LTC7871/LTC7060
High Power PolyPhase® Bidirectional Supply/Charger

DESCRIPTION

Demonstration circuit 2886A is a high power, high efficiency six-phase bidirectional converter featuring the LTC®7871 and LTC7060. The terminals labeled V_{HIGH} and V_{LOW} are either inputs or outputs depending on the direction of power flow. When the switch at SW1 is in the BUCK position, V_{LOW} provides a 14V output and V_{HIGH} is the input with a range of 30V to 70V. When the switch is in the BOOST position, V_{HIGH} provides a 48V output and V_{LOW} is the input with a range of 10V to 14V. The maximum V_{LOW} current is 180A in both directions. The maximum output power is 2.5kW when operating as a buck within the input voltage range. When operating as a boost, the maximum output power is 2.4kW when the input voltage is 14V. External airflow is required when operating at maximum power. The MOSFETs in each phase are driven by the LTC7060 half bridge driver. Each LTC7060 gate driver is placed next to the MOSFETs and receives a PWM signal from the LTC7871.

The inductor current for each phase is sensed with a low 1mΩ sense resistor using a highly accurate AC/DC current sensing architecture with low power dissipation. The LTC7871's constant-current loop provides a DC current limit for the current flowing in or out of the V_{LOW} terminal depending on the state of the BUCK pin. This current can be programmed with the SETCUR pin and monitored with the IMON pin.

The DC2886A provides a SPI compatible serial port. With a DC2026C (Linduino® One) demo board and QuikEval™ software on a host computer, the user can:

- Margin the regulated V_{LOW} or V_{HIGH} up or down.
- Margin the DC current limit up or down with the SETCUR pin.
- Adjust the frequency spread and modulation rate of the spread spectrum circuit, when spread spectrum is enabled.
- Monitor the operational status and faults of the LTC7871.

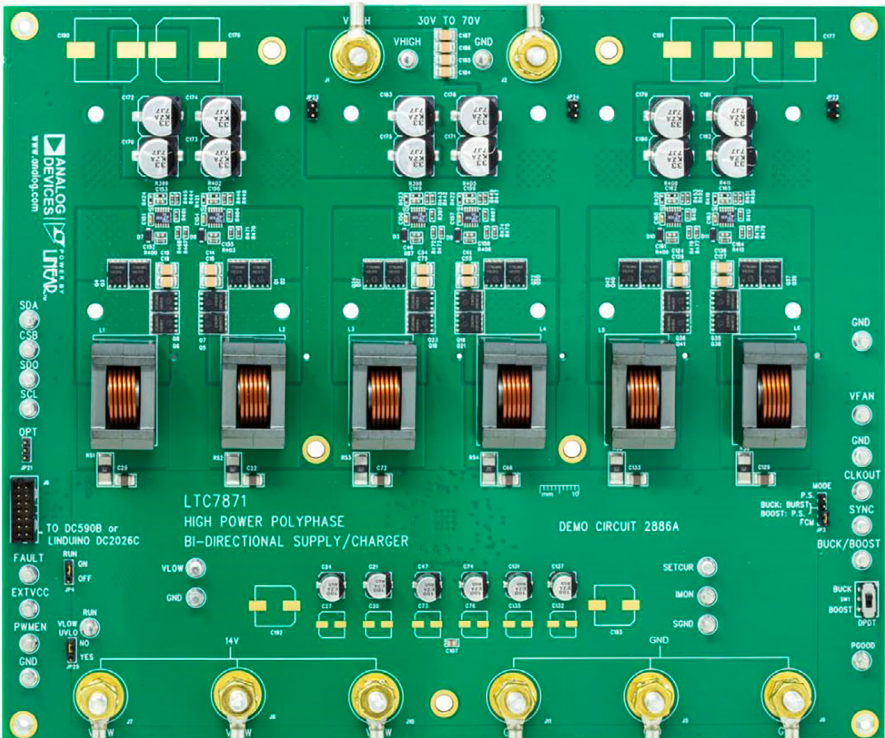Additional features of the DC2886A include:

- Pin selectable light load operating modes
    - Buck: FCM, pulse-skipping and Burst Mode® Operation
    - Boost: FCM and pulse-skipping
- SYNC and CLKOUT pins
- Optional jumper to enable spread spectrum modulation
- RUN, FAULT, PGOOD and PWNEN pins
- BUCK pin to externally control the direction of power flow
- Footprint for an optional heatsink

Design files for this circuit board are available.

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BOARD PHOTO

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

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Buck Mode						
V_{HIGH}	Supply Range		30	48	70	V
V_{LOW}	Output Voltage		13.6	14.0	14.4	V
$I_{LOW(MAX)}$			180			A
f_{SWITCH}	Operating Frequency			150		kHz
	Efficiency	$V_{HIGH} = 48V$ $I_{LOW} = 180A$ 400LFM Airflow		97.5		%
Boost Mode						
V_{LOW}	Supply Range		10	12	14	V
V_{HIGH}	Output Voltage		46.9	48.4	49.8	V
$I_{HIGH(MAX)}$		$V_{LOW} = 14V$ $V_{LOW} = 12V$ $V_{LOW} = 10V$	51 44 35			A
f_{SWITCH}	Operating Frequency			150		kHz
	Efficiency	$V_{LOW} = 14V$ $I_{HIGH} = 51A$ 400LFM Airflow		97.2		%

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QUICK START PROCEDURE

Instructions for operating the DC2886A are below.

Constant-Voltage (CV) Buck Mode

1. Refer to the connection diagram shown in Figure 1.

2. Place SW1 in the BUCK position.

3. Connect the input supply to V_{HIGH} and the load to V_{LOW}. Next connect the voltmeters to monitor V_{HIGH} and V_{LOW}.

4. Turn on the V_{HIGH} supply. With no load, slowly increase the V_{HIGH} supply until V_{HIGH} reaches 30V. At this point, 14V should appear on V_{LOW}. The regulation limits are shown in the Performance Summary section.

5. Next, increase V_{HIGH} to 48V. Recheck the regulation.

6. Apply load up to 180A across V_{LOW}. Recheck the regulation.

7. After the basic performance has been verified, the other aspects of performance can be measured and observed.
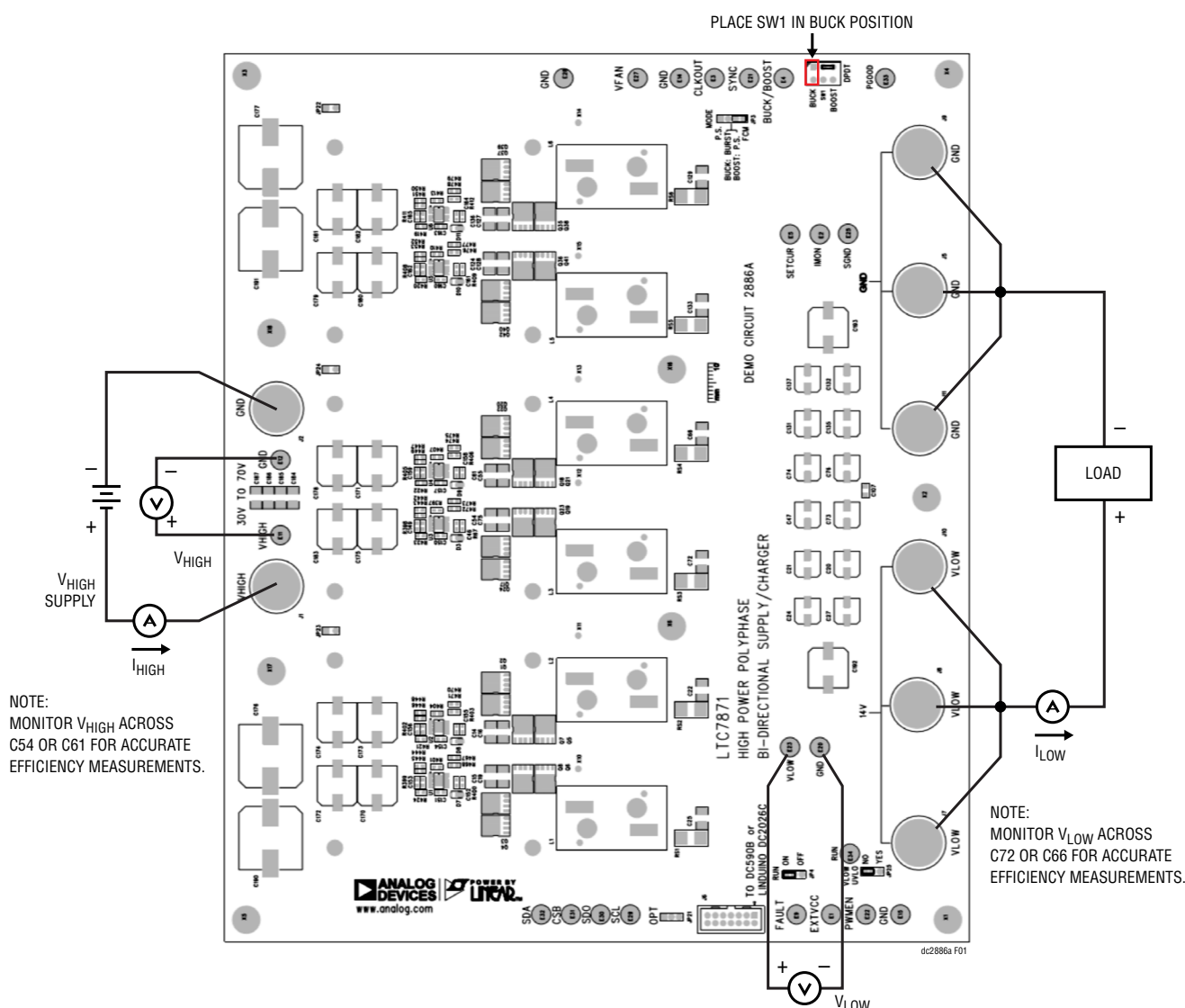

Figure 1. Proper Measurement Equipment Setup for BUCK Mode

QUICK START PROCEDURE

Constant-Voltage (CV) Boost Mode

1. Refer to the connection diagram in Figure 2.

2. Place SW1 in the BOOST position.

3. Connect the input supply to V_{LOW} and the load to V_{HIGH}. Next connect the voltmeters to monitor V_{LOW} and V_{HIGH}.

4. Turn on the V_{LOW} supply. With no load, slowly increase the V_{LOW} supply until V_{LOW} reaches 10V. At this point, 48V should appear on the output. The regulation limits are shown in the Performance Summary section.

5. Next, increase V_{LOW} to 14V. Recheck the regulation.

6. Apply load up to 51A across V_{HIGH}. Recheck the regulation.

7. After the basic performance has been verified, the other aspects of performance can be measured and observed.

Note: When measuring the output voltage or input voltage ripple, be sure to measure directly across an output or input capacitor. Do not use the ground lead on the oscilloscope probe. See Figure 3.
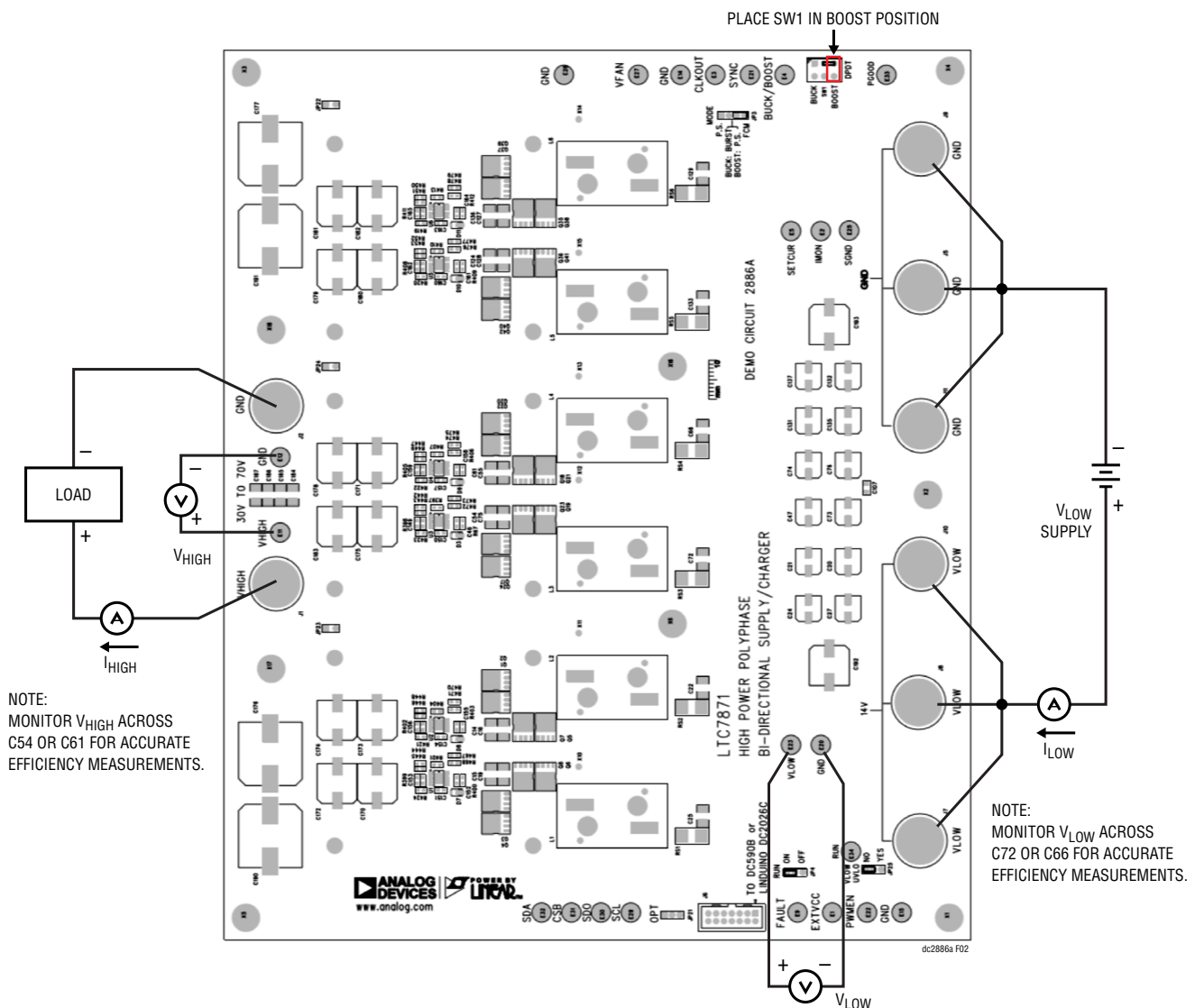

Figure 2. Proper Measurement Equipment Setup for BOOST Mode

dc2886a F02

QUICK START PROCEDURE

Constant-Current (CC) Mode

The DC2886A can operate as a constant-current source when operating either as a buck or a boost. There are the setup instructions.

1. For buck operation, setup DC2886A as shown in Figure 1. For boost operation, setup DC2886A as shown in Figure 2. The load will need to have a constant-voltage mode.

2. If the converter is setup as a buck, the CV setting for the load should be 10V or less. If the converter is setup as a boost, the CV setting should be 40V or less.

3. Connect a bench voltage source to the SETCUR pin as shown in Figure 4. This could be either a DC voltage or the output of a pulse generator.

4. Monitor SETCUR, IMON and I_{LOW} or I_{HIGH} while adjusting the SETCUR voltage. Figure 16 shows an example.

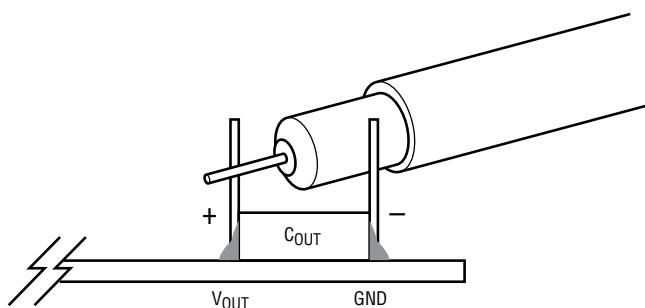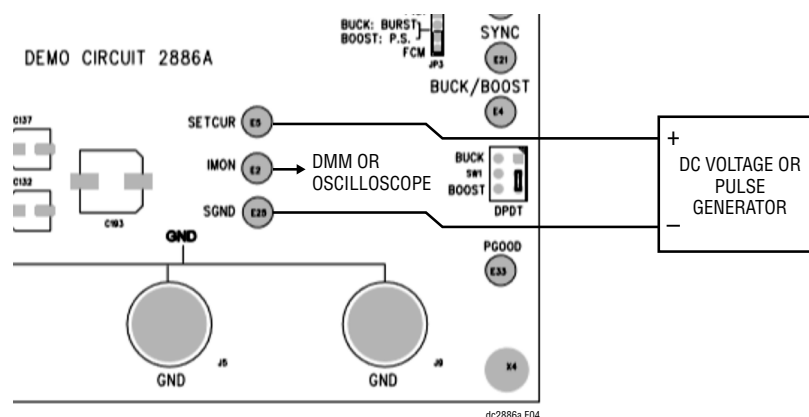For buck to boost or boost to buck transition testing, setup the DC2886A as shown in Figure 5.

Figure 3. How to Measure the Output or Input Voltage Ripple

$I_{LOW(MAX)} = SETCUR/(K \cdot R_{SNS}) \cdot$ # PHASES
GIVEN: K = 20 ($I_{LIM} = \frac{3}{4}$ V5), $R_{SNS} = 1m\Omega$, # PHASES = 6
$I_{LOW(MAX)} = SETCUR \cdot 300$

$IMON = I_{LOW}/300 + 1.25V$
I_{LOW} IS POSITIVE DURING BUCK OPERATION, NEGATIVE DURING BOOST OPERATION

Figure 4. Using SETCUR Pin to Control DC Current
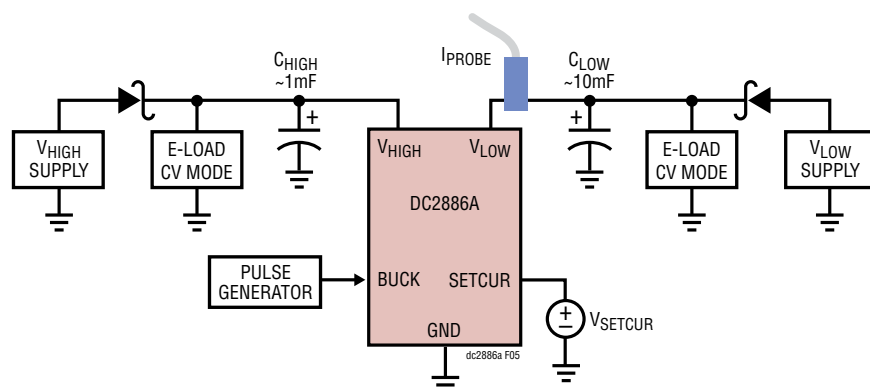
QUICK START PROCEDURE

Figure 5. Typical Setup for the Buck/Boost Transition Test

External Bulk Capacitance

Additional bulk capacitance may be required across the input for either power flow direction, especially if operating at or near full load with supply cables longer than 2 feet. Depending on the supply cable inductance, when operating as a boost, an extra 10mF of bulk capacitance across V_{LOW} may be required. When operating as a buck, an extra 1mF of bulk capacitance across V_{HIGH} may be required. For buck/boost transition testing, this extra capacitance should be added across both inputs. Likely choices for the external capacitance are either aluminum electrolytic or super capacitors with sufficient voltage rating.

Thermal Considerations

With full continuous load on the output in either direction at room temperature ambient, 400LFM of airflow is recommended with full load. All the efficiency curves and thermal images shown in the Typical Performance Characteristics section were taken with this amount of airflow from an adjustable external fan. To further aid with thermals, the DC2886A has three optional footprints for a board mounted heatsink and DC fan. The heatsinks are placed at HS1–HS3 on the bottom layer underneath the power stages for phases 1 and 2, phases 3 and 4 and phases 5 and 6. The DC fan is mounted over the heatsink. Terminals labeled V_{FAN1}–V_{FAN3} provide the fans with power from V_{LOW}. See Figure 6 for details.

SUGGESTED COMPONENTS:
FAN: DELTA ELECTRONICS EFB0612HHA
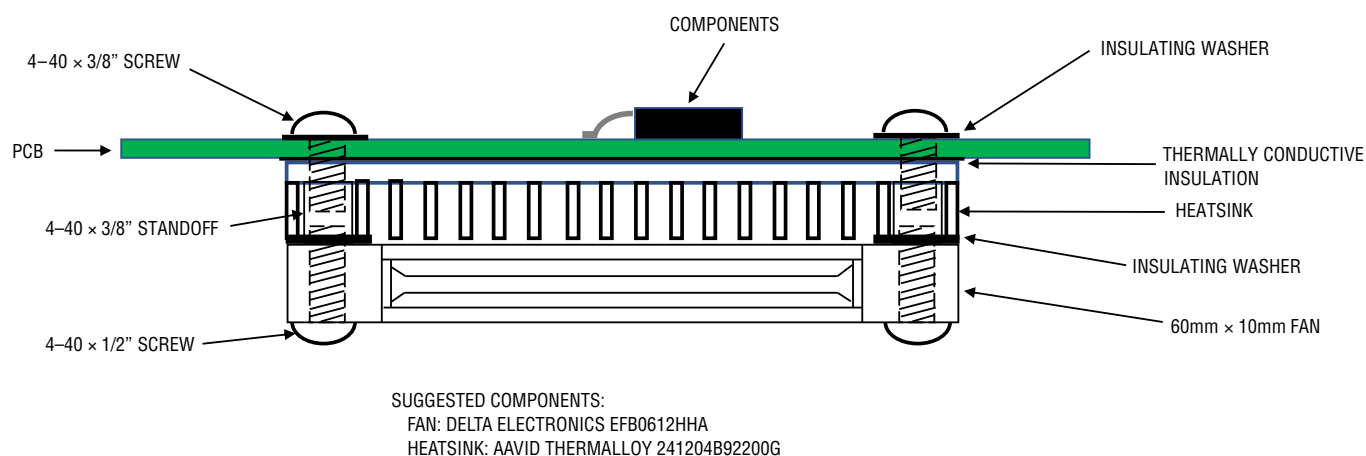HEATSINK: AAVID THERMALLOY 241204B92200G

Figure 6. DC2886A Optional Heatsink and Fan Mounting Assembly Drawing (Fan May Be Powered from V_{LOW} by Plugging Its Connector to the Terminals Labeled V_{FAN1} to V_{FAN3})

QUICK START PROCEDURE

SPI Interface

To control or monitor the DC2886A from QuikEval on a host computer, follow these steps:

1. Refer to Figure 7.

2. If QuikEval is already installed, download the latest software by selecting Tools → Update Program. If QuikEval is not installed, then click on this link.

3. Connect J6 of the DC2886A to a DC2026C with a 14-pin ribbon cable.

4. Connect the DC2026C to the host computer with a USB cable.

5. Refer to the demo manual of the DC2026C for further details.

6. Apply a voltage within the specified input range to either V_{HIGH} or V_{LOW} depending on the direction of power flow.

7. Start QuikEval on the host computer.

8. Use QuikEval to monitor and control the LTC7871. The LTC7871 QuikEval GUI is shown in Figure 8. The dashboard is on the left and an optional design tool is on the right.

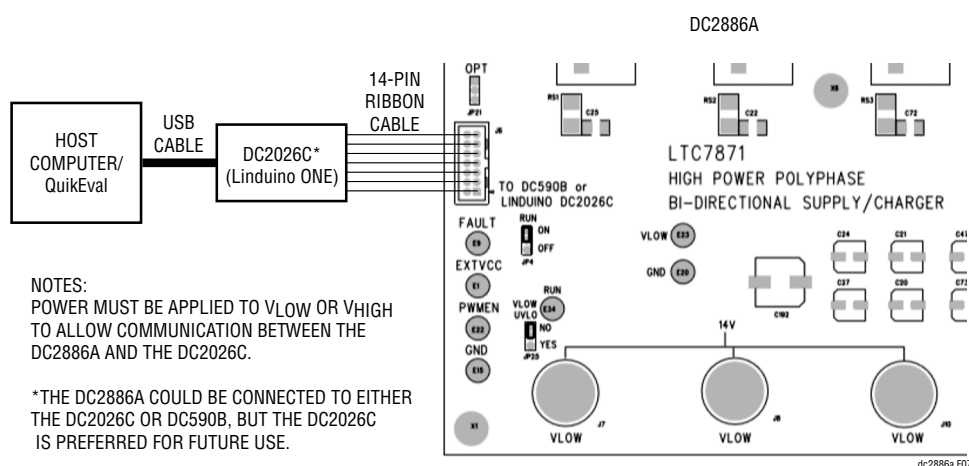   a. To read the status, either press the Read Once button or the Read Continuously button in the dashboard.

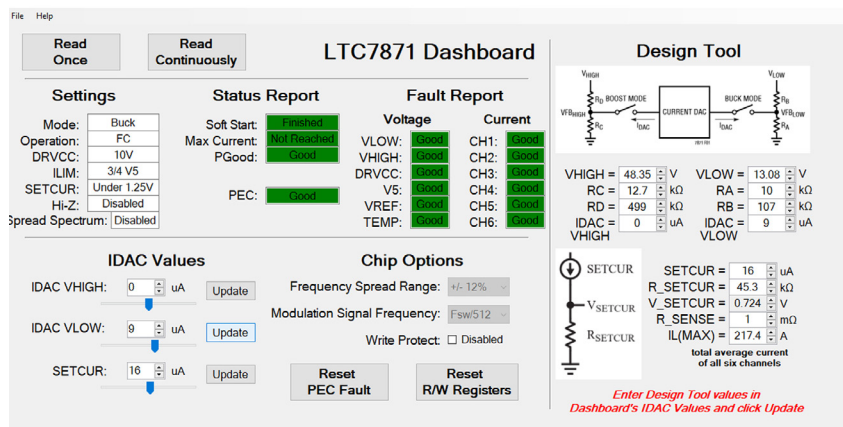**Figure 7. Connecting the DC2886A to a Host Computer (Refer to DC2026C Demo Manual for More Details)**

Figure 8. LTC7871 QuikEval GUI (Design Tool Only Available When Enabled from the File Menu)

QUICK START PROCEDURE

b. QuikEval can margin V_{LOW}, V_{HIGH} and the DC I_{LOW} current limit up or down by writing to the register which controls the current source digital to analog converter (IDAC) for the VFB_{LOW}, VFB_{HIGH} or SETCUR pins. To use this feature, make sure the Read Continuously button is not enabled. This button is gray when not enabled.

c. An optional design tool can be enabled from the File menu. It calculates the required IDAC value to

margin the V_{LOW}, V_{HIGH} or DC I_{LOW} current limit to a given value. To use this tool, enter the values for the feedback divider or SETCUR resistor and then enter the value for the desired V_{LOW}, V_{HIGH} or $I_{L(MAX)}$ which is the DC I_{LOW} current limit. The design tool will then provide the calculated IDAC value. To update the LTC7871's registers, enter the calculated IDAC values in the dashboard and then press the respective Update button.

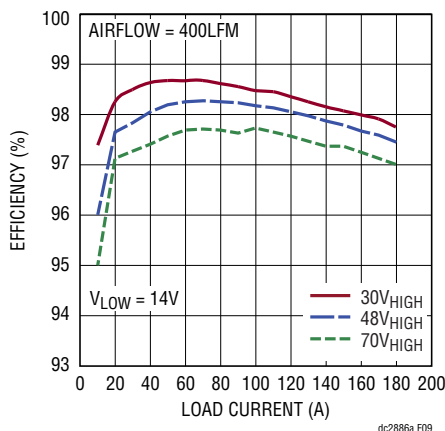## TYPICAL PERFORMANCE CHARACTERISTICS $T_A = 25°C$, unless otherwise noted.

Figure 9. Efficiency While Operating as a BUCK, Input Voltage Varied, Converter Setup for FCM, External Fan Is Used
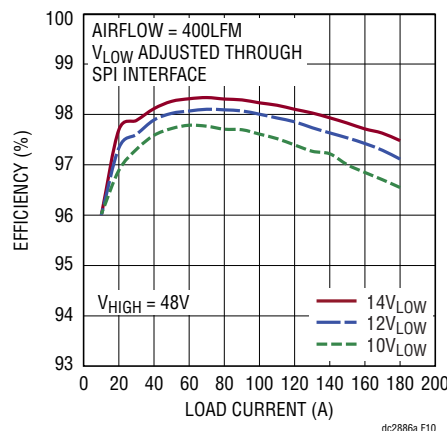

Figure 10. Efficiency While Operating as a BUCK, Output Voltage Varied, Converter Setup for FCM, External Fan Is Used
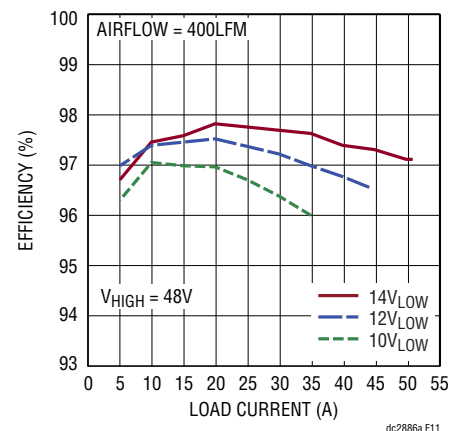

Figure 11. Efficiency While Operating as a BOOST, Input Voltage Varied, Converter Setup for FCM, External Fan Is Used
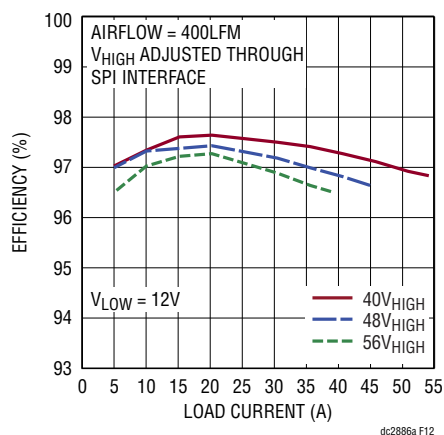

Figure 12. Efficiency While Operating as a BOOST, Output Voltage Varied, Converter Setup for FCM, External Fan Is Used
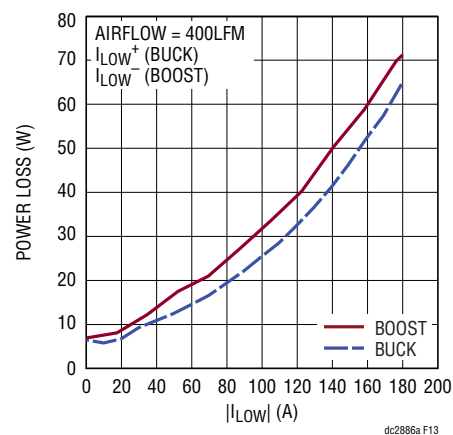

Figure 13. Buck vs Boost Power Loss Comparison, $V_{HIGH} = 48V$, $V_{LOW} = 14V$, External Fan Is Used

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TYPICAL PERFORMANCE CHARACTERISTICS

Figure 14. Thermal Image While Operating as a BUCK,
V_{HIGH} = 48V, V_{LOW} = 14V, Load = 180A, Airflow = 400LFM,
External Fan Is Used, DRV_{CC} = 10V, f_{SWITCH} = 150kHz

Figure 15. Thermal Image While Operating as a BOOST,
V_{LOW} = 14V, V_{HIGH} = 48V, Load = 51A, Airflow = 400LFM,
External Fan Is Used, DRV_{CC} = 10V, f_{SWITCH} = 150kHz

Figure 16. I_{LOW} Stepped from 10A to 50A with the SETCUR Pin
While Operating in CC BUCK Mode, V_{HIGH} = 48V, V_{LOW} Clamped
at 10V with Electronic Load, 2× 10mF Bulk Capacitance Across
V_{LOW}. ILIM = Float

Figure 17. Boost to Buck Transition of the DC2886A Demo Board,
I_{LOW} = 0A, V_{LOW} Clamped at 10V, V_{HIGH} Clamped at 40V

PARTS LIST

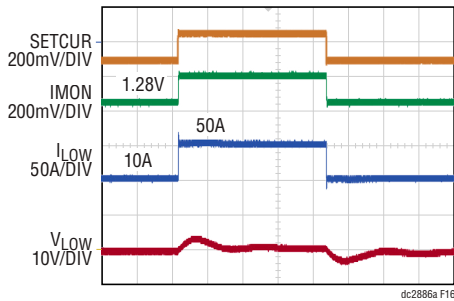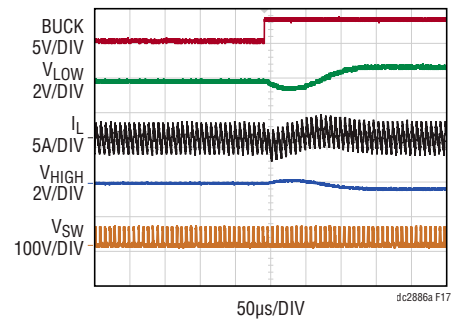| ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	R7	RES., 10k , 5%, 1/10W, 0603	SAMSUNG, RC1608J103CS YAGEO, RC0603JR-0710KL
2	1	R10	RES., 1k , 5%, 1/10W, 0603	SAMSUNG, RC1608J102CS YAGEO, RC0603JR-071KL
3	6	R67, R400, R403, R406, R409, R412	RES., 1Ω, 1%, 1/10W, 0603	YAGEO, RC0603FR-071RL
4	1	R36	RES., 48.7k , 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF4872V VISHAY, CRCW060348K7FKEA
5	6	R39, R40, R43, R49, R93, R103	RES., 1.5k , 1%, 1/10W, 0603	NIC, NRC06F1501TRF VISHAY, CRCW06031K50FKEA
6	8	R18, R123, R398, R399, R402, R405, R408, R411	RES., 100k , 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1003TRF PANASONIC, ERJ3EKF1003V VISHAY, CRCW0603100KFKEA
7	1	R430	RES., 12.7k , 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF1272V VISHAY, CRCW060312K7FKEA
8	6	RS1, RS2, RS3, RS4, RS5, RS6	RES., 0.001Ω, 1%, 1W, 2512, METAL, SENSE, AEC-Q200	VISHAY, WSL25121L000FEA
9	5	R8, R9, R418, R428, R469	RES., 10k , 1%, 1/10W, 0603, AEC-Q200	KOA SPEER, RK73H1JTTD1002F PANASONIC, ERJ3EKF1002V VISHAY, CRCW060310K0FKEA VISHAY, CRCW060310K0FKEB
10	2	R454, R455	RES., 0.01Ω, 1%, 1/2W, 1210, SENSE, AEC-Q200	YAGEO, RL1210FR-070R01L
11	1	R431	RES., 499k , 1%, 1/8W, 0805, AEC-Q200	NIC, NRC10F4993TRF PANASONIC, ERJ6ENF4993V VISHAY, CRCW0805499KFKEA
12	1	R29	RES., 2.2Ω, 1%, 1/4W, 1206, AEC-Q200	VISHAY, CRCW12062R20FKEA
13	1	R44	RES., 37.4k , 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ-3EKF3742 PANASONIC, ERJ3EKF3742V VISHAY, CRCW060337K4FKEA
14	1	R1	RES., 3.01MΩ, 1%, 1/8W, 0805, AEC-Q200	VISHAY, CRCW08053M01FKEA
15	1	R2	RES., 210k , 1%, 1/8W, 0805, AEC-Q200	VISHAY, CRCW0805210KFKEA
16	6	R31, R32, R53, R65, R97, R98	RES., 16.9k , 1%, 1/8W, 0805, AEC-Q200	STACKPOLE ELECT., INC., RMCF0805FT16K9 VISHAY, CRCW080516K9FKEA
17	6	R419, R420, R421, R422, R423, R424	RES., 10Ω, 1%, 1/10W, 0603	NIC, NRC06F10R0TRF PANASONIC, ERJ3EKF10R0V ROHM, MCR03EZPFX10R0 VISHAY, CRCW060310R0FKEA YAGEO, RC0603FR-0710RL
18	1	R11	RES., 3.01k , 1%, 1/10W, 0603	VISHAY, CRCW06033K01FKEA YAGEO, RC0603FR-073K01L
19	1	R17	RES., 30.1k , 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF3012V VISHAY, CRCW060330K1FKEA
20	39	R19, R397, R401, R404, R407, R410, R413, R426, R429, R432, R433, R434, R435, R436, R437, R442, R443, R444, R445, R446, R447, R448, R449, R450, R451, R452, R453, R467, R468, R470, R471, R472, R473, R474, R475, R476, R477, R478, R479	RES., 0Ω, 1/10W, 0603	BOURNS, CR0603-J/-000ELF VISHAY, CRCW06030000Z0EAC YAGEO, RC0603FR-070RL

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
21	2	R425, R438	RES., 45.3k , 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF4532V VISHAY, CRCW060345K3FKEA
22	6	R38, R41, R42, R50, R94, R112	RES., 1.69k , 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1691TRF PANASONIC, ERJ3EKF1691 VISHAY, CRCW06031K69FKEA
23	1	R15	RES., 130k , 1%, 1/8W, 0805	NIC, NRC10F1303TRF
24	1	R427	RES., 107k , 1%, 1/8W, 0805	VISHAY, CRCW0805107KFKEA
25	2	C11, C189	CAP., 47pF, C0G, 50V, 5%, 0603	KEMET, C0603C470J5GACTU MURATA, GRM1885C1H470JA01D TDK, CGJ3E2C0G1H470J080AA VISHAY, VJ0603A470JXAAC
26	7	C22, C25, C66, C72, C129, C133, C188	CAP., 10µF, X7R, 25V, 10%, 1210	AVX, 12103C106KAT2A MURATA, GRM32DR71E106KA12L
27	7	C105, C150, C151, C154, C157, C160, C163	CAP., 1µF, X7R, 25V, 10%, 0603, AEC-Q200	MURATA, GCM188R71E105KA64D TAIYO YUDEN, TMK107AB7105KAHT TDKCGA3E1X7R1E105K080AC
28	12	C46, C149, C152, C153, C155, C156, C158, C159, C161, C162, C164, C165	CAP., 0.22µF, X7R, 25V, 10%, 0603	MURATA, GRM188R71E224KA88D TDK, C1608X7R1E224K080AC YAGEO, CC0603KRX7R8BB224
29	15	C6, C7, C9, C28, C29, C32, C33, C34, C35, C45, C48, C122, C123, C125, C140	CAP., 0.1µF, X7R, 25V, 10%, 0603, AEC-Q200	AVX, 06033C104K4T4A SAMSUNG, CL10B104KA8WPNC
30	12	C170, C171, C172, C173, C174, C175, C178, C179, C180, C181, C182, C183	CAP., 33µF, ALUM. ELECT. HYB., 80V, 20%, 10mm × 10.2mm, RADIAL, AEC-Q200	PANASONIC, EEHZC1K330P
31	3	C10, C31, C107	CAP., 4.7µF, X7R, 16V, 10%, 0805	AVX, 0805YC475KAT2A KEMET, C0805C475K4RACTU MURATA, GRM21BR71C475KA73L NIC, NMC0805X7R475K16TRPLPF TAIYO YUDEN, EMK212B7475KG-T
32	6	C21, C24, C47, C74, C131, C137	CAP., 100µF, ALUM POLY HYB, 25V, 20%, 6.3mm × 7.7mm, D8, SMD, RADIAL, AEC-Q200	PANASONIC, EEHZA1E101XP
33	1	C12	CAP., 10pF, C0G, 100V, ±0.1pF, 0603	AVX, 06031A100BAT2A KEMET, C0603C100B1GAC
34	16	C14, C15, C16, C19, C54, C55, C61, C75, C124, C127, C128, C136, C184, C185, C186, C187	CAP., 2.2µF, X7R, 100V, 10%, 1210	AVX, 12101C225KAT2A MURATA, GRM32ER72A225KA35, GRM32ER72A225KA35L NIC, NMC1210X7R225K100TRPLPF TDK, C3225X7R2A225K230AB
35	1	C5	CAP., 47pF, C0G, 50V, 10%, 0603	AVX, 06035A470KAT2A KEMET, C0603C470K5GACTU VISHAY, VJ0603A470KXAAC
36	1	C39	CAP., 1µF, X7R, 100V, 10%, 1206	AVX, 12061C105KAT2A MURATA, GRM31CR72A105KA01L
37	6	L1, L2, L3, L4, L5, L6	IND., 6.8µH, PWR, CHOKE, 20%, 41A, 2mΩ, 4-TERM, THT, AEC-Q200	SAGAMI ELEC CO., LTD., CVE2622C-6R8M-R
38	6	D3, D7, D8, D9, D10, D11	DIODE, SCHOTTKY, 100V, 1A, POWERDI-123	DIODES INC., DFLS1100-7
39	1	D12	DIODE, SCHOTTKY, 20V, 2A, SOD-323F	NEXPERIA, PMEG2020EJ, 115
40	12	Q1, Q2, Q3, Q4, Q17, Q20, Q22, Q24, Q37, Q39, Q40, Q42	XSTR., MOSFET, N-CH, 80V, 49A, PG-TDSON-8	INFINEON, BSC117N08NS5, BSC117N08NS5ATMA1

PARTS LIST

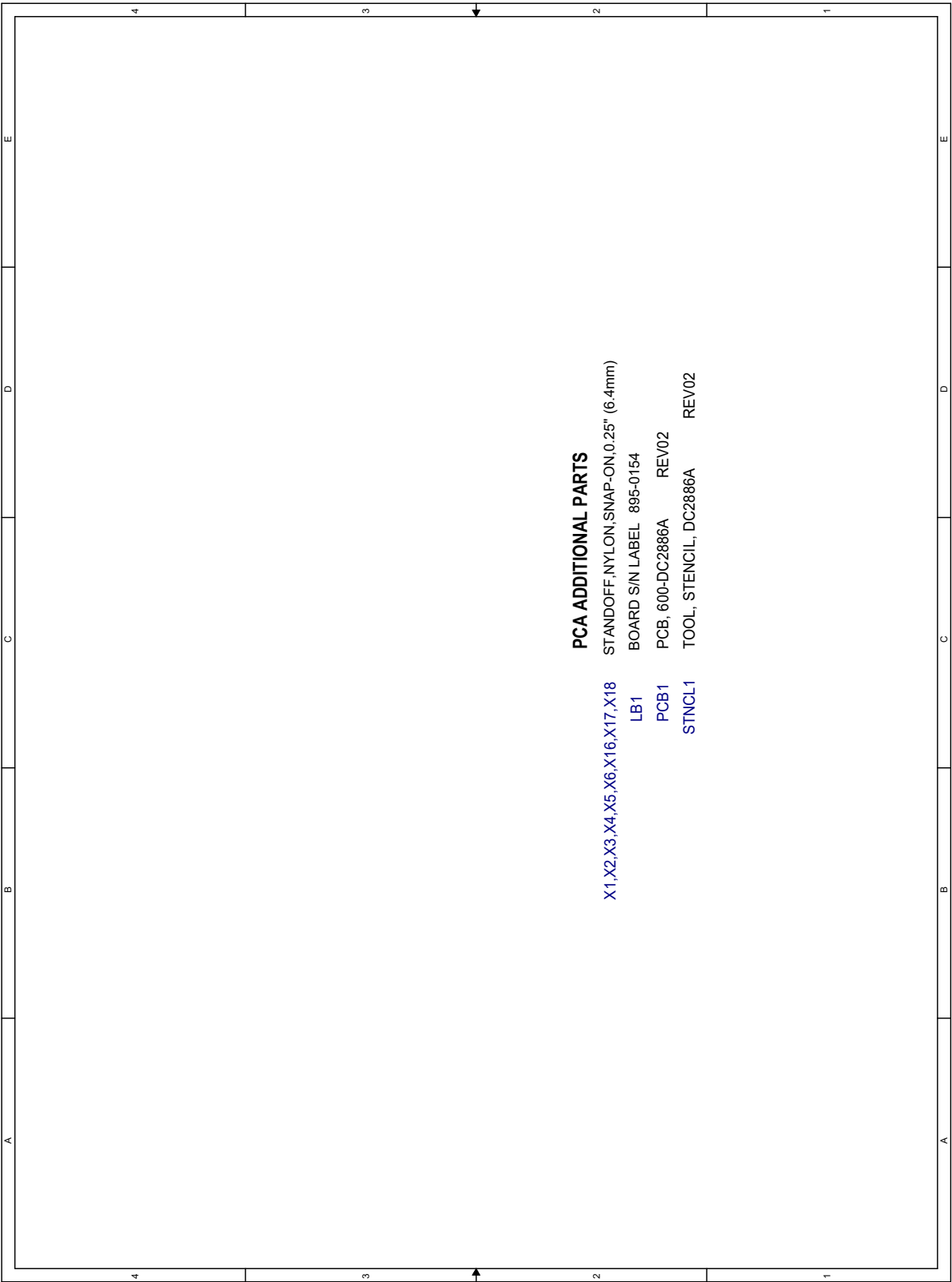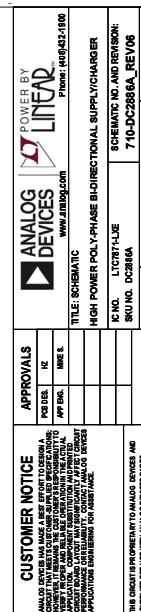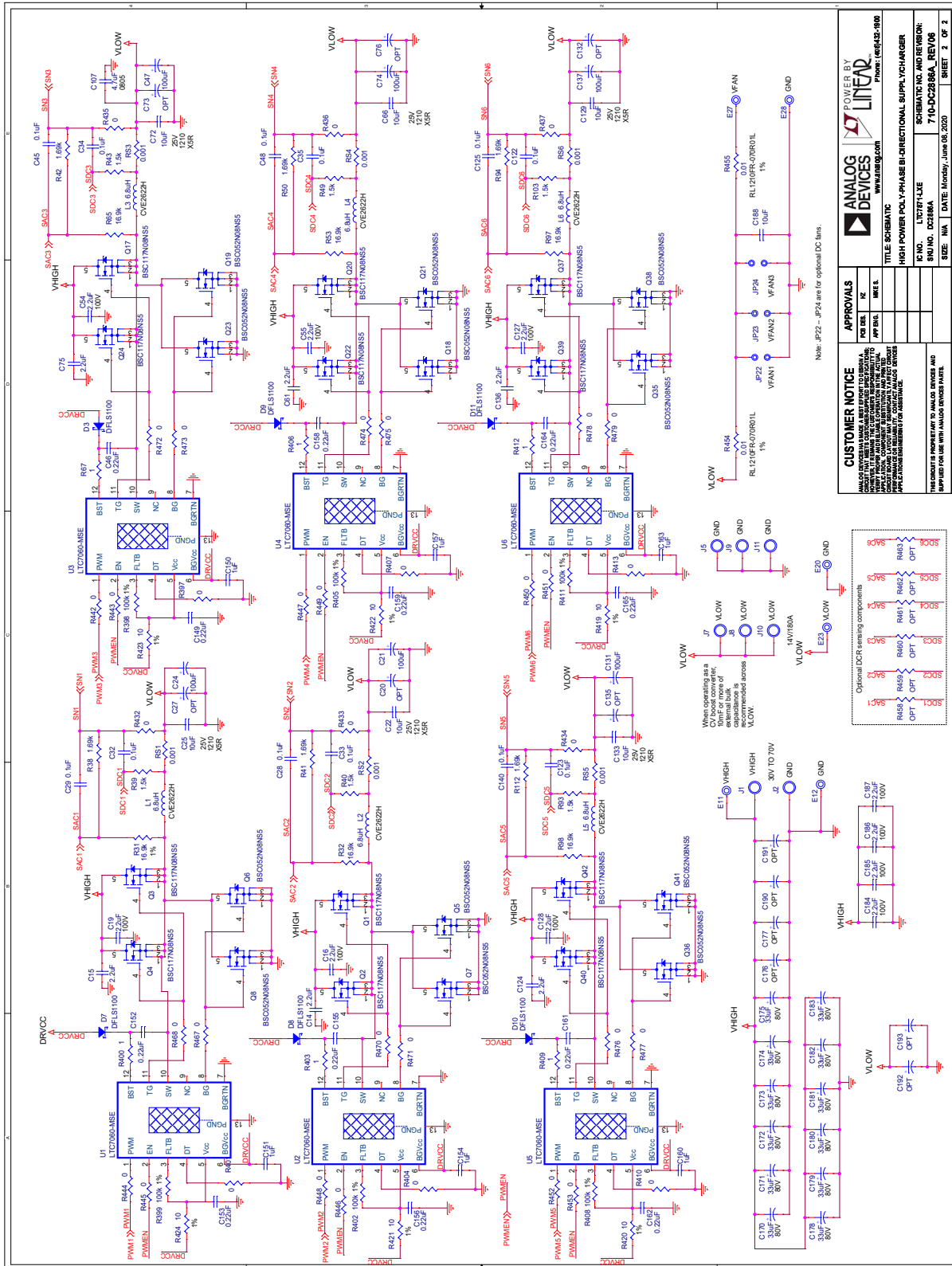| ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
41	12	Q5, Q6, Q7, Q8, Q18, Q19, Q21, Q23, Q35, Q36, Q38, Q41	XSTR., MOSFET, N-CH, 80V, 95A, PG-TDSON-8	INFINEON, BSC052N08NS5, BSC052N08NS5ATMA1
42	6	U1, U2, U3, U4, U5, U6	IC, DC/DC CONVERTER, MSE-12	ANALOG DEVICES, LTC7060EMSE#PBF, LTC7060EMSE#TRPBF
43	1	U7	IC, HIGH POWER POLY-PHASE, BIDIRECTIONAL SUPPLY/CHARGER	ANALOG DEVICES, LTC7871ELWE#PBF
SPI Interface				
1	3	R439, R440, R441	RES., 4.99k , 1%, 1/10W, 0603	PANASONIC, ERJ3EKF4991V YAGEO, RC0603FR-074K99L
2	1	R417	RES., 100Ω, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1000TRF PANASONIC, ERJ3EKF1000V VISHAY, CRCW0603100RFKEA
3	3	R12, R415, R416	RES., 100Ω, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1000TRF PANASONIC, ERJ3EKF1000V VISHAY, CRCW0603100RFKEA
4	1	C169	CAP., 0.1µF, X7R, 25V, 10%, 0603, AEC-Q200	AVX, 06033C104K4T4A SAMSUNG, CL10B104KA8WPNC
5	1	U8	IC, MEMORY, EEPROM, 2Kb (256x8), TSSOP-8, 400kHz	MICROCHIP, 24LC025-I/ST, 24LC025T-I/ST
Additional Circuit Components				
1	0	R20, R414, R456, R457, R458, R459, R460, R461, R462, R463	RES., OPTION, 0603	
2	0	R464, R465, R466	RES., OPTION, 0805	
3	0	C192, C193	CAP., OPTION, ALUM. ELECT., SMD	
4	0	C176, C177, C190, C191	CAP., 100µF, ALUM. ELECT., 100V, 10%, 16mm × 16.5mm SMD	SUN ELECTRONIC INDUSTRIES CORP, 100CE100KXT+D
5	0	C148, C166, C167, C194, C195, C196	CAP., OPTION, 0603	
6	0	C20, C27, C73, C76, C132, C135	CAP., OPTION, ALUM. ELECT., SMD	
7	0	Z1	DIODE, OPTION, SOD-123	
8	0	D13, D14	DIODE, OPTION, SOD-323	
9	0	C168	CAP., 15µF, TANT, 16V, 20%, 3528	KEMET, T521B156M016ATE090
Hardware				
1	1	J6	CONN., HDR, SHROUDED, MALE, 2×7, 2mm, VERT, ST, THT	MOLEX, 87831-1420
2	3	XJP3, XJP10, XJP11	CONN., SHUNT, FEMALE, 2-POS, 2mm	SAMTEC, 2SN-BK-G
3	1	JP3	CONN., HDR., MALE, 1×4, 2mm, THT, STR	SULLINS CONNECTOR SOLUTIONS, NRPN041PAEN-RC
4	3	JP4, JP21, JP25	CONN., HDR., MALE, 1×3, 2mm, THT, STR, NO SUBS. ALLOWED	SAMTEC, TMM-103-02-L-S
5	3	JP22, JP23, JP24	CONN., HDR, MALE, 1×2, 2.54mm, VERT, ST, THT	WURTH, 61300211121
6	23	E1, E2, E3, E4, E5, E9, E11, E12, E14, E15, E20, E21, E22, E23, E25, E27, E28, E29, E30, E31, E32, E33, E34	TEST POINT, TURRET, 0.094 MTG. HOLE, PCB 0.062 THK	MILL-MAX, 2501-2-00-80-00-00-07-0
7	1	SW1	SWITCH, SLIDE, DPDT, 0.3A, 6VDC, PTH	C&K, JS202011CQN
8	8	J1, J2, J5, J7, J8, J9, J10, J11	EVAL BOARD STUD HARDWARE SET, #10-32	
9	9	X1, X2, X3, X4, X5, X6, X16, X17, X18	STANDOFF, NYLON, SNAP-ON, 0.25 (6.4mm)	KEYSTONE, 8831 WURTH, 70293100

SCHEMATIC DIAGRAM

PCA ADDITIONAL PARTS

X1,X2,X3,X4,X5,X6,X16,X17,X18	STANDOFF,NYLON,SNAP-ON,0.25" (6.4mm)
LB1	BOARD S/N LABEL 895-0154
PCB1	PCB, 600-DC2886A REV02
STNCL1	TOOL, STENCIL, DC2886A REV02

SCHEMATIC DIAGRAM

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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