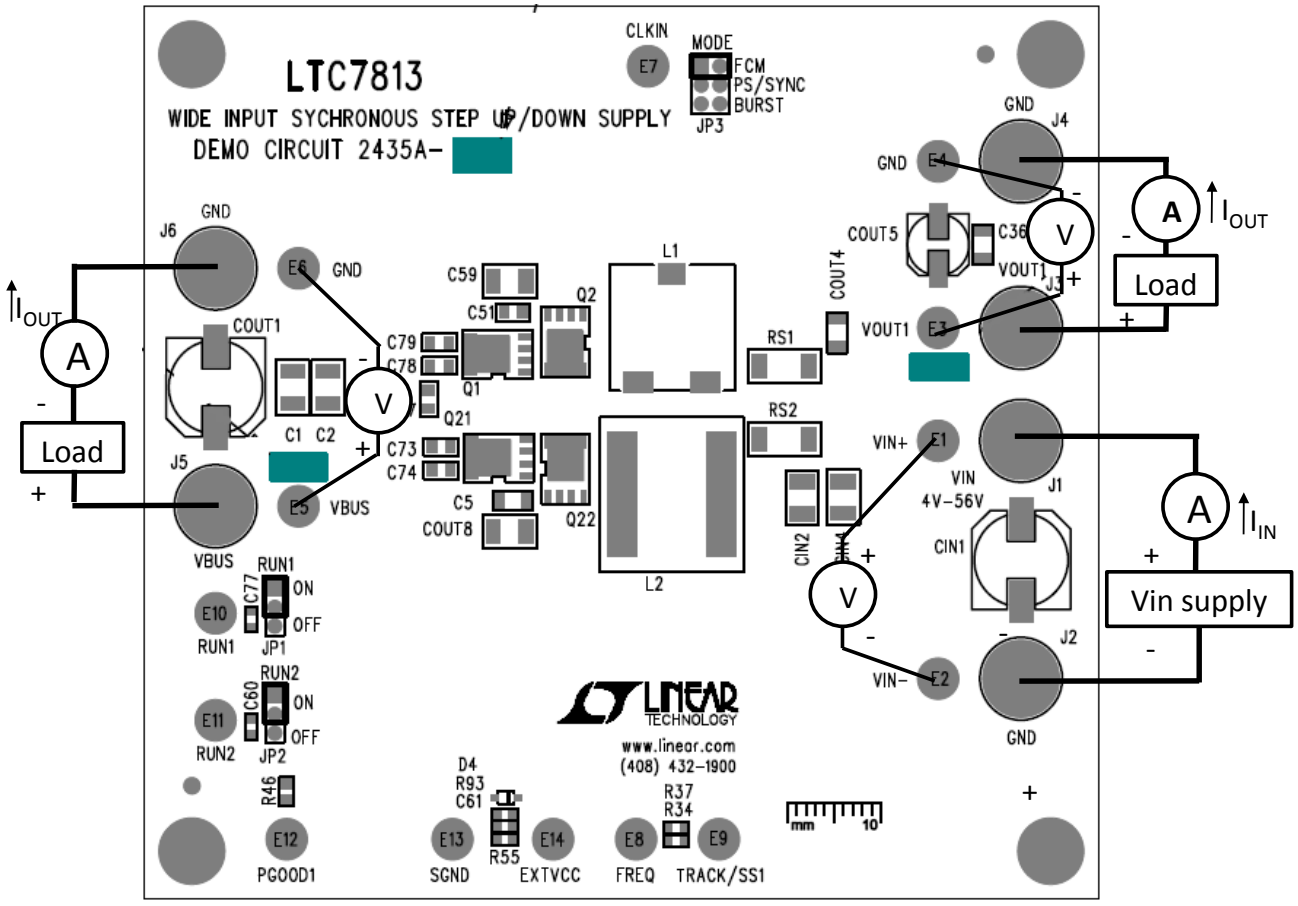


Figure 2. Proper Measurement Equipment Setup

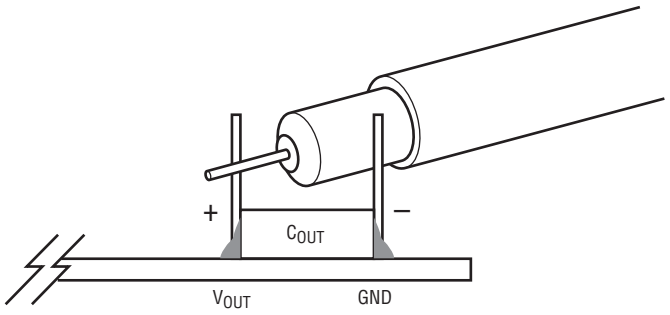


Figure 3. Measuring Input or Output Ripple Across Terminals or Directly Across Ceramic Capacitor

FREQUENCY SYNCHRONIZATION AND MODE SELECTION

DC2435A's mode selector allows the converter to run in forced continuous operation, pulse skip operation, Burst Mode or be synchronizing to an external clock by changing the position of JP3.

Table 2. Mode Selection and Synchronized Operation Options

CONFIGURATION	JP3
Forced Continuous Operation	FCM
Pulse-Skipping Operation	PS/Sync
Synchronized to External Clock Applied to CLKIN Pin	PS/Sync
Burst Mode Operation	Burst

RAIL TRACKING

DC2435A is configured for an on board soft start circuit. The soft start ramp rate can be adjusted by changing the value of C47. DC2435A can also be modified to track an external reference. Refer to Table 3 for tracking options and to the data sheet for more details.

Table 3. V_{OUT1} Tracking Options

CONFIGURATION	R34	R37	C47	TRK/SS1 TURRET
Soft-Start Without Tracking (Default)	OPEN	OPEN	0.1µF	OPEN
V_{OUT1} Tracking Scaled External Reference	Resistor	Divider	OPEN	External Reference

OPTIONAL INDUCTOR DCR CURRENT SENSING

DC2435A provides an optional circuit for Inductor DCR Current Sensing. Inductor DCR Current Sensing uses the DCR of the inductor to sense the inductor current instead of discrete sense resistors. The advantages of DCR sensing are lower cost, reduced board space and higher efficiency, but the disadvantage is a less accurate current limit. If DCR sensing is used, be sure to select an inductor current with a sufficiently high saturation current or use an iron powder type material.

Refer to Table 4 for Optional Inductor DCR Current Sensing setup and to the data sheet for more details.

Table 4. Optional Inductor DCR Current Sensing

	CHANNEL 1	RS1	R39	R40	C15	R51	R53	R62
CONFIGURATION	CHANNEL 2	RS2	R80	R81	C56	R89	R90	R91
Current Sense Resistor (Default)		Ref. Sch.	Ref. Sch.	Ref. Sch.	Ref. Sch.	OPEN	OPEN	OPEN
Inductor DCR Current Sensing		0Ω Copper	OPEN	OPEN	Calculated Value from Data Sheet			0Ω

LOW QUIESCENT CURRENT APPLICATIONS AND MEASUREMENT

The typical quiescent current (I_Q) of the LTC7813 controller is 29µA in sleep mode as specified in the LTC7813 data sheet. However, the input current of the DC2435A board can be higher than this value because of additional circuit outside of the IC. To reduce the total input current, large value FB divider resistors should be used. In addition, some of the optional pull-up resistors should be removed from the board. Refer to Table 5 for the low input quiescent current setup.

Table 5. Low Input Quiescent Current Configuration

Reference Designator	R46
Function	PGOOD1
Stuffing Option	OPEN

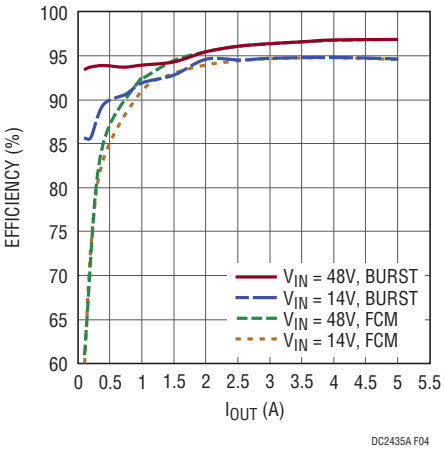


Figure 4. DC2435A-A V_{OUT1} Typical Efficiency vs Load Current

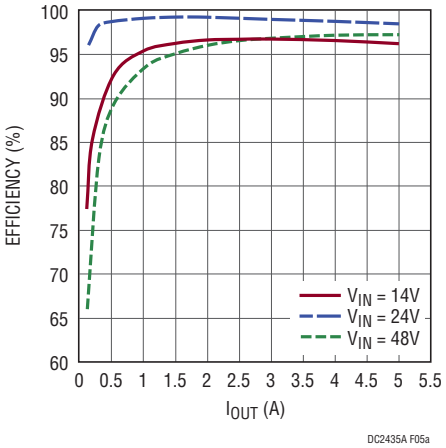


Figure 5a. DC2435A-B V_{OUT1} Typical Efficiency vs Load Current

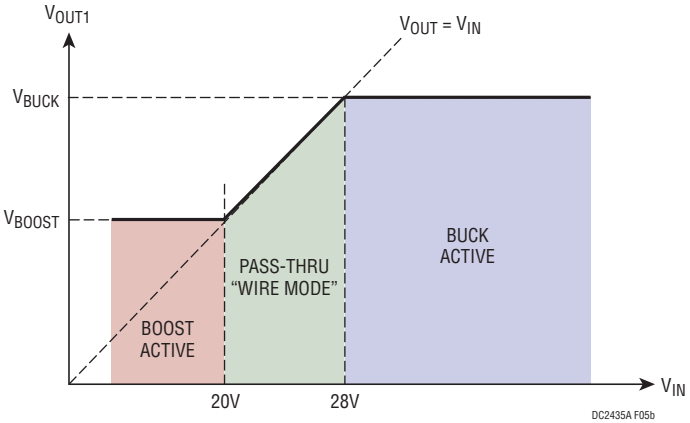


Figure 5b. DC2435A-B V_{OUT1} Operating Modes vs V_{IN}

Figure 5.

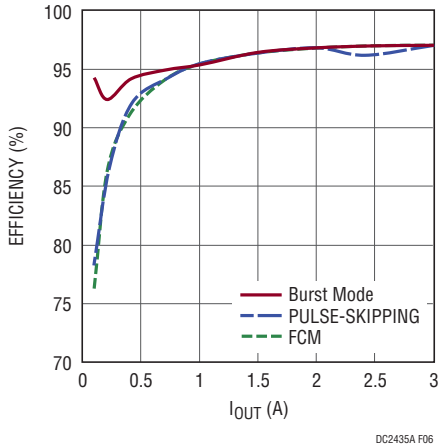


Figure 6. DC2435A-C V_{BUS} Typical Efficiency vs Load Current (V_{IN} = 14V)

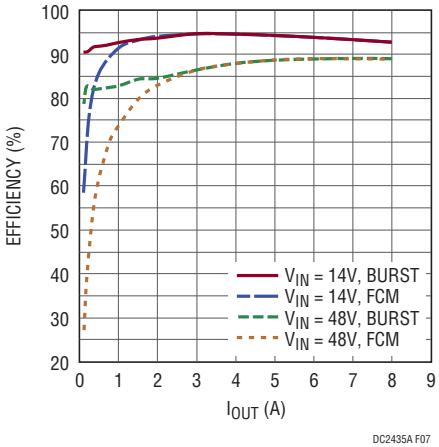


Figure 7. DC2435A-C V_{OUT1} Typical Efficiency vs Load Current

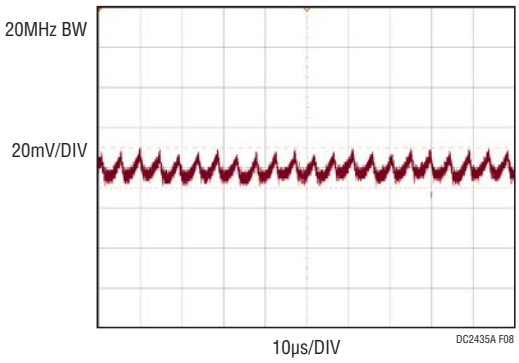


Figure 8. DC2435A-A V_{OUT1} Voltage Ripple at V_{IN} = 14V

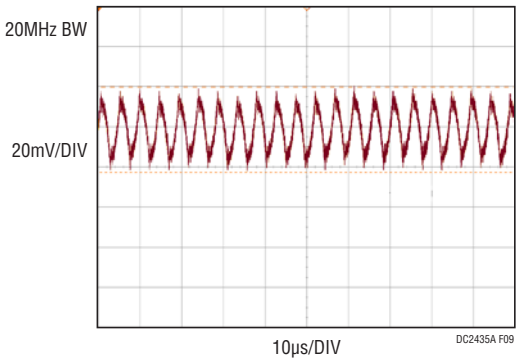


Figure 9. DC2435A-A V_{OUT1} Voltage Ripple at V_{IN} = 48V

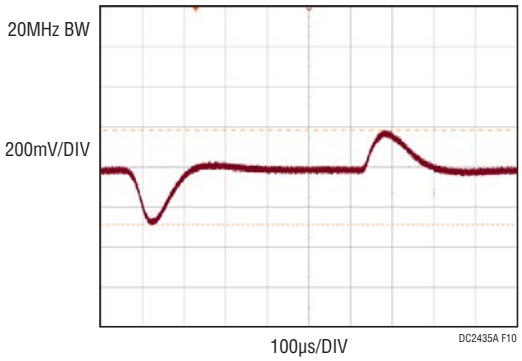


Figure 10. DC2435A-A V_{OUT1} 0A to 2.5A Load Transient at V_{IN} = 14V

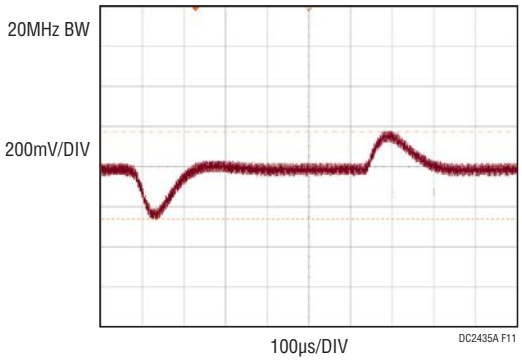


Figure 11. DC2435A-A V_{OUT1} 0A to 2.5A Load Transient at V_{IN} = 48V

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
			DC2435A-A	
Required Circuit Components				
1	2	CIN1, COUT1	CAP, 33µF, 63V, 20%, ELEC	SUN ELEC. 63HVH33M
2	1	COUT2	CAP, 100µF, 63V, 20%, ELEC	UNITED CHEMI CON, EMZA630ADA101MJA0G
3	6	CIN2, CIN3, CIN4, COUT6, COUT8, C80	CAP, 4.7µF, X7R, 100V, 10%,1210	MURATA, GRM32ER72A475KE14L
4	2	COUT4, C5	CAP, 2.2µF, X7R, 100V,10%,1206	MURATA, GRM31CR72A225KA73L
5	2	COUT5, COUT11	CAP, 68µF, 35V, 20%, D8	PANASONIC, EEHZA1V680XP
6	5	C4, C17, C21, C47, C52	CAP, 0.1µF, X7R, 25V ,10%, 0603	TDK, C1608X7R1E104K
7	3	C15, C56, C62	CAP, 1nF, X7R, 50V,10%,0603	AVX, 06035C102KAT2A
8	1	C43	CAP, 68pF, NPO, 50V, 10%,0603	AVX, 06035A680KAT2A
9	1	C44	CAP, 4.7nF, X7R, 50V,10%,0603	AVX, 06035C472KAT2A
10	1	C49	CAP, 47pF X7R, 50V, 5%, 0603	AVX, 06035A470JAT2A
11	1	C53	CAP, 820pF X7R, 50V, 5%, 0603	AVX, 06035A821JAT2A
12	1	C54	CAP, 27nF, X7R, 50V,10%, 0603	AVX, 06035C273KAT2A
13	1	C61	CAP, 1µF, X5R, 25V, 20%, 0603	TDK, C1608X5R1E105M
14	2	C64, C81	CAP, 4.7µF X5R,10V, 20%, 0603	AVX, 0603ZD475MAT2A
15	1	L1	IND, 22µH	COILCRAFT, SER1390-223MLD
16	1	L2	IND, 15µH	COILCRAFT, XAL1510-153MED
17	1	Q1	XSTR, N-CHANNEL MOSFET	INFINEON, BSC123N08NS3G
18	1	Q2	XSTR, N-CHANNEL MOSFET	INFINEON, BSC042NE7NS3G
19	1	Q21	XSTR, N-CHANNEL MOSFET	INFINEON, BSC026N08NS5
20	1	Q22	XSTR, N-CHANNEL MOSFET	INFINEON, BSC072N08NS5
21	1	R33	RES., 11.5kΩ,1/10W, 1%, 0603	VISHAY, CRCW060311K5FKEA
22	1	R35	RES., 7.5kΩ,1/10W, 1%, 0603	VISHAY, CRCW06037K5FKEA
23	2	R43, R78	RES., 332kΩ,1/10W, 1%, 0603	VISHAY, CRCW0603332KFKEA
24	2	R46, R48	RES., 100kΩ,1/10W, 5%, 0603	VISHAY, CRCW0603100KJNEA
25	1	R72	RES., 37.4kΩ,1/10W, 1%, 0603	VISHAY, CRCW060337K4FKEA
26	1	R75	RES., 3.6kΩ,1/10W, 1%, 0603	VISHAY, CRCW06033K60FKEA
27	1	R79	RES., 14.7kΩ,1/10W, 1%, 0603	VISHAY, CRCW060314K7FKEA
28	1	R81	RES., 100Ω,1/10W, 5%, 0603	VISHAY, CRCW0603100RJNEA
29	1	R86	RES., 2.2Ω,1/10W, 5%, 0603	VISHAY, CRCW06032R20JNEA
30	1	R92	RES., 90.9kΩ,1/10W, 1%, 0603	VISHAY, CRCW060390K9FKEA
31	1	RS1	RES., SENSE, 0.008Ω,1/2W, 1%, 2010	VISHAY, WSL20108L000FEA18
32	1	RS2	RES., SENSE, 0.006Ω,1/2W, 1%, 2010	VISHAY, WSL20106L000FEA18
33	1	U1	IC, LOW I_Q, 60V BOOST + BUCK SYNCHRONOUS CONTROLLER	LINEAR TECH. LTC7813EUH#PBF
Additional Demo Board Circuit Components				
1	0	C1, C2, C3, CIN5, C6, C59, C68	CAP, OPTION, 1210	OPTION
2	0	C36	CAP, OPTION, 1206	OPTION
3	0	C7, C39, C40, C51, C66, C67, C73, C74, C78, C79	CAP, OPTION, 0805	OPTION
4	0	C55, C57, C60, C63, C65, C77	CAP, OPTION, 0603	OPTION

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
5	0	D3	DIODE, OPTION, SMB	OPTION
6	0	D4	DIODE, OPTION, SOD323	OPTION
7	0	L3	IND, OPTION	OPTION
8	0	Q9, Q11, Q18, Q19	XSTR, OPTION, N-CHANNEL MOSFET	OPTION
9	11	R34, R36, R39, R40, R70, R80, R95, R96, R103, R105, R108	RES., 0Ω, 1/10W, 0603	VISHAY, CRCW06030000Z0EA
10	0	R37, R51, R53, R55, R62, R85, R89, R90, R91, R93, R94, R104, R106, R107, R109, R110, R111	RES., OPTION, 0603	OPTION
11	0	R82	RES., OPTION, 1206	OPTION
12	0	R100	RES., OPTION, 0805	OPTION
13	0	R101	RES., OPTION, 2010	OPTION
14	1	R102	RES., 0Ω, 2010	VISHAY, CRCW20100000Z0EF
15	0	RS3	RES., SENSE, OPT, 2010	OPTION
Hardware: For Demo Board Only				
1	14	E1-E14	TURRET	MILL-MAX, 2501-2-00-80-00-00-07-0
2	2	JP1, JP2	CONN., HEADER, 1×3, 2mm	WURTH ELEKTRONIK, 620-003-111-21
3	1	JP3	CONN., HEADER, 2×3, 2mm	WURTH ELEKTRONIK, 620-006-211-21
4	3	XJP1, XJP2, XJP3	SHUNT, 2mm	WURTH ELEKTRONIK, 608-002-134-21
5	6	J1, J2, J3, J4, J5, J6	JACK, BANANA	KEYSTONE, 575-4
6	0	J9, J10	PAD	NONE
7	4		STANDOFF, SNAP ON	KEYSTONE, 8832
			DC2435A-B	
1	2	CIN1, COUT1	CAP, 33µF, 63V, 20%, ELEC	SUN ELEC. 63HVH33M
2	1	COUT2	CAP, 100µF, 63V, 20%, ELEC	UNITED CHEMI CON, EMZA630ADA101MJA0G
3	6	CIN2, CIN3, CIN4, COUT6, COUT8, C80	CAP, 4.7µF, X7R, 100V, 10%,1210	MURATA, GRM32ER72A475KE14L
4	2	COUT4, C5	CAP, 2.2µF, X7R, 100V,10%,1206	MURATA, GRM31CR72A225KA73L
5	2	COUT5, COUT11	CAP, 68µF, 35V, 20%, D8	PANASONIC, EEHZA1V680XP
6	5	C4, C17, C21, C47, C52	CAP, 0.1µF, X7R, 25V ,10%, 0603	TDK, C1608X7R1E104K
7	3	C15, C56, C62	CAP, 1nF, X7R, 50V,10%,0603	AVX, 06035C102KAT2A
8	1	C43	CAP, 68pF, NPO, 50V, 10%,0603	AVX, 06035A680KAT2A
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10	1	C49	CAP, 47pF X7R, 50V, 5%, 0603	AVX, 06035A470JAT2A
11	1	C53	CAP, 820pF X7R, 50V, 5%, 0603	AVX, 06035A821JAT2A
12	1	C54	CAP, 27nF, X7R, 50V,10%, 0603	AVX, 06035C273KAT2A
13	1	C61	CAP, 1µF, X5R, 25V, 20%, 0603	TDK, C1608X5R1E105M
14	2	C64, C81	CAP, 4.7µF X5R,10V, 20%, 0603	AVX, 0603ZD475MAT2A
15	1	L1	IND, 22µH	COILCRAFT, SER1390-223ML
16	1	L2	IND, 15µH	COILCRAFT, XAL1510-153MED
17	1	Q1	XSTR, N-CHANNEL MOSFET	INFINEON, BSC123N08NS3G
18	1	Q2	XSTR, N-CHANNEL MOSFET	INFINEON, BSC042NE7NS3G
19	1	Q21	XSTR, N-CHANNEL MOSFET	INFINEON, BSC026N08NS5

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
20	1	Q22	XSTR, N-CHANNEL MOSFET	INFINEON, BSC072N08NS5
21	1	R33	RES., 9.76kΩ,1/10W, 1%, 0603	VISHAY, CRCW06039K76FKEA
22	1	R35	RES., 7.5kΩ,1/10W, 1%, 0603	VISHAY, CRCW06037K5FKEA
23	2	R43, R78	RES., 332kΩ,1/10W, 1%, 0603	VISHAY, CRCW0603332KFKEA
24	2	R46, R48	RES., 100kΩ,1/10W, 5%, 0603	VISHAY, CRCW0603100KJNEA
25	1	R72	RES., 37.4kΩ,1/10W, 1%, 0603	VISHAY, CRCW060337K4FKEA
26	1	R75	RES., 3.6kΩ,1/10W, 1%, 0603	VISHAY, CRCW06033K60FKEA
27	1	R79	RES., 21kΩ,1/10W, 1%, 0603	VISHAY, CRCW060321K0FKEA
28	1	R81	RES., 100Ω,1/10W, 5%, 0603	VISHAY, CRCW0603100RJNEA
29	1	R86	RES., 2.2ΩS,1/10W, 5%, 0603	VISHAY, CRCW06032R20JNEA
30	1	R92	RES., 90.9kΩ,1/10W, 1%, 0603	VISHAY, CRCW060390K9FKEA
31	1	RS1	RES., SENSE, 0.008Ω,1/2W, 1%, 2010	VISHAY, WSL20108L000FEA18
32	1	RS2	RES., SENSE, 0.006Ω,1/2W, 1%, 2010	VISHAY, WSL20106L000FEA18
33	1	U1	IC, LOW I_Q, 60V BOOST + BUCK SYNCHRONOUS CONTROLLER	LINEAR TECH. LTC7813EUH#PBF
Additional Demo Board Circuit Components				
1	0	C1, C2, C3, CIN5, C6, C59, C68	CAP., OPTION, 1210	OPTION
2	0	C36	CAP,. OPTION, 1206	OPTION
3	0	C7, C39, C40, C51, C66, C67, C73, C74, C78, C79	CAP., OPTION, 0805	OPTION
4	0	C55, C57, C60, C63, C65, C77	CAP., OPTION, 0603	OPTION
5	0	D3	DIODE, OPTION, SMB	OPTION
6	0	D4	DIODE, OPTION, SOD323	OPTION
7	0	L3	IND., OPTION	OPTION
8	0	Q9, Q11, Q18, Q19	XSTR, OPTION, N-CHANNEL MOSFET	OPTION
9	11	R34, R36, R39, R40, R70, R80, R95, R96, R103, R105, R108	RES., 0Ω, 1/10W, 0603	VISHAY, CRCW06030000Z0EA
10	0	R37, R51, R53, R55, R62, R85, R89, R90, R91, R93, R94, R104, R106, R107, R109, R110, R111	RES., OPTION, 0603	OPTION
11	0	R82	RES., OPTION, 1206	OPTION
12	0	R100	RES., OPTION, 0805	OPTION
13	0	R101	RES., OPTION, 2010	OPTION
14	1	R102	RES., 0Ω, 2010	VISHAY, CRCW20100000Z0EF
15	0	RS3	RES., SENSE, OPT, 2010	OPTION
Hardware: For Demo Board Only				
1	14	E1-E14	TURRET	MILL-MAX, 2501-2-00-80-00-00-07-0
2	2	JP1, JP2	CONN., HEADER, 1×3, 2mm	WURTH ELEKTRONIK, 620-003-111-21
3	1	JP3	CONN., HEADER, 2×3, 2mm	WURTH ELEKTRONIK, 620-006-211-21
4	3	XJP1, XJP2, XJP3	SHUNT, 2mm	WURTH ELEKTRONIK, 608-002-134-21
5	6	J1, J2, J3, J4, J5, J6	JACK, BANANA	KEYSTONE, 575-4
6	0	J9, J10	PAD	NONE
7	4		STANDOFF, SNAP ON	KEYSTONE, 8832

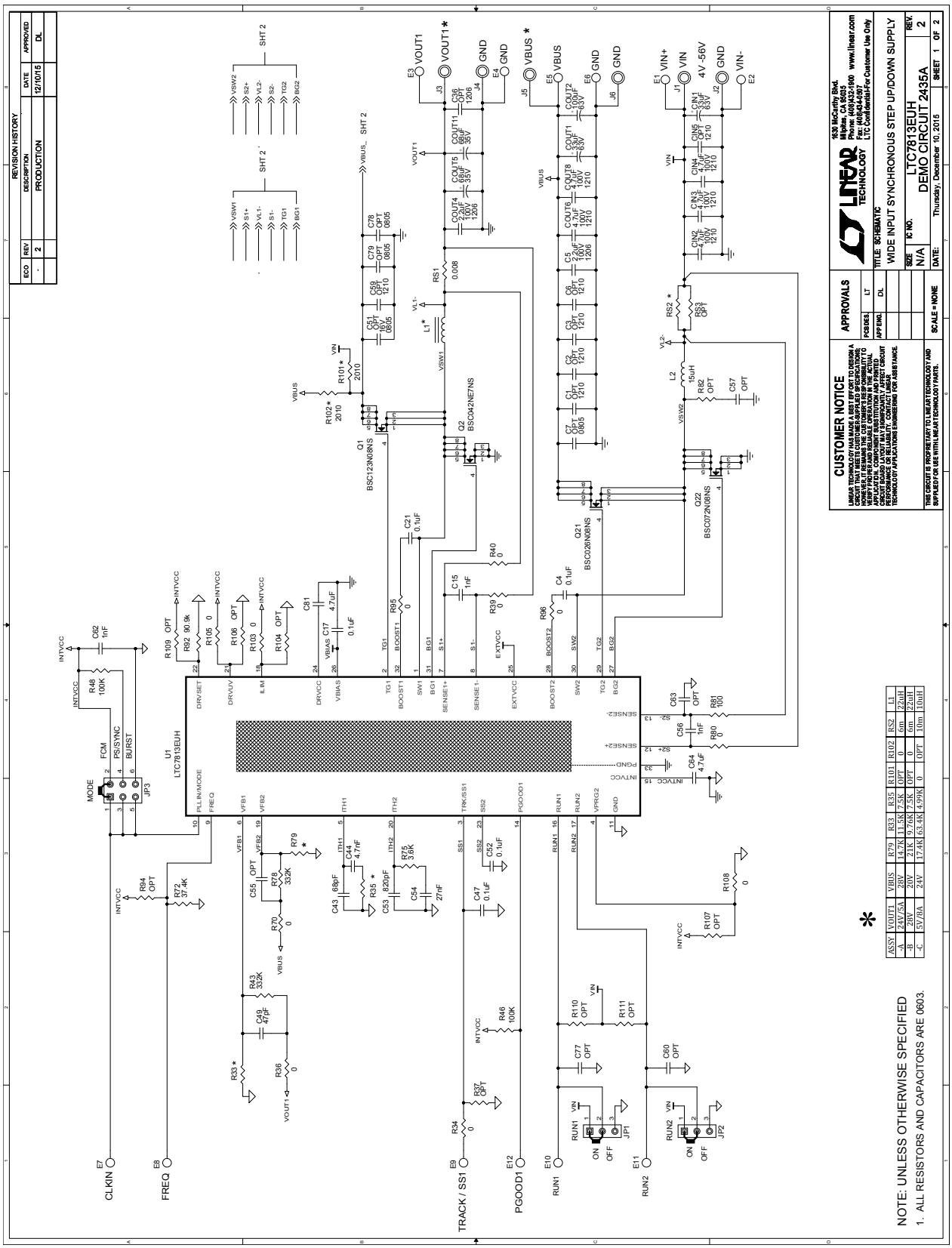
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
			DC2435A-C	
1	2	CIN1, COUT1	CAP, 33µF, 63V, 20%, ELEC	SUN ELEC. 63HVH33M
2	1	COUT2	CAP, 100µF, 63V, 20%, ELEC	UNITED CHEMI CON, EMZA630ADA101MJA0G
3	6	CIN2, CIN3, CIN4, COUT6, COUT8, C80	CAP, 4.7µF, X7R, 100V, 10%,1210	MURATA, GRM32ER72A475KE14L
4	2	COUT4, C5	CAP, 2.2µF, X7R, 100V,10%,1206	MURATA, GRM31CR72A225KA73L
5	2	COUT5, COUT11	CAP, 68µF, 35V, 20%, D8	PANASONIC, EEHZA1V680XP
6	5	C4, C17, C21, C47, C52	CAP, 0.1µF, X7R, 25V ,10%, 0603	TDK, C1608X7R1E104K
7	3	C15, C56, C62	CAP, 1nF, X7R, 50V,10%,0603	AVX, 06035C102KAT2A
8	1	C43	CAP, 68pF, NPO, 50V, 10%,0603	AVX, 06035A680KAT2A
9	1	C44	CAP, 4.7nF, X7R, 50V,10%,0603	AVX, 06035C472KAT2A
10	1	C49	CAP, 47pF X7R, 50V, 5%, 0603	AVX, 06035A470JAT2A
11	1	C53	CAP, 820pF X7R, 50V, 5%, 0603	AVX, 06035A821JAT2A
12	1	C54	CAP, 27nF, X7R, 50V,10%, 0603	AVX, 06035C273KAT2A
13	1	C61	CAP, 1µF, X5R, 25V, 20%, 0603	TDK, C1608X5R1E105M
14	2	C64, C81	CAP, 4.7µF X5R,10V, 20%, 0603	AVX, 0603ZD475MAT2A
15	1	L1	IND, 10µH	COILCRAFT, SER1390-103ML
16	1	L2	IND, 15µH	COILCRAFT, XAL1510-153MED
17	1	Q1	XSTR, N-CHANNEL MOSFET	INFINEON, BSC123N08NS3G
18	1	Q2	XSTR, N-CHANNEL MOSFET	INFINEON, BSC042NE7NS3G
19	1	Q21	XSTR, N-CHANNEL MOSFET	INFINEON, BSC026N08NS5
20	1	Q22	XSTR, N-CHANNEL MOSFET	INFINEON, BSC072N08NS5
21	1	R33	RES., 63.4kΩ,1/10W, 1%, 0603	VISHAY, CRCW060363K4FKEA
22	1	R35	RES., 4.99kΩ,1/10W, 1%, 0603	VISHAY, CRCW06034K99FKEA
23	2	R43, R78	RES., 332kΩ,1/10W, 1%, 0603	VISHAY, CRCW0603332KFKEA
24	2	R46, R48	RES., 100kΩ,1/10W, 5%, 0603	VISHAY, CRCW0603100KJNEA
25	1	R72	RES., 37.4kΩ,1/10W, 1%, 0603	VISHAY, CRCW060337K4FKEA
26	1	R75	RES., 3.6kΩ,1/10W, 1%, 0603	VISHAY, CRCW06033K60FKEA
27	1	R79	RES., 17.4kΩ,1/10W, 1%, 0603	VISHAY, CRCW060317K4FKEA
28	1	R81	RES., 100Ω,1/10W, 5%, 0603	VISHAY, CRCW0603100RJNEA
29	1	R86	RES., 2.2Ω,1/10W, 5%, 0603	VISHAY, CRCW06032R20JNEA
30	1	R92	RES., 90.9kΩ,1/10W, 1%, 0603	VISHAY, CRCW060390K9FKEA
31	1	RS1	RES., SENSE,0.008Ω,1/2W, 1%, 2010	VISHAY, WSL20108L000FEA18
32	1	RS2	RES., SENSE, 0.010Ω,1/2W, 1%, 2010	VISHAY, WSL201010L000FEA18
33	1	U1	IC, LOW I_Q, 60V BOOST + BUCK SYNCHRONOUS CONTROLLER	LINEAR TECH. LTC7813EUH#PBF
Additional Demo Board Circuit Components				
1	0	C1, C2, C3, CIN5, C6, C59, C68	CAP, OPTION, 1210	OPTION
2	0	C36	CAP, OPTION, 1206	OPTION
3	0	C7, C39, C40, C51, C66, C67, C73, C74, C78, C79	CAP, OPTION, 0805	OPTION
4	0	C55, C57, C60, C63, C65, C77	CAP, OPTION, 0603	OPTION

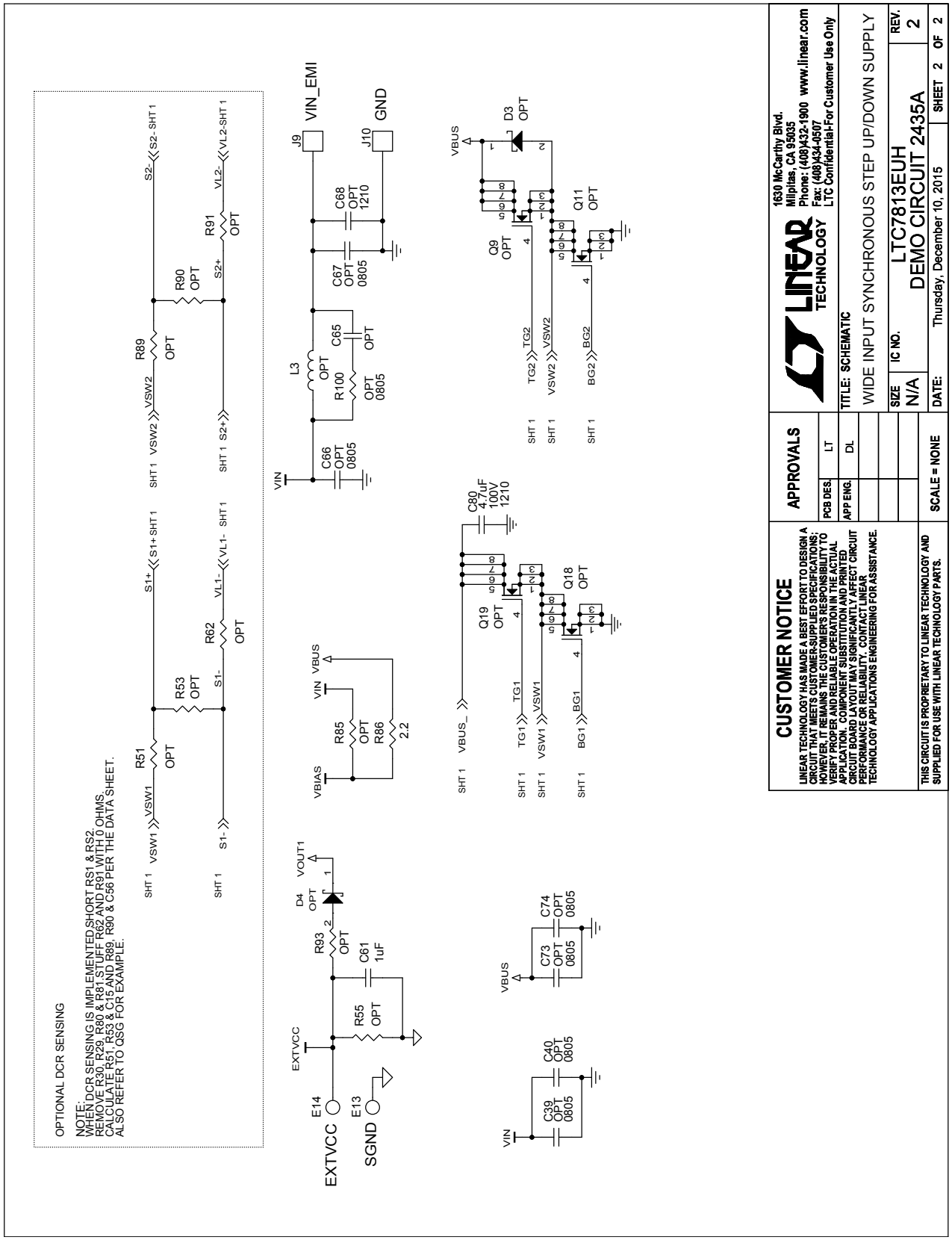
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
5	0	D3	DIODE, OPTION, SMB	OPTION
6	0	D4	DIODE, OPTION, SOD323	OPTION
7	0	L3	IND, OPTION	OPTION
8	0	Q9, Q11, Q18, Q19	XSTR, OPTION, N-CHANNEL MOSFET	OPTION
9	11	R34, R36, R39, R40, R70, R80, R95, R96, R103, R105, R108	RES., 0Ω, 1/10W, 0603	VISHAY, CRCW06030000Z0EA
10	0	R37, R51, R53, R55, R62, R85, R89, R90, R91, R93, R94, R104, R106, R107, R109, R110, R111	RES., OPTION, 0603	OPTION
11	0	R82	RES., OPTION, 1206	OPTION
12	0	R100	RES., OPTION, 0805	OPTION
13	1	R101	RES., 0Ω, 2010	VISHAY, CRCW20100000Z0EF
14	0	R102	RES., OPTION, 2010	OPTION
15	0	RS3	RES., SENSE, OPT, 2010	OPTION
Hardware: For Demo Board Only				
1	14	E1-E14	TURRET	MILL-MAX, 2501-2-00-80-00-00-07-0
2	2	JP1, JP2	CONN., HEADER, 1×3, 2mm	WURTH ELEKTRONIK, 620-003-111-21
3	1	JP3	CONN., HEADER, 2×3, 2mm	WURTH ELEKTRONIK, 620-006-211-21
4	3	XJP1, XJP2, XJP3	SHUNT, 2mm	WURTH ELEKTRONIK, 608-002-134-21
5	6	J1, J2, J3, J4, J5, J6	JACK, BANANA	KEYSTONE, 575-4
6	0	J9, J10	PAD	NONE
7	4		STANDOFF, SNAP ON	KEYSTONE, 8832

SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



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