

LTC8210

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

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 LTC8210 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-through. Pass-through 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-through 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.](#)

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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-Through), 2A 60V _{IN} , 56V _{OUT} (Buck-Boost), 2A 72V _{IN} , 56V _{OUT} (Buck), 2A | 96% 94% 99% 93% 96% |

DEMO MANUAL DC2814A-C

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.

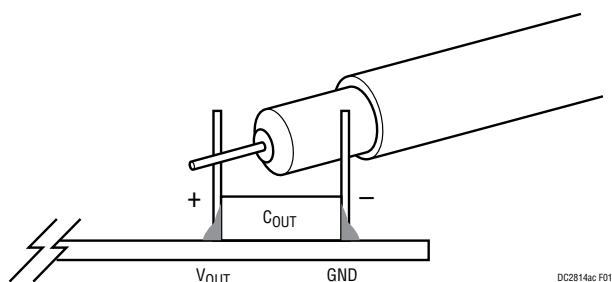


Figure 1. Measuring Output Voltage Ripple

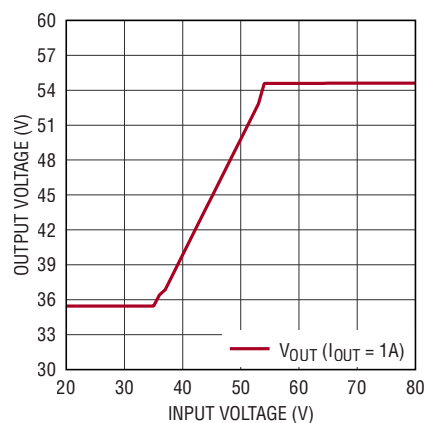


Figure 2. Output Voltage vs Input Voltage

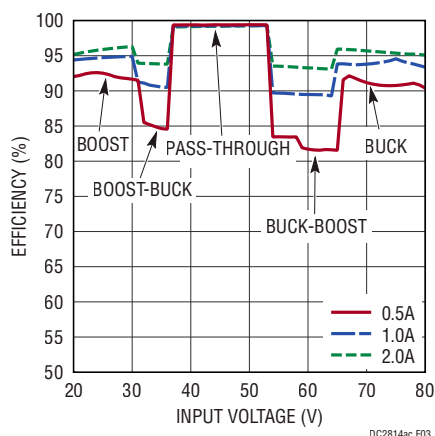


Figure 3. Efficiency vs Input Voltage

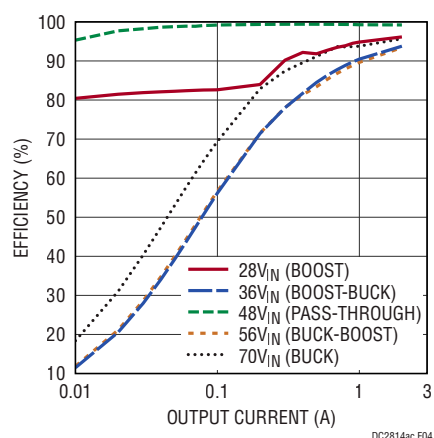


Figure 4. Efficiency vs Output Current

TEST RESULTS

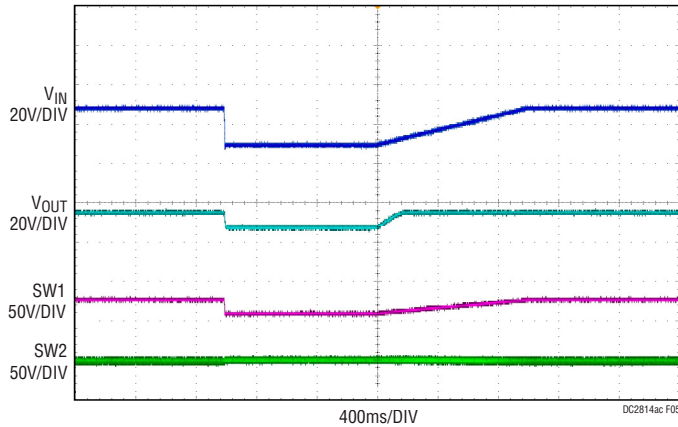


Figure 5. DO-160 – Engine Starting Undervoltage (Z) ($I_{OUT} = 2A$)

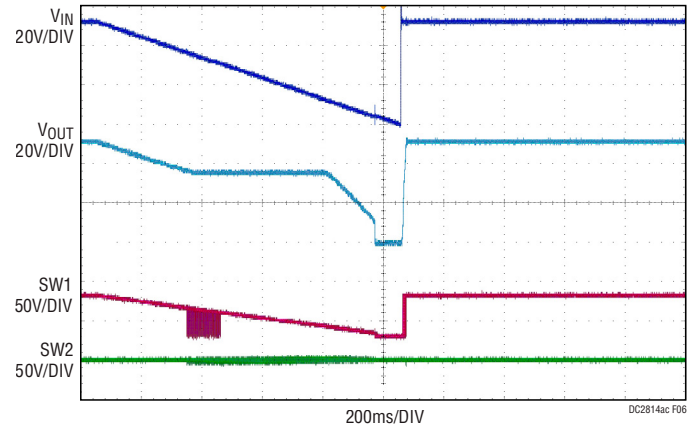


Figure 6. LV148 E48-07 – Slow Decrease, Fast Increase in Supply Voltage ($I_{OUT} = 2A$)

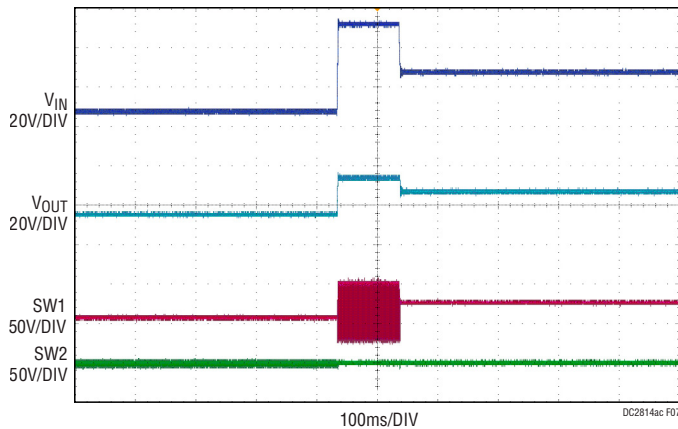


Figure 7. DO-160 Abnormal Surge Voltage (Z) ($I_{OUT} = 2A$)

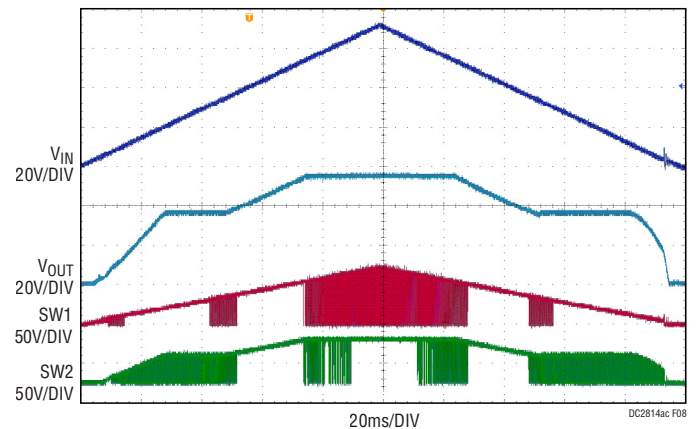


Figure 8. V_{IN} Range ($I_{OUT} = 2A$)

TEST RESULTS

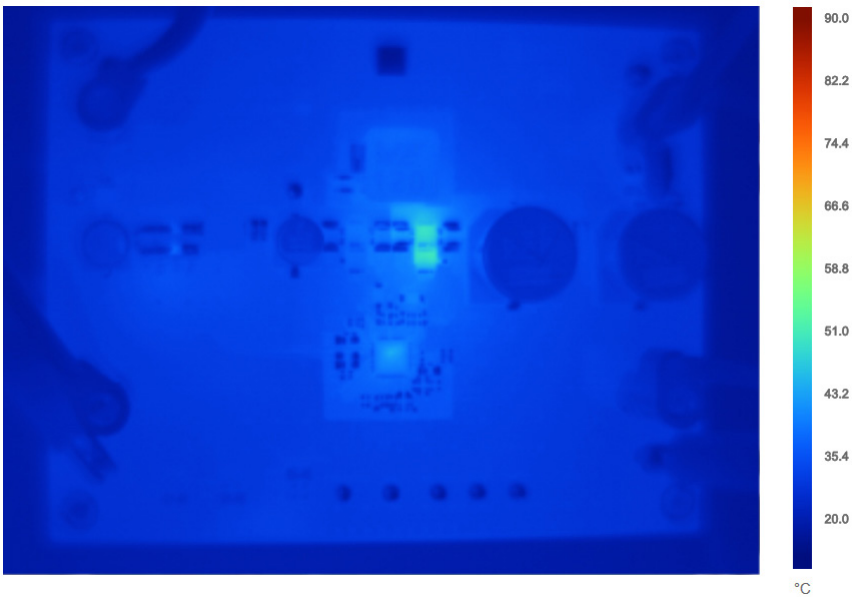


Figure 9. DC2814A-C Thermal Performance at 28V_{IN} (Boost), 36V_{OUT}, 2A Load Current

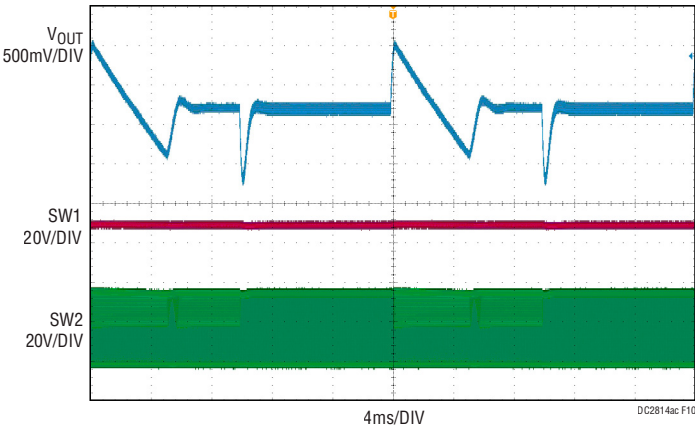


Figure 10. DC2814A-C Load Transients at 28V_{IN} (Boost), 36V_{OUT}, 0.2A to 1.8A Load Current

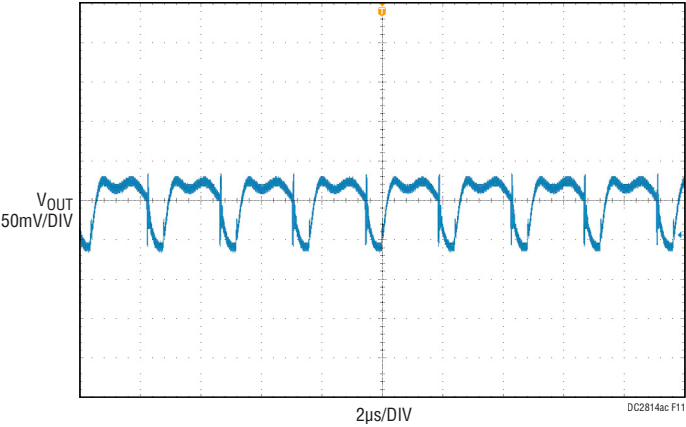


Figure 11. DC2814A-C Output Voltage Ripple at 28V_{IN} (Boost), 36V_{OUT}, 2A Load Current

TEST RESULTS

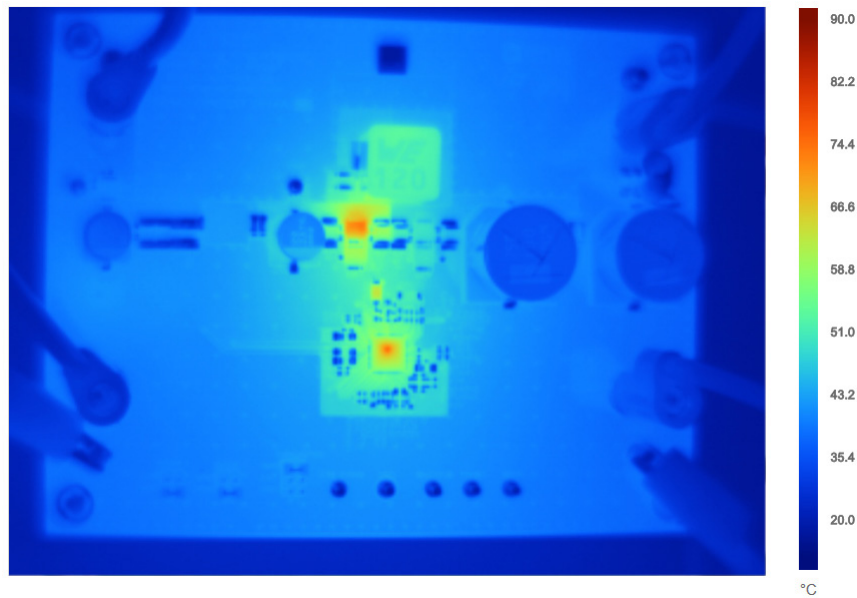


Figure 12. DC2814A-C Thermal Performance at 36V_{IN} (Buck-Boost), 36V_{OUT}, 2A Load Current

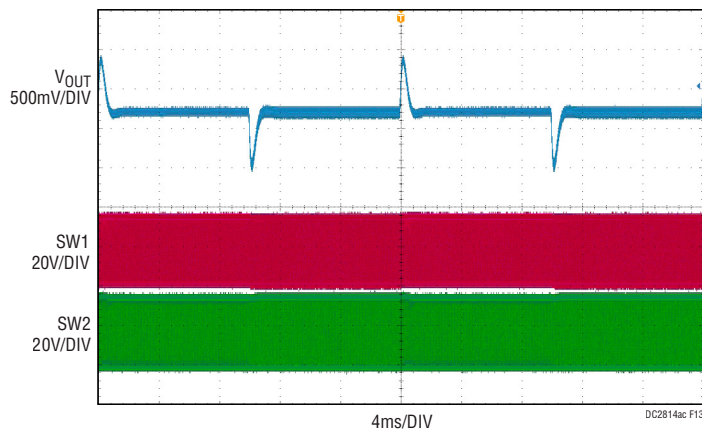


Figure 13. DC2814A-C Load Transients at 34V_{IN} (Buck-Boost), 34V_{OUT}, 0.2A to 1.8A Load Current

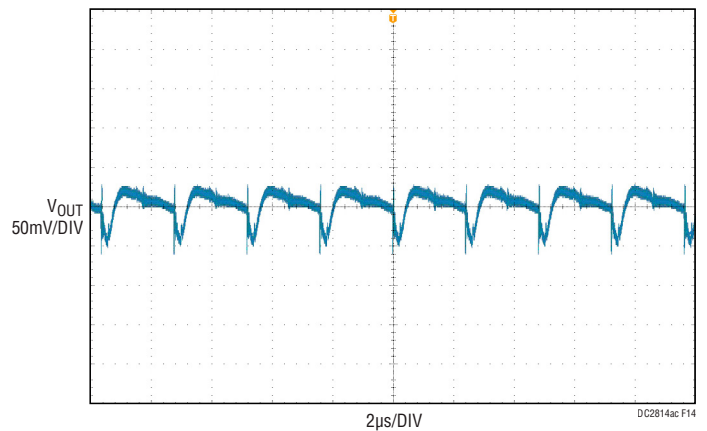


Figure 14. DC2814A-C Output Voltage Ripple at 36V_{IN} (Buck-Boost), 36V_{OUT}, 2A Load Current

TEST RESULTS

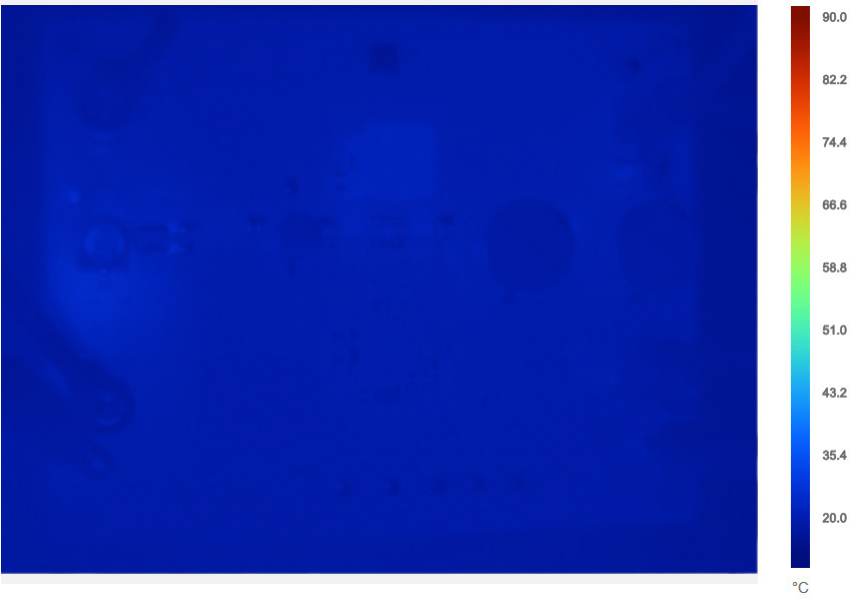


Figure 15. DC2814A-C Thermal Performance at 45V_{IN} (Pass-Through), 45V_{OUT}, 2A Load Current

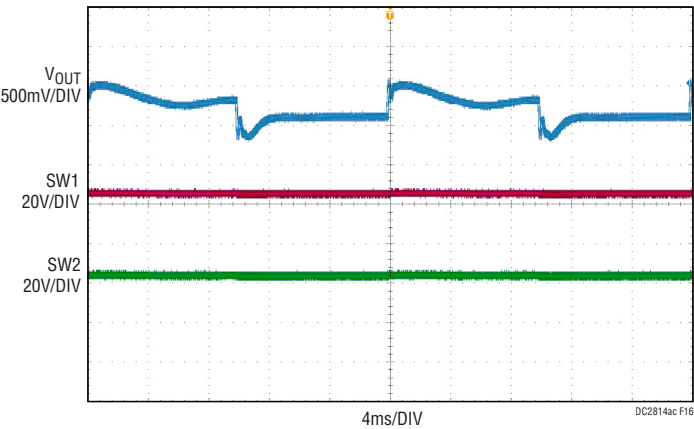


Figure 16. DC2814A-C Load Transients at 45V_{IN} (Pass-Through), 45V_{OUT}, 0.2A to 1.8A Load Current

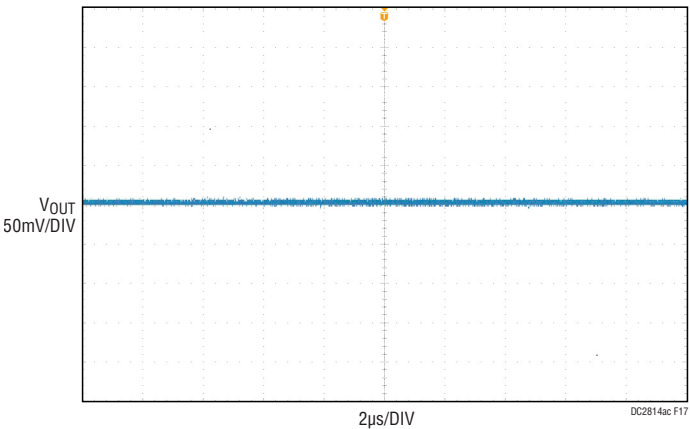


Figure 17. DC2814A-C Output Voltage Ripple at 45V_{IN} (Pass-Through), 45V_{OUT}, 2A Load Current

TEST RESULTS

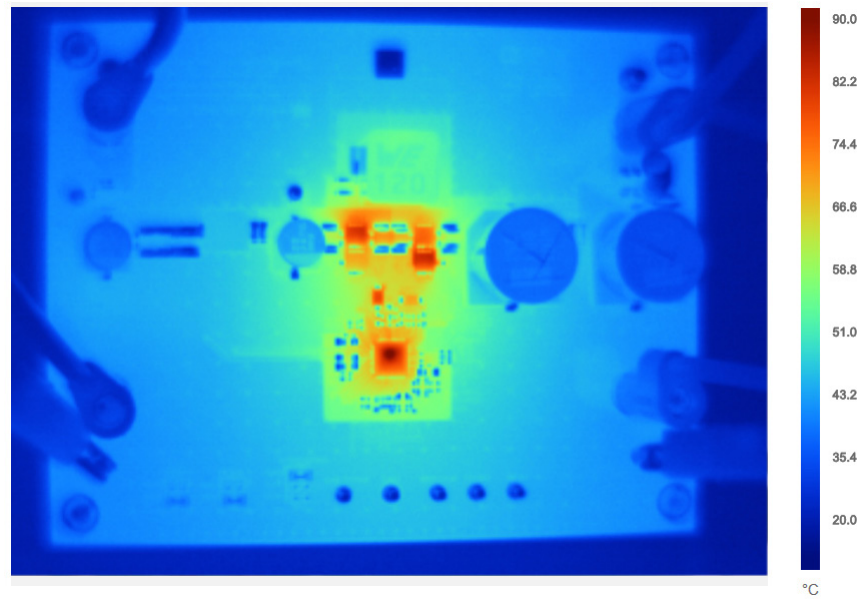


Figure 18. DC2814A-C Thermal Performance at 60V_{IN} (Buck-Boost), 56V_{OUT}, 2A Load Current

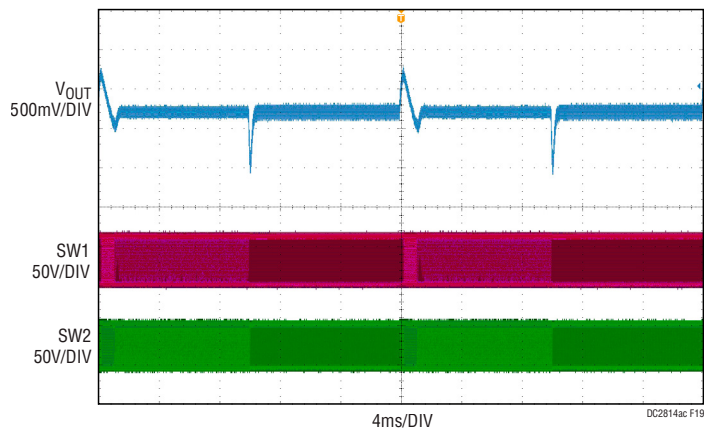


Figure 19. DC2814A-C Load Transients at 60V_{IN} (Buck-Boost), 56V_{OUT}, 0.2A to 1.8A Load Current

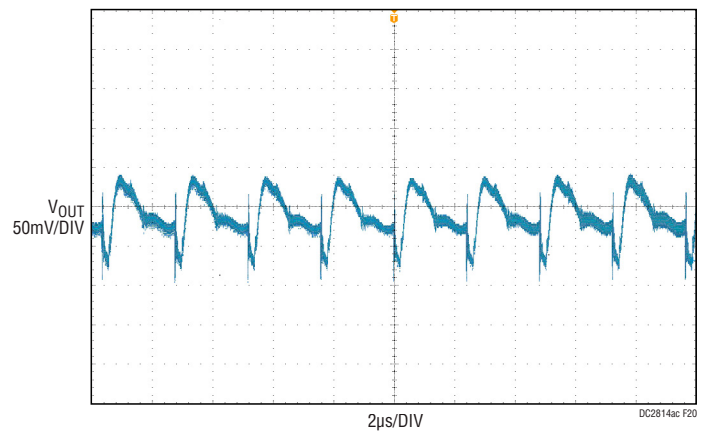


Figure 20. DC2814A-C Output Voltage Ripple at 60V_{IN} (Buck-Boost), 56V_{OUT}, 2A Load Current

TEST RESULTS

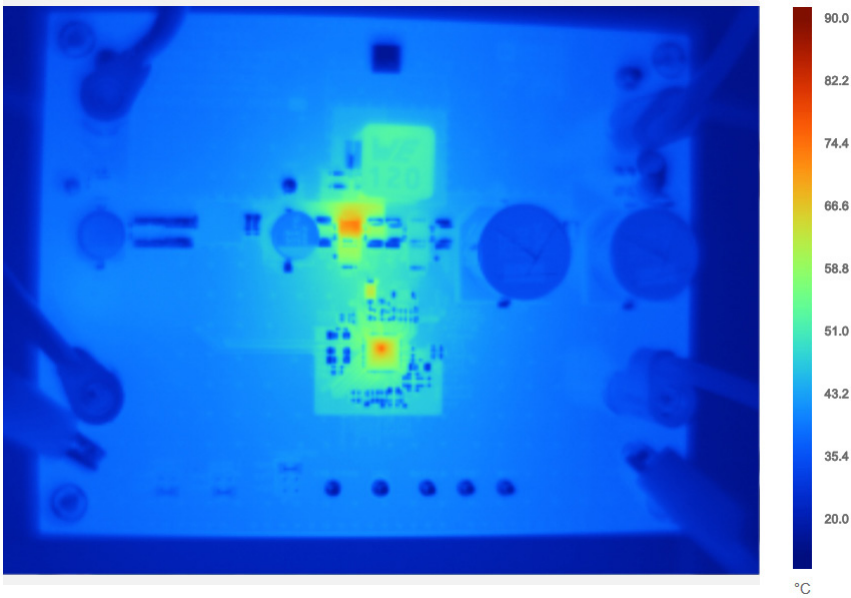


Figure 21. DC2814A-C Thermal Performance at 72V_{IN} (Buck), 56V_{OUT}, 2A Load Current

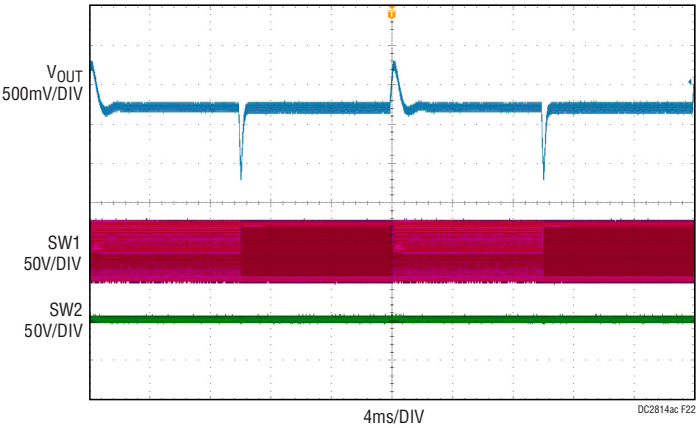


Figure 22. DC2814A-C Load Transients at 72V_{IN} (Buck), 56V_{OUT}, 0.2A to 1.8A Load Current

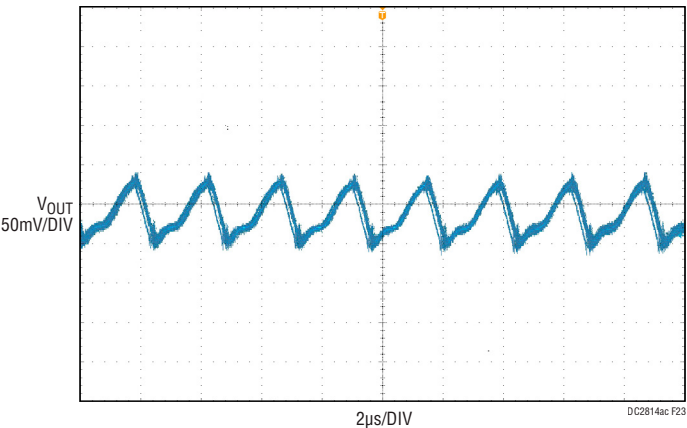


Figure 23. DC2814A-C Output Voltage Ripple at 72V_{IN} (Buck), 56V_{OUT}, 2A Load Current

PARTS LIST

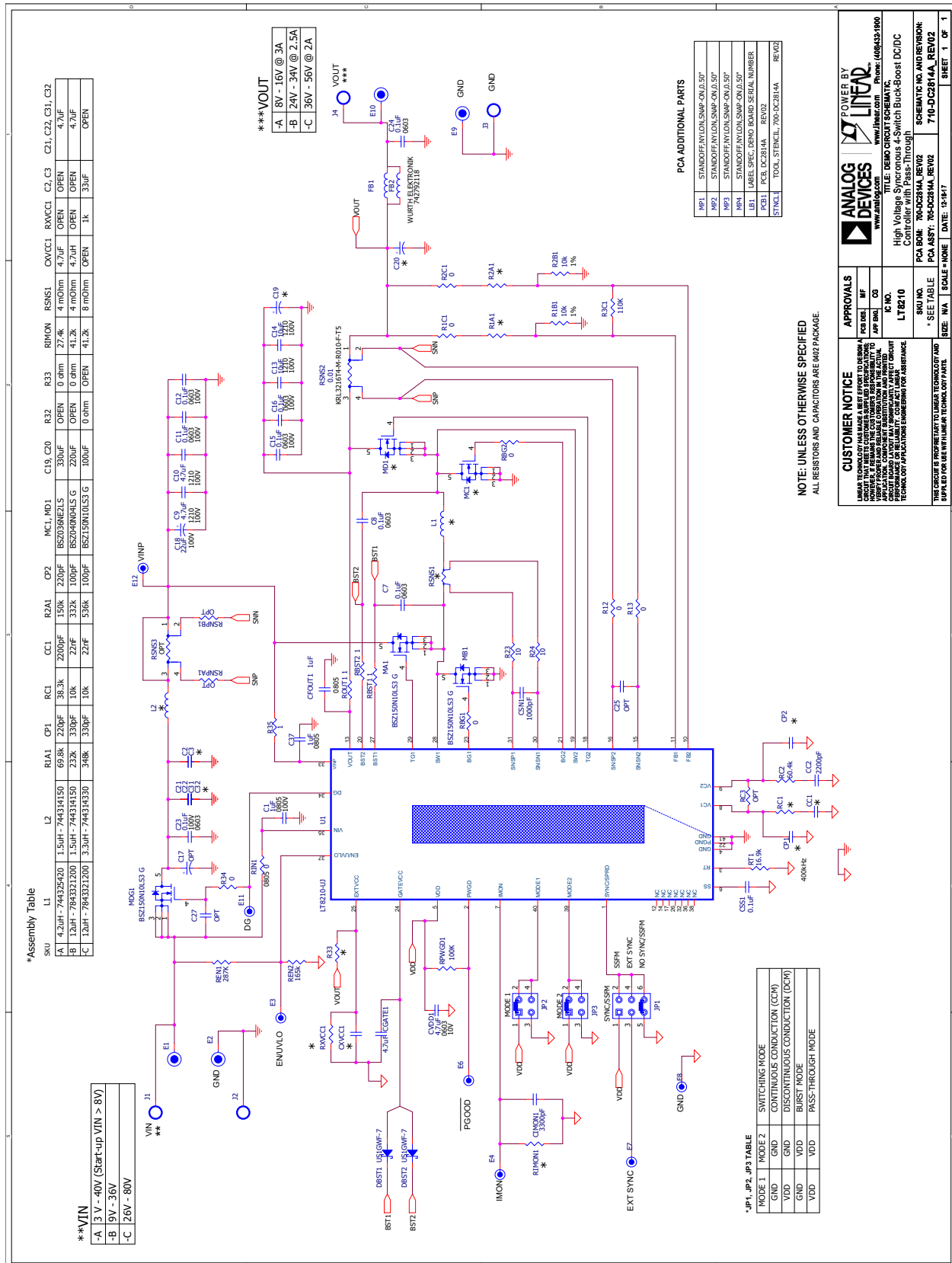
| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|------------------------------------|-----|--------------------------------------|---|---|
| Required Circuit Components | | | | |
| 1 | 2 | C1, CFOUT1 | CAP, 1 μ F, X7S, 100V, 10%, 0805, SOFT TERM | MURATA GRJ21BC72A105KE11L TDK C2012X7S2A105K125AE |
| 2 | 2 | C2, C3 | CAP, 33 μ F, X7S, 100V, 20%, 2220, AEC-Q200 | TDK CAA572X7S2A336M |
| 3 | 8 | C7, C8, C11, C12, C15, C16, C23, C24 | CAP, 0.1 μ F, X7S, 100V, 10%, 0603 | TAIYO YUDEN HMK107C7104KA-T TDK C1608X7S2A104K080AB |
| 4 | 2 | C9, C10 | CAP, 4.7 μ F, X7S, 100V, 20%, 1210 | TDK C3225X7S2A475M200AB |
| 5 | 2 | C13, C14 | CAP, 10 μ F, X7S, 100V, 10%, 1210 | MURATA GRM32EC72A106KE05L |
| 6 | 1 | C18 | CAP, 22 μ F, ALUM ELECT, 100V, 20%, 8x10.2mm SMD, AEC-Q200 | PANASONIC EEETG2A220UP |
| 7 | 2 | C19, C20 | CAP, 100 μ F, ALUM ELECT, 100V, 10%, 16x16.5mm SMD | SUN ELECTRONIC INDUSTRIES CORP 100CE100KXT+D |
| 8 | 1 | C37 | CAP, 1 μ F, X7S, 100V, 10%, 0805, SOFT TERM | AVX 08053C105KAT2A MURATA GRJ21BC72A105KE11 |
| 9 | 1 | CC1 | CAP, 0.022 μ F, 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, 4.7 μ F, 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, 0.1 μ F, X7R, 25V, 10%, 0402 | AVX 04023C104KAT2A TAIYO YUDEN TMK105B7104KV-FR |
| 17 | 1 | CVDD1 | CAP, 4.7 μ F, X5R, 10V, 10%, 0603 | TDK CGB3B1X5R1A475K055AC |
| 18 | 2 | DBST1, DBST2 | DIODE, RECT, 400V, 1A, SOD123F, AEC-Q101 | DIODES INC US1GW7-7 |
| 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, 600 Ω AT 100MHZ, FERRITE BEAD, 25%, 2.5A, 70m Ω , 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, 10 μ " Au | SAMTEC TMM-102-02-L-D |
| 25 | 1 | L1 | IND, 12 μ H, POWER, 20%, 7.1A, 21.5m Ω , 1212, AEC-Q200 | WURTH ELEKTRONIK 7843321200 |
| 26 | 1 | L2 | IND, 3.3 μ H, PWR, 20%, 9A, 9m Ω , 7050 | WURTH ELEKTRONIK 744314330 |
| 27 | 1 | LB1 | LABEL SPEC, DEMO BOARD SERIAL NUMBER | BRADY THT-96-717-10 |

DEMO MANUAL DC2814A-C

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, 348k Ω , 1%, 1/16W, 0402 | KOA SPEER RK73H1ETTP3483F VISHAY CRCW0402348KFKED YAGEO RC0402FR-07348KL |
| 32 | 3 | R1B1, R2B1, RC1 | RES, 10k Ω , 1%, 1/16W, 0402 | VISHAY CRCW040210K0FKED NIC NRC04F1002TRF |
| 33 | 7 | R1C1, R2C1, R12, R13, R34, RBG1, RBG2 | RES, 0 Ω , 1/16W, 0402 | ROHM MCR01MZPJ000 VISHAY CRCW04020000Z0ED NIC NRC04Z0TRF YAGEO RC0402JR-070RL |
| 34 | 1 | R2A1 | RES, 536k Ω , 1%, 1/16W, 0402 | VISHAY CRCW0402536KFKED |
| 35 | 2 | R23, R24 | RES, 10 Ω , 1%, 1/16W, 0402, AEC-Q200 | NIC NRC04F10R0TRF VISHAY CRCW040210R0FKED |
| 36 | 4 | R35, RBST1, RBST2, ROUT1 | RES, 1 Ω , 1%, 1/16W, 0402 | VISHAY CRCW04021R00FKED |
| 37 | 1 | RC2 | RES, 60.4k Ω , 1%, 1/16W, 0402 | NIC NRC04F6042TRF VISHAY CRCW040260K4FKED |
| 38 | 1 | REN1 | RES, 287k Ω , 1%, 1/16W, 0402, AEC-Q200 | VISHAY CRCW0402287KFKED |
| 39 | 1 | REN2 | RES, 165k Ω , 1%, 1/16W, 0402, AEC-Q200 | VISHAY CRCW0402165KFKED |
| 40 | 1 | RIMON1 | RES, 41.2k Ω , 1%, 1/16W, 0402, AEC-Q200 | VISHAY CRCW040241K2FKED |
| 41 | 1 | RIN1 | RES, 0 Ω , 1/8W, 0805 | VISHAY CRCW08050000Z0EA YAGEO RC0805JR-070RL |
| 42 | 1 | RPWGD1 | RES, 100k Ω , 1%, 1/16W, 0402, AEC-Q200 | NIC NRC04F1003TRF VISHAY CRCW0402100KFKED |
| 43 | 1 | RSNS1 | RES, 0.008 Ω , 1%, 1W, 1206, 4-TERM, SENSE, AEC-Q200 | SUSUMU KRL3216T4-M-R008-F-T5 |
| 44 | 1 | RSNS2 | RES, 0.01 Ω , 1%, 1W, 1206, 4-TERM, SENSE, AEC-Q200 | SUSUMU KRL3216T4-M-R010-F-T5 |
| 45 | 1 | RT1 | RES, 16.9k Ω , 1%, 1/10W, 0603, AEC-Q200 | NIC NRC06F1692TRF PANASONIC ERJ3EKF1692V VISHAY CRCW060316K9FKEA |
| 46 | 1 | RXVCC1 | RES, 1k Ω , 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



**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.

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