

Dual Power Supply Monitor and Margining Controller with LTC3828 Dual DC/DC Supply

DESCRIPTION

The DC980A and DC980B are a demonstration system that showcases the [LTC2970](#), a dual power supply monitor and margining controller with an I²C interface. The DC980A board contains the LTC2970 device and the DC980B board contains the [LTC3828](#) dual DC/DC controller. The two boards interface to each other via a 20-pin connector. The DC980B board features the LTC3828 dual output, 2-phase synchronous buck regulator. The LTC2970's two voltage-buffered, 8-bit IDACs allow highly accurate margining of the LTC3828's output voltages. The IDACs can be configured to automatically servo the power supplies to a desired voltage using the ADC for feedback. The DC980B comes preconfigured with 3.3V and 5V power supply rail voltages.

The LTC2970's low drift reference and 14-bit $\Delta\Sigma$ A/D converter allow precise measurements of two power supply output voltages and load currents. Fault management allows ALERTB to be asserted for configurable over- and undervoltage fault conditions.

This demonstration system is supported by the LTpowerPlay™ graphical user interface (GUI) which enables complete control of all the features of the device. Together, the LTpowerPlay software and DC980A/DC980B hardware system create a powerful development environment for designing and testing hardware configurations for the LTC2970. The software displays the LTC2970 features and provides real time measurements from the device's ADC and status registers. Telemetry also allows easy access of the fault status created by the LTC2970.

The LTC2970 features may be evaluated with the LTC3828 based power supplies, or alternatively the DC980B board may be removed and DC980A can then be connected to an external power supply circuit.

The DC980B demo board is powered by an external 8V to 15V power supply. To power the DC980A demo board, you have two choices. It may be powered from either the DC590 USB-to-I²C controller or from the DC980B board using an external jumper wire. Communication with the software is provided through the DC590 USB-to-I²C controller. The following is a checklist of items which can be obtained from the LTC website or LTC field sales.

- USB-to-I²C/Serial Controller (DC590)
- LTpowerPlay Software

DC980A/DC980B Features

- Monitors and Margins Two Power Supplies
- Two Output Voltage Monitors
- Two Input Voltage Monitors
- Two Output Current Monitors
- Telemetry Reads Back V_{IN} , V_{OUT} , I_{OUT} , Temperature
- Supported by LTpowerPlay GUI
- I²C Adjustable OV/UV Trip Points
- Margin or Trim Supplies to $\pm 0.5\%$ Accuracy
- I²C/SMBus Serial Interface
- Programmable GPIO for Fault Reporting
- Powered from External Power Supply
- LTC2970 Available in 24-Pin QFN Package

Design files for this circuit board are available at
<http://www.linear.com/demo/DC980>

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DEMO MANUAL

DC980A/DC980B

PERFORMANCE SUMMARY

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

Table 1. LTC2970 Performance Summary

PARAMETER	CONDITIONS	VALUE
$12V_{IN}$ Supply Input Voltage Range		8V to 15V
V_{DD} Supply Input Voltage Range		4.5V to 5.75V
ADC Full-Scale Accuracy		$\pm 0.4\%$
ADC Total Unadjusted Error	$V_{IN} = 3V$	$\pm 0.5\%$
ADC Input Range		0V to 6V
ADC Resolution	Resolution = 8.192V/16384	500 μ V/LSB
ADC Conversion Rate		30Hz
Margining DAC Resolution		8-Bits
Temperature Sensor Resolution		0.25 $^\circ\text{C}$ /LSB
I ² C Serial Clock Frequency		10kHz to 400kHz

Table 2. Demo Board System Specifications

	NOMINAL UNTRIMMED V_{OUT}	TOP FEEDBACK RESISTOR	BOTTOM FEEDBACK RESISTOR	DAC RESISTOR	IDAC RESISTOR	MARGIN RANGE
VOUT1	5V $\pm 1.5\%$	105k	20k	147k	6.34k	$\pm 10\%$
VOUT2	3.3V $\pm 1.5\%$	95.3k	30.1k	196k	6.34k	$\pm 10\%$

Notes:

1. Load current < 5A is recommended.
2. Output voltages can be margined by $\pm 10\%$ from nominal with the default resistor values. These values may be changed to create output voltages other than 5V and 3.3V. Use the Resistor Selection Tool which is accessed from LTpowerPlay. The LTC3828's feedback node voltage is 0.8V.

GLOSSARY OF TERMS

The following list contain terms used throughout the document.

Channel: The collection of functions that monitor, supervise, and trim a given power supply rail.

Margin: Term used typically in board level testing that increases/decreases the output voltage to look for sensitivity/marginality problems.

Monitor: The act of measuring voltage, current, and temperature readings.

Rail: The final output voltage that the power supply controller manages.

Supervise: The act of quickly responding (warning or faulting) to a voltage or current condition that is compared to preprogrammed values.

Trim: The act of adjusting the final output voltage. A servo loop is typically used to trim the voltage.

LTpowerPlay GUI SOFTWARE

LTpowerPlay is a powerful Windows-based tool that supports Linear Technology products, including the LTC2970 dual power supply monitor and margining controller. You can use LTpowerPlay to evaluate Linear Technology ICs by connecting to a demo board system. LTpowerPlay utilizes the DC590 USB I²C/serial controller to communicate with one of many potential targets, including the DC980A/B 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://www.linear.com/ltpowerplay>

To access technical support documents for LTC Power System Management Products visit Help, View Online help on the LTpowerPlay menu.

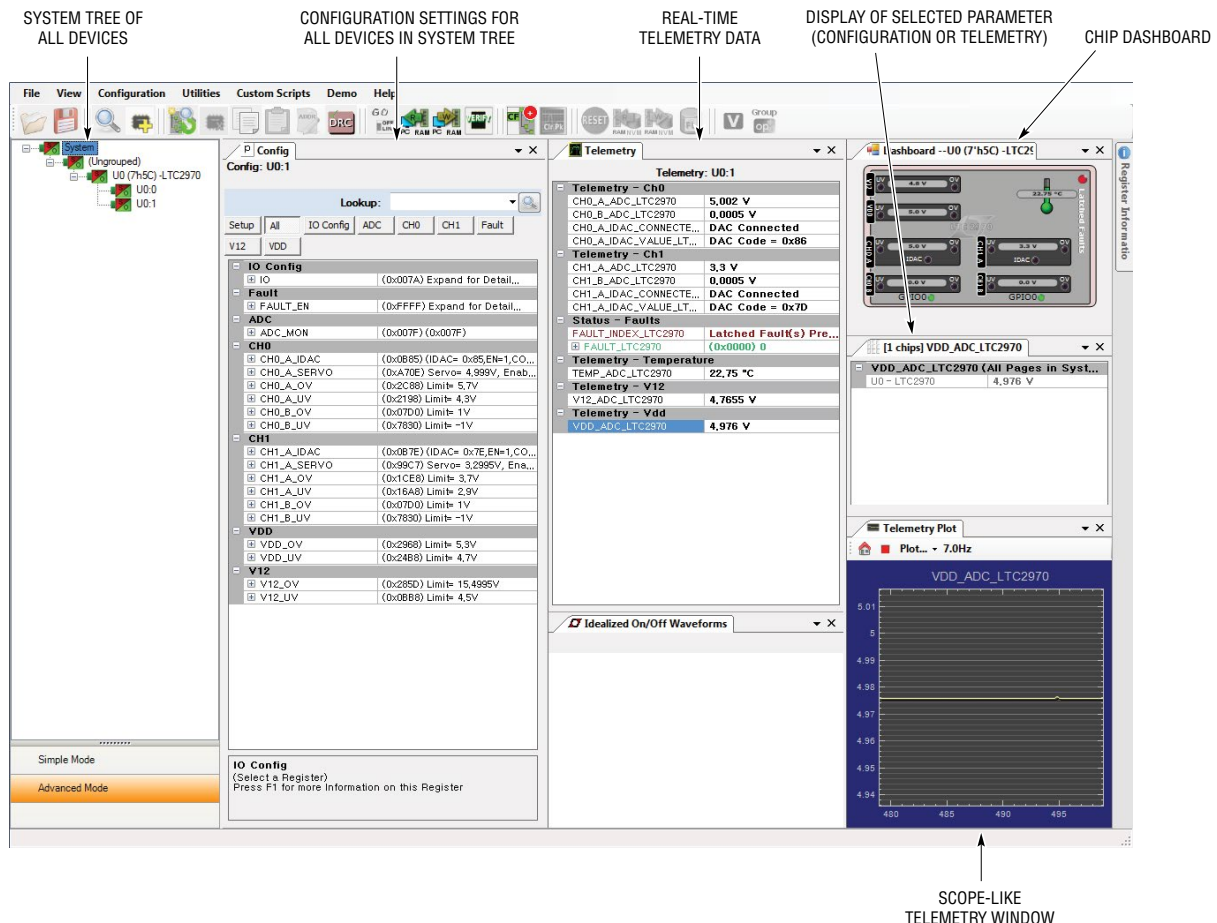


Figure 1. Screenshot of LTpowerPlay GUI

DEMO MANUAL

DC980A/DC980B

QUICK START PROCEDURE

The following procedure describes how to set up a DC980A, DC980B, and DC590 for demonstration purposes or to evaluate the performance of the LTC2970.

1. Download and install LTpowerPlay: <http://www.linear.com/ltpowerplay>
2. The default locations of DC980A's configuration jumpers are as follows:

JP1 ASEL0	JP2 ASEL1	JP3 GRIO_CFG	JP4 WRITE- PROTECT	JP5 DAC1 TERMINATION	JP6 DAC0 TERMINATION	JP7 VDD SOURCE
LO	LO	GND	ON	IOUT0	IOUT1	DC590

3. The default locations of DC980B's configuration jumpers are as follows:

JP1 PHSMD	JP2 FSET	JP3 FCB	JP4 RUN1	JP5 RUN2	JP6 TRACK2	JP7 TRACK1
0	550kHz	CCM	ON	ON	EXT1	VOUT1

4. Connect the DC980A and DC980B boards using the 20-pin analog interface connector. Connect DC980A to the DC590 USB I²C/serial controller using the supplied 14-conductor ribbon cable.
5. Connect a power supply (8V to 15V) to the DC980B's VIN and GND turrets. Refer to Figure 2 for the connections.
NOTE: Make sure that the input voltage does not exceed 15V. Be sure JP7 on the DC980A board is set to DC590.

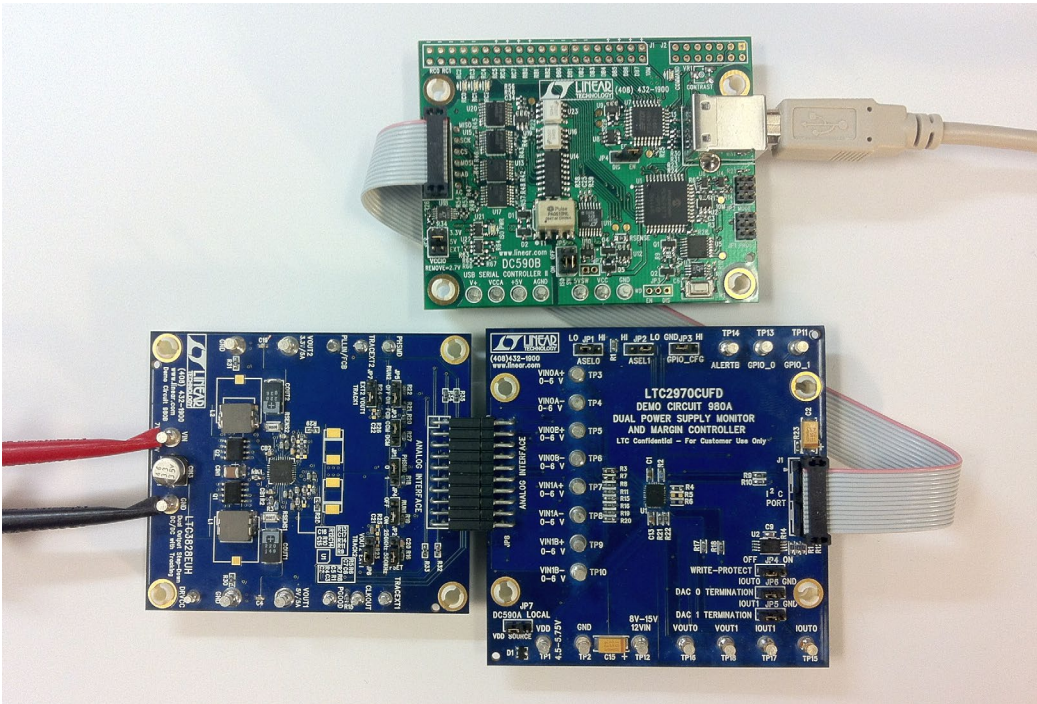
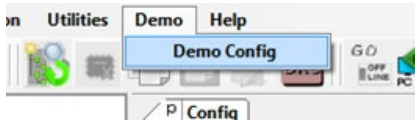


Figure 2. Connecting DC980A/DC980B Boards and the DC590 I²C/Serial Controller

dc980abf

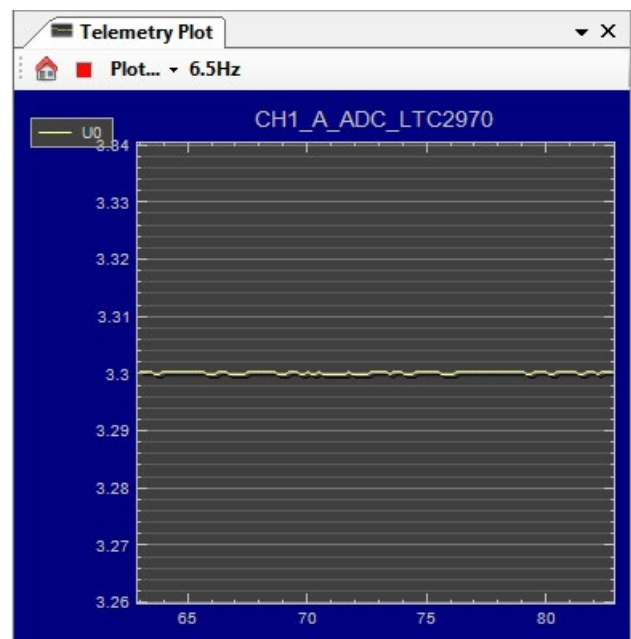
QUICK START PROCEDURE

6. Connect the USB cable from the host computer to the DC590. Launch LTpowerPlay. The software automatically identifies the DC980A and builds a system tree for the LTC2970. The GUI should appear as that shown in Figure 1.
 - a. Load default configuration into the LTC2970. From the pull-down menu select Demo > Demo Config.



- b. Check for the LTC3828 output voltages by clicking on CH0_A_ADC_LTC2970 or CH1_A_ADC_LTC2970.

Telemetry - Ch0	
CH0_A_ADC_LTC2970	4.998 V
CH0_B_ADC_LTC2970	0 V
CH0_A_IDAC_READ_LTC2970	0x0B85
Telemetry - Ch1	
CH1_A_ADC_LTC2970	3.3005 V
CH1_B_ADC_LTC2970	0 V
CH1_A_IDAC_READ_LTC2970	0x037E



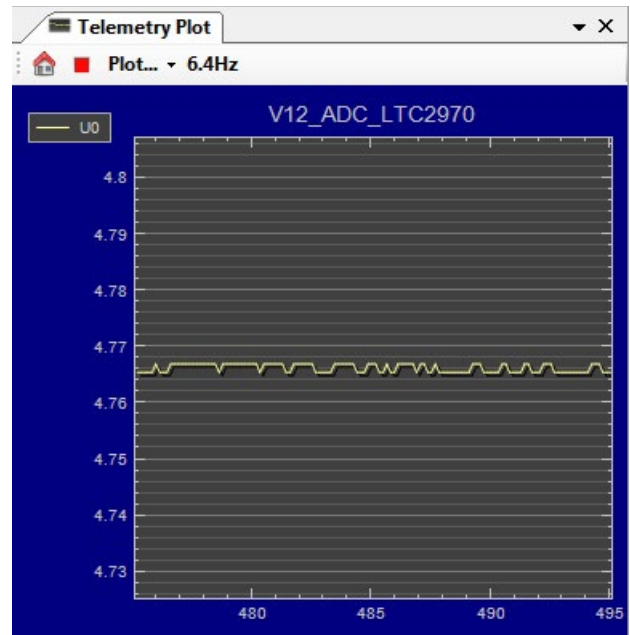
DEMO MANUAL

DC980A/DC980B

QUICK START PROCEDURE

- c. Check VDD and V12 input voltages *Note: If JP7 is set to DC590 position, the V12 telemetry reading will be ~5V.*

Telemetry - V12	4.7655 V
V12_ADC_LTC2970	4.7655 V
Telemetry - Vdd	4.9775 V
VDD_ADC_LTC2970	4.9775 V



ALTERNATE DC980A POWERING METHOD

The DC980A board may be powered from the input supply that powers the DC980B board. This configuration allows the LTC2970 to make a direct reading of VIN and display the readback value in the V12_ADC_LTC2970 register in LTpowerPlay. It requires an external jumper wire. Ensure that all power is removed from both boards. On the DC980A

board, move jumper JP7 to the LOCAL position. Place a jumper wire between the VIN turret of the DC980B and the 12VIN turret of the DC980A. Note that the LTC2970's voltage range is 8V to 15V. **Ensure that the DC980B is powered by a voltage between 8V and 15V.** Apply power.

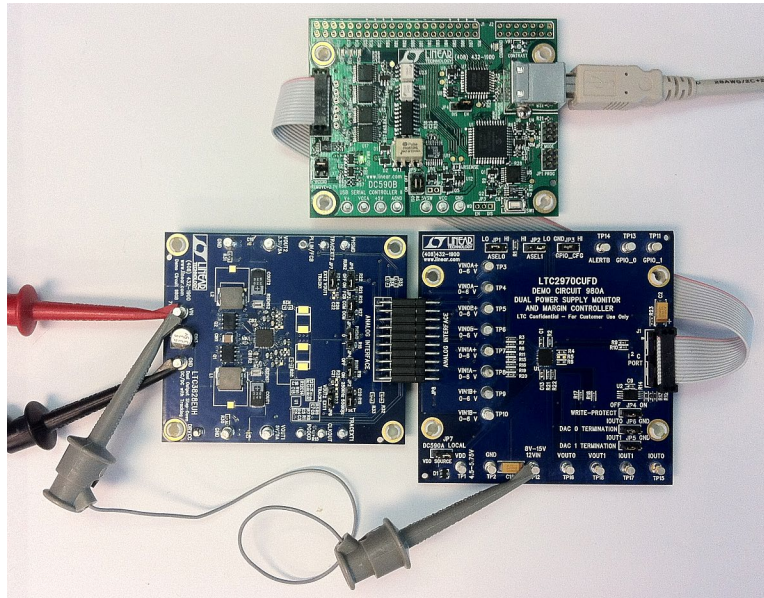
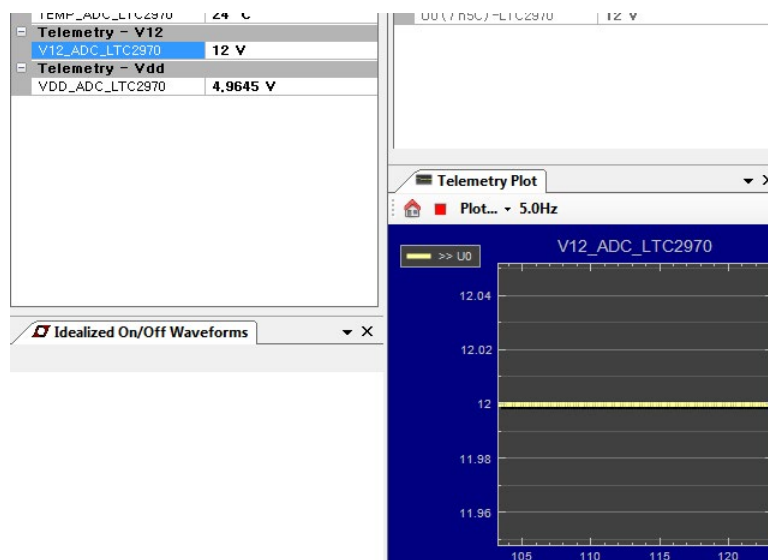


Figure 3. Connecting DC980A/B Boards with VIN Jumper to 12VIN Turret

The 12V telemetry register and plot should look like this:



DC980A DETAILS

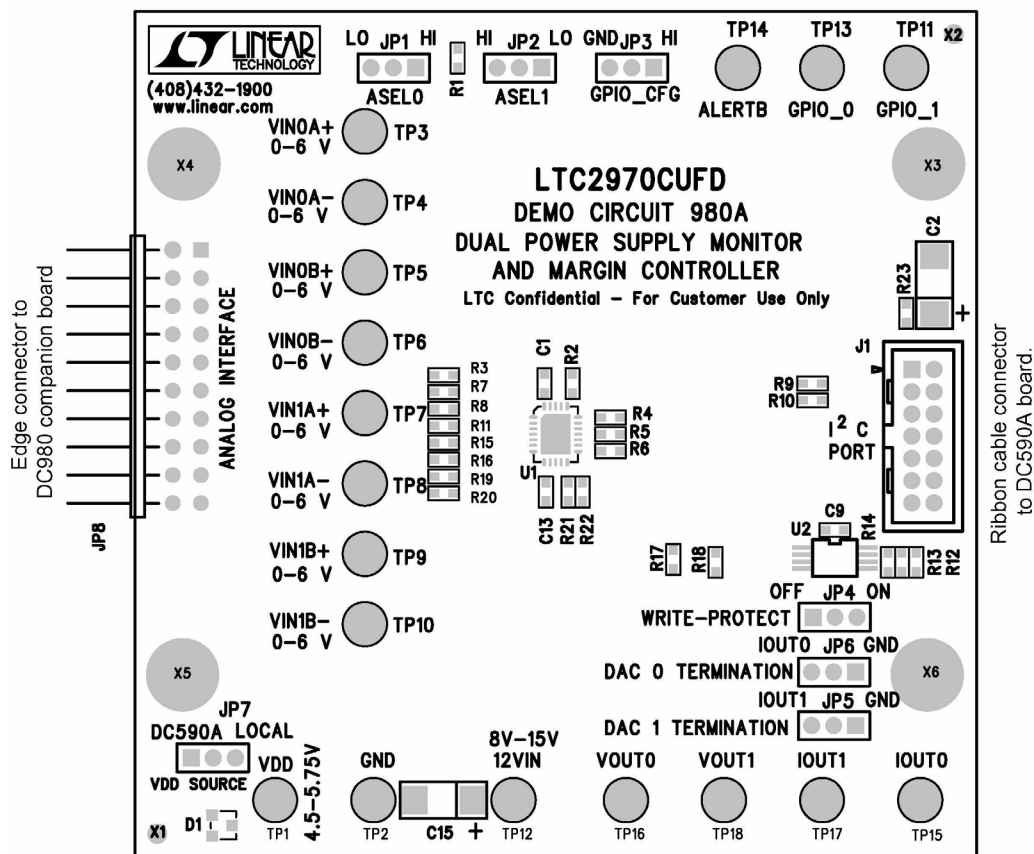


Figure 4. DC980A Board

DC980B DETAILS

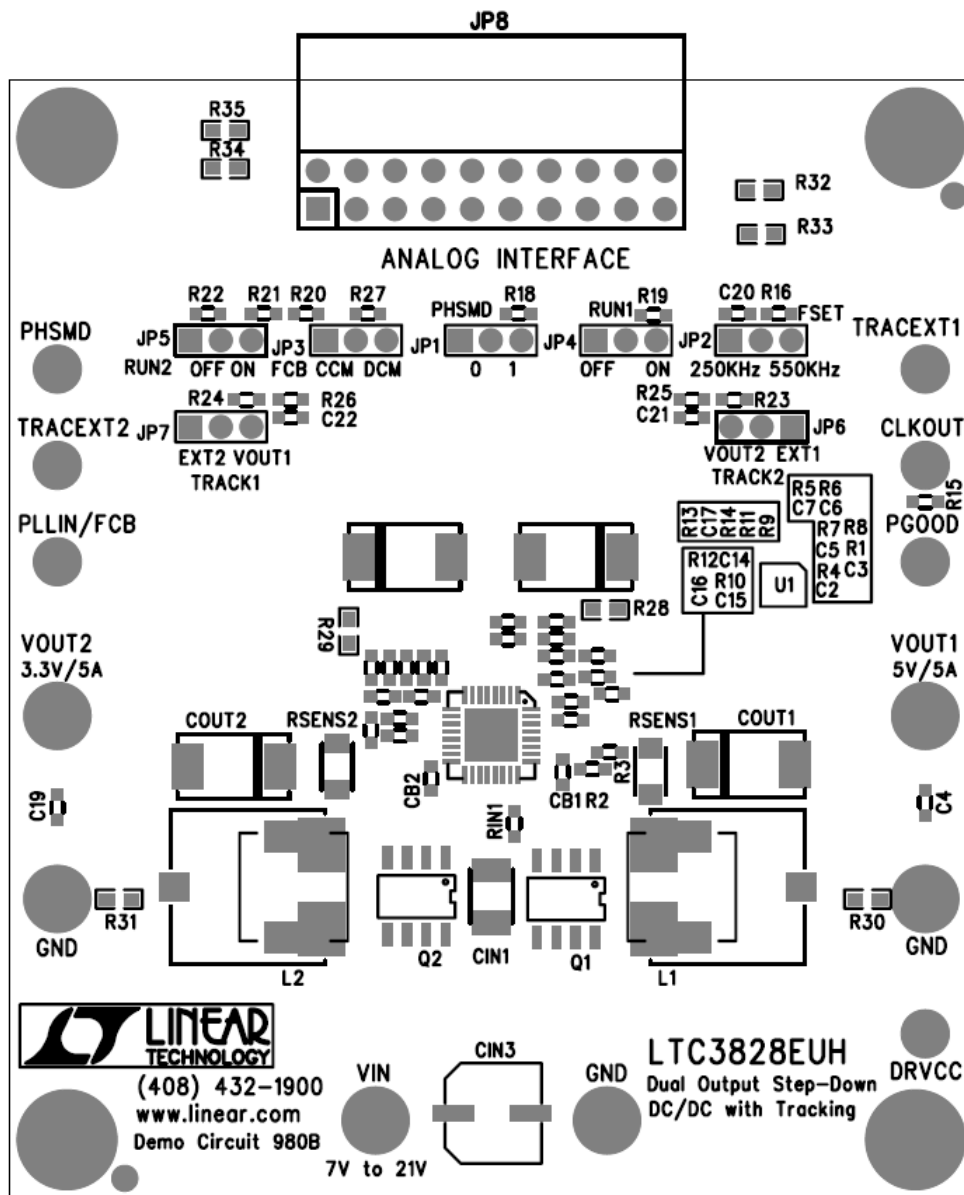


Figure 5. DC980B Board

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DC980A/DC980B

PARTS LIST—DC980A

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	C1	CAP CER 1 μ F 16V 20% X7R 0603	TDK C1608X7R1C105M
2	2	C2, C15	CAP TANTALUM 10 μ F 25V 20% 6032	AVX TAJW106M025R
3	2	C9, C13	CAP CER 0.1 μ F 16V 20% X7R 0603	AVX 0603YC104MAT
4	1	D1	DIODE, SCHOTTKY 200mW SOT-23	DIODES INC BAT54
5	1	R1	RES 10k Ω 0.1W 5% 0603 SMD	VISHAY CRCW0603103JRT6
6	1	R2	RES 100k Ω 0.1W 5% 0603 SMD	VISHAY CRCW0603100KFKEA
7	13	R3, R7 TO R11, R15, R16, R19 TO R23	RES 0 Ω 0.1W 0603 SMD	VISHAY CRCW0603000ZRT6
8	3	R4, R5, R6	RES 2k Ω 0.1W 1% 0603 SMD	VISHAY CRCW06032K00JNEA
9	3	R12, R13, R14	RES 4.99k Ω 0.1W 1% 0603 SMD	VISHAY CRCW06034K99JNEA
10	2	R17, R18	RES 6.34k Ω 0.1W 1% 0603 SMD	VISHAY CRCW06036K34JNEA
11	1	U1	IC, 2-CH POWER SUPPLY MONITOR AND MARGIN CONTROLLER	LINEAR TECHNOLOGY LTC2970CUFD
12	1	U2	IC, 2k-Bit I ² C SERIAL EEPROM	MICROCHIP 24LC025-I/ST
Additional Demo Board Circuit Components				
13	0	C3, C4, C5, C8, C10 TO C12, C14 (OPT)	OPTION - DO NOT STUFF	
14	0	C6, C7 (OPT)	OPTION - DO NOT STUFF	
Hardware: For Demo Board Only				
15	1	J1	2MM PIN HEADER, 2x7	MOLEX 87831-1420
16	1	JP8	CONN HEADER, 2x10 RIGHT ANGLE	MILL-MAX 802-10-020-20-001
17	7	JP1 TO JP7	2MM PIN HEADER, 1x3	SAMTEC TMM-103-02-L-S
18	4	MH1 TO MH4	STANDOFF, NYLON SNAP-ON	KEYSTONE 8831
19	7	SH1 TO SH7	SHUNT FOR 2MM PIN HEADER	SAMTEC 2SN-BK-G
20	18	TP1 TO TP18	TERM SOLDER TURRET 0.219" 0.078"L	MILL MAX 2501-2-00-80-00-00-07-0

PARTS LIST—DC980B

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	3	CB1, CB2, C12	CAP CER 0.1 μ F 16V 10% X7R 0603	MURATA GRM188R71C104KA01D
2	2	CIN1, CIN2	CAP CER 10 μ F 25V 10% X7R 1210	MURATA GRM32DR71E106KA12L
3	1	CIN3	CAP ALUM 33 μ F 25V 20% 6.3x6 SMD	NICHICON PCV1E330MCL1GS
4	1	COUT1	CAP ALUM POLY 150 μ F 6.3V 7343	PANASONIC EEF-CX0J151XR
5	1	COUT2	CAP ALUM POLY 180 μ F 4V 7343	PANASONIC EEF-SX0G181ER
6	2	C2, C15	CAP CER 100pF 50V 5% C0G 0603	MURATA GRM1885C1H101JA01D
7	2	C3, C16	CAP CER 470pF 50V 5% C0G 0603	MURATA GRM1885C1H471JA01D
8	3	C5, C7, C14	CAP CER 1000pF 50V 5% C0G 0603	MURATA GRM1885C1H102JA01D
9	3	C4, C10, C19	CAP CER 1 μ F 10V 10% X5R 0603	MURATA GRM188R61A105KA61D
10	2	C9, C13	CAP CER 1 μ F 25V 10% X7R 0805	TDK C2012X7R1E105K125AB
11	1	C11	CAP TANT 4.7 μ F 10V 0805	MURATA GRM21BR71A475KA73K
12	2	C20, C21	CAP CER 10nF 25V 10% X7R 0603	MURATA GRM188R71E103KA01D
13	2	D1, D3	SCHOTTKY DIODE 30V 0.1A SOD-323	CENTRAL SEMI CMDSH-3 TR
14	2	L1, L2	INDUCTOR, 2.2 μ H	WÜRTH 74437346022
15	2	Q1, Q2	MOSFET Nch DUAL PWR SW 30V 12m Ω S08	IR IRF8313PBF
16	5	R1, R7, R11, R12, RIN1	RES 10 Ω 0.1W 5% 0603	VISHAY CRCW060310R0JNEA
17	2	R2, R16	RES 10k Ω 0.1W 1% 0603 SMD	VISHAY CRCW0603103JRT6
18	2	R3, R18	RES 100k Ω 0.1W 1% 0603 SMD	VISHAY CRCW0603100KFKEA
19	2	R4, R10	RES 42.2k Ω 0.1W 1% 0603 SMD	VISHAY CRCW060349K2FKEA
20	3	R5, R20, R21	RES 20k Ω 0.1W 1% 0603 SMD	VISHAY CRCW060320K0FKEA
21	1	R6	RES 105k Ω 0.1W 1% 0603 SMD	VISHAY CRCW0603105KFKEA
22	2	R13, R26	RES 30.1k Ω 0.1W 1% 0603 SMD	VISHAY CRCW060330K1FKEA
23	2	R14, R24	RES 95.3k Ω 0.1W 1% 0603 SMD	VISHAY CRCW060395K3FKEA
24	2	R19, R22	RES 8.2k Ω 0.1W 5% 0603 SMD	VISHAY CRCW06038K20FKEA
25	1	R27	RES 1k Ω 0.1W 5% 0603 SMD	VISHAY CRCW06031K00JNEA
26	1	R28	RES 147k Ω 0.1W 1% 0603 SMD	VISHAY CRCW0603147KFKEA
27	1	R29	RES 196k Ω 0.1W 1% 0603 SMD	VISHAY CRCW0603196KFKEA
28	2	RSNS1, RSNS2	RES 0.01 Ω 0.5W 1% 1206	STACKPOLE CSR1206FK10L0
29	1	U1	IC, 2-CH STEP DOWN CONTROLLER QFN28	LINEAR TECHNOLOGY LTC3828EUH

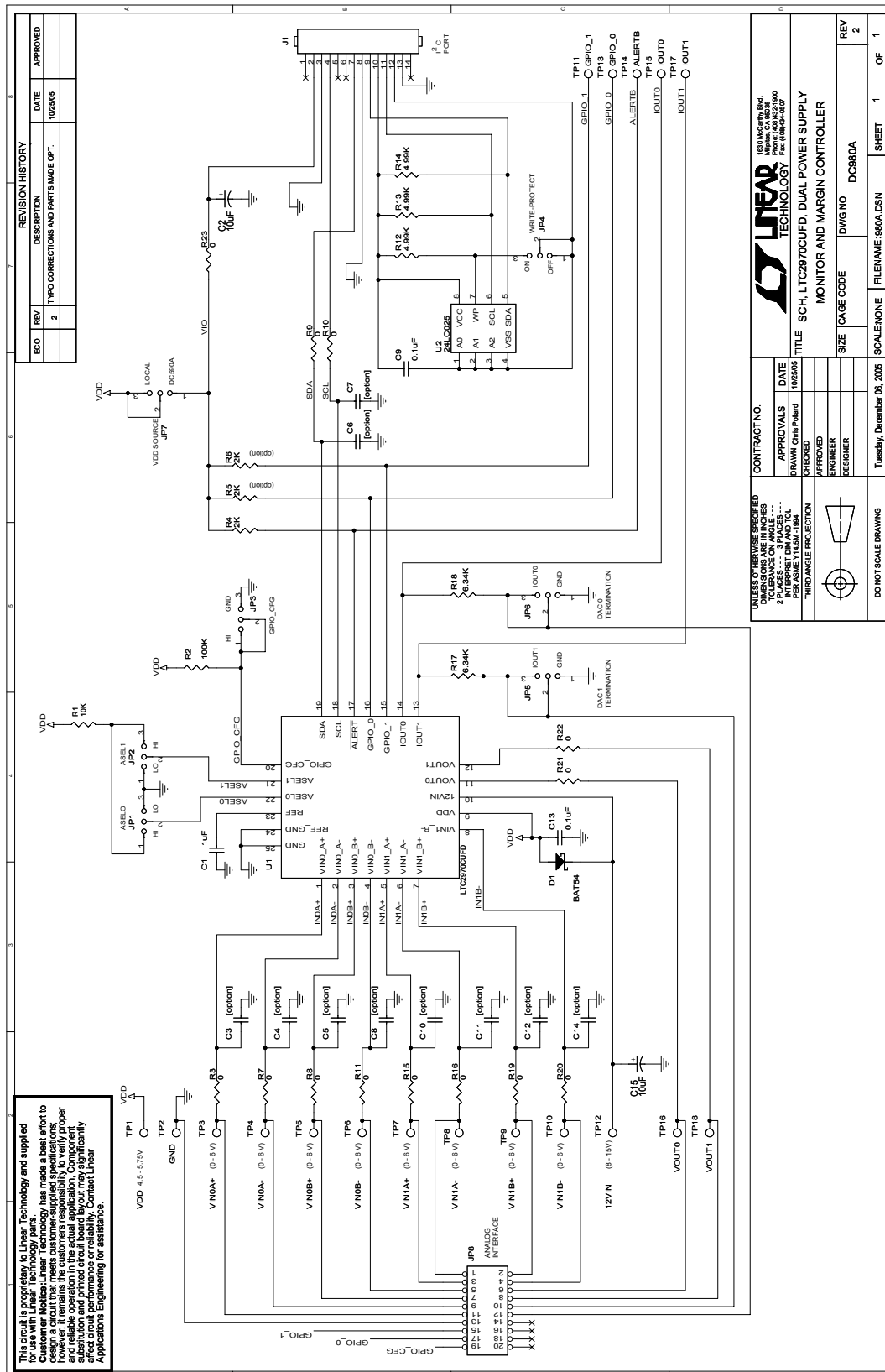
DEMO MANUAL

DC980A/DC980B

PARTS LIST—DC980B

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Additional Demo Board Circuit Components				
30	0	C6, C17 (OPT)	CAP CER 180PF NPO 5% 0603 (OPT)	DO NOT INSTALL
31	0	C22 (OPT)	CAP CER 10nF 25V 10% X7R 0603 (OPT)	DO NOT INSTALL
32	0	D4, D2 (OPT)	DIODE, POWERMITE (OPT)	DO NOT INSTALL
33	0	D5 (OPT)	DIODE, SOT-323 (OPT)	DO NOT INSTALL
34	0	Q3, Q4 (OPT)	MOSFET Nch DUAL PWR SW 30V S08 (OPT)	DO NOT INSTALL
35	0	Q5, Q6 (OPT)	MOSFET Nch DUAL PWR SW 30V S08 (OPT)	DO NOT INSTALL
36	0	R8, R9, R23, R25 (OPT)	RES USER SELECTABLE 0603 (OPT)	DO NOT INSTALL
37	4	R15, R17, R30, R31	RES 0Ω 0.1W 0603 SMD	VISHAY CRCW0603000ZRT6
38	4	R32 TO R35	RES 10Ω 1/16W 5% 0603	PANASONIC ERJ-3EKF10R0V
Hardware: For Demo Board Only				
39	7	E1, E2, E5, E7, E12 TO E14	TERM SOLDER TURRET 0.156"H 0.084"L	MILL MAX 2308-2-00-80-00-00-07-0
40	6	E4, E6, E8 TO E11	TERM SOLDER TURRET 0.219" 0.078"L	MILL MAX 2501-2-00-80-00-00-07-0
41	7	JP1 TO JP7	2MM PIN HEADER 1X3	WÜRTH 620 003 111 21
42	1	JP8	CONN RECEPT, 2x10 RIGHT ANGLE	MILL-MAX 803-93-020-20-001
43	4	MH1 TO MH4	STANDOFF, NYLON SNAP-ON	KEYSTONE 8831
44	7	SH1 TO SH7	SHUNT FOR 2MM PIN HEADER	WÜRTH 608 002 134 21

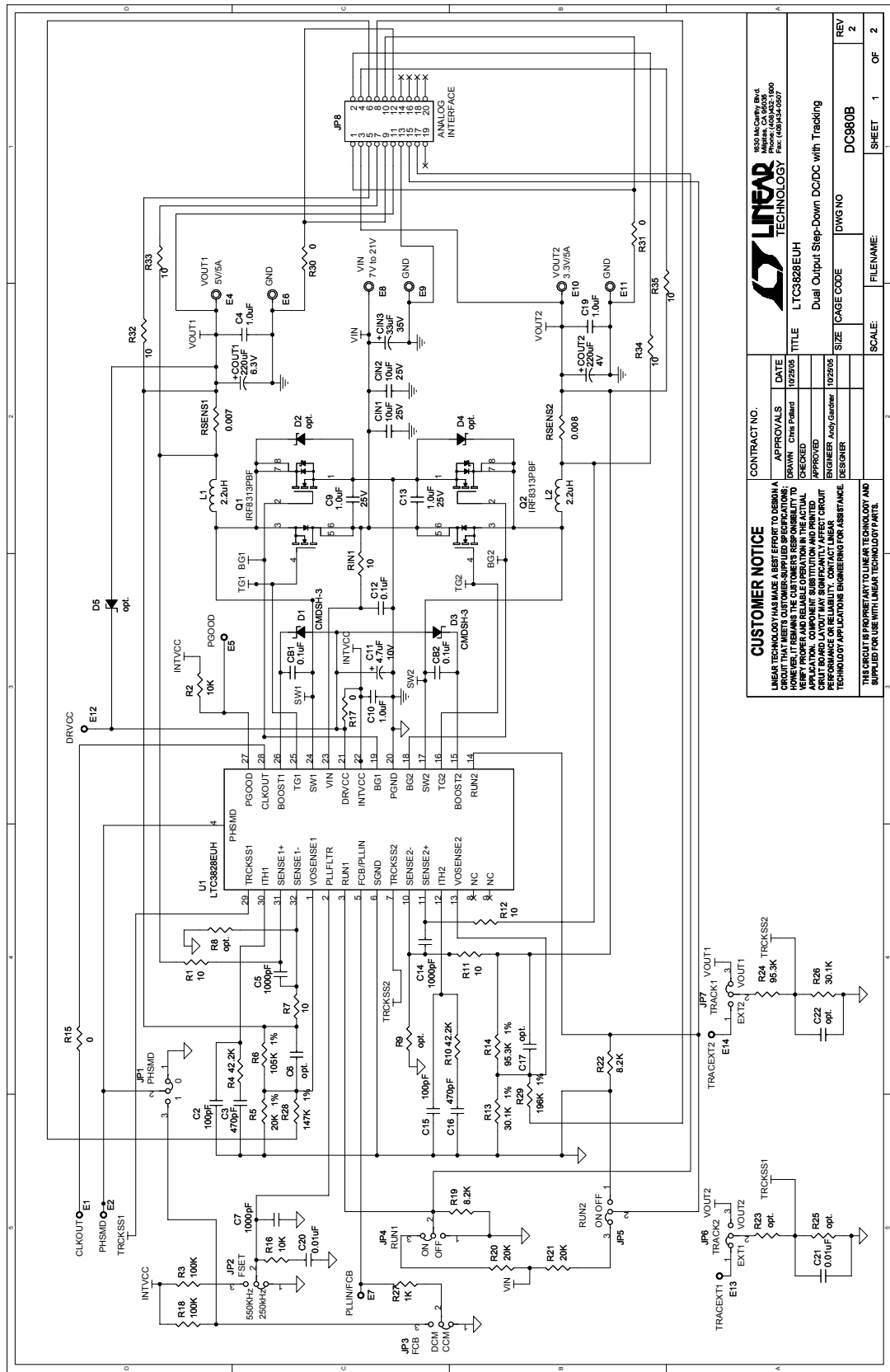
SCHEMATIC DIAGRAM



DEMO MANUAL

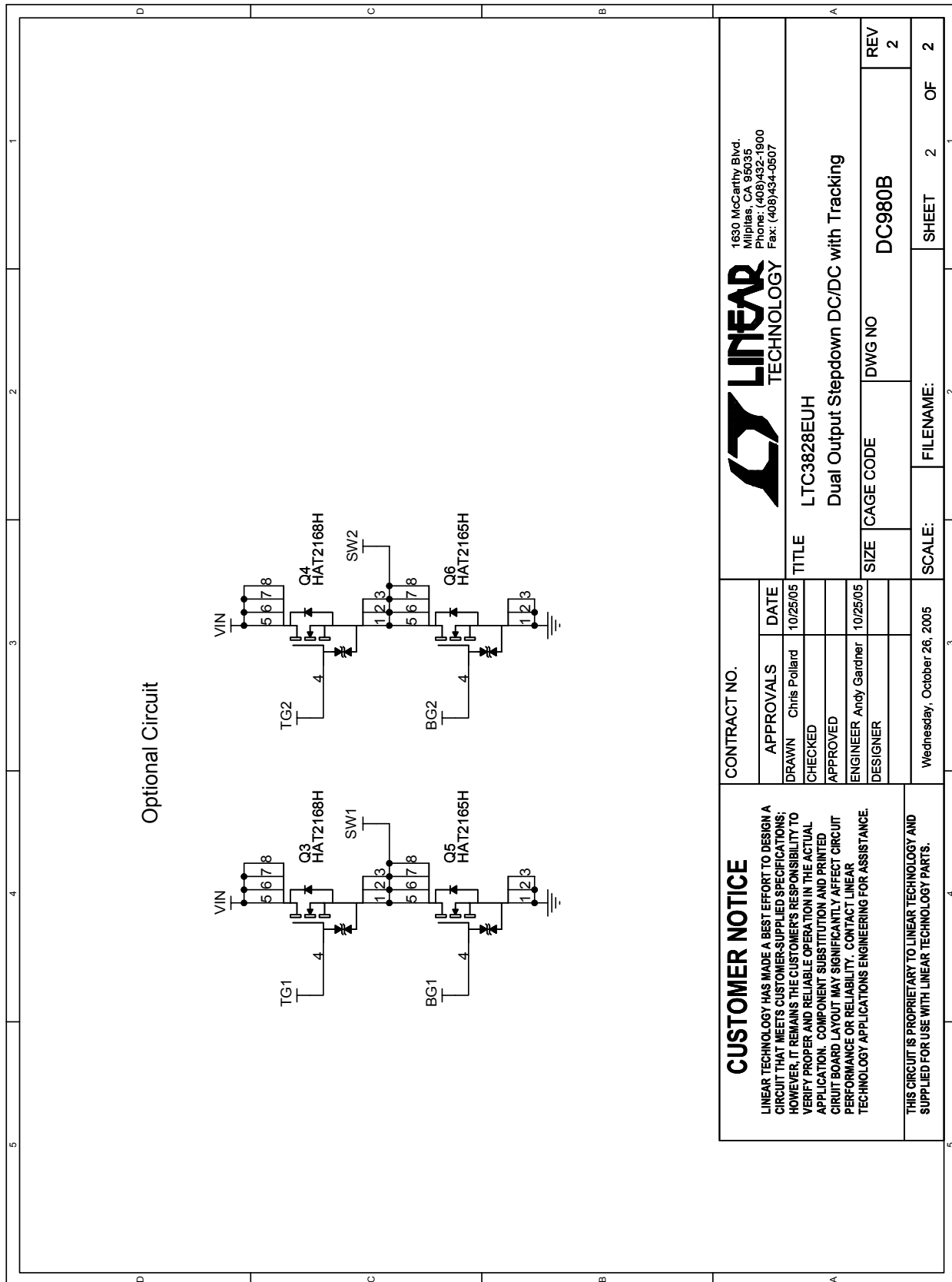
DC980A/DC980B

SCHEMATIC DIAGRAM



dc980abf

SCHEMATIC DIAGRAM



dc980abf

DEMO MANUAL

DC980A/DC980B

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.

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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.

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