

LTC7841 60V Dual-Phase Single Output Synchronous Boost Controller with PMBus

DESCRIPTION

Demonstration circuit 2798A is a high voltage, dual-phase single output boost converter with 10V to 16V input range. The output voltage is adjustable from V_{IN} to 48V. And the output can supply a 10A maximum load current. The demo board has a LTC7841 controller, which is a 60V dual-phase single output boost controller with digital power system management. Please see the LTC7841 data sheet for more detailed information.

The DC2798A powers up to default settings and produces power based on the command from the serial bus communication. This allows easy evaluation of the DC/DC converter. To fully explore the extensive power system management features of the part, download the GUI

software LTpowerPlay® onto your PC and use ADI's I²C/SMBus/PMBus dongle DC1613A to connect to the board. LTpowerPlay allows the user to reconfigure the part on-the-fly, view telemetry of voltage, current, temperature and fault status.

GUI Download

The software can be downloaded from:

[LTpowerPlay](#)

For more details and instructions of LTpowerPlay, please refer to LTpowerPlay GUI for LTC7841 Quick Start Guide.

Design files for this circuit board are available.

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BOARD PHOTO

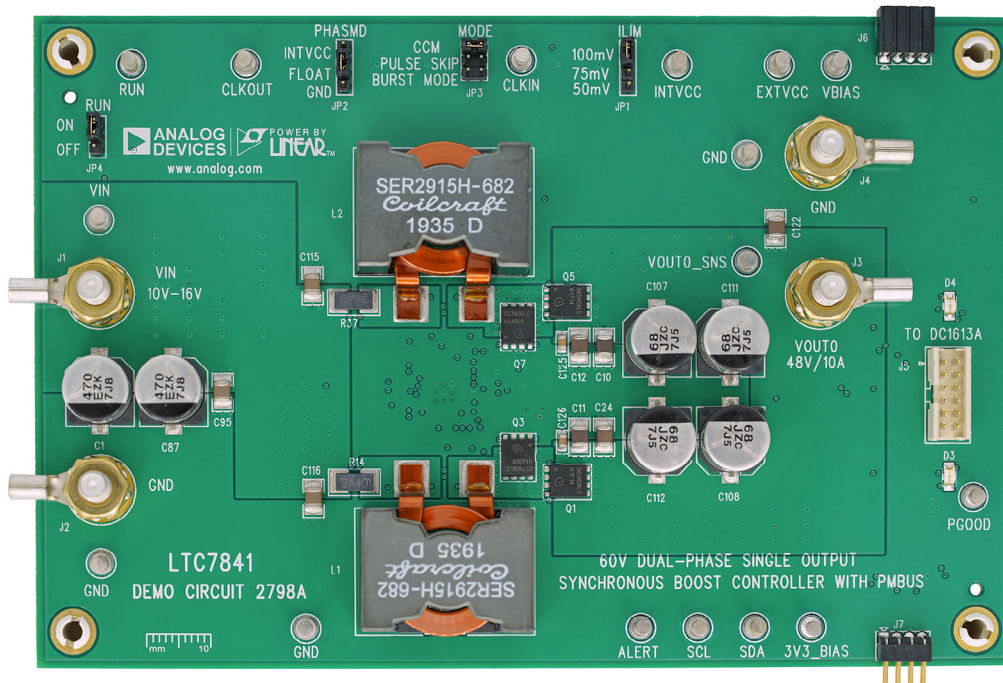


Figure 1. Single-Output LTC7841/DC2798A Demo Circuit

DEMO MANUAL DC2798A

PERFORMANCE SUMMARY Specifications are at $T_A = 25^\circ\text{C}$

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range		10		16	V
Output Voltage, V_{OUT}	$V_{IN} = 10\text{V to }16\text{V}$, $I_{OUT} = 0\text{A to }10\text{A}$	16		48 (Default)	V
Maximum Output Current, I_{OUT}	$V_{IN} = 10\text{V to }16\text{V}$, $V_{OUT} = 16\text{V to }48\text{V}$		10		A
Typical Efficiency	$V_{IN} = 12\text{V}$, $V_{OUT} = 48\text{V}$, $I_{OUT} = 10\text{A}$		97.4 (See Figure 5)		%
Default Switching Frequency			150		kHz

QUICK START PROCEDURE

Demonstration circuit DC2798A is easy to set up to evaluate the performance of the LTC7841. Refer to Figure 2 for the proper measurement equipment set-up and follow the procedure below.

1. With power off, connect the input power supply to V_{IN} (10V to 16V) and GND (input return).
2. Connect the 48V output load between V_{OUT0} and GND (Initial load: No Load).
3. Connect the DVMs to the input and outputs. Set default jumper position: JP1: 100mV (ILIM); JP2: FLOAT; JP3: CCM; JP4: ON.
4. Connect the dongle to DC2798A and turn on the input power supply.

5. Follow the LTpowerPlay Quick Start Procedure section to set the proper output voltage.
6. 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 3 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.

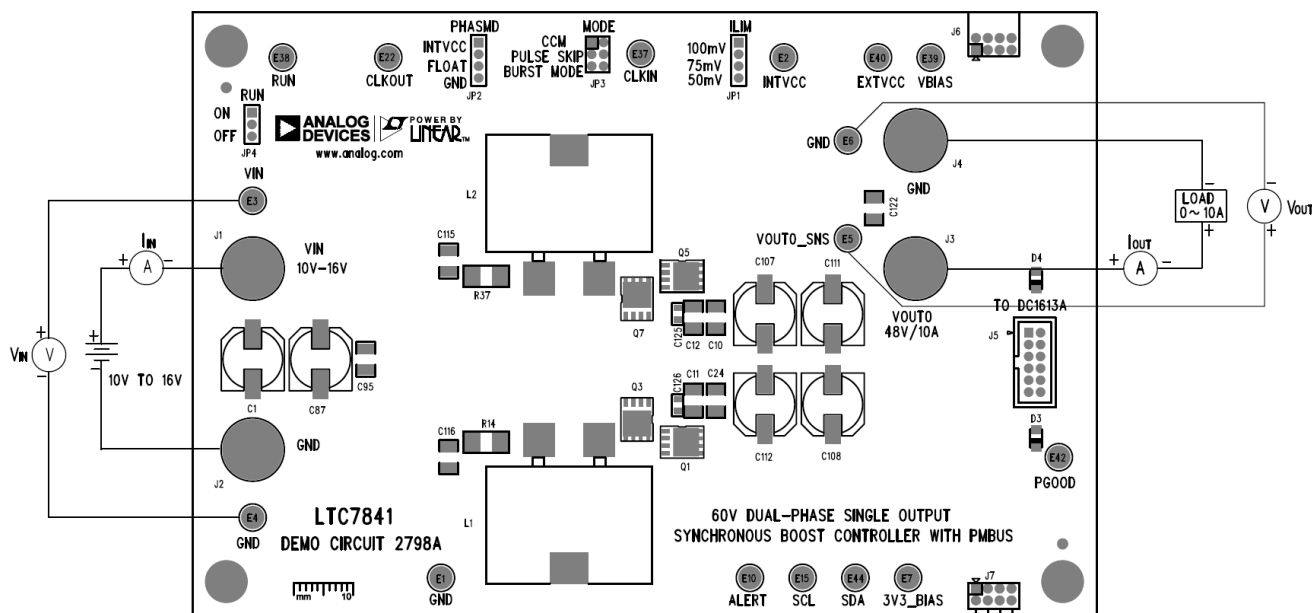


Figure 2. Proper Measurement Equipment Set-Up

QUICK START PROCEDURE

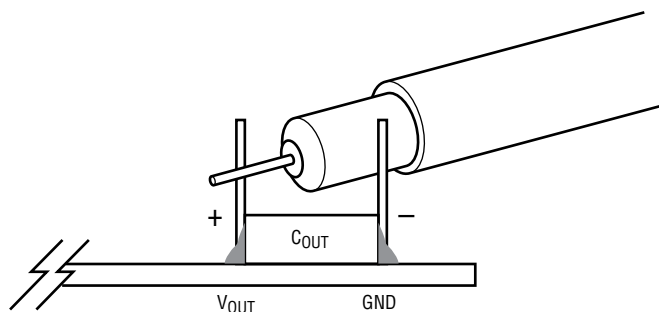


Figure 3. Measuring Output Voltage Ripple

Connecting a PC to DC2798A

You can use a PC to configure the power management features of the LTC7841 such as: nominal V_{OUT} , margin

set points, ON/OFF control. The DC1613A dongle may be plugged when V_{IN} is present.

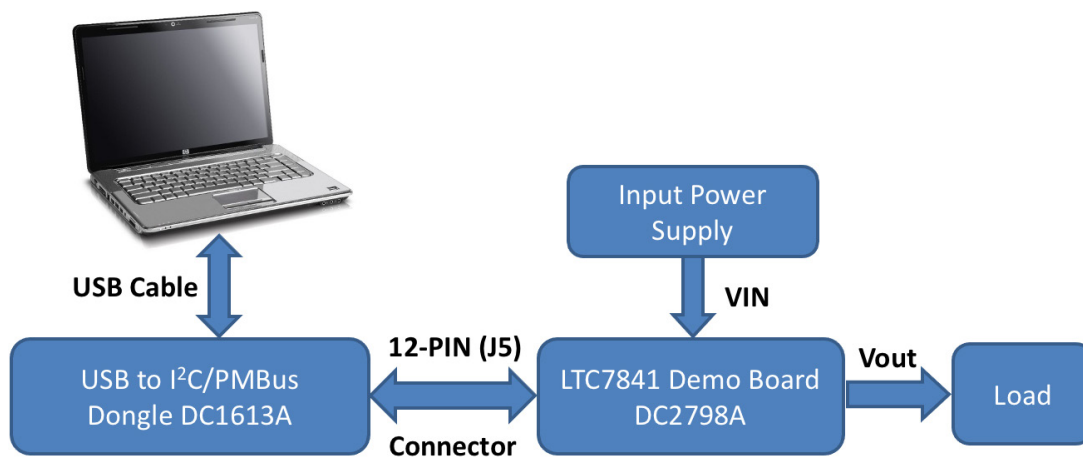


Figure 4. Demo Set-Up with PC

QUICK START PROCEDURE

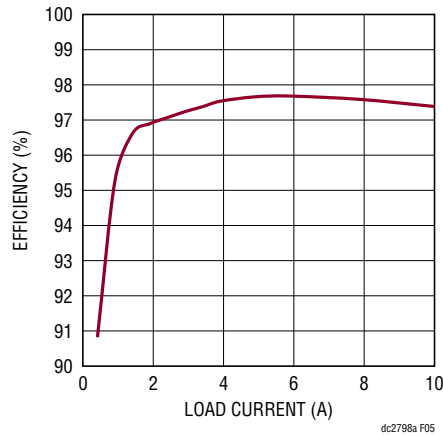


Figure 5. Efficiency vs Load Current at $V_{IN} = 12V$, $f_s = 150kHz$, $V_{OUT} = 48V$

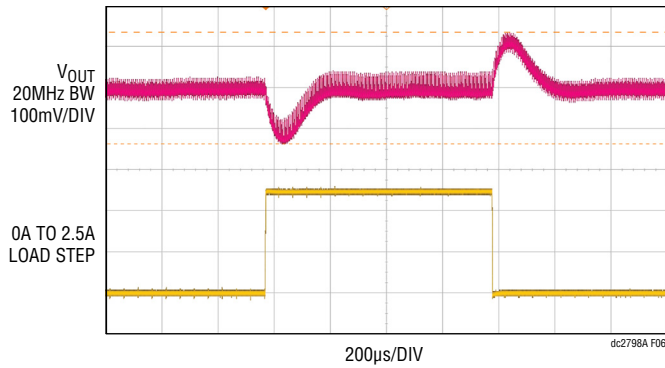


Figure 6. V_{OUT} Load Transient Response at $V_{IN} = 12V$, $V_{OUT} = 48V$

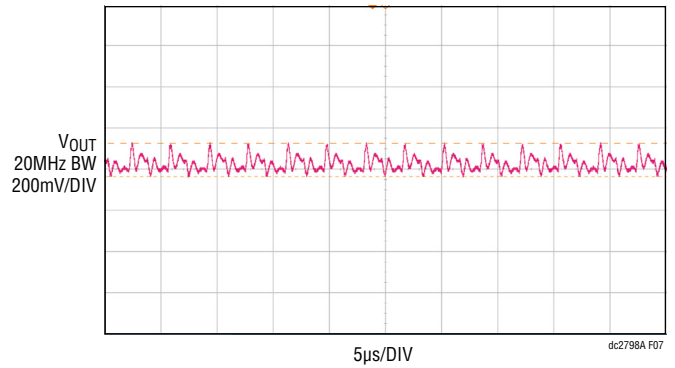


Figure 7. V_{OUT} Voltage Ripple at $V_{IN} = 12V$, $V_{OUT} = 48V$, $I_{OUT} = 10A$

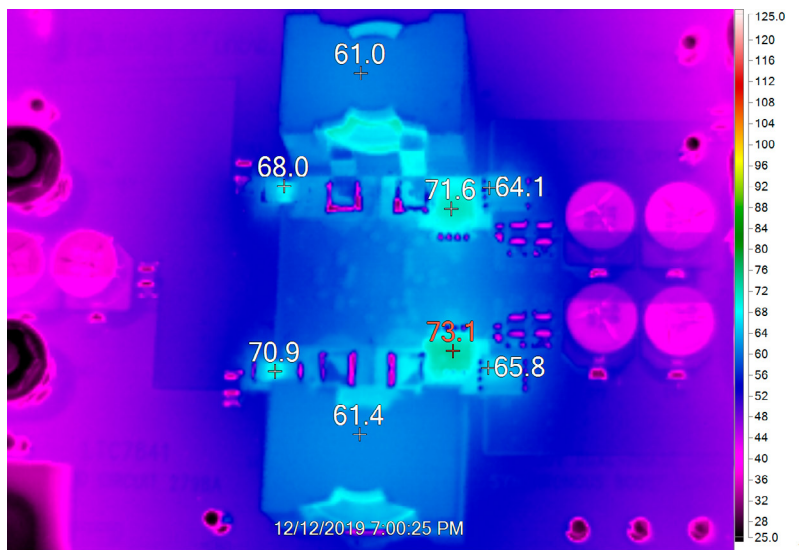


Figure 8. Thermal at $V_{IN} = 12V$, $V_{OUT} = 48V$, $I_{OUT} = 10A$, $T_A = 25^\circ C$, No Airflow

LTPOWERPLAY SOFTWARE GUI

LTpowerPlay is a powerful Windows-based development environment that supports Analog Devices power system management ICs and μ Modules, including LTM4675, LTM4676, LTM4677, LTM4678, LTM4680, LTM4700, LTM4664, LTC3880, LTC3882, LTC3883, LTC3884, LTC7880 and LTC7841. The software supports a variety of different tasks. You can use LTpowerPlay to evaluate Analog Devices ICs by connecting to a demo board system. LTpowerPlay provides unprecedented diagnostic and debug features. It becomes a valuable diagnostic tool during board bring-up to program or tweak the power management scheme in a system, or to diagnose power issues when bringing up rails. LTpowerPlay utilizes the DC1613A USB-to-SMBus controller to communicate with one of

many potential targets, including LTM4675, LTM4676, LTM4677, LTM4678, LTM4680, LTM4700, LTM4664, LTC3880, LTC3882, LTC3883, LTC3884, LTC7880 and LTC7841's demo system, or a customer board. The software also provides an automatic update feature to keep the software current with the latest set of device drivers and documentation. The LTpowerPlay software can be downloaded from:

[LTpowerPlay](#)

To access technical support documents for LTC Digital Power Products visit the LTpowerPlay Help menu. Online help also available through the LTpowerPlay.

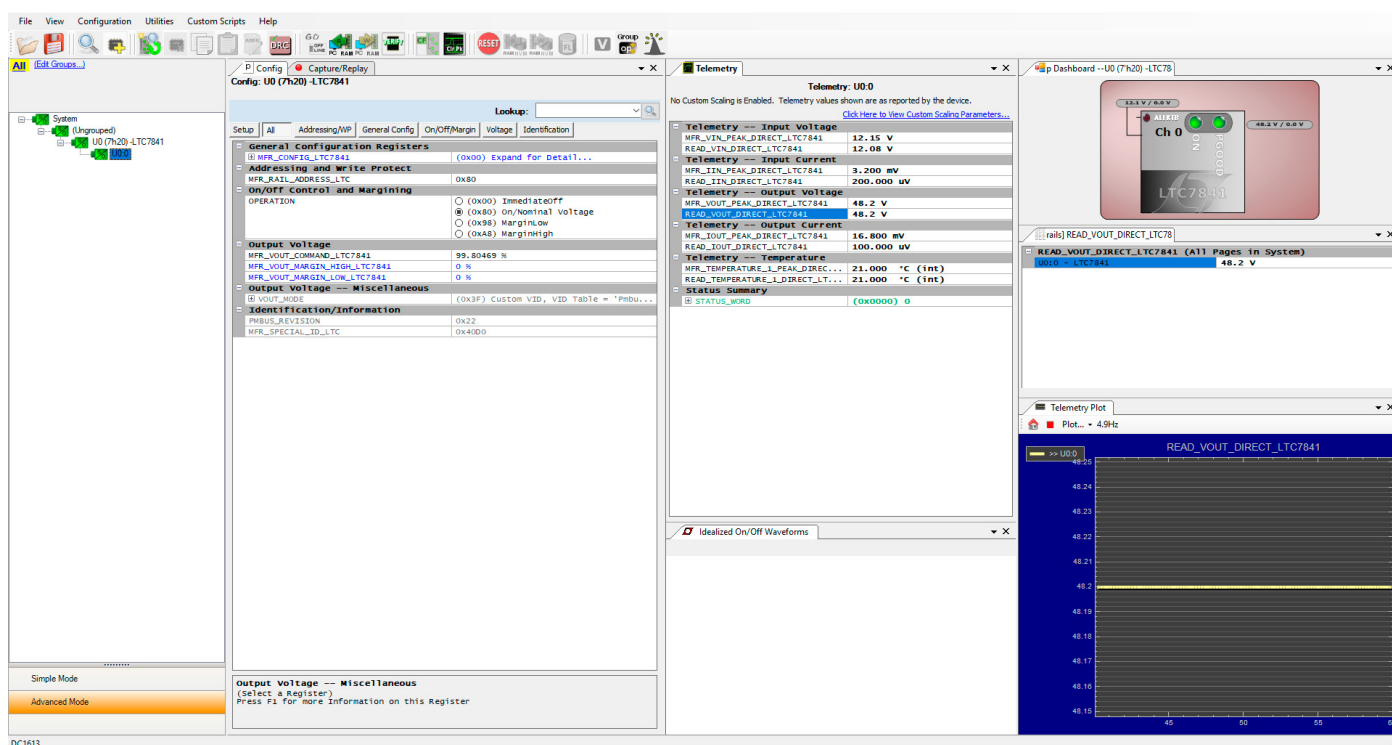


Figure 9. LTpowerPlay Main Interface

LTPowerPLAY QUICK START PROCEDURE

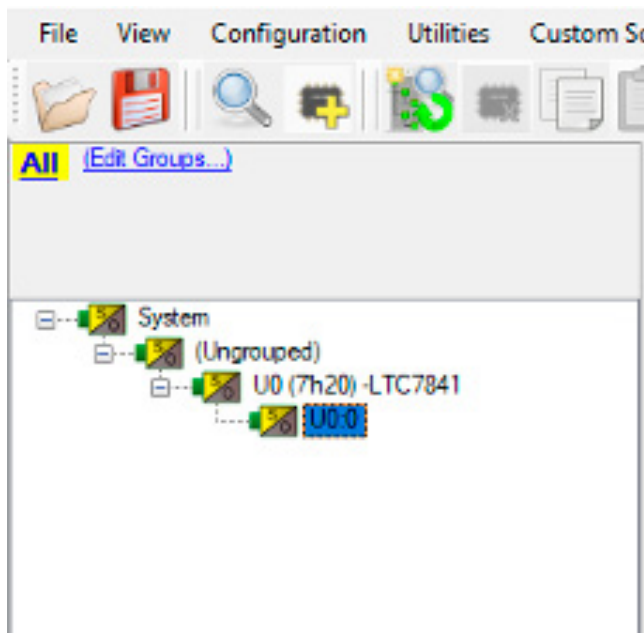
The following procedure describes how to use LTpowerPlay to monitor and change the settings of LTC7841.

1. Download and install the LTPowerPlay GUI:

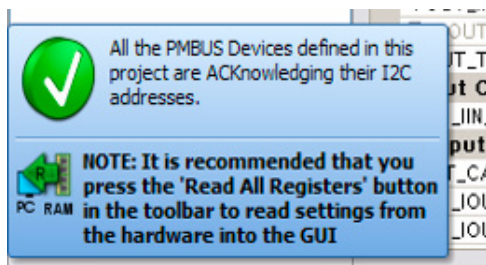
[LTpowerPlay](#)

2. Launch the LTpowerPlay GUI.

- a. The GUI should automatically identify the DC2798A. The system tree on the left hand side should look like this:



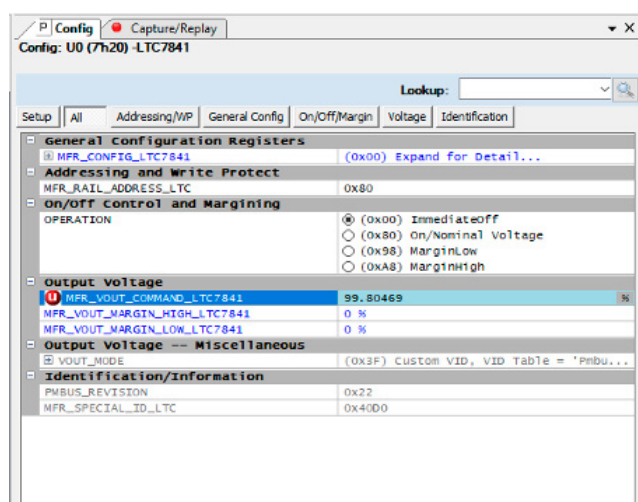
- b. A green message box shows for a few seconds in the lower left-hand corner, confirming that LTC7841 is communicating:



- c. Writing to the MFR_VOUT_COMMAND register via the PMBus allows the adjustment of the V_{OUT} reference from 0% to 100% of the maximum reference of 2.4V. With current demo board setting (R193 = 191k, and R194 = 10k), the V_{FB}/V_{OUT} ratio is about 1/20. Follow Equation 1 to get the correct V_{OUT}.

$$V_{OUT} = 20 \cdot \text{MFR_VOUT_COMMAND} (\%) \cdot 2.4 \quad (1)$$

If you want to set the output voltage to be 48V. In the Config tab, type in 99.8 in the MFR_VOUT_COMMAND_LTC7841 box, like this:



Then, click the “W” (PC to RAM) icon to write these register values to the LTC7841. After finishing this step, the V_{OUT} internal reference voltage is set to ~2.4V.

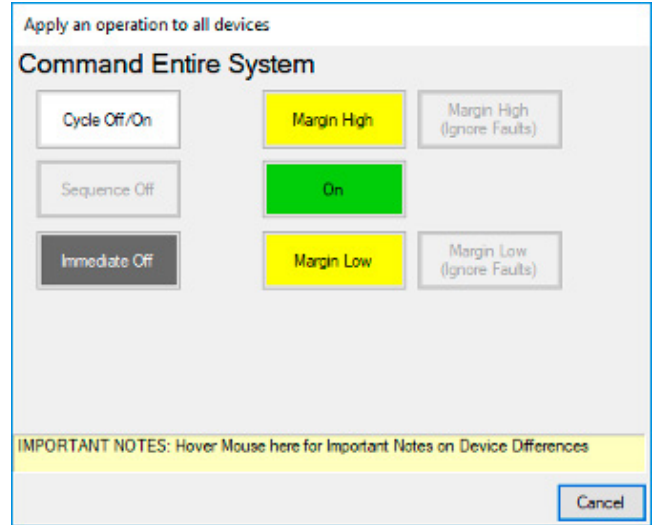


If the write is successful, you will see the following message:



LTPOWERPLAY QUICK START PROCEDURE

- d. If you want to set the output voltage to be 24V. In the Config tab, type in 50 in the MFR_VOUT_COMMAND_LTC7841 box. Then the V_{OUT} internal reference voltage is set to ~1.2V.
- e. In order to turn on the power stage, click the “Apply an operation to all devices” icon
- f. In the popup “Apply an operation to all devices” dialog box, click the “On” button to turn on the power stage



- g. After the test, in the popup “Apply an operation to all devices” dialog box, click the “Immediate Off” button to turn off the power stage.

DEMO MANUAL DC2798A

PARTS LIST

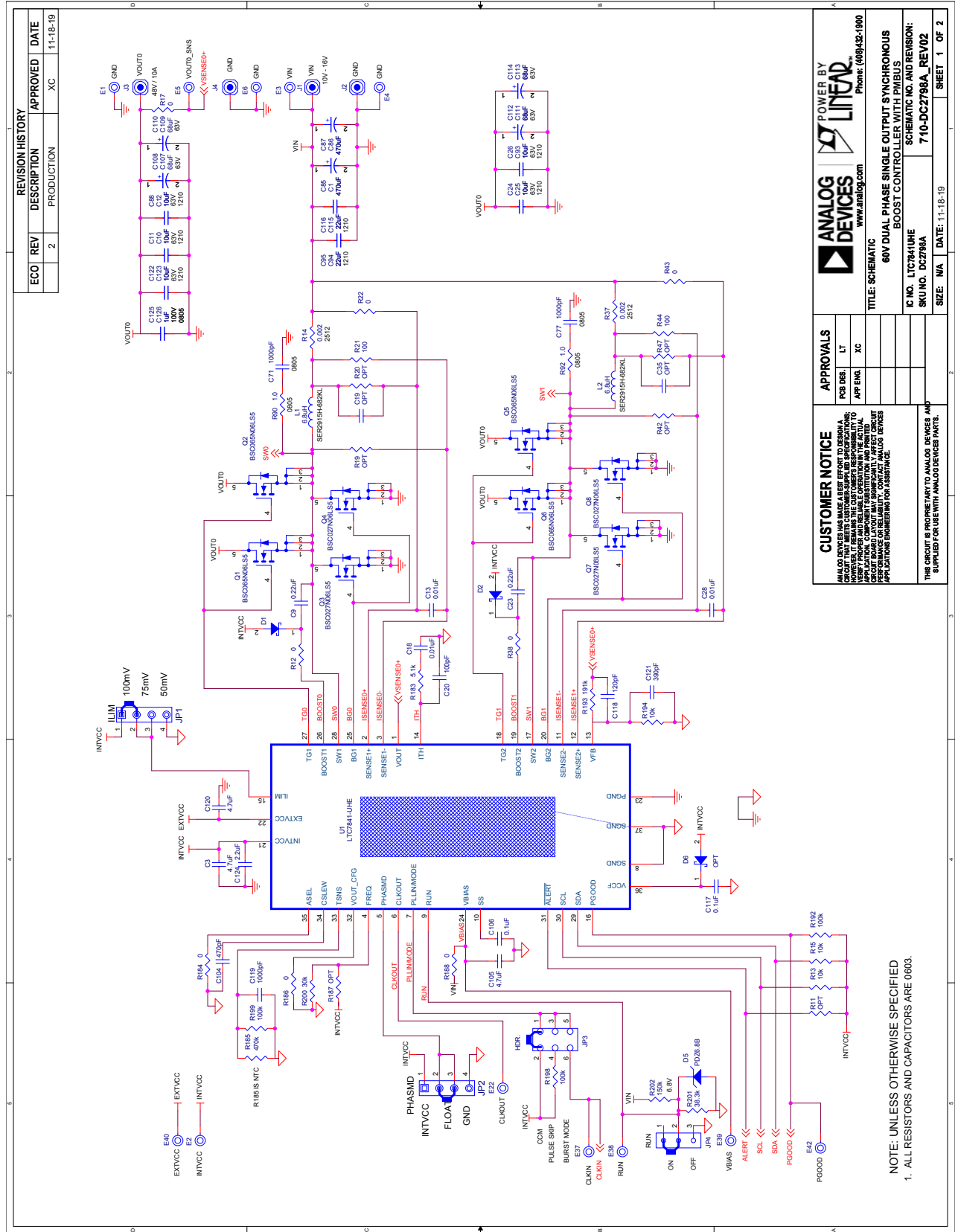
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	4	C1, C85-C87	CAP., 470µF, ALUM POLY HYB, 25V, 20%, 10x10.2mm, G, SMD, RADIAL, AEC-Q200	PANASONIC, EEHZK1E471P
2	3	C3, C105, C120	CAP., 4.7µF, X5R, 25V, 10%, 0603	MURATA, GRM188R61E475KE15D
3	2	C9, C23	CAP., 0.22µF, X7R, 25V, 10%, 0603	MURATA, GRM188R71E224KA88D
4	10	C10-C12, C24-C26, C88, C93, C122, C123	CAP., 10µF, X7R, 63V, 10%, 1210	SAMSUNG, CL32B106KMVNNWE
5	2	C13, C28	CAP., 0.01µF, X7R, 16V, 10%, 0603	AVX, 0603YC103KAT2A
6	1	C18	CAP., 0.01µF, X7R, 25V, 10%, 0603, AEC-Q200	AVX, 06033C103K4Z2A
7	1	C20	CAP., 100pF, COG/NPO, 50V, 5%, 0603	AVX, 06035A101JAT2A
8	2	C71, C77	CAP., 1000pF, COG, 100V, 5%, 0805	TDK, C2012C0G2A102J060AA
9	4	C94, C95, C115, C116	CAP., 22µF, X7R, 25V, 10%, 1210	SAMSUNG, CL32B226KAJNNNE
10	1	C104	CAP., 470pF, X7R, 50V, 10%, 0603	AVX, 06035C471KAT2A
11	2	C106, C117	CAP., 0.1µF, X7R, 100V, 10%, 0603	AVX, 06031C104KAT2A
12	8	C107-C114	CAP., 68µF, ALUM POLY HYB, 63V, 20%, 10x10.2mm, G, SMD, RADIAL, AEC-Q200	PANASONIC, EEHZC1J680P
13	1	C118	CAP., 120pF, COG/NPO, 100V, 5%, 0603	AVX, 06031A121JAT2A
14	1	C119	CAP., 1000pF, X7R, 16V, 10%, 0603	WURTH ELEKTRONIK, 885012206034
15	1	C121	CAP., 390pF, COG/NPO, 50V, 5%, 0603	AVX, 06035A391JAT2A
16	1	C124	CAP., 2.2µF, X7S, 16V, 10%, 0603, AEC-Q200	TDK, CGA3E1X7S1C225K080AC
17	2	C125, C126	CAP., 1µF, X7S, 100V, 10%, 0805	MURATA, GRJ21BC72A105KE11L
18	2	D1, D2	DIODE, SCHOTTKY, 100V, 1A, POWERDI-123	DIODES INC., DFLS1100-7
19	1	D5	DIODE, ZENER, 6.8V, 400mW, SOD-323	NEXPERIA, PDZ6.8B, 115
20	2	L1, L2	IND., 6.8µH, POWER SHIELDED WIREWOUND, 10%, 30A, 0.00205Ω, 27.9mm x 27.94mm	COILCRAFT, SER2915H-682KL
21	4	Q1, Q2, Q5, Q6	XSTR., MOSFET, N-CH, 60V, 64A, PG-TDSON-8	INFINEON, BSC065N06LS5
22	4	Q3, Q4, Q7, Q8	XSTR., MOSFET, N-CH, 60V, 100A, PG-TDSON-8	INFINEON, BSC027N06LS5
23	3	R13, R15, R194	RES., 10k, 1%, 1/10W, 0603	VISHAY, CRCW060310K0FKEC
24	2	R14, R37	RES., 0.002Ω, 1%, 3W, 2512, METAL, SENSE, AEC-Q200	PANASONIC, ERJMS4SF2M0U
25	2	R21, R44	RES., 100Ω, 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF1000V
26	2	R90, R92	RES., 1.0Ω, 5%, 1/2W, 0805	PANASONIC, ERJ6DQJ1R0V
27	1	R183	RES., 5.1k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F5101TRF
28	1	R185	RES., 470k, 1%, 210mW, 0805, NTC THERMISTOR, AEC-Q200	VISHAY, NTCS0805E3474FXT
29	3	R192, R198, R199	RES., 100k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW0603100KFKEA
30	1	R193	RES., 191k, 1%, 1/10W, 0603	VISHAY, CRCW0603191KFKEA
31	1	R200	RES., 30k, 1%, 1/10W, 0603, AEC-Q200	KOA SPEER, RK73H1JTDD3002F
32	1	R201	RES., 38.3k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F3832TRF
33	1	R202	RES., 150k, 1%, 1/10W, 0603	PANASONIC, ERJ3EKF1503V
34	1	U1	IC, POWER CONTROLLER, QFN-36 (5x6)	ANALOG DEVICES., LTC7841EUHE#PBF

PARTS LIST

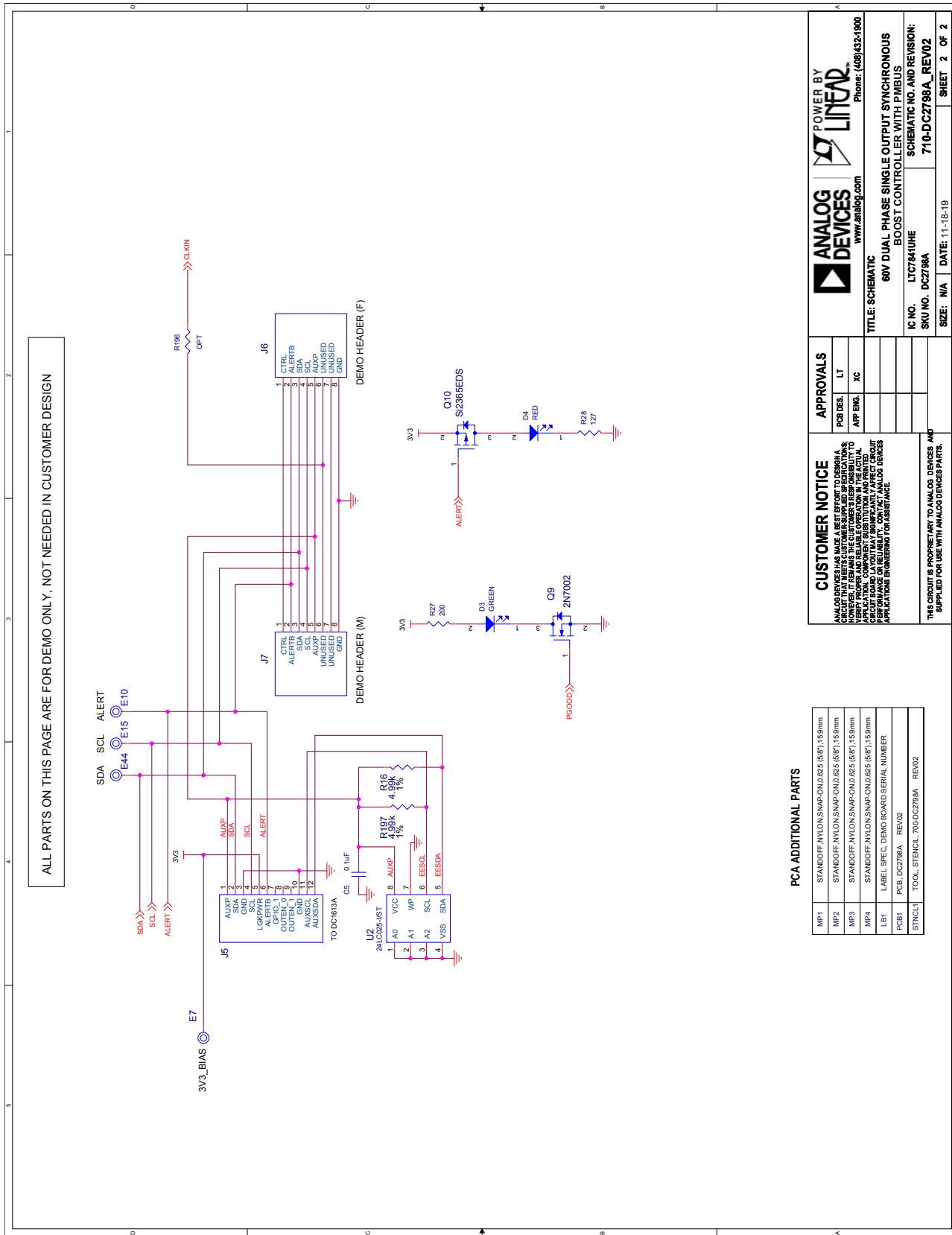
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Additional Demo Board Circuit Components				
1	1	C5	CAP, 0.1 μ F, X7R, 50V, 10%, 0603	AVX, 06035C104KAT2A
2	0	C19, C35	CAP, OPTION, 0603	
3	1	D3	LED, GREEN, WATERCLEAR, 1206	WURTH ELEKTRONIK, 150120GS75000
4	1	D4	LED, RED, WATERCLEAR, 1206	WURTH ELEKTRONIK, 150120RS75000
5	0	D6	DIODE, OPTION, SCHOTTKY, POWERDI 123	
6	1	Q9	XSTR., MOSFET N-CH, 60V, 300mA, SOT-23	VISHAY, 2N7002K-T1-GE3
7	1	Q10	XSTR., MOSFET, P-CH, 20V, 5.9A, TO-236 (SOT23-3)	VISHAY, Si2365EDS-T1-GE3
8	0	R11, R19, R20, R42, R47, R187, R196	RES., OPTION, 0603	
9	8	R12, R17, R22, R38, R43, R184, R186, R188	RES., 0 Ω , 1/10W, 0603, AEC-Q200	VISHAY, CRCW06030000Z0EA
10	2	R16, R197	RES., 4.99k, 1%, 1/10W, 0603	PANASONIC, ERJ3EKF4991V
11	1	R27	RES., 200 Ω , 1%, 1/10W, 0603	VISHAY, CRCW0603200RFKEA
12	1	R28	RES., 127 Ω , 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1270TRF
13	1	U2	IC, MEMORY, EEPROM, 2Kb (256x8), TSSOP-8, 400kHz	MICROCHIP, 24LC025-I/ST
Hardware For Demo Board Only				
1	16	E1-E7, E10, E15, E22, E37-E40, E42, E44	TEST POINT, TURRET, 0.094" MTG. HOLE, PCB 0.062" THK	MILL-MAX, 2501-2-00-80-00-00-07-0
2	4	J1-J4	EVAL BOARD STUD HARDWARE SET, #10-32	ANALOG DEVICES, 720-0010
3	1	J5	CONN., HDR, SHROUDED, MALE, 2x6, 2mm, VERT, ST, THT	FCI, 98414-G06-12ULF
4	1	J6	CONN., HDR, FEMALE, 2x4, 2mm, R/A THT	SULLINS CONNECTOR SOLUTIONS, NPPN042FJFN-RC
5	1	J7	CONN., HDR, MALE, 2x4, 2mm, R/A THT	MOLEX, 87760-0816
6	2	JP1, JP2	CONN., HDR, MALE, 1x4, 2mm, VERT, ST, THT	SAMTEC, TMM-104-02-L-S
7	1	JP3	CONN., HDR., MALE, 2x3, 2mm, VERT, ST, THT	WURTH ELEKTRONIK, 62000621121
8	1	JP4	CONN., HDR, MALE, 1x3, 2mm, VERT, ST, THT	WURTH ELEKTRONIK, 62000311121
9	4	MP1-MP4	STANDOFF, NYLON, SNAP-ON, 0.625 (5/8"), 15.9mm	KEYSTONE, 8834
10	4	XJP2, XJP7-XJP9	CONN., SHUNT, FEMALE, 2-POS, 2mm	SAMTEC, 2SN-BK-G

DEMO MANUAL DC2798A

SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



PCA ADDITIONAL PARTS

MP1	STANDOFF: NYLON, SMP-ON-0.625 (567), 1.59mm
MP2	STANDOFF: NYLON, SMP-ON-0.625 (567), 1.59mm
MP3	STANDOFF: NYLON, SMP-ON-0.625 (567), 1.59mm
MP4	STANDOFF: NYLON, SMP-ON-0.625 (567), 1.59mm
LB1	LABEL SPEC: DEMO BOARD SERIAL NUMBER
PCB1	PCB: DC2798A REV02
STNCL1	TOOL: STENCIL_700-DC2798A REV02

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APPROVALS

PCB DES.	LT
APP ENG.	XC

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TITLE: SCHEMATIC
60V DUAL PHASE SINGLE OUTPUT SYNCHRONOUS BOOST CONTROLLER WITH P-MEUS

IC NO.: LTC784UIHE
SKU NO.: DC2798A
SCHEMATIC NO. AND REVISION: 710-DC2798A_REV02
SIZE: N/A
DATE: 11-18-19
SHEET 2 OF 2



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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