

LTC3883EUH

Single-Phase, Step-Down DC/DC Controller with Digital Power Management

DESCRIPTION

Demonstration circuit 1778B-A is a single-output, synchronous buck converter featuring the [LTC3883EUH](#), a single-output current mode controller with digital power management and input current sense capability. It senses output inductor current across a sense resistor.

The board can be populated with the LTC3883EUH-1, which allows the user to provide bias power to the IC from an external power supply to save on-board LDO power loss.

The output voltage of the board can be programmed from 0.5V to 5V, with output current up to 20A. The factory default setting for the output is 1.8V.

The DC1778B-A powers up to default settings and produces power based on configuration resistors, or NVM, without the need for any serial bus communication. This allows easy evaluation of the DC/DC converter aspects of the LTC3883. To fully explore the extensive digital

power management features of the part, download the LTpowerPlay® GUI software onto your PC and use LTC's I²C/SMBus/PMBus dongle DC1613A to connect to the board. LTpowerPlay allows the user to reconfigure the part on-the-fly and store the configuration in EEPROM, view telemetry of voltage, current, temperature and fault status.

GUI DOWNLOAD

The software can be downloaded from:

<http://www.linear.com/ltpowerplay>

For more details and instructions of LTpowerPlay, please refer to the LTpowerPlay for LTC3883 Quick Start Guide.

Design files for this circuit board are available at
<http://www.linear.com/demo/DC1778B-A>

LT, LT, LTC, LTM, Linear Technology, the Linear logo and LTpowerPlay are registered trademarks of Linear Technology Corporation. All other trademarks are the property of their respective owners.

PERFORMANCE SUMMARY

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

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	Input Supply Range		6.5	12	24	V
V_{OUT}	Output Voltage Range	$I_{OUT} = 0\text{A to } 20\text{A}$, $V_{IN} = 6.5\text{V to } 24\text{V}$	0.5	1.8	5.0	V
V_{OUT_ACC}	Output Voltage Range Accuracy	$I_{OUT} = 0\text{A to } 20\text{A}$, $V_{IN} = 6.5\text{V to } 24\text{V}$, $V_{OUT} = 0.5\text{V to } 5.0\text{V}$	-0.5		0.5	%
I_{OUT}	Output Current Range		0		20	A
f_{SW}	Factory Default Switching			425		kHz
EFF	Peak Efficiency	$V_{OUT} = 1.8\text{V}$, See Figure 6		91.4		%

QUICK START PROCEDURE

Demonstration circuit 1778B-A makes it easy to set up to evaluate the performance of the LTC3883. Refer to Figure 3 for proper measurement equipment setup, and follow the procedure below.

NOTE: When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the output voltage ripple by touching the probe tip directly across the C11. See Figure 5 for the proper scope probe technique.

1. Make sure jumpers are in the following positions:

JUMPER	POSITION	FUNCTION
JP1	OFF	Write Protection of LTC3883
JP2	FT3	GPIOB to Fault 3 (of the Connector)
JP3	CTRL0	RUN to Control 0 (of the Connector)
JP5	OFF	EXTVCC_DRV: External V_{CC} for the LTC3883-1
JP6	ON	LED Indicator

2. With power off, connect the input power supply to V_{IN} and GND. Connect active load to the output.
3. Make sure RUN switch (SW1) is OFF.
4. Turn on the power at the input.

NOTE: Make sure that the input voltage does not exceed 24V.

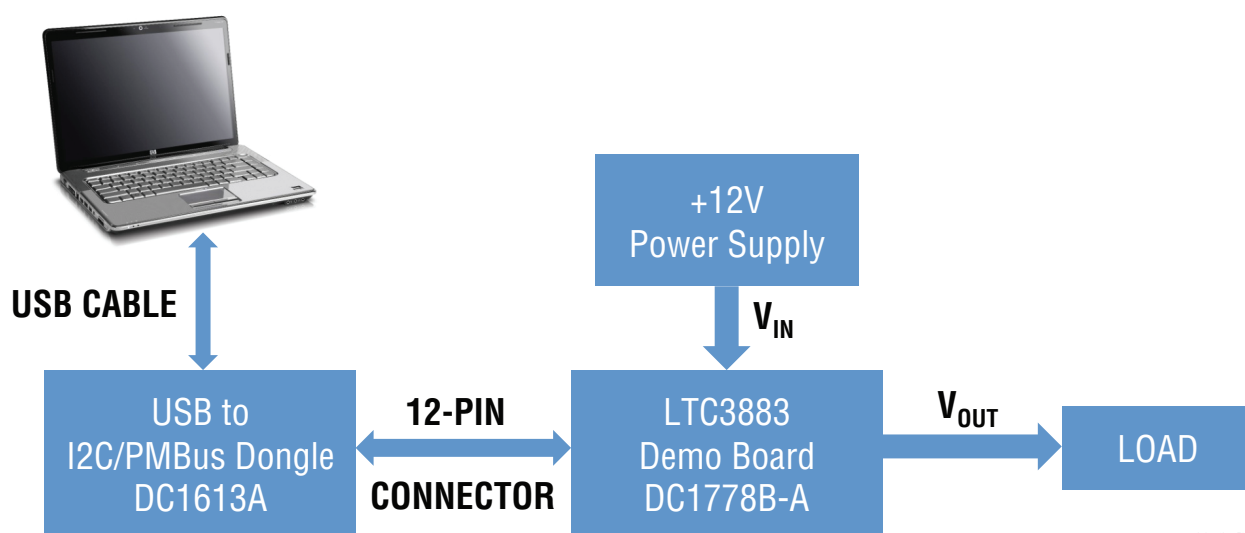
5. Turn on the RUN switch as desired.
6. Check for the correct output voltage. $V_{OUT} = 1.8V \pm 0.5\%$ (1.791V ~ 1.809V).

NOTE: If there is no output, temporarily disconnect the load to make sure that the load is not set too high.

7. Once the proper output voltages are established, adjust the loads within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other parameters.
8. Connect the dongle and control the output voltages from the GUI. See LTpowerPlay for LTC3883 Quick Start Guide for detail.

CONNECTING A PC TO DC1778B-A

You can use a PC to reconfigure the power management features of the LTC3883, such as: nominal V_{OUT} , margin set points, OV/UV limits, temperature fault limits, sequencing parameters, the fault log, fault responses, GPIO and other functionality. The DC1613A dongle may be plugged in regardless of whether or not V_{IN} is present.



dc1778b-a F01

Figure 1. Demo Setup with PC

QUICK START PROCEDURE

Plug the dongle into the correct connector. The dongle can be hot plugged.

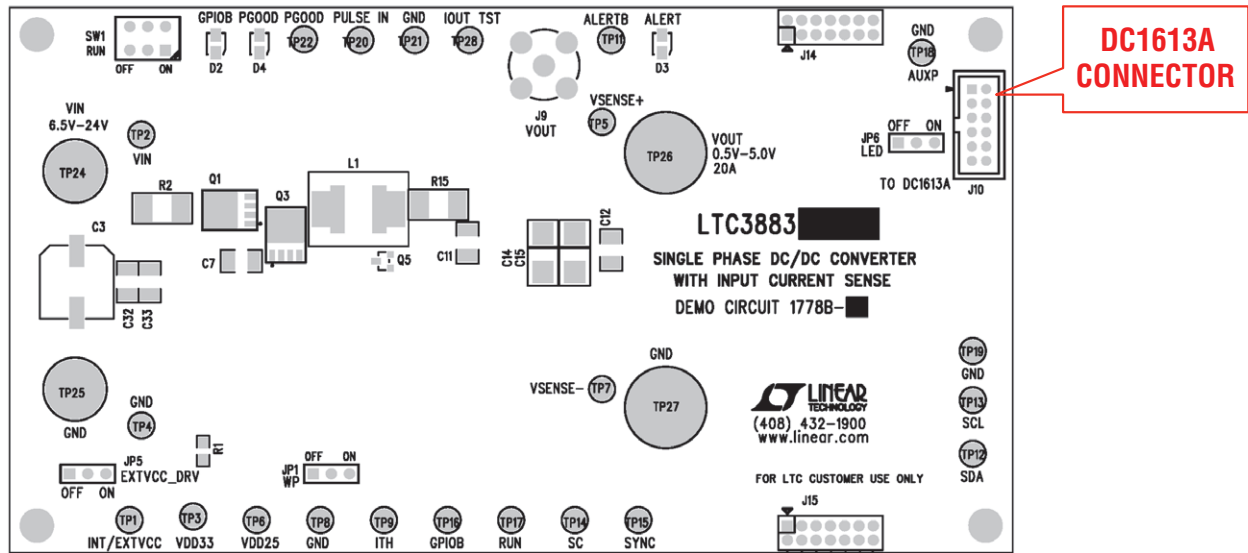


Figure 2. Dongle Connector Locations

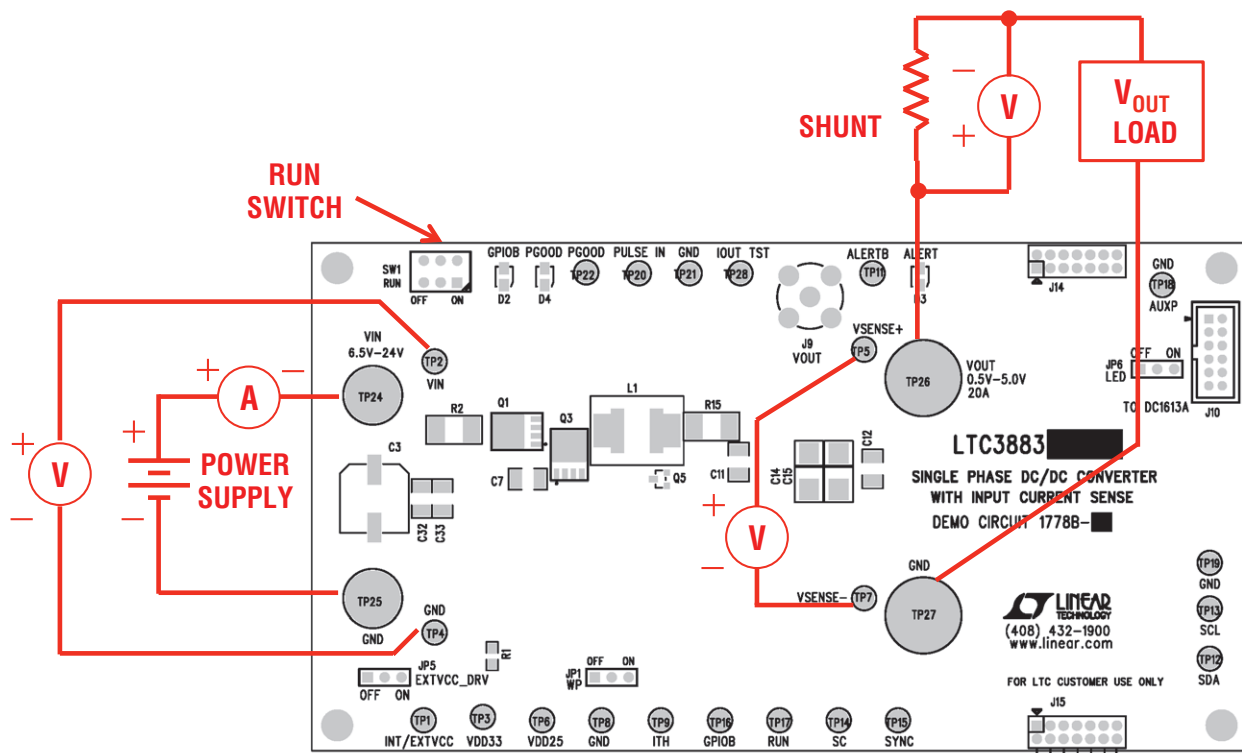


Figure 3. Power Test Setup

QUICK START PROCEDURE

Combining DC1778B-A with Other Digital Power Demo Boards

The DC1778B-A may be plugged together in a multiboard array with other LTC digital power boards, using J6 and J7.

Measuring Efficiency (See Figure 4)

To accurately measure efficiency of any configuration, do the following:

- Make sure R52 (bleeder resistor on bottom side of board) is not installed.
- Set JP6 to OFF to disable the regulator that provides power to LEDs.
- Measure V_{IN} across the input ceramic capacitor (C7). Measure V_{OUT} across the output ceramic capacitor (C11).

Evaluating the LTC3883 When V_{IN} Is Below 6V

For applications using an input voltage within 4.5V to 6V, please install R5 to connect V_{IN} directly to INTVCC. Please be aware that in this case V_{IN} cannot exceed 6V, otherwise the chip will be damaged.

Evaluating the LTC3883-1

For applications that require the highest possible efficiency, the LTC3883-1 allows the user to supply the

bias voltage and gate driver current from an external power supply. Connect the external power supply, 4.8V to 5.2V, to the EXTVCV pin. Obtain a DC1778B-A with an LTC3883-1 installed from your Linear Technology Field Applications Engineer.

To use the on-board LDO to drive INTVCC, make the following modifications to the demo board:

- Set JP5 to ON so that U3 provides the 5V drive to INTVCC. U3 takes the place of the external power supply.

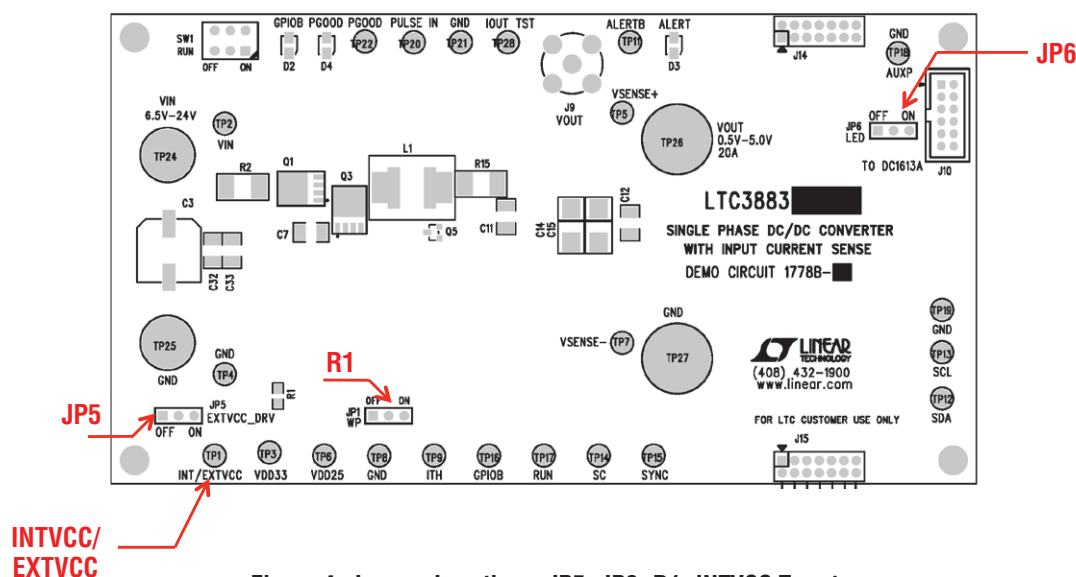
- Install R1.

To accurately measure efficiency of a demo board containing an LTC3883-1:

- Drive INTVCC from an external source through the pin named: INT/EXTVCC.
- Set JP5 to OFF to disable U3.
- Measure V_{IN} across the input ceramic capacitor (C7). Measure V_{OUT} across the output ceramic capacitor (C11).

Measuring Output Ripple Voltage

An accurate ripple measurement may be performed by using the configuration in Figure 5 across C11.



QUICK START PROCEDURE

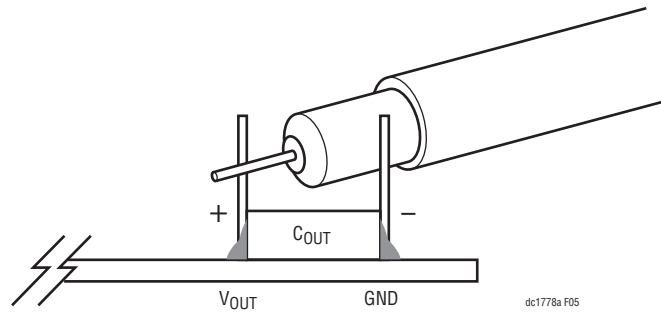


Figure 5. Measuring Output Voltage Ripple

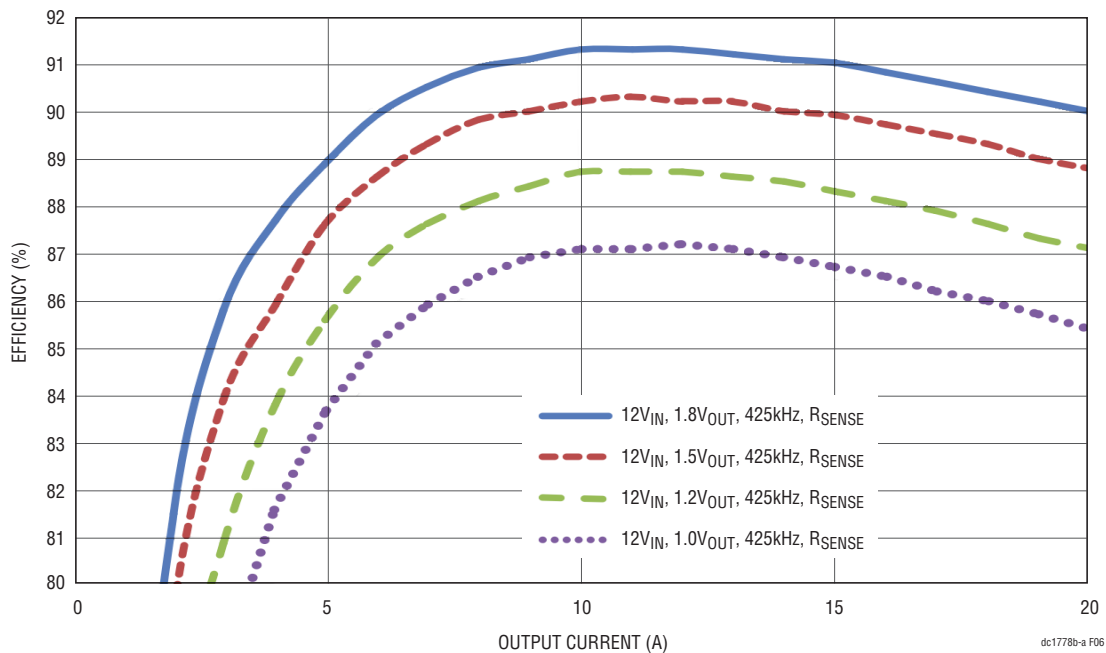


Figure 6. Typical Efficiency Curves, DC1778B-A Sense Resistor Current Sensing, 12V_{IN}, f_{SW} = 425kHz

QUICK START PROCEDURE

LTpowerPlay Software GUI

LTpowerPlay is a powerful Windows-based development environment that supports Linear Technology digital power ICs with EEPROM, including the LTC3883, LTC2974 and LTC2978. The software supports a variety of different tasks. You can use LTpowerPlay to evaluate Linear Technology ICs by connecting to a demo board system. LTpowerPlay can also be used in an offline mode (with no hardware present) in order to build a multichip configuration file that can be saved and reloaded at a later time. 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 the LTC3880's DC1590B 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:

<http://linear.com/ltpowerplay>

To access technical support documents for LTC Digital Power Products visit Help. View online help on the LTpowerPlay menu.

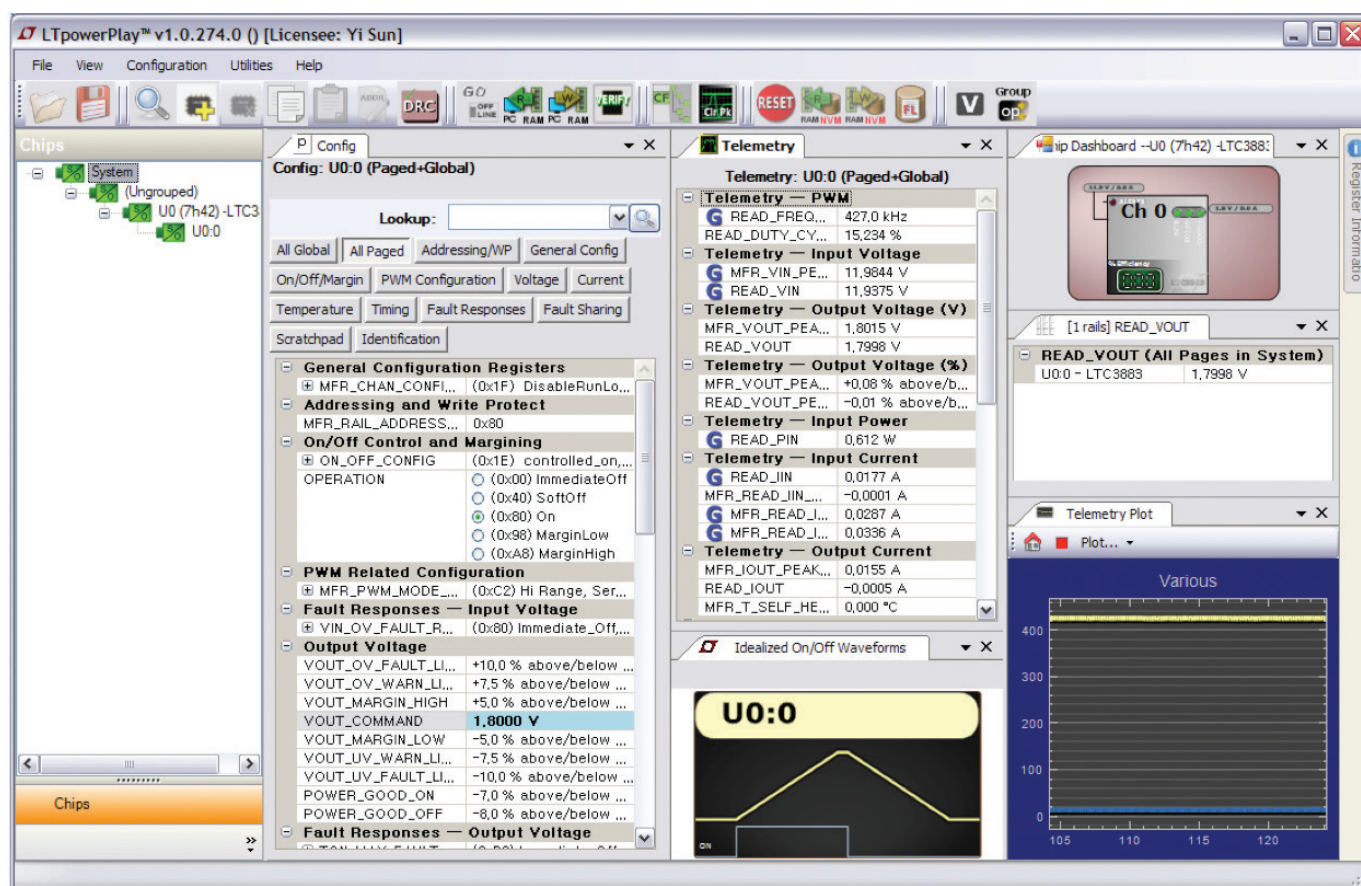


Figure 7. LTpowerPlay Software GUI

GUI QUICK START PROCEDURE

LTpowerPlay Software GUI

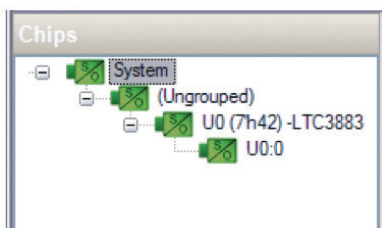
The following procedure describes how to use LTpowerPlay to monitor and change the settings of the LTC3883.

1. Download and install the LTpowerPlay GUI:

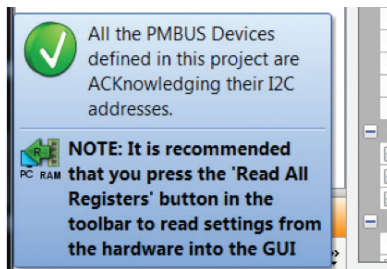
<http://linear.com/ltpowerplay>

2. Launch the LTpowerPlay GUI.

- a. The GUI should automatically identify the LTC3883. The system tree on the left hand side should look like this:



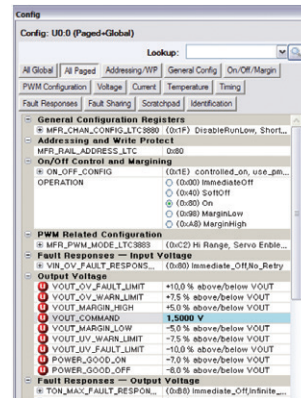
- b. A green message box shows for a few seconds in the lower left hand corner, confirming that the LTC3883 is communicating:



- c. In the tool bar, click the “R” (RAM to PC) icon to read the RAM from the LTC3883. This reads the configuration from the RAM of LTC3883 and loads it into the GUI.



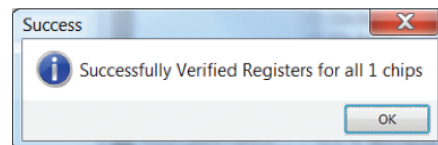
- d. To change the output voltage to a different value, like 1.5V: In the Config tab, type 1.5 in the VOUT_COMMAND box, like this:



Then, click the “W” (PC to RAM) icon to write these register values to the LTC3883. After finishing this step, you will see the output voltage will change to 1.5V.



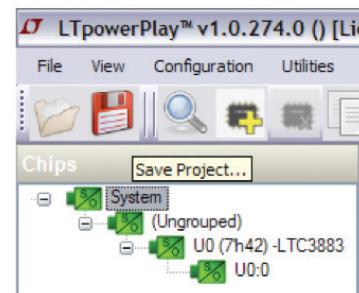
If the write is successful, this message appears:



- e. To save the changes into the NVM: In the tool bar, click the “RAM to NVM” button:



- f. Save the demo board configuration to a (*.proj) file by clicking the Save icon. Name it whatever you want.



DEMO MANUAL DC1778B-A

GUI QUICK START PROCEDURE

Loading a LTC3883 Configuration (*.proj) File with the GUI

- In the upper left hand corner of the GUI: File>Open>browse to your *.proj file. This will load the file into the GUI.
- Click the “Go On Line” button to link the GUI to the existing LTC3883, as this:



- Click on the “W” (PC to RAM) button. This loads the configuration into LTC3883 RAM.
- Then, you can save the configuration to the EEPROM. Please see previous step f for details.

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART #
Required Circuit Components				
1	5	C2, C10, C50, C6, C18	CAP., 0.1μF, X7R, 25V, 10%, 0603	TDK, C1608X7R1E104K080AA
2	4	C4, C5, C8, C34	CAP., 1μF, X5R, 25V, 10%, 0603	AVX, 06033D105KAT2A
3	4	C7, C9, C32, C33	CAP., 10μF, X5R, 35V, 10%, 1210	AVX, 1210DD106KAT2A
4	1	C29	CAP., 10μF, X5R, 25V, 10%, 1206	MURATA, GRM31CR61E106KA12L
5	2	C26, C27	CAP., 1μF, X7R, 25V, 10%, 1206	AVX, 12063C105KAT2A
6	2	C1, C25	CAP., 4.7μF, X5R, 10V, 10%, 0603	AVX, 0603ZD475KAT2A
7	3	C11, C12, C13	CAP., 100μF, X5R, 6.3V, 10%, 1210	AVX, 12106D107KAT2A
8	2	C14, C15	CAP., POSCAP, 330μF, 6.3V, 20%, 7343, D3L CASE	PANASONIC, 6TPF330M9L
9	1	C3	CAP., ALUM., ELECT., 150μF, 35V, 20%	SUN ELECTRONIC, 35HVP150M
10	2	Q1, Q6	XSTR., MOSFET, N-CH, 25V, 58A, TDSO-N-8	INFINEON, BSC050NE2LS
11	1	Q3	XSTR., MOSFET, N-CH, 25V, 100A, TDSO-N-8	INFINEON, BSC010NE2LSI
12	1	R23	RES., 24.9k, 1/10W, 1%, 0603	VISHAY, CRCW060324K9FKEA
13	1	R28	RES., 4.32k, 1/10W, 1%, 0603	VISHAY, CRCW06034K32FKEA
14	1	R2	RES., SENSE, 0.005Ω, 1W, 1%, 2512	PANASONIC, ERJM1WSF5M0U
15	2	R3, R4	RES., 100Ω, 1/10W, 1%, 0603	VISHAY, CRCW0603100RFKEA
16	7	R14, R16, R22, R33, R79, R83, R90	RES., 0, 1/10W, 0603	NIC, NRC06ZOTRF
17	3	R6, R84, R85	RES., 4.99k, 1/10W, 1%, 0603	VISHAY, CRCW06034K99FKEA
18	3	R7, R12, R13	RES., 1k, 1/10W, 1%, 0603	VISHAY, CRCW06031K00FKEA
19	8	R8, R9, R10, R11, R32, R53, R49, R61	RES., 10k, 1/10W, 1%, 0603	NIC, NRC06F1002TRF
20	3	R51, R55, R60	RES., 249Ω, 1/10W, 1%, 0603	VISHAY, CRCW0603249RFKEA
21	1	R52	RES., 30Ω, 1W, 1%, 2512	VISHAY, CRCW251230R0FKEG
22	1	R54	RES., SENSE, 0.05Ω, 1/2W, 1%, 2010	VISHAY, WSL2010R0500FEA
23	2	R56, R57	RES., 100k, 1/10W, 1%, 0603	VISHAY, CRCW0603100KFKEA PANASONIC, ERJ3EKF1003V
24	1	R77	RES., 10Ω, 1/10W, 1%, 0603	VISHAY, CRCW060310R0FKEA

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART #
25	1	R58	RES., 3Ω, 1/10W, 1%, 0603	VISHAY, CRCW06033R00FKEA
26	1	R62	RES., 15.8k, 1/10W, 1%, 0603	VISHAY, CRCW060315K8FKEA
27	0	R17, R18, R5 (OPT)	RES., OPTION, 0603	OPT.
28	2	R19, R20	RES., 0Ω, 1/10W, 0603	NIC, NRC06ZOTRF
29	2	R21, R27	RES., 100Ω, 1/10W, 1%, 0603	VISHAY, CRCW0603100RFKEA
30	1	L1	ND., HIGH FREQ. PWR., 0.2μH	VITEC, 59PR9875
31	1	U1	IC, LTC3883EUA, QFN 6mm × 6mm	LINEAR TECH., LTC3883EUA#10CB-1PBF-ES
32	0	C16 (OPT)	CAP., OPTION, 0603	OPT.
33	1	C17	CAP., 1000pF, X7R, 25V, 10%, 0603	AVX, 06033C102KAT2A
34	1	R15	RES., SENSE, 0.002Ω, 1W, 1%, 2512	VISHAY, WSL25122L000FEA
35	0	R17, R18(OPT)	RES., OPTION, 0603	OPT.
36	2	R19, R20	RES., 0Ω, 1/10W, 0603	NIC, NRC06ZOTRF
37	2	R21, R27	RES., 100Ω, 1/10W, 1%, 0603	VISHAY, CRCW0603100RFKEA
38	1	L1	IND., HIGH FREQ. PWR., 0.4μH	VITEC, 59PR9875
39	1	U1	IC, LTC3883EUA, QFN 6mm × 6mm	LINEAR TECH., LTC3883EUA#10CB-1PBF-ES

Additional Circuit Components

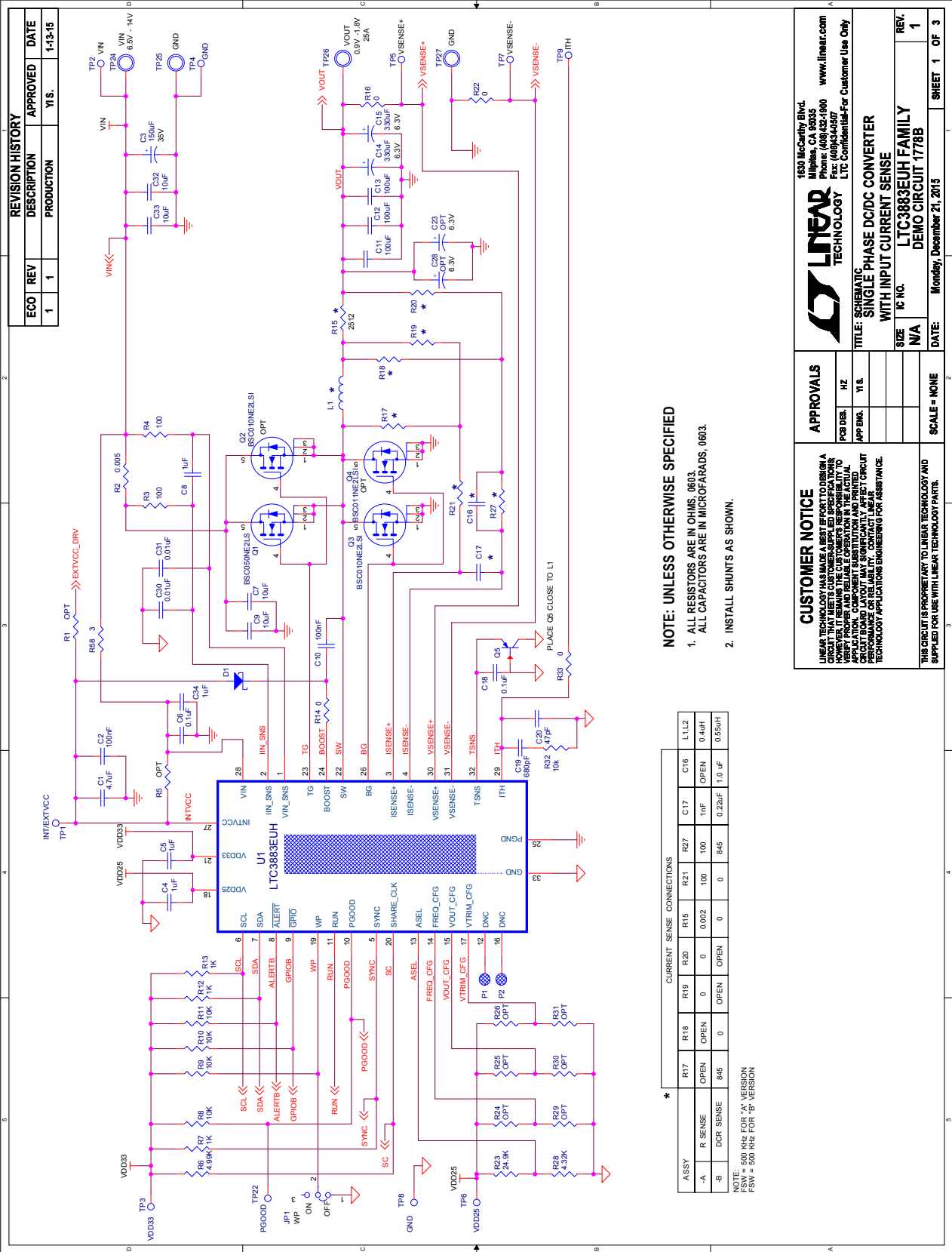
1	0	C23, C28 (OPT)	CAP., POSCAP, 330μF, 4V, D3L	OPT.
2	1	C19	CAP., 680pF, X7R, 25V, 10%, 0603	AVX, 06033C681KAT2A
3	1	C20	CAP., 47pF, C0G, 50V, 5%, 0603	AVX, 06035A470JAT2A
4	1	C46	CAP., 0.01μF, X7R, 50V, 10%, 0603	AVX, 06035C103KAT2A
5	1	C24	CAP., 0.22μF, X5R, 25V, 10%, 0805	AVX, 08053D224KAT2A
6	2	C30, C31	CAP., 0.01μF, X5R, 50V, 10%, 0603	AVX, 06035D103KAT2A
7	1	D1	DIODE, SCHOTTKY, SOD-323	CENTRAL SEMI., CMDSH-3 TR LEAD FREE
8	2	D2, D4	LED, GREEN WATER CLEAR, 571nm @ 5mA, 4.5 ~28mcd @5mA, 0603	LITE ON LTST-C193KGKT-5A
9	1	D3	LED, RED, WATER CLEAR, 631nm @ 5mA, 7.1 ~45mcd @ 5mA, 0603	LITE-ON LTST-C193KRKT-5A
10	0	D9 (OPT)	DIODE, SOD-323	OPT.
11	0	Q2 (OPT)	XSTR., MOSFET SPEED SRS 30V 30A LPAK	OPT.
12	0	Q4 (OPT)	XSTR., MOSFET JET SERIES LPAK	OPT.
13	1	Q5	XSTR., GP SS, PNP, 40V, SOT-23	ON SEMI., MMBT3906LT1G
14	2	Q7, Q10	XSTR., MOSFET, P-CH, 20V, 0.58A, SOT-23	VISHAY, SI2365EDS-T1-GE3
15	2	Q8, Q9	XSTR., MOSFET, N-CH, 60V, 115MA, SOT-23	FAIRCHILD, 2N7002
16	0	R1(OPT)	RES., OPTION, 0805	OPT.
17	0	R5, R24-R26, R29-R31, R81, R82, R86, R87, R96 (OPT)	RES., OPTION, 0603	OPT.
18	1	SW1	SWITCH, SUB MINIATURE SLIDE DPDT 6VDC 0.3A, THRU-HOLE	C&K COMPONENTS, JS202011CQN
19	1	U5	I.C., EEPROM SERIAL-I ² C, 2K-bit, TSSOP-8	MICROCHIP, 24LC025-I/ST
20	1	U3	I.C., LT1129CS8-5, S8 PACKAGE	LINEAR TECH, LT1129CS8-5#PBF
21	1	U4	I.C., LT1129CS8-3.3 S8 PACKAGE	LINEAR TECH. LT1129CS8-3.3#PBF

DEMO MANUAL DC1778B-A

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART #
Hardware				
1	3	JP1, JP5, JP6	CONN., HEADER, 1×3, 2.54mm	SAMTEC, TSW-103-07-L-S
2	3	JP1,JP5,JP6	SHUNT, 2.54mm	SAMTEC, SNT-100-BK-G
3	2	TP24, TP25	CONN., JACK, BANANA, NON-INSULATED, 0.218"	KEYSTONE, 575-4
4	2	TP26, TP27	STUD, FASTENER, #10-32	PEM, KFH-032-10
5	4	TP26, TP27 (×2)	NUT, BRASS, #10-32	ANY 10-32M/S BR PL
6	2	TP26-TP27	RING, LUG, CRIMP, #10	KEYSTONE, 8205
7	2	TP26-TP27	WASHER, TIN PLATED BRASS, #10	ANY 10EXT BZ TN
8	1	J14	CONN RECEPT 2mm DUAL R/A 14POS (F)	SULLINS, NPPN072FJFN-RC
9	1	J15	HEADER 14POS 2mm R/A GOLD (M)	MOLEX, 87760-1416
10	1	J10	CONN., HEADER, 12POS, 2mm, STR DL, THRU-HOLE	FCI, 98414-G06-12ULF
11	1	J9	CONN., BNC PC MOUNT RECEPT. JACK, 50Ω, TF-4 POST	AMPHENOL CONNEX, 112404
12	21	TP1-TP9, TP11-TP22, TP28	TEST POINT, TURRET, 0.064" MTG. HOLE	MILL-MAX, 2308-2-00-80-00-00-07-0

SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM

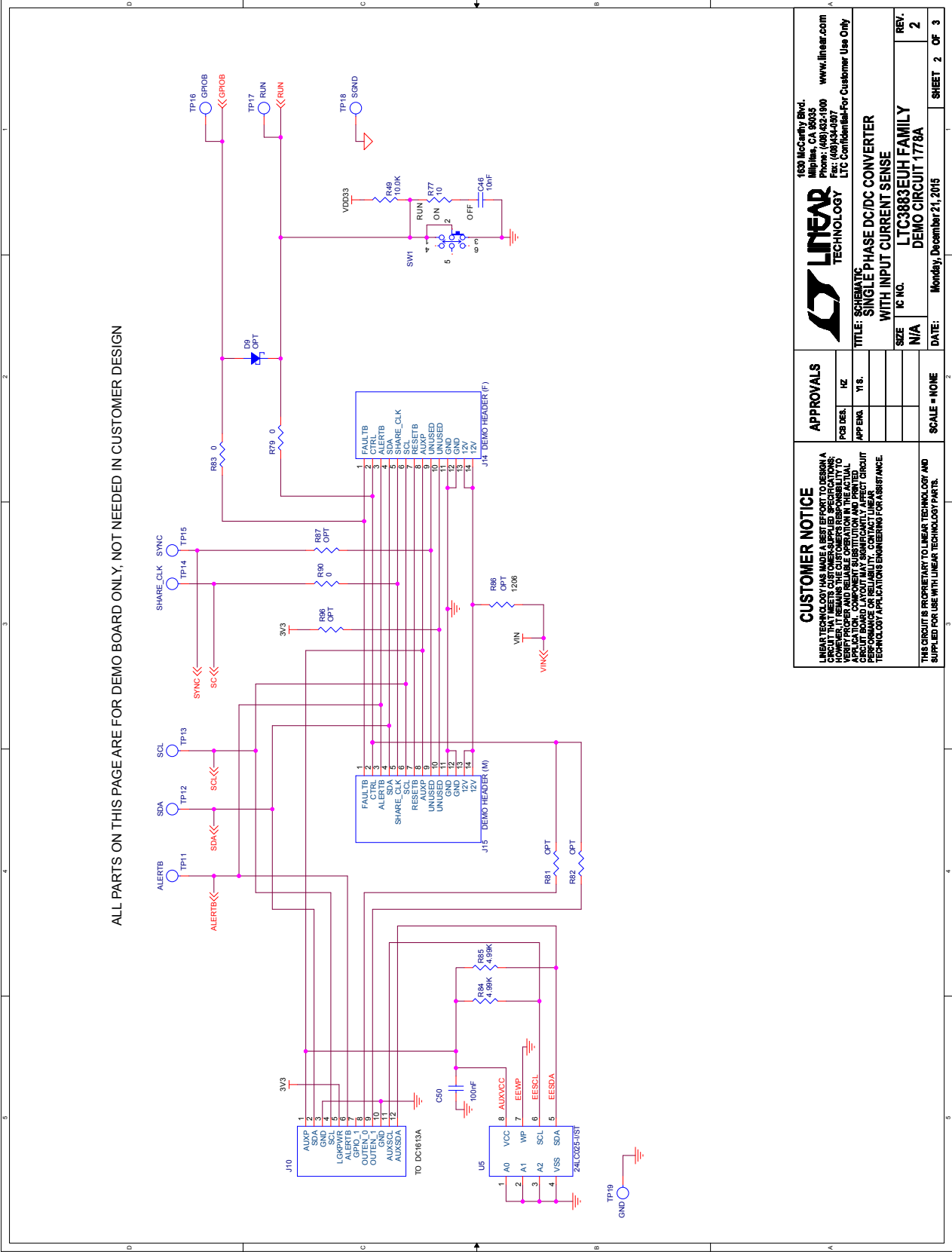


Figure 9. Demo Circuit 1778B-A Single-Phase DC/DC Converter with Input Current Sense

CUSTOMER NOTICE LINEAR TECHNOLOGY HAS MADE A BEST EFFORT TO DESIGN A CIRCUIT THAT MEETS OUR CUSTOMER'S REQUIREMENTS. HOWEVER, IT REMAINS THE CUSTOMER'S RESPONSIBILITY TO VERIFY PROPER AND RELIABLE OPERATION IN THE ACTUAL CIRCUIT. CUSTOMERS MUST CONTACT LINEAR TECHNOLOGY FOR ASSISTANCE. LAYOUT MAY VARY WITHOUT AFFECT CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE.		APPROVALS <table><tr><td>DESIGN</td><td>HC</td></tr><tr><td>APP'NG</td><td>YLS</td></tr></table>		DESIGN	HC	APP'NG	YLS
DESIGN	HC						
APP'NG	YLS						
LINEAR TECHNOLOGY 1630 McCarthy Blvd. Milpitas, CA 95035 Phone: (408) 432-1900 Fax: (408) 434-2007 www.linear.com		SCHEMATIC TITLE: SINGLE PHASE DC/DC CONVERTER WITH INPUT CURRENT SENSE					
		SIZE	16 IN.				
		N/A	LTC3883EUH FAMILY DEMO CIRCUIT 1778A				
		REV.	2				
THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.		SCALE = 1:1	DATE: Monday, December 21, 2015	SHEET 2 OF 3			

SCHEMATIC DIAGRAM

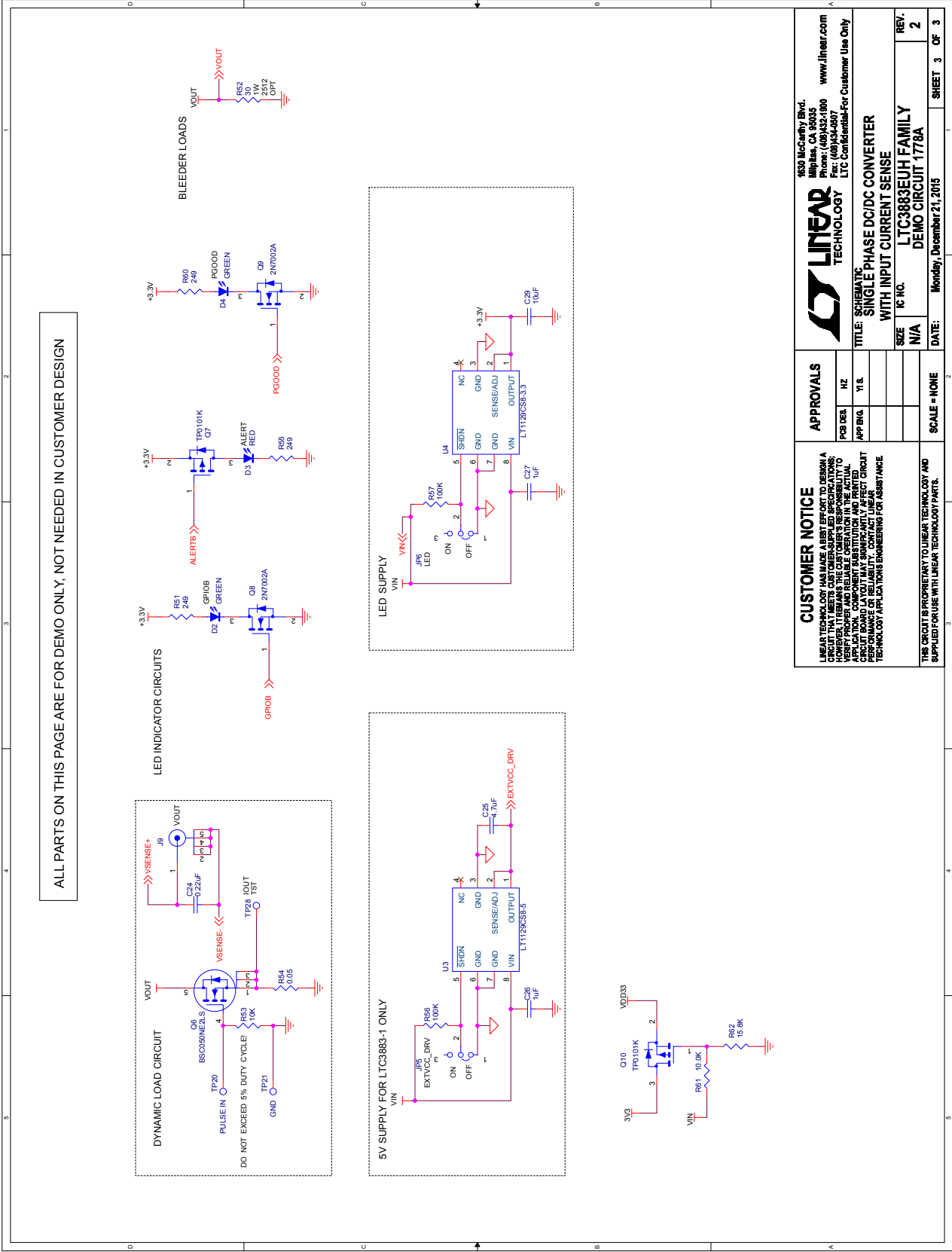


Figure 10. Demo Circuit 1778B-A Single-Phase DC/DC Converter with Input Current Sense

DEMO MANUAL DC1778B-A

DEMONSTRATION BOARD IMPORTANT NOTICE

Linear Technology Corporation (LTC) provides the enclosed product(s) under the following **AS IS** conditions:

This demonstration board (DEMO BOARD) kit being sold or provided by Linear Technology is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not provided by LTC for commercial use. As such, the DEMO BOARD herein may not be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including but not limited to product safety measures typically found in finished commercial goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may or may not meet the technical requirements of the directive, or other regulations.

If this evaluation kit does not meet the specifications recited in the DEMO BOARD manual the kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY THE SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THIS INDEMNITY, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user releases LTC from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge. Also be aware that the products herein may not be regulatory compliant or agency certified (FCC, UL, CE, etc.).

No License is granted under any patent right or other intellectual property whatsoever. **LTC assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or any other intellectual property rights of any kind.**

LTC currently services a variety of customers for products around the world, and therefore this transaction **is not exclusive**.

Please read the DEMO BOARD manual prior to handling the product. Persons handling this product must have electronics training and observe good laboratory practice standards. **Common sense is encouraged.**

This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

Mailing Address:

Linear Technology
1630 McCarthy Blvd.
Milpitas, CA 95035

Copyright © 2004, Linear Technology Corporation

dc1778baf