LT8210
High Voltage, High Efficiency Synchronous Buck-Boost Converter with Input to Output Pass-Thru

DESCRIPTION

Demonstration circuit 2814A-A is a high voltage, high efficiency synchronous buck-boost DC/DC converter with an input voltage range of 8V to 80V. After the part has started, the input voltage can run down to 3.5V. It can supply a 3A maximum load current with an output range of 8V to 16V. The demo board features the LT8210EUJ controller. The constant frequency current mode architecture allows a phase-lockable frequency of up to 400kHz, while an optional input or output current feedback loop provides support for applications such as battery charging. With a wide input range, wide output range, and seamless transfers between operation modes, the LT8210 is ideal for industrial, automotive, medical, military, and avionics applications.

The converter has four modes of operation: burst, pulse skip, forced continuous mode, or pass-thru. Pass-thru is a feature that passes the input directly to the output when the input voltage is within a user programmable window. Switching losses drop to zero and efficiency is maximized. For input voltage above or below the pass-thru window, the buck or boost regulation loops maintain the output at the set maximum or minimum values, respectively. Reverse input protection is also implemented on this demo board.

The available versions of the DC2814A are:

DC2814A-A: 8V to 40V_{IN}, 80V_{IN} Surge (60s), Operates Down to 3.5V_{IN} after Start-Up, V_{OUT} = 8V to 16V at 3A

DC2814A-B: 9V to 36V_{IN}, 80V_{IN} Surge (60s), V_{OUT} = 24V to 36V at 2.5A

DC2814A-C: 26V to 80V_{IN}, V_{OUT} = 36V to 56V at 2A

Design files for this circuit board are available.

PERFORMANCE SUMMARY **Specifications are at T_A = 25°C**

PARAMETER	CONDITIONS	VALUE
Input Voltage Range, V_{IN}		8V to 40V Continuous, 80V Surge (60 Seconds) (Operates Down to 3.5V after Start-Up)
Output Voltage, V_{OUT}	V_{IN} = 3.5V (8V Start-Up) to 80V, I_{OUT} = 0A to 3A	8V to 16V
Maximum Output Current, I_{OUT}	V_{IN} = 3.5V (8V Start-Up) to 80V, V_{OUT} = 8V to 16V	3A
Default Operating Frequency		385kHz (R_T = 16.9k)
Typical Efficiency	6V_{IN}, 8V_{OUT} (Boost), 3A 8V_{IN}, 8V_{OUT} (Buck-Boost), 3A 12V_{IN}, 12V_{OUT} (Pass-Thru), 3A 17V_{IN}, 16V_{OUT} (Buck-Boost), 3A 30V_{IN}, 16V_{OUT} (Buck), 3A	94% 94% 98% 95% 94%

QUICK START PROCEDURE

Demonstration circuit 2814A-A is easy to set up to evaluate the performance of the LT8210. Refer to the following procedure:

1. With power off, connect the input power supply to V_{IN} (8V to 40V) and GND (input return).
2. Connect the 8V to 16V output load between V_{OUT} and GND.
3. Connect the DVMs to the input and the output.
4. Turn on the input power supply and then check for the proper output voltages. V_{OUT} should be between 8V to 16V, depending on the input voltage (see Figure 4).
5. Once the proper output voltages are established, adjust the loads within the operating range and observe the output voltage regulation, ripple voltage and other parameters.
6. After the part starts, the input voltage can be reduced to as low as 3.5V.
7. The input voltage may be raised up to 80V for short periods of time.

Note: When measuring the output or input voltage ripple, do not use the long ground lead on the oscilloscope probe. See Figure 1 for the proper scope probe technique. Short, stiff leads need to be soldered to the (+) and (–) terminals of an output capacitor. The probe's ground ring needs to touch the (–) lead and the probe tip needs to touch the (+) lead.

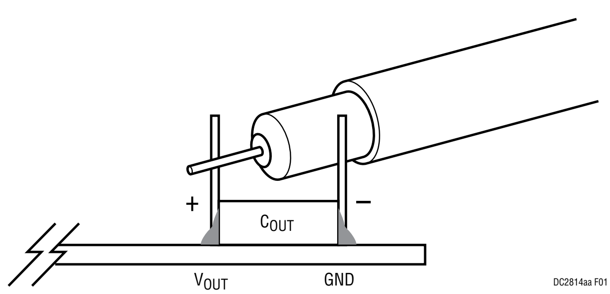

Figure 1. Measuring Output Voltage Ripple

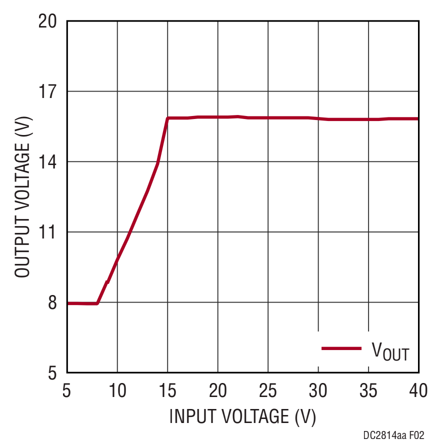

Figure 2. Output Voltage vs Input Voltage

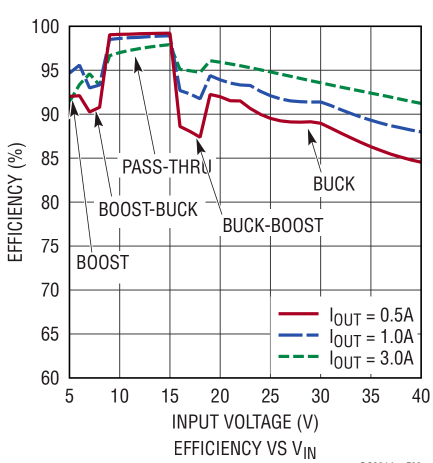

Figure 3. Efficiency vs V_{IN}

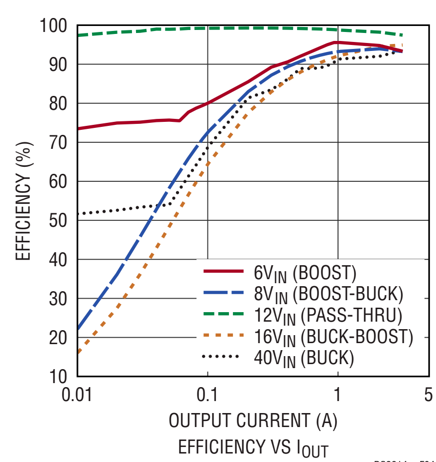

Figure 4. Efficiency vs I_{OUT}

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TEST RESULTS

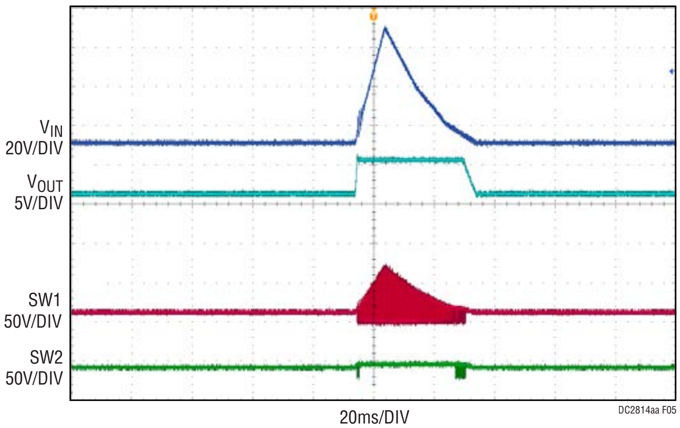


Figure 5. ISO16750 4.6.4, Test A without Centralized Load Dump Suppression (I_{OUT} = 3A)

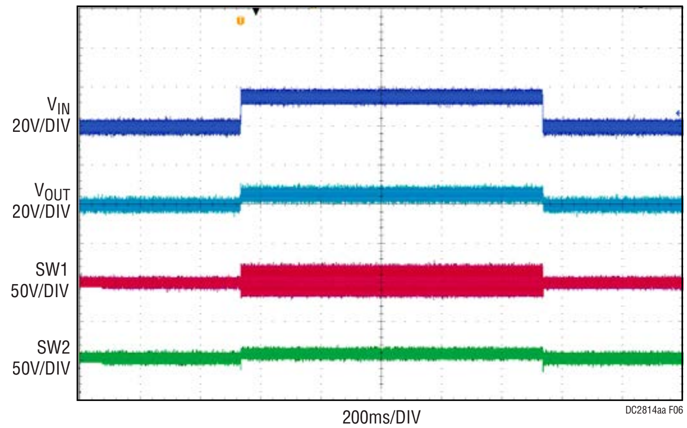


Figure 6. LV124 E-04, Jumpstart (I_{OUT} = 3A)

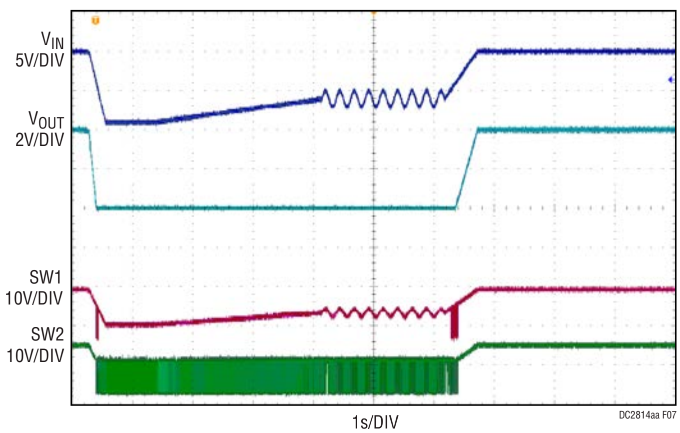


Figure 7. ISO16750 4.6.3, Starting Profile (I_{OUT} = 1.5A)

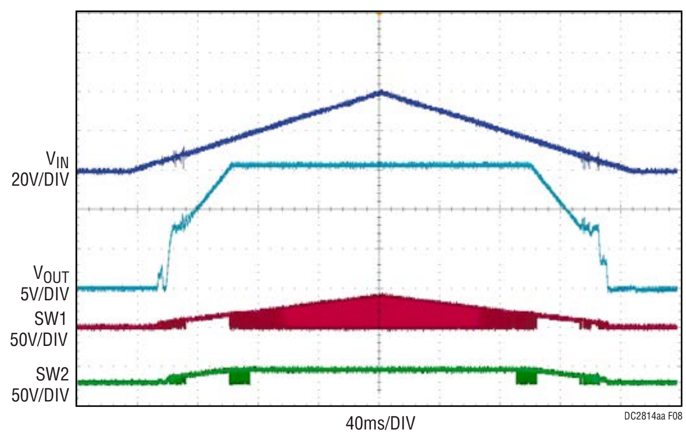


Figure 8. V_{IN} Range (I_{OUT} = 3A)

TEST RESULTS

Figure 9. DC2814A-A Thermal Performance at $6V_{IN}$ (Boost), $8V_{OUT}$, 3A Load Current

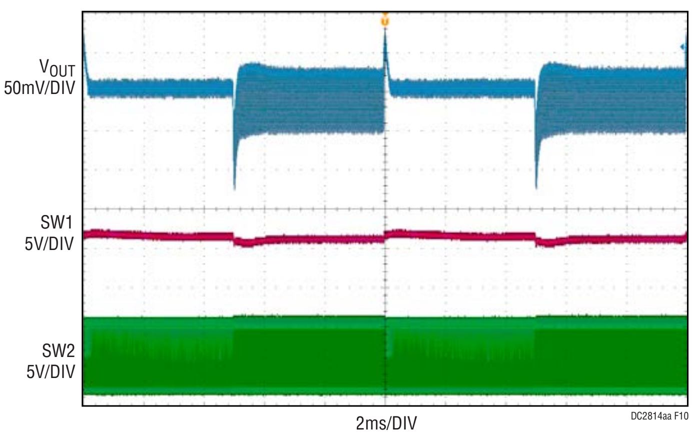


Figure 10. DC2814A-A Load Transients at $6V_{IN}$ (Boost), $8V_{OUT}$, 0.3A to 2.7A Load Current

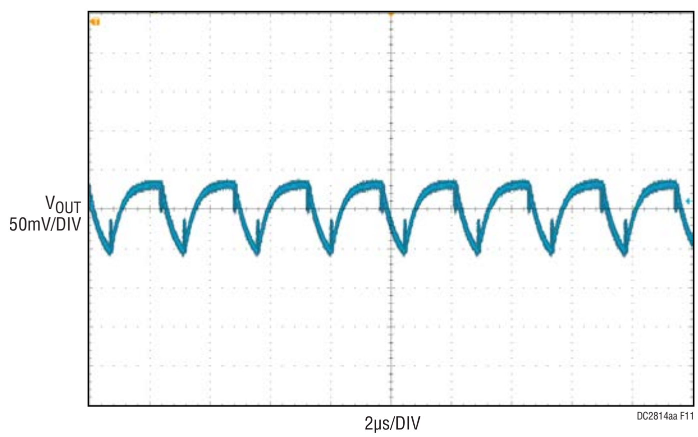


Figure 11. DC2814A-A Output Voltage Ripple at $6V_{IN}$ (Boost), $8V_{OUT}$, 3A Load Current

TEST RESULTS

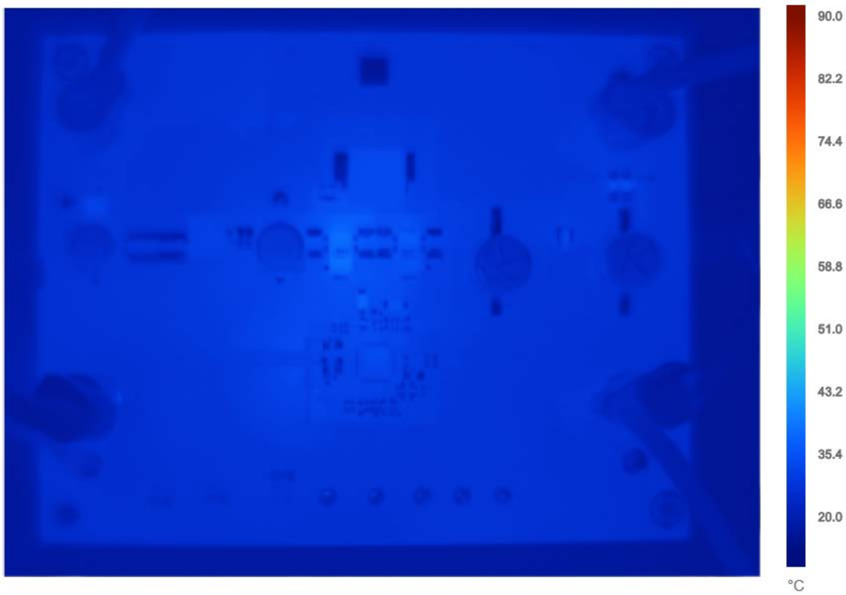


Figure 12. DC2814A-A Thermal Performance at 8V_{IN} (Buck-Boost), 8V_{OUT}, 3A Load Current

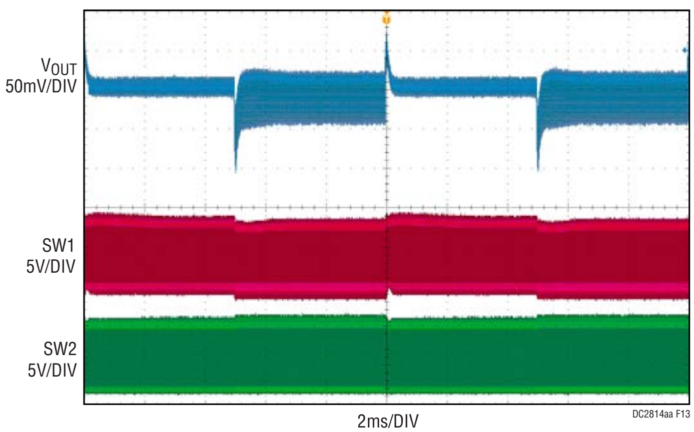


Figure 13. DC2814A-A Load Transients at 7.5V_{IN} (Buck-Boost), 8V_{OUT}, 0.3A to 2.7A Load Current

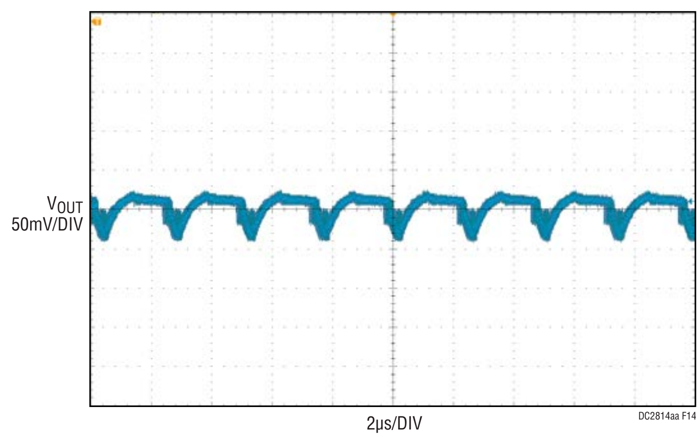


Figure 14. DC2814A-A Output Voltage Ripple at 8V_{IN} (Buck-Boost), 8V_{OUT}, 3A Load Current

TEST RESULTS

Figure 15. DC2814A-A Thermal Performance at $12V_{IN}$ (Pass-Thru), $12V_{OUT}$, 3A Load Current

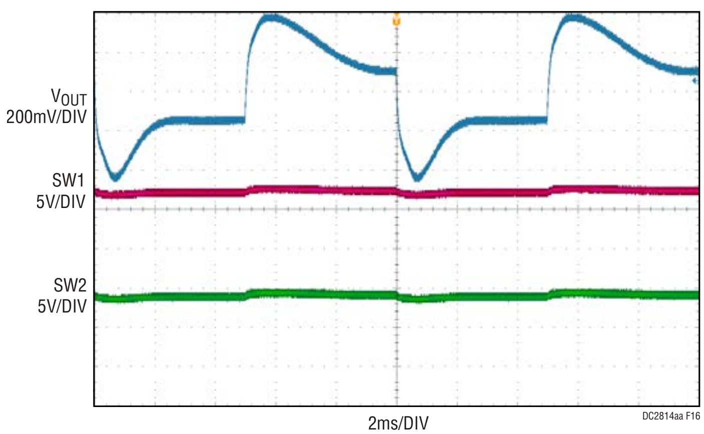


Figure 16. DC2814A-A Load Transients at $12V_{IN}$ (Pass-Thru), $12V_{OUT}$, 0.3A to 2.7A Load Current

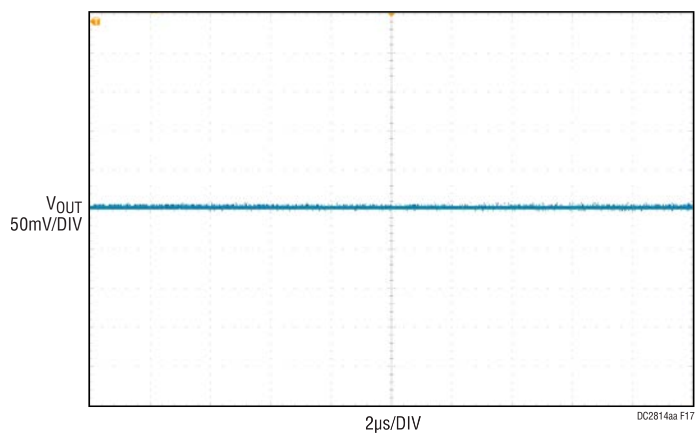


Figure 17. DC2814A-A Output Voltage Ripple at $12V_{IN}$ (Pass-Thru), $12V_{OUT}$, 3A Load Current

TEST RESULTS

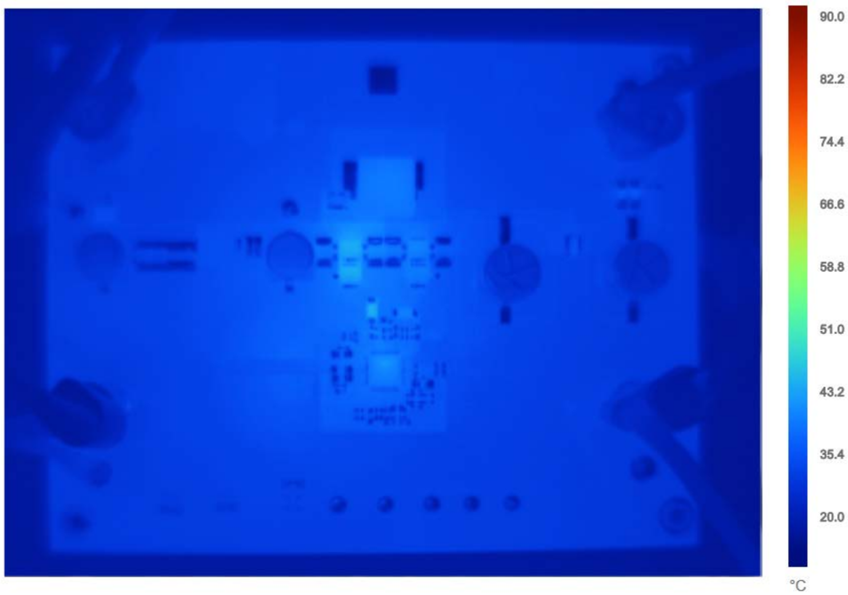


Figure 18. DC2814A-A Thermal Performance at $17V_{IN}$ (Buck-Boost), $16V_{OUT}$, 3A Load Current

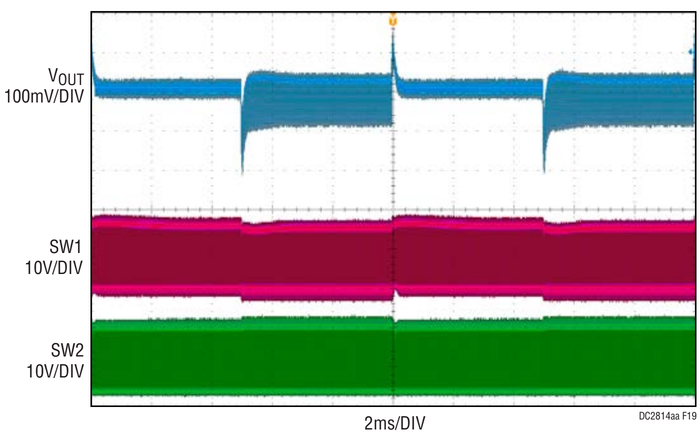


Figure 19. DC2814A-A Load Transients at $17V_{IN}$ (Buck-Boost), $16V_{OUT}$, 0.3A to 2.7A Load Current

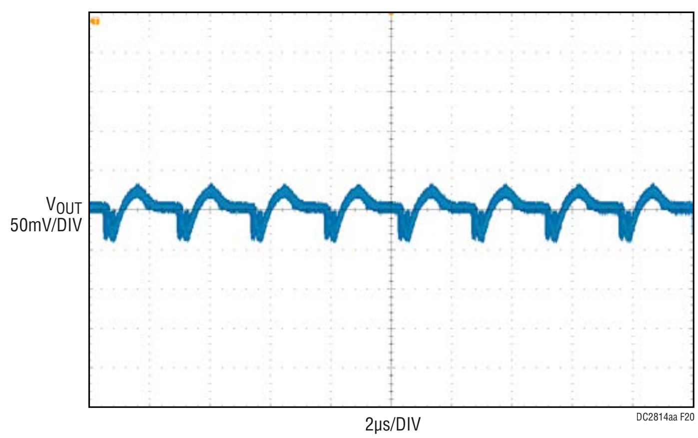


Figure 20. DC2814A-A Output Voltage Ripple at $17V_{IN}$ (Buck-Boost), $16V_{OUT}$, 3A Load Current

TEST RESULTS

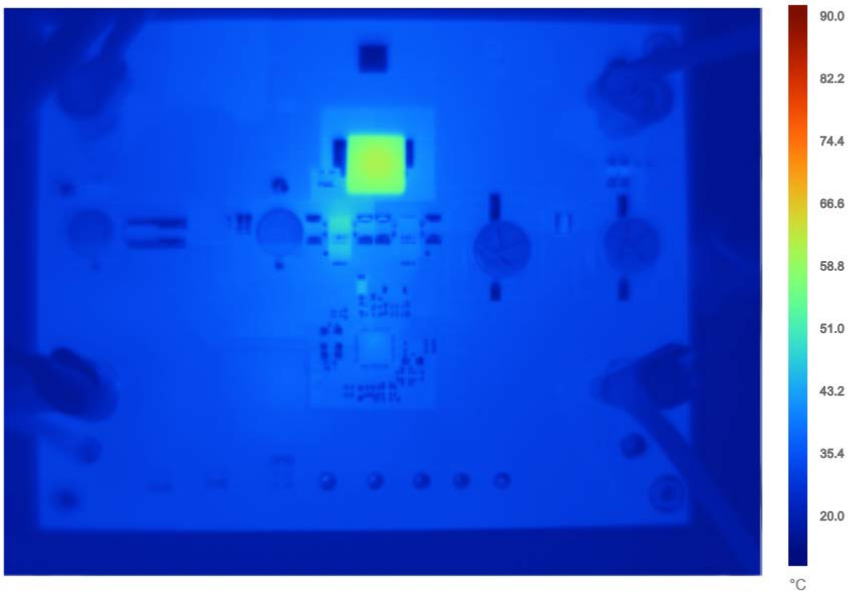


Figure 21. DC2814A-A Thermal Performance at $30V_{IN}$ (Buck), $16V_{OUT}$, 3A Load Current

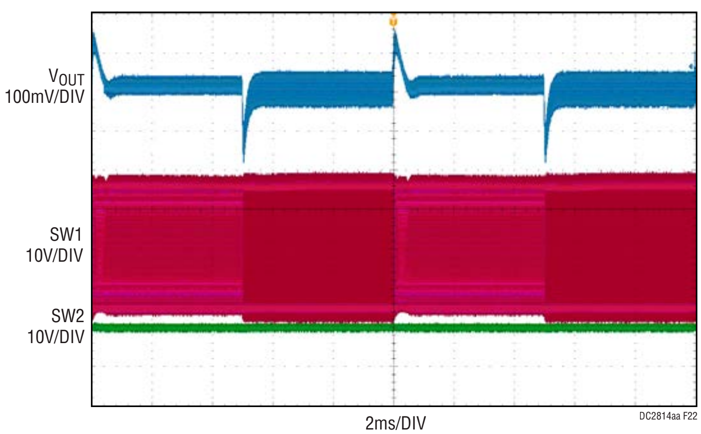


Figure 22. DC2814A-A Load Transients at $30V_{IN}$ (Buck), $16V_{OUT}$, 0.3A to 2.7A Load Current

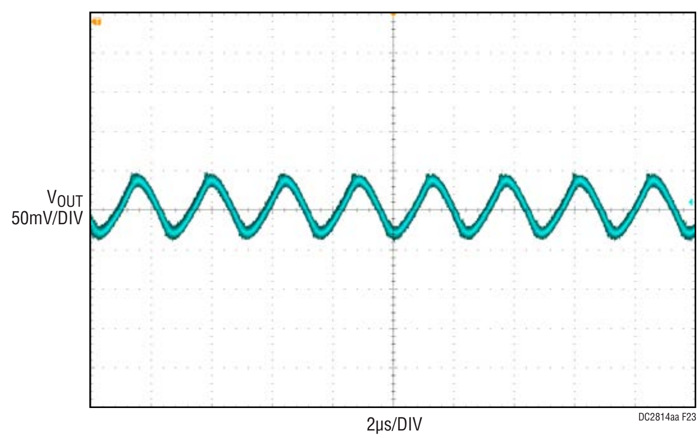


Figure 23. DC2814A-A Output Voltage Ripple at $30V_{IN}$ (Buck), $16V_{OUT}$, 3A Load Current

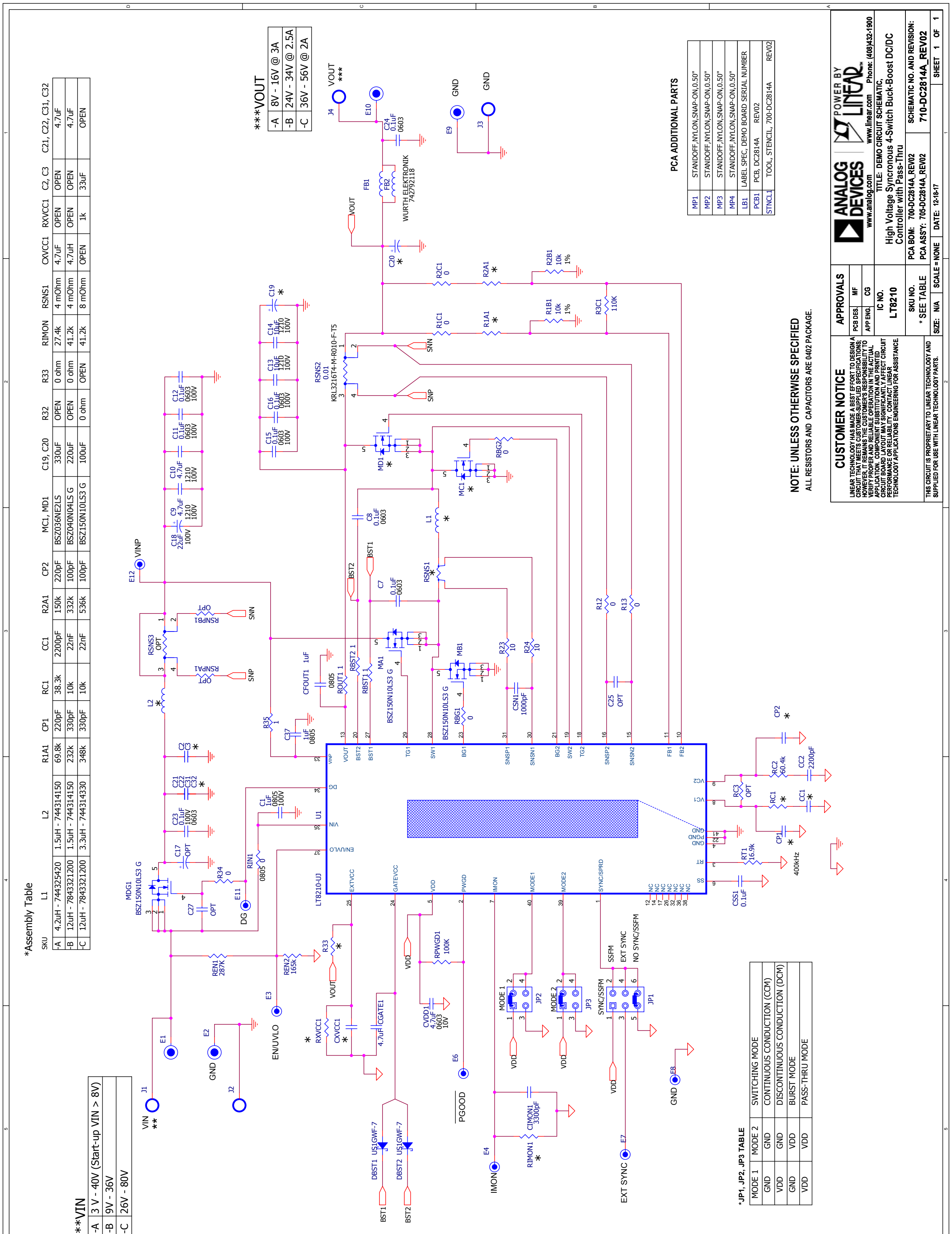
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	C1, CFOUT1	CAP, 1µF ,X7S, 100V, 10%, 0805, SOFT TERM	MURATA GRJ21BC72A105KE11L TDK C2012X7S2A105K125AE
2	5	C7, C8, C11, C12, C23	CAP, 0.1µF, X7S, 100V, 10%, 0603	TAIYO YUDEN HMK107C7104KA-T TDK C1608X7S2A104K080AB
3	6	C9, C10, C21, C22, C31, C32	CAP, 4.7µF, X7S, 100V, 20%, 1210	TDK C3225X7S2A475M200AB
4	2	C13, C14	CAP, 10µF, X7R, 25V, 20%, 1210	KEMET C1210C106M3RAC7800 TDK C3225X7R1E106M250AC
5	3	C15, C16, C24	CAP, 0.1µF, X7R, 50V, 10%, 0603, AEC-Q200	TDK CGA3E2X7R1H104K080AA
6	1	C18	CAP, 22µF, ALUM ELECT, 100V, 20%, 8x10.2mm SMD, AEC-Q200	PANASONIC EEETG2A220UP
7	2	C19, C20	CAP, 330µF, ALUM ELECT, 35V, 20%, SMD 10mm × 10.2mm	SUN ELECTRONIC INDUSTRIES CORP 35CE330AX
8	1	C37	CAP, 1µF, X7S, 100V, 10%, 0805, SOFT TERM	AVX 08053C105KAT2A MURATA GRJ21BC72A105KE11
9	1	CC1	CAP, 2200pF, X7R, 25V, 10%, 0402	AVX 04023C222KAT2A
10	1	CC2	CAP, 2200pF, X7R, 16V, 10%, 0402	AVX 0402YC222KAT2A KEMET C0402C222K4RACTU MURATA GRM155R71C222KA01D
11	1	CGATE1	CAP, 4.7µF, X5R, 10V, 10%, 0402	TDK C1005X5R1A475K050BC
12	1	CIMON1	CAP, 3300pF, X7R, 16V, 10%, 0402	AVX 0402YC332KAT2A MURATA GRM15XR71C332KA86D
13	2	CP1, CP2	CAP, 220pF, NP0, 25V, 10%, 0402	AVX 04023A221KAT2A
14	1	CSN1	CAP, 1000pF, X7R, 16V, 10%, 0402	AVX 0402YC102KAT2A MURATA GRM155R71C102KA01D
15	1	CSS1	CAP, 0.1µF, X7R, 25V, 10%, 0402	AVX 04023C104KAT2A TAIYO YUDEN TMK105B7104KV-FR
16	1	CVDD1	CAP, 4.7µF, X5R, 10V, 10%, 0603	TDK CGB3B1X5R1A475K055AC
17	1	CXVCC1	CAP, 4.7µF, X5R, 16V, 20%, 0603	TDK C1608X5R1C475M080AC
18	2	DBST1, DBST2	DIODE, RECT, 400V, 1A, SOD123F, AEC-Q101	DIODES INC US1GWF-7
19	4	E1, E2, E9, E10	TEST POINT, TURRET, 0.094", MTG HOLE	MILL-MAX 2501-2-00-80-00-00-07-0
20	7	E3, E4, E6, E7, E8, E11, E12	TEST POINT, TURRET, 0.064", MTG HOLE	MILL-MAX 2308-2-00-80-00-00-07-0
21	2	FB1, FB2	IND, 600Ω AT 100MHz, FERRITE BEAD, 25%, 2.5A, 70mΩ, 1206	WURTH ELEKTRONIK 742792118
22	4	J1, J2, J3, J4	CONN, BANANA JACK, FEMALE, THT, NON-INSULATED, SWAGE	KEYSTONE 575-4
23	1	JP1	CONN, HDR, MALE, 2x3, 2mm, VERT, STR, THT	SAMTEC TMM-103-02-L-D
24	2	JP2, JP3	CONN, HDR, MALE, 2x2, 2mm, VERT, STR, THT, 10µ" Au	SAMTEC TMM-102-02-L-D
25	1	L1	IND, 4.2µH, PWR, 20%, 11A, 7.1mΩ, 1050	WURTH ELEKTRONIK 744325420
26	1	L2	IND, 1.5µH, PWR, 20%, 13A, 4.3mΩ, 7050	WURTH ELEKTRONIK 744314150
27	1	LB1	LABEL SPEC, DEMO BOARD SERIAL NUMBER	BRADY THT-96-717-10
28	3	MA1, MB1, MDG1	XSTR, MOSFET, N-CH, 100V, 40V, PG-TSDSON-8	INFINEON BSZ150N10LS3 G INFINEON BSZ150N10LS3GATMA1
29	2	MC1, MD1	XSTR, MOSFET, N-CH, 25V, 16A, PG-TSDSON-8	INFINEON BSZ036NE2LS INFINEON BSZ036NE2LSATMA1

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
30	4	MP1, MP2, MP3, MP4	STANDOFF, NYLON, SNAP-ON, 0.50"	KEYSTONE 8833
31	1	PCB1	PCB, DC2814A	PHASE 3 600-DC2814A
32	1	R1A1	RES, 69.8kΩ, 1%, 1/16W, 0402	VISHAY CRCW040269K8FKED
33	2	R1B1, R2B1	RES, 10kΩ, 1%, 1/16W, 0402, AEC-Q200	VISHAY CRCW040210K0FKED NIC NRC04F1002TRF
34	8	R1C1, R2C1, R12, R13, R33, R34, RBG1, RBG2	RES, 0Ω, 1/16W, 0402	ROHM MCR01MZPJ000 VISHAY CRCW04020000Z0ED NIC NRC04ZOTRF YAGEO RC0402JR-070RL
35	1	R2A1	RES, 150kΩ, 1%, 1/16W, 0402	VISHAY CRCW0402150KFKED
36	2	R23, R24	RES, 10Ω, 1%, 1/16W, 0402, AEC-Q200	NIC NRC04F10R0TRF VISHAY CRCW040210R0FKED
37	4	R35, RBST1, RBST2, ROUT1	RES, 1Ω, 1%, 1/16W, 0402	VISHAY CRCW04021R00FKED
38	1	RC1	RES, AEC-Q200, 38.3kΩ, 1%, 1/16W, 0402	VISHAY CRCW040238K3FKED
39	1	RC2	RES, 60.4kΩ, 1%, 1/16W, 0402	NIC NRC04F6042TRF VISHAY CRCW040260K4FKED
40	1	REN1	RES, 287kΩ, 1%, 1/16W, 0402, AEC-Q200	VISHAY CRCW0402287KFKED
41	1	REN2	RES, 165kΩ, 1%, 1/16W, 0402, AEC-Q200	VISHAY CRCW0402165KFKED
42	1	RIMON1	RES, 27.4kΩ, 1%, 1/16W, 0402, AEC-Q200	VISHAY CRCW040227K4FKED
43	1	RIN1	RES, 0Ω, 1/8W, 0805	VISHAY CRCW08050000Z0EA YAGEO RC0805JR-070RL
44	1	RPWGD1	RES, 100kΩ, 1%, 1/16W, 0402, AEC-Q200	NIC NRC04F1003TRF VISHAY CRCW0402100KFKED
45	1	RSNS1	RES, 0.004Ω, 1%, 1W, 1206, 4-TERM, SENSE, AEC-Q200	SUSUMU KRL3216T4-M-R004-F-T1
46	1	RSNS2	RES, 0.01Ω, 1%, 1W ,1206 , 4-TERM, SENSE, AEC-Q200	SUSUMU KRL3216T4-M-R010-F-T5
47	1	RT1	RES, 16.9kΩ, 1%, 1/10W, 0603, AEC-Q200	NIC NRC06F1692TRF PANASONIC ERJ3EKF1692V VISHAY CRCW060316K9FKEA
48	1	STNCL1	TOOL, STENCIL, 700-DC2814A	ANALOG DEVICES 830-DC2814A
49	1	U1	IC, 100V, BUCK-BOOST CONTROLLER, QFN-40 (6x6)	ANALOG DEVICES LT8210EUJ#PBF ANALOG DEVICES LT8210EUJ#TRPBF
50	3	XJP1, XJP2, XJP3	CONN, SHUNT, FEMALE, 2-POS, 2mm	SAMTEC 2SN-BK-G

SCHEMATIC DIAGRAM



Rev. 0

ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

ANALOG DEVICES

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