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

DESCRIPTION

Demonstration circuit 2814A-C is a high voltage, high efficiency synchronous buck-boost DC/DC converter with an input voltage range of 26V to 80V. It can supply a 2A maximum load current with an output range of 36V to 56V. 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 to –40V 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	UNITS
Input Voltage Range		26V to 80V Continuous
Output Voltage, V_{OUT}	V_{IN} = 26V to 80V, I_{OUT} = 0A to 2A	36V to 56V
Maximum Output Current, I_{OUT}	V_{IN} = 26V to 80V, V_{OUT} = 36V to 56V	2A
Default Operating Frequency		350kHz (R_T = 16.9k)
Typical Efficiency	28V_{IN}, 36V_{OUT} (Boost), 2A 36V_{IN}, 36V_{OUT} (Buck-Boost), 2A 45V_{IN}, 45V_{OUT} (Pass-Thru), 2A 60V_{IN}, 56V_{OUT} (Buck-Boost), 2A 72V_{IN}, 56V_{OUT} (Buck), 2A	96% 94% 99% 93% 96%

QUICK START PROCEDURE

Demonstration circuit 2814A-C 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} (26V to 80V) and GND (input return).
2. Connect the 36V to 56V 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 36V to 56V.
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.

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.

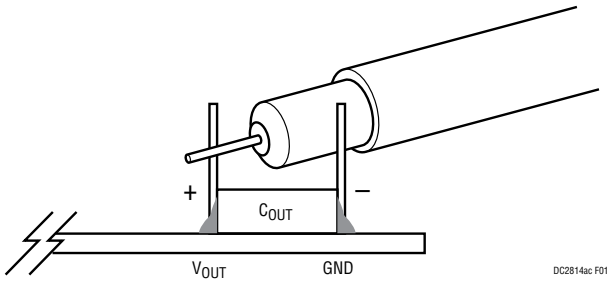


Figure 1. Measuring Output Voltage Ripple

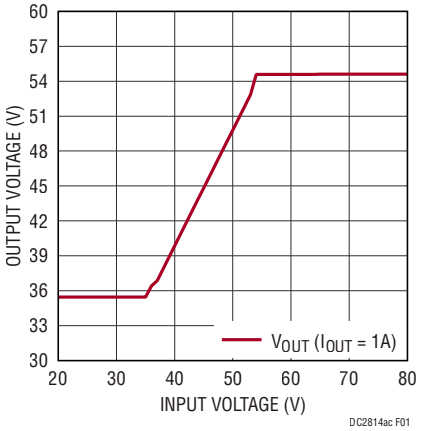


Figure 2. Output Voltage vs Input Voltage

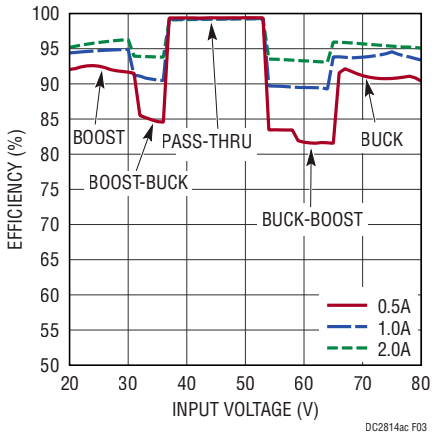


Figure 3. Efficiency vs Input Voltage

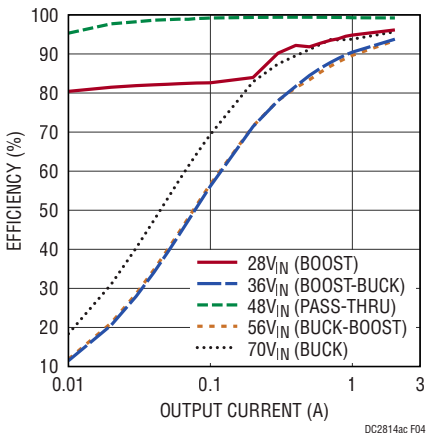


Figure 4. Efficiency vs Output Current

TEST RESULTS

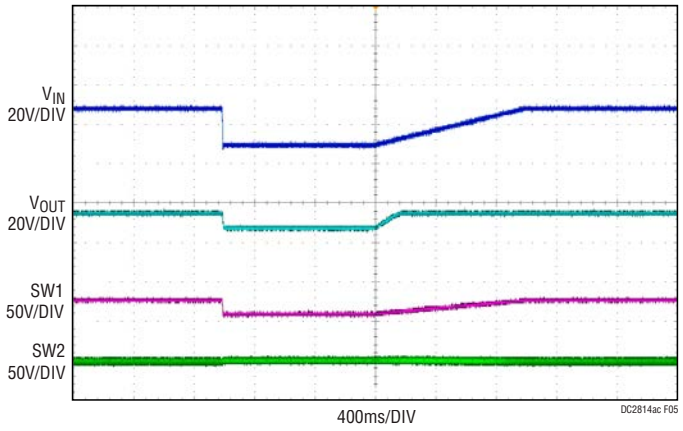


Figure 5. DO-160 – Engine Starting Undervoltage (Z) (I_{OUT} = 2A)

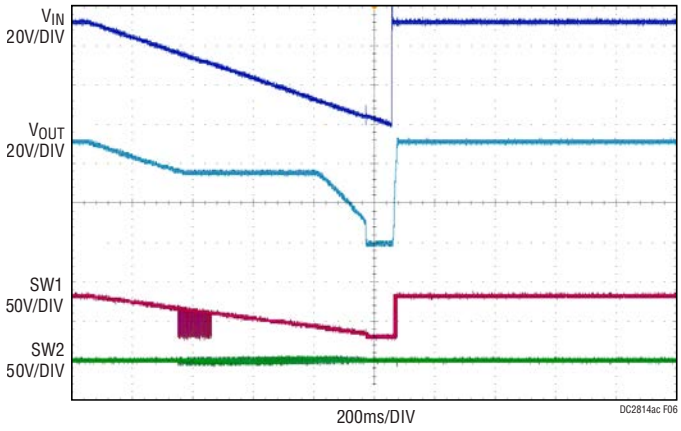


Figure 6. LV148 E48-07 – Slow Decrease, Fast Increase in Supply Voltage (I_{OUT} = 2A)

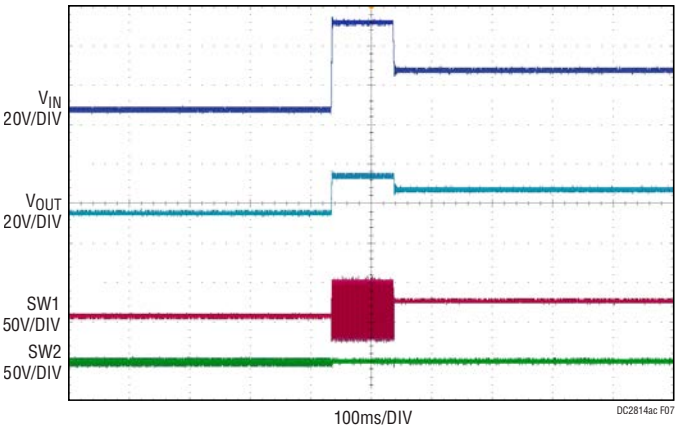


Figure 7. DO-160 Abnormal Surge Voltage (Z) (I_{OUT} = 2A)

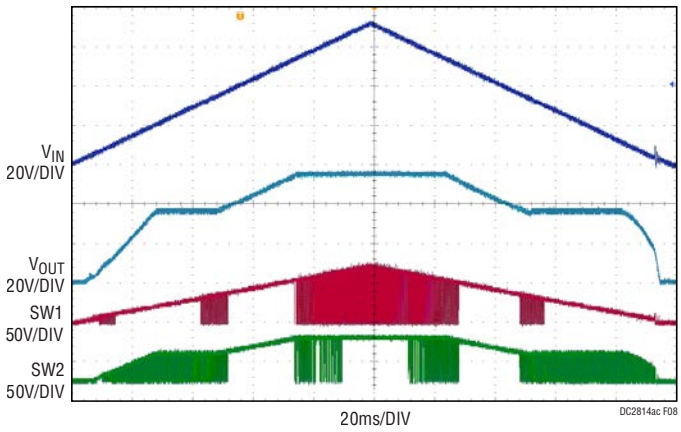


Figure 8. V_{IN} Range (I_{OUT} = 2A)

TEST RESULTS

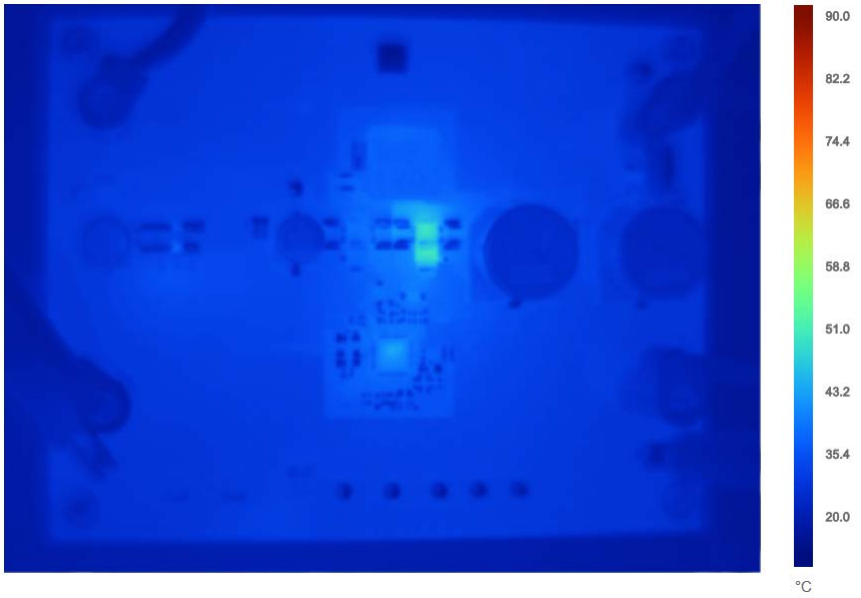


Figure 9. DC2814A-C Thermal Performance at $28V_{IN}$ (Boost), $36V_{OUT}$, 2A Load Current

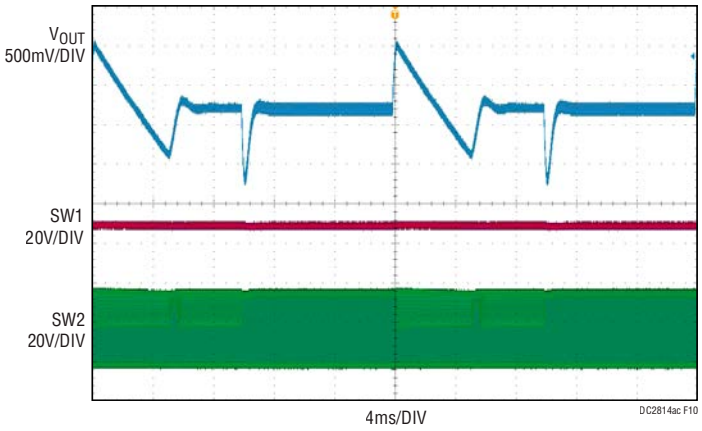


Figure 10. DC2814A-C Load Transients at $28V_{IN}$ (Boost), $36V_{OUT}$, 0.2A to 1.8A Load Current

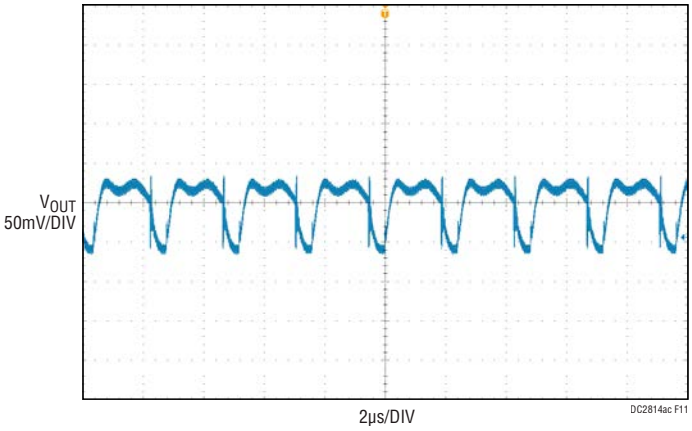


Figure 11. DC2814A-C Output Voltage Ripple at $28V_{IN}$ (Boost), $36V_{OUT}$, 2A Load Current

TEST RESULTS

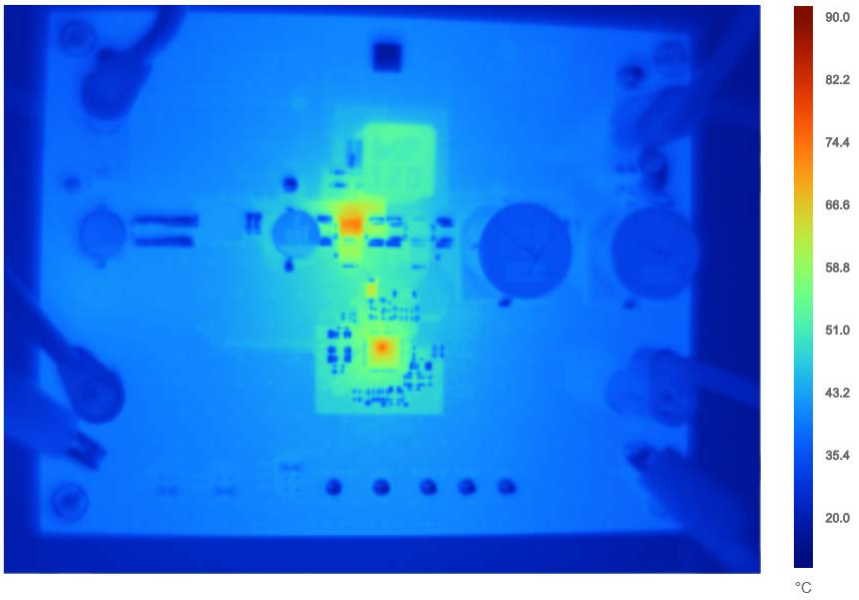


Figure 12. DC2814A-C Thermal Performance at $36V_{IN}$ (Buck-Boost), $36V_{OUT}$, 2A Load Current

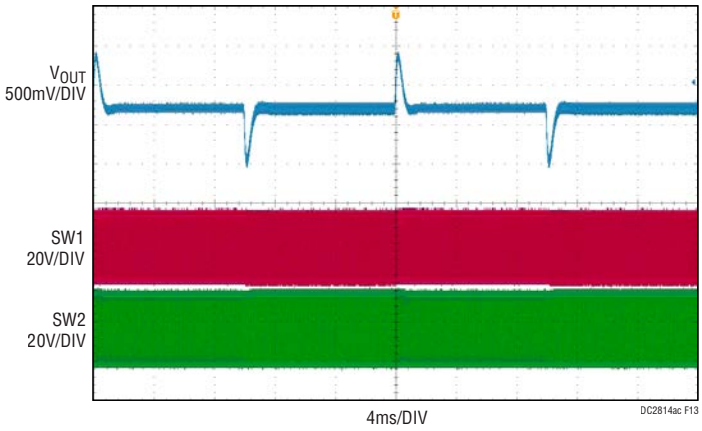


Figure 13. DC2814A-C Load Transients at $34V_{IN}$ (Buck-Boost), $34V_{OUT}$, 0.2A to 1.8A Load Current

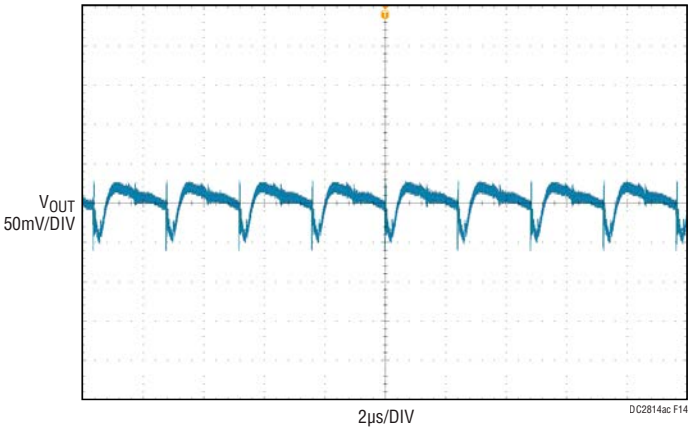


Figure 14. DC2814A-C Output Voltage Ripple at $36V_{IN}$ (Buck-Boost), $36V_{OUT}$, 2A Load Current

TEST RESULTS

Figure 15. DC2814A-C Thermal Performance at $45V_{IN}$ (Pass-Thru), $45V_{OUT}$, 2A Load Current

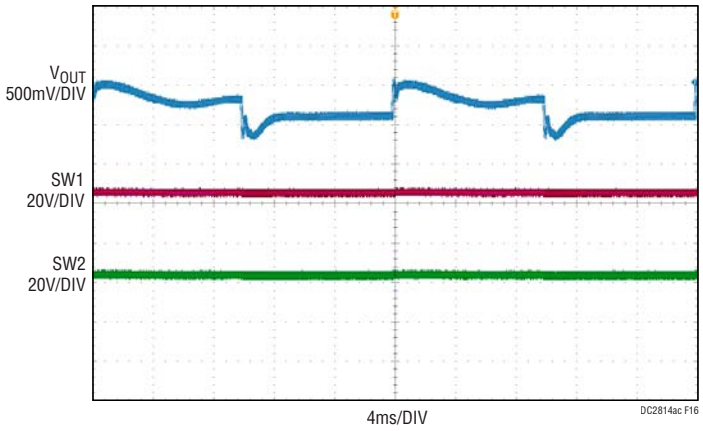


Figure 16. DC2814A-C Load Transients at $45V_{IN}$ (Pass-Thru), $45V_{OUT}$, 0.2A to 1.8A Load Current

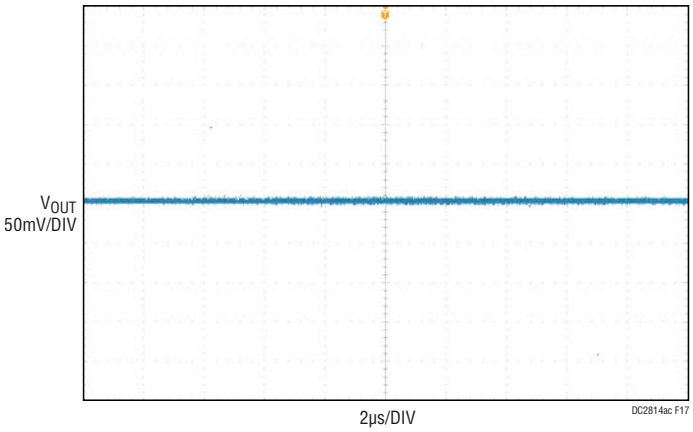


Figure 17. DC2814A-C Output Voltage Ripple at $45V_{IN}$ (Pass-Thru), $45V_{OUT}$, 2A Load Current

TEST RESULTS

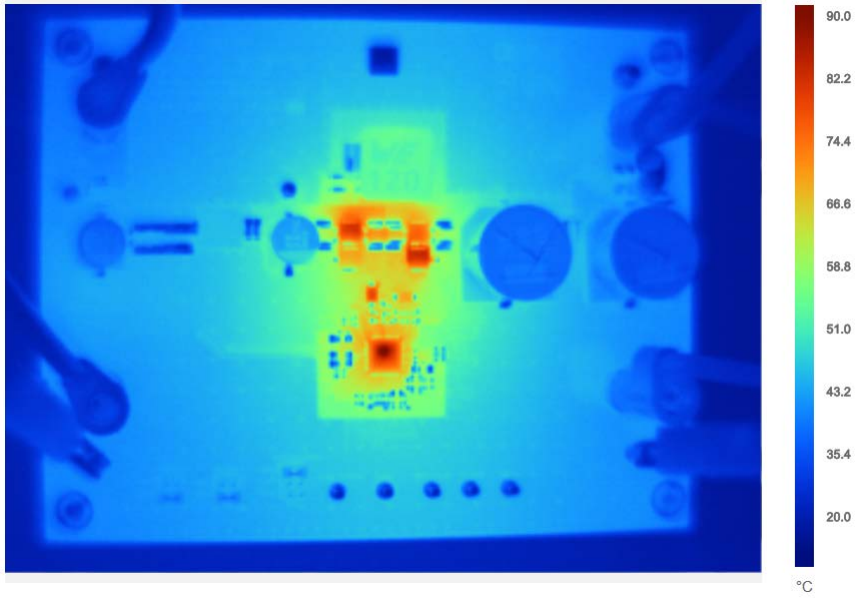


Figure 18. DC2814A-C Thermal Performance at $60V_{IN}$ (Buck-Boost), $56V_{OUT}$, 2A Load Current

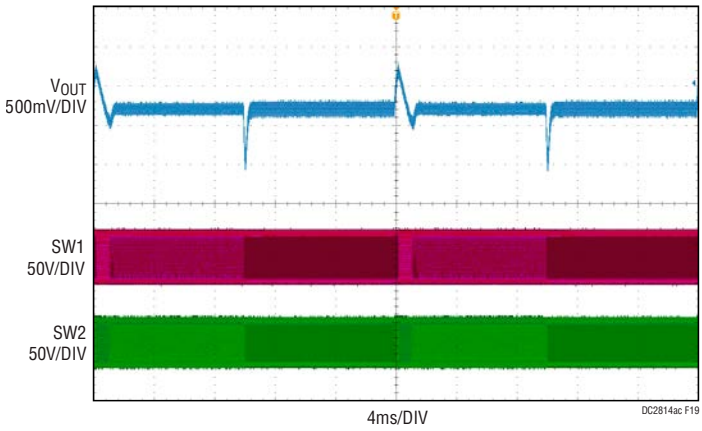


Figure 19. DC2814A-C Load Transients at $60V_{IN}$ (Buck-Boost), $56V_{OUT}$, 0.2A to 1.8A Load Current

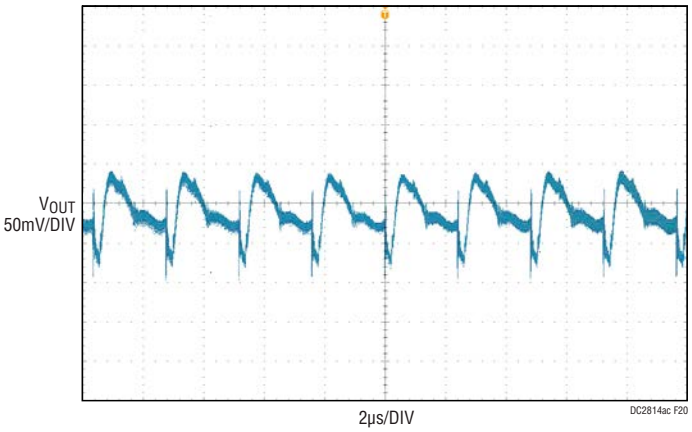


Figure 20. DC2814A-C Output Voltage Ripple at $60V_{IN}$ (Buck-Boost), $56V_{OUT}$, 2A Load Current

TEST RESULTS

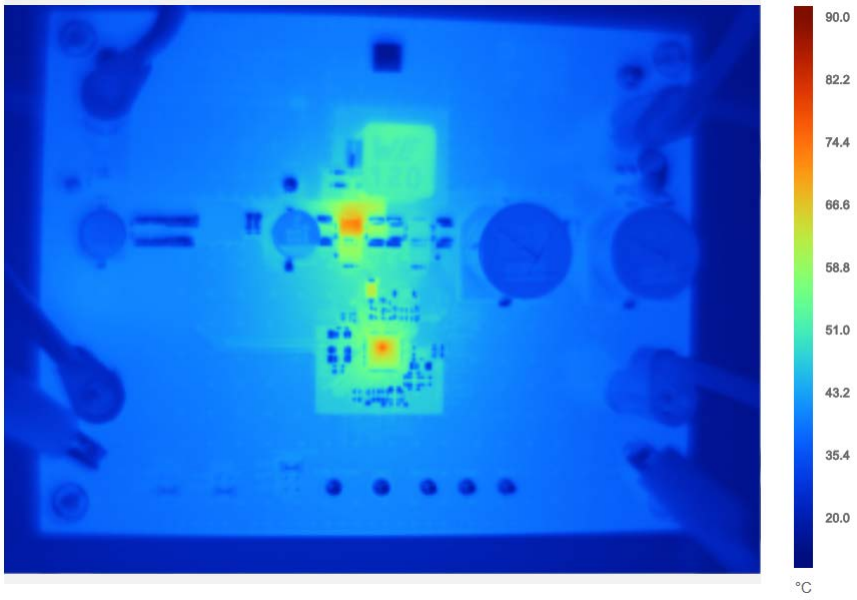


Figure 21. DC2814A-C Thermal Performance at $72V_{IN}$ (Buck), $56V_{OUT}$, 2A Load Current

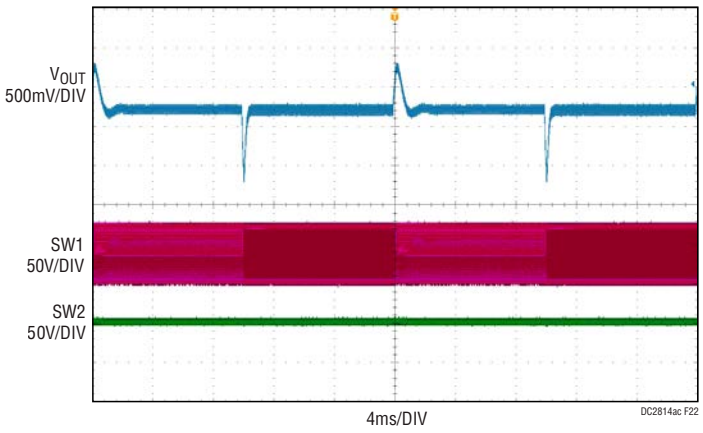


Figure 22. DC2814A-C Load Transients at $72V_{IN}$ (Buck), $56V_{OUT}$, 0.2A to 1.8A Load Current

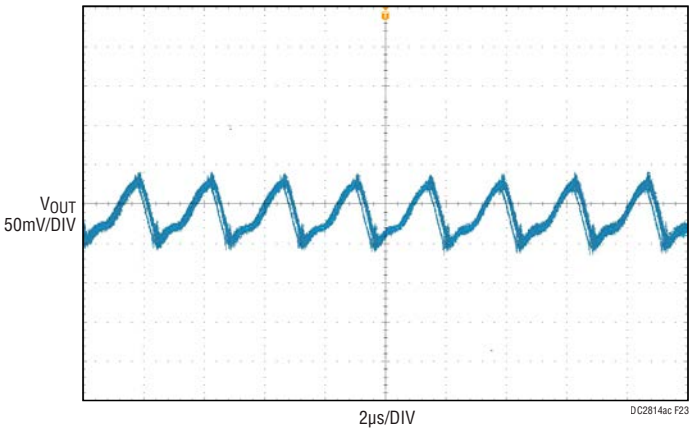


Figure 23. DC2814A-C Output Voltage Ripple at $72V_{IN}$ (Buck), $56V_{OUT}$, 2A Load Current

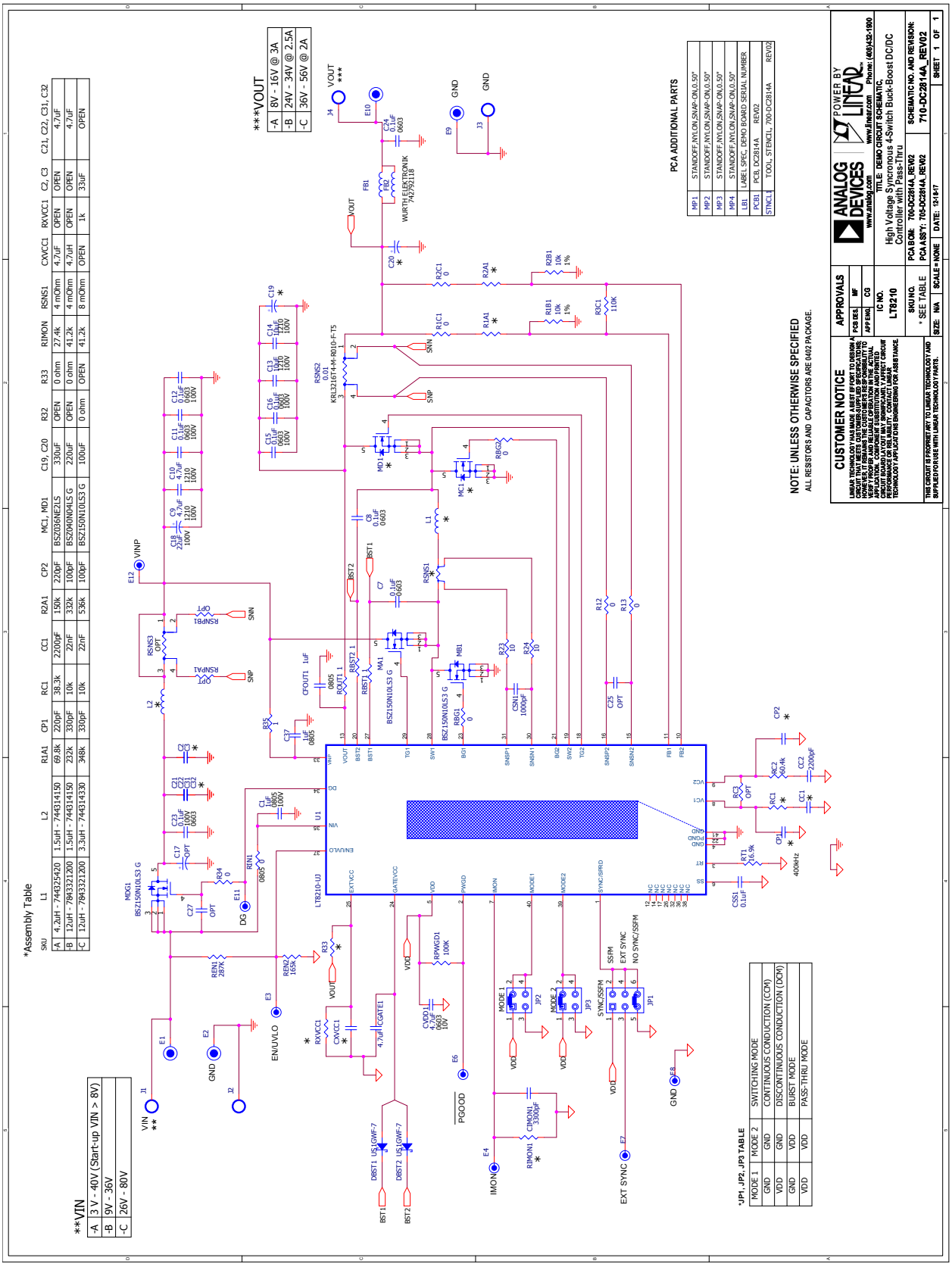
PARTS LIST

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	2	C2, C3	CAP, 33µF, X7S, 100V, 20%, 2220, AEC-Q200	TDK CAA572X7S2A336M
3	8	C7, C8, C11, C12, C15, C16, C23, C24	CAP, 0.1µF, X7S, 100V, 10%, 0603	TAIYO YUDEN HMK107C7104KA-T TDK C1608X7S2A104K080AB
4	2	C9, C10	CAP, 4.7µF, X7S, 100V, 20%, 1210	TDK C3225X7S2A475M200AB
5	2	C13, C14	CAP, 10µF, X7S, 100V, 10%, 1210	MURATA GRM32EC72A106KE05L
6	1	C18	CAP, 22µF, ALUM ELECT, 100V, 20%, 8x10.2mm SMD, AEC-Q200	PANASONIC EEETG2A220UP
7	2	C19, C20	CAP, 100µF, ALUM ELECT, 100V, 10%, 16x16.5mm SMD	SUN ELECTRONIC INDUSTRIES CORP 100CE100KXT+D
8	1	C37	CAP, 1µF, X7S, 100V, 10%, 0805 , SOFT TERM	AVX 08053C105KAT2A MURATA GRJ21BC72A105KE11
9	1	CC1	CAP, 0.022µF, X7R, 16V, 10%, 0402	AVX 0402YC223KAT2A MURATA GRM155R71C223KA01D
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	1	CP1	CAP, 330pF, X7R, 50V, 10%, 0402	AVX 04025C331KAT2A KEMET C0402C331K5RACTU NIC NMC0402X7R331K50TRPF
14	1	CP2	CAP, 100pF, C0G, 50V, 5%, 0402	AVX 04025A01JAT2A MURATA GRM1555C1H101JA01D
15	1	CSN1	CAP, 1000pF, X7R, 16V, 10%, 0402	AVX 0402YC102KAT2A MURATA GRM155R71C102KA01D
16	1	CSS1	CAP, 0.1µF, X7R, 25V, 10%, 0402	AVX 04023C104KAT2A TAIYO YUDEN TMK105B7104KV-FR
17	1	CVDD1	CAP, 4.7µF, X5R, 10V, 10%, 0603	TDK CGB3B1X5R1A475K055AC
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, 12µH, POWER, 20%, 7.1A, 21.5mΩ, 1212, AEC-Q200	WURTH ELEKTRONIK 7843321200
26	1	L2	IND, 3.3µH, PWR, 20%, 9A, 9mΩ, 7050	WURTH ELEKTRONIK 744314330
27	1	LB1	LABEL SPEC, DEMO BOARD SERIAL NUMBER	BRADY THT-96-717-10

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
28	5	MA1, MB1, MC1, MD1, MDG1	XSTR, MOSFET, N-CH, 100V, 40V, PG-TSDSON-8	INFINEON BSZ150N10LS3 G INFINEON BSZ150N10LS3GATMA1
29	4	MP1, MP2, MP3, MP4	STANDOFF, NYLON, SNAP-ON, 0.50"	KEYSTONE 8833
30	1	PCB1	PCB, DC2814A	PHASE 3 600-DC2814A
31	1	R1A1	RES, 348kΩ, 1%, 1/16W, 0402	KOA SPEER RK73H1ETTP3483F VISHAY CRCW0402348KFKED YAGEO RC0402FR-07348KL
32	3	R1B1, R2B1, RC1	RES, 10kΩ, 1%, 1/16W, 0402	VISHAY CRCW040210K0FKED NIC NRC04F1002TRF
33	7	R1C1, R2C1, R12, R13, R34, RBG1, RBG2	RES, 0Ω, 1/16W, 0402	ROHM MCR01MZPJ000 VISHAY CRCW04020000Z0ED NIC NRC04Z0TRF YAGEO RC0402JR-070RL
34	1	R2A1	RES, 536kΩ, 1%, 1/16W, 0402	VISHAY CRCW0402536KFKED
35	2	R23, R24	RES, 10Ω, 1%, 1/16W, 0402, AEC-Q200	NIC NRC04F10R0TRF VISHAY CRCW040210R0FKED
36	4	R35, RBST1, RBST2, ROUT1	RES, 1Ω, 1%, 1/16W, 0402	VISHAY CRCW04021R00FKED
37	1	RC2	RES, 60.4kΩ, 1%, 1/16W, 0402	NIC NRC04F6042TRF VISHAY CRCW040260K4FKED
38	1	REN1	RES, 287kΩ, 1%, 1/16W, 0402, AEC-Q200	VISHAY CRCW0402287KFKED
39	1	REN2	RES, 165kΩ, 1%,1 /16W, 0402, AEC-Q200	VISHAY CRCW0402165KFKED
40	1	RIMON1	RES, 41.2kΩ, 1%, 1/16W, 0402, AEC-Q200	VISHAY CRCW040241K2FKED
41	1	RIN1	RES, 0Ω, 1/8W ,0805	VISHAY CRCW08050000Z0EA YAGEO RC0805JR-070RL
42	1	RPWGD1	RES, 100kΩ, 1%, 1/16W, 0402, AEC-Q200	NIC NRC04F1003TRF VISHAY CRCW0402100KFKED
43	1	RSNS1	RES, 0.008Ω, 1%, 1W, 1206, 4-TERM, SENSE, AEC-Q200	SUSUMU KRL3216T4-M-R008-F-T5
44	1	RSNS2	RES, 0.01Ω, 1%, 1W, 1206, 4-TERM, SENSE, AEC-Q200	SUSUMU KRL3216T4-M-R010-F-T5
45	1	RT1	RES, 16.9kΩ, 1%, 1/10W, 0603, AEC-Q200	NIC NRC06F1692TRF PANASONIC ERJ3EKF1692V VISHAY CRCW060316K9FKEA
46	1	RXVCC1	RES, 1kΩ, 1%, 1/10W, 0603, AEC-Q200	VISHAY CRCW06031K00FKEA NIC NRC06F1001TRF PANASONIC ERJ3EKF1001V
47	1	STNCL1	TOOL, STENCIL, 700-DC2814A	ANALOG DEVICES 830-DC2814A
48	1	U1	IC, 100V, BUCK-BOOST CONTROLLER, QFN-40 (6x6)	ANALOG DEVICES LT8210EUJ#PBF ANALOG DEVICES LT8210EUJ#TRPBF
49	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.