DEMO MANUAL DC1540B

LTC2977 8-Channel Power System Manager with EEPROM

DESCRIPTION

The DC1540B is a demonstration system for the LTC®2977 8-channel I²C/SMBus/PMBus Power System Manager with EEPROM. It consists of 2 circuit boards namely the DC1360B and DC1361B. The DC1360B contains all the circuitry needed to insert the LTC2977 into a power system and control eight power supplies. The DC1361B contains eight power supplies (LTM4603EV) which are configured to be controlled by an LTC2977. Together these two boards form a sophisticated, 8-channel, digitally programmable power supply.

This demonstration system is supported by LTpowerPlay™ software and a graphical user interface (GUI) that enables complete control of all the LTC2977 features. You can obtain this GUI from the website www.linear.com/ltpowerplay.com. LTpowerPlay and the DC1540B, create a powerful development environment in which you can design configuration settings for the LTC2977. The configuration settings can be stored in the LTC2977 EEPROM and also in a file, which can be used to order pre-programmed devices. LTpowerPlay displays all of the configuration settings and real-time measurements that the LTC2977 performs and allows easy access to the fault log created by the LTC2977. The LTC2977 on the DC1360B comes pre-programmed with EEPROM values appropriate for the eight power supplies used on the DC1361B.

The LTC2977 can be configured to monitor current on odd numbered channels. In the DC1540B, this feature can be enabled on Channel 7 (see "Measuring Current"). Channels 1 and 2 can be configured to do coincident tracking of Channel 0 by using JP2 and JP3 (see "DC1361B Details – Top Side"). An LTC Hot Swap™ circuit on the DC1361B enables the LTC2977 to soft-start V_{IN} and shut off V_{IN} in response to output faults.

Multiple DC1540Bs can be cascaded together to form a high channel count power supply (see "Multi-Board Arrays"). This configuration demonstrates features of the LTC2977 which allow timing and fault information to be shared across multiple LTC2977s, allowing the formation of a single, coherent power supply control system. This configuration is easily supported by the LTpowerPlay GUI and allows the user to configure up to 9 LTC2977s, controlling up to 72 separate power supplies.

To get this demo system up and running, connect the DC1540B to your computer using a DC1427A or a DC1613 (USB to I²C/SMBus/PMBus Controller). The following is a checklist of items which you can obtain from the LTC website or LTC Field Sales.

- USB to I²C/SMBus/PMBus Controller (DC1613A)
- LTpowerPlay GUI
- LTC2977 Resistor Selection Tool for calculating resistors values and proper DAC range settings (in the GUI)

LTC2977 Features

- I²C/SMBus Communication
- Configuration EEPROM
- PMBus Compliant
- Fault Logging to Internal EEPROM
- Differential Input, 16-bit ΔΣ ADC with less than ±0.25% of Total Unadjusted Error Using On-Chip Reference
- Monitors Eight Output Channels and One Input Voltage
- Programmable Watchdog Timer
- 8-Channel Sequencer
- Eight 10-Bit OV/UV Supervisors
- Eight 10-Bit Margin/Trim DAC's with Soft-Connect
- A Closed-Loop Digital Servo Accurately Trims the Outputs
- Supports Multi-Channel Fault Management
- Programmable Fault Responses
- On-Chip Digital Temperature Sensor

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

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Table 1. LTC2977 Performance Summary (Specifications are at T_A = 25°C)

PARAMETER	CONDITION		VALUE
V_{PWR} Supply Input Voltage Range			4.5V to 15V
V_{DD33} Supply Input Voltage Range			3.13V to 3.47V
ADC Total Unadjusted Error	$V_{IN} \geq 1V$		±0.25%
ADC Voltage Sensing Input Range			–0.1V to 6V
ADC Current Sensing Input Range			–170mV to 170mV
ADC Voltage Sensing Resolution	$0V \leq V_{IN_ADC} \leq 6V$		122µV/LSB
ADC Current Sense Resolution	$0mV < \lvert V_{IN_ADC} \rvert < 16mV$ $16mV < \lvert V_{IN_ADC} \rvert < 32mV$ $32mV < \lvert V_{IN_ADC} \rvert < 63.9mV$ $63.9mV < \lvert V_{IN_ADC} \rvert < 127.9mV$ $127.9mV < \lvert V_{IN_ADC} \rvert$		15.6µV/LSB 31.25µV/LSB 62.5µV/LSB 125µV/LSB 250µV/LSB
Voltage Buffered IDAC Resolution 10 bits	Buffer gain setting 0		1.38mV/LSB
	Buffer gain setting 1		2.65mV/LSB
Temperature Sensor TUE			±1°C
Voltage Supervisor Input Voltage Range (Programmable)	$V_{SENSEP[n]}$	Low resolution	0 to 6V
		High resolution	0 to 3.8V
	$V_{SENSEM[n]}$		–0.1 to 0.1V
Voltage Supervisor Sensing Resolution	0V to 3.8V range: 4.096/1024		4mV/LSB
	0V to 6V range: 8.192/1024		8mV/LSB
Voltage Supervisor Total Unadjusted Error	$2V < V_{IN_VS} < 6V$, Low Resolution Mode		±1.25 %
	$1.5V < V_{IN_VS} < 3.8V$, High Resolution Mode		±1.0 %
	$0.8V < V_{IN_VS} < 1.5V$, High Resolution Mode		±1.5 %
I^2C Serial Clock Frequency			10kHz to 400kHz

Demo System Specifications

Table 2. Specifications-DC1361B

V_{OUT} Name	Nominal Voltage-Untrimmed
V_{OUT_0}	3.325V ± 1.5%
V_{OUT_1}	2.497V ± 1.5%
V_{OUT_2}	1.989V ± 1.5%
V_{OUT_3}	1.804V ± 1.5%
V_{OUT_4}	1.502V ± 1.5%
V_{OUT_5}	1.200V ± 1.5%
V_{OUT_6}	0.999V ± 1.5%
V_{OUT_7}	0.799V ± 1.5%

Notes:

- Load current less than 2A on each output is recommended.
- Max current into J11 (+12V) should be < 6A max.
- Output voltages can be margined by a minimum of ±15% from nominal with the default resistor values on the DC1361B. These values can be easily changed. See section Changing DC1361B Nominal Output Voltages. Use the LTC2977 Resistor Selection Tool which is accessed from LTpowerPlay.

What Can You Do With This Demo System ?

- Prototype your system. You can change the nominal V_{OUT}'s of the modules to match your system. You can also change the range and resolution of margining. Set sequencing. Set OV/UV limits. And much more!
- Create your own configuration that you can store in the EEPROM of the LTC2977 or save to a file. This file can be used to order pre-programmed parts.
- Test most conceivable fault scenarios. All outputs can be shorted.

Demo System Hardware

Hardware required:

1. PC + USB cable
2. 12V, >0.5A power supply
3. USB to I²C/SMBus/PMBus Controller
4. DC1540B = DC1360B + DC1361B

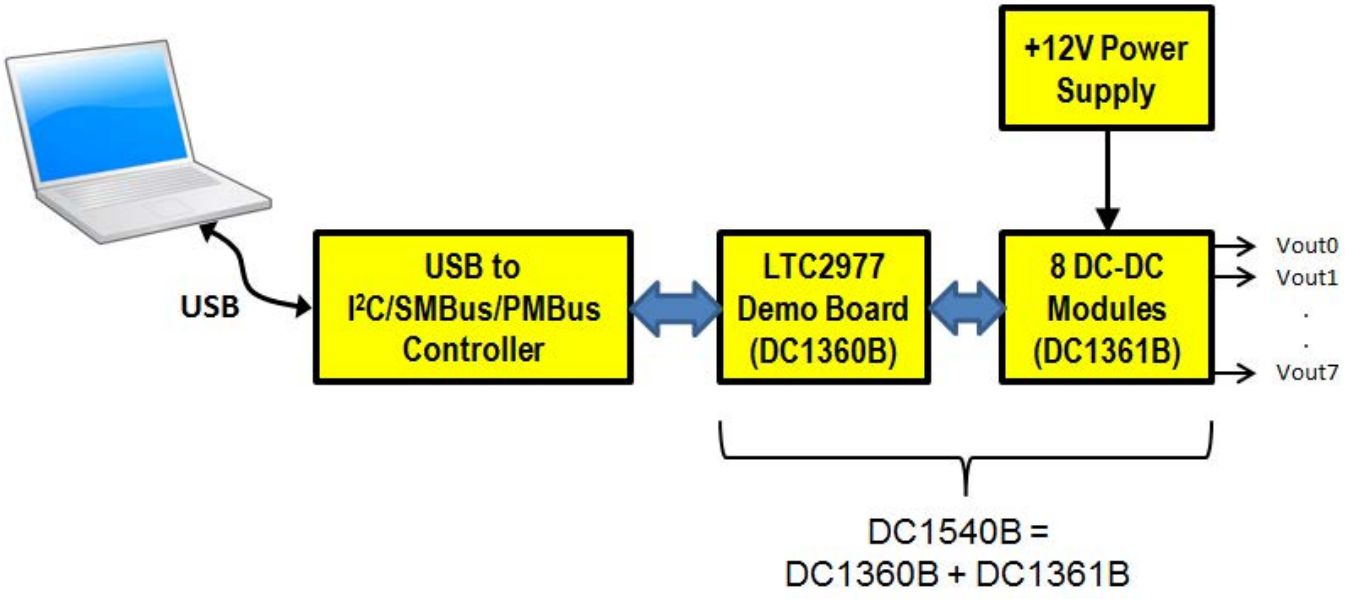


Figure 1. Single LTC2977 Demo Setup Using DC1540B

DOWNLOAD GUI TO YOUR PC

LTpowerPlay can be downloaded from www.linear.com/ltpowerplay. Complete instructions are located there.

QUICK START PROCEDURE

The following procedure describes how to set up one DC1540B.

1. Remove both boards from bag.
2. Place boards on level surface. Connect boards together using the 54-pin edge connector. See below.

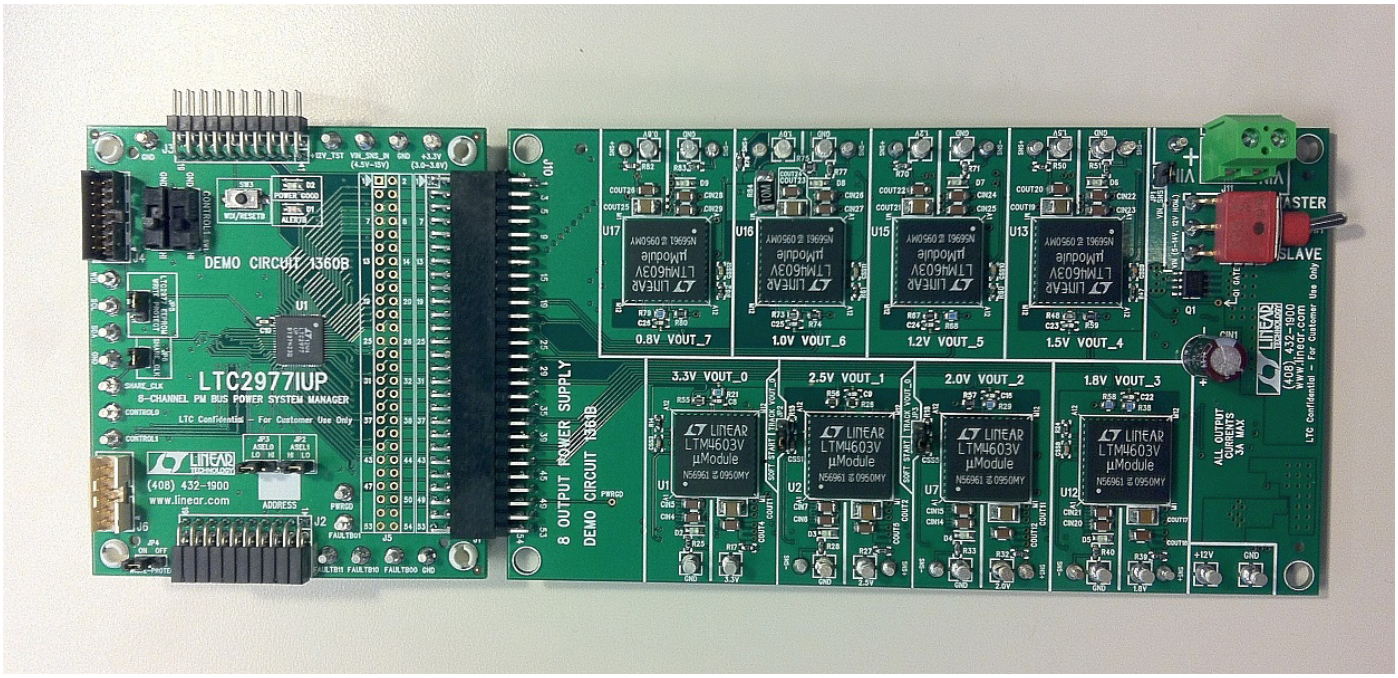


Figure 2. Plug Boards Together

3. On DC1360B, set jumpers and switches as follows. See also Table 3.
   a. Set both SW1 and SW2 (CONTROL0 and CONTROL1) to GND.
   b. Set JP5 to OFF.
   c. Make sure JP6 is installed.
   d. Set JP3 (ASEL0) to LO and JP2 (ASEL1) to LO.
   e. Set JP4 to ON.
4. On DC1361B, set jumpers and switches as follows. See also Table 3.
   a. JP1 = INSTALLED
   b. JP2, JP3 = SOFT START
   c. SW1 = MASTER
5. Plug in the USB to I^2C/SMBus/PMBus Controller into a USB port on your PC.
6. Connect a 12V power supply with >1/2 Amp capacity to the VIN+ and VIN– inputs of the green terminal block J11 on DC1361B. Do not turn on 12V yet. Be careful to hook up polarity correctly! See Figure 5.
7. If you have a DC1427A, connect to J4 on DC1360B as shown in Figure 3.

QUICK START PROCEDURE

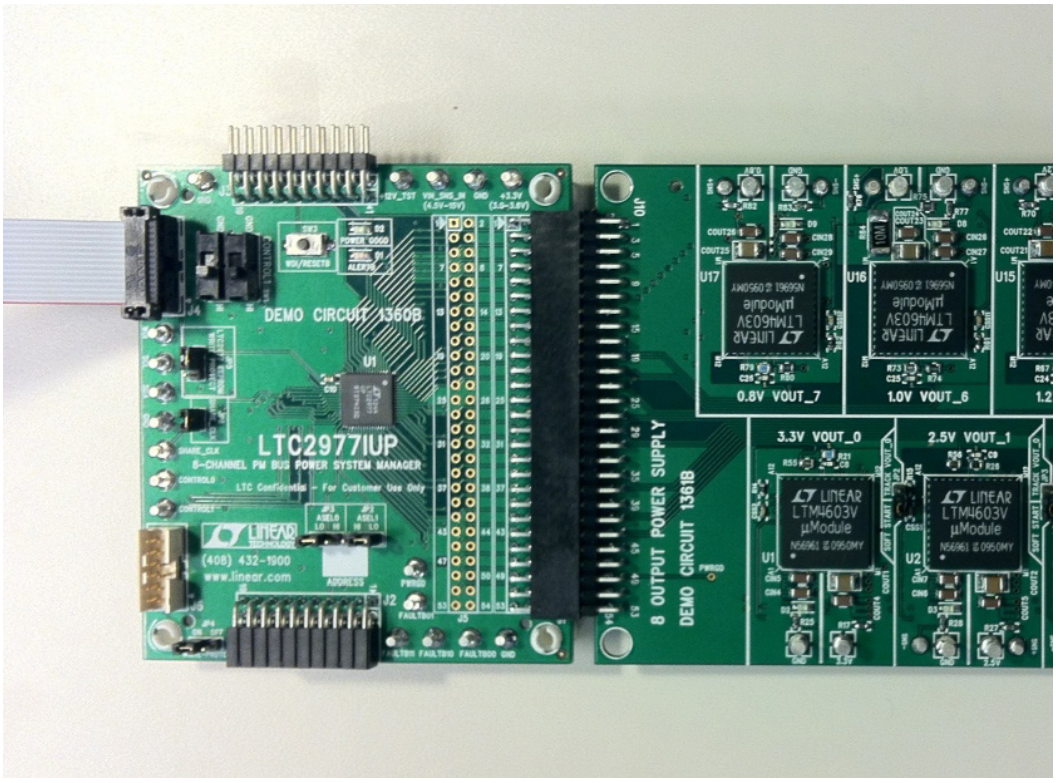


Figure 3. DC1427A Connection

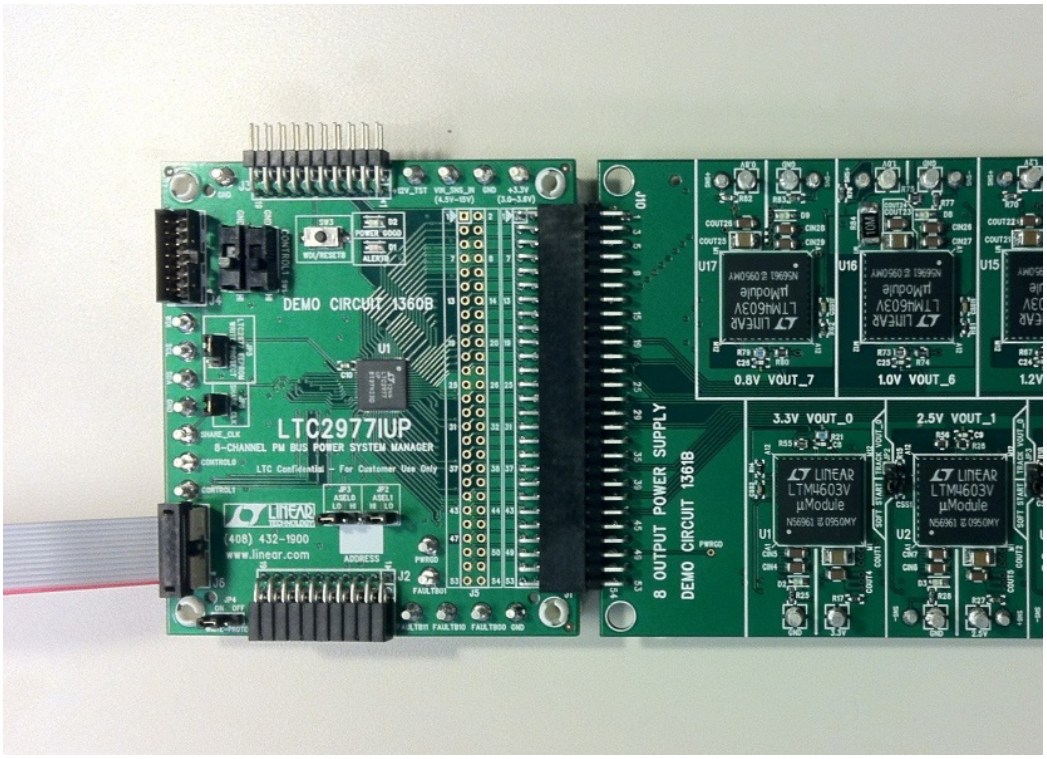
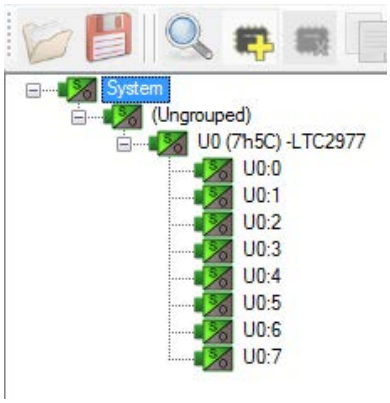


Figure 4. DC1613 Connection

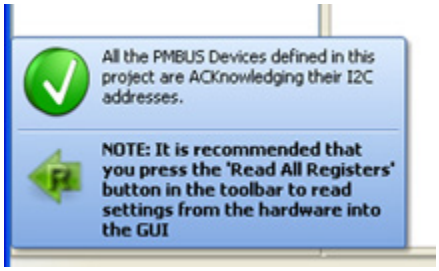
QUICK START PROCEDURE

8. Launch the LTpowerPlay GUI.

   a. The GUI should identify the LTC2977. The system tree on the left hand side should look like:



   b. Confirm that the LTC2977 is communicating. A green message box shows for a few seconds in the lower left hand corner



   c. In the Toolbar, click the “R” icon to read the RAM from the LTC2977. This reads the default configuration from the RAM in the LTC2977 on the DC1360B and loads it into the GUI.

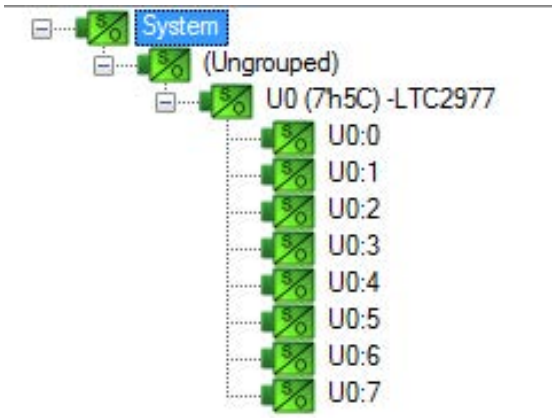
   d. Save the demo board default configuration to a (*.proj) file. Click the “Save” icon and save the file. You can chose your own filename.

9. Turn on the +12V power supply.

10. Slide the 2 black switches CONTROL 0 and CONTROL 1 to the HI position. This turns on the board.

QUICK START PROCEDURE

The System Tree on the left hand side should turn all green. All 8 green LEDs on the DC1361B should illuminate.



11. You are now ready to execute one of the LTC2977 demos embedded in the GUI or experiment with the part.

LOADING A CONFIGURATION (*.proj) FILE WITH THE GUI

1. In the upper left hand corner of the GUI, File > Open > browse to your *.proj file. This will load the file into the GUI.
2. Click on the

arrow. This loads the file into the working RAM of the LTC2977.
3. To store in EEPROM, click on the STORE button. It is the icon with the “W” on it (see below).

NOTES:

1. To configure the jumpers and switches, see Tables 3, 4, 5 and 6. If using more than one LTC2977, use the ASELs to assign different addresses for each LTC2977.
2. On DC1361B, set the MASTER/SLAVE switch to MASTER if you want the Hot Swap chip to shut off in response to an output OV fault. To recover from shut off, you must command the channel that produced the OV off then on with the OPERATION command or you can toggle the VinShareEnable bit in MFR_CONFIG_ALL_LTC2977 to 0 then 1.
3. When the USB to I^2C/SMBus/PMBus controller power is applied, the LTC2977 will load the contents of its EEPROM into operating RAM.
4. For help on any command, highlight the command in the GUI and press F1.
5. The LTM4603 outputs may be shorted indefinitely. This is a good way to induce UV faults.
6. If the DC1360B is used without the DC1361B, it will report an overtemperature fault because its V_{SENSE} inputs are floating. This may be avoided by tying the V_{SENSE} inputs to defined voltages.

DC1540B - DETAILS (DC1360B +DC1361B)

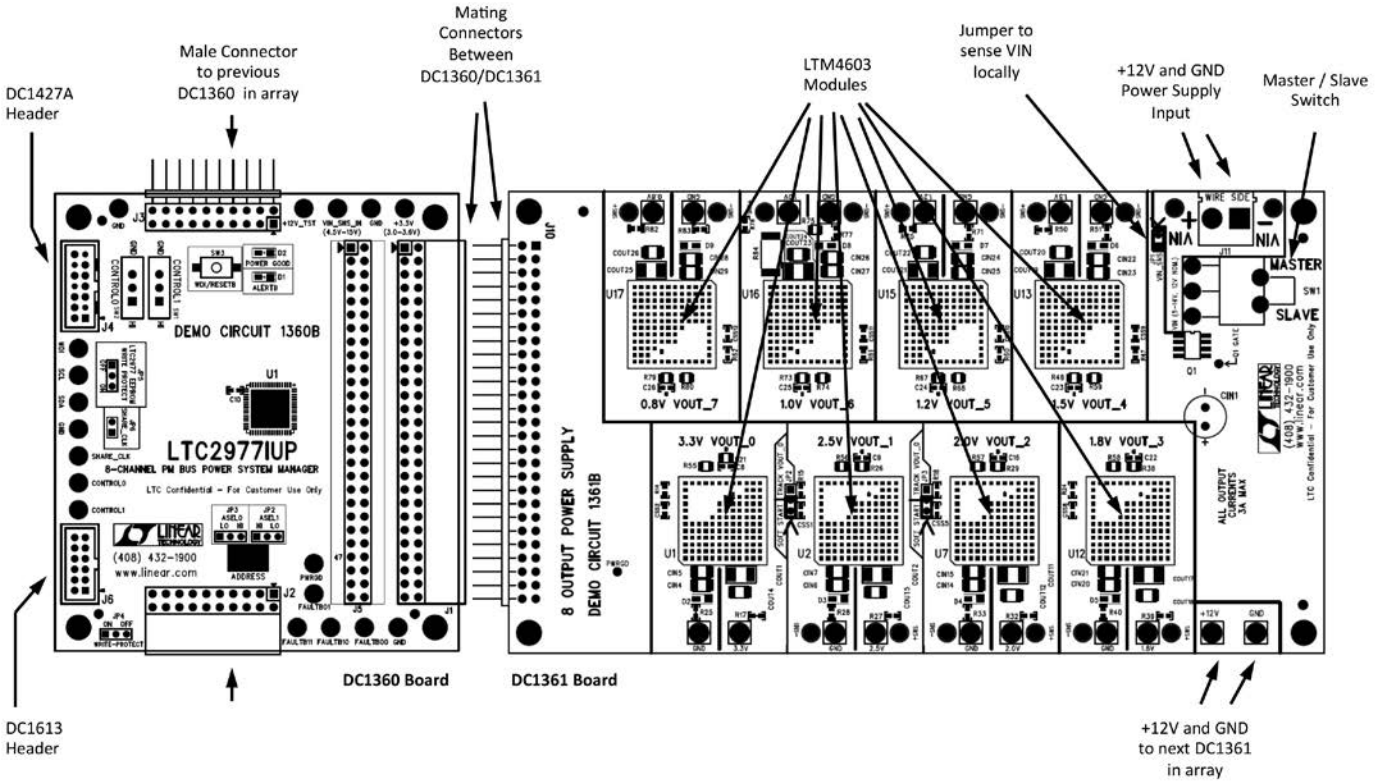


Figure 5. DC1540B Details

DC1360B DETAILS - TOP SIDE

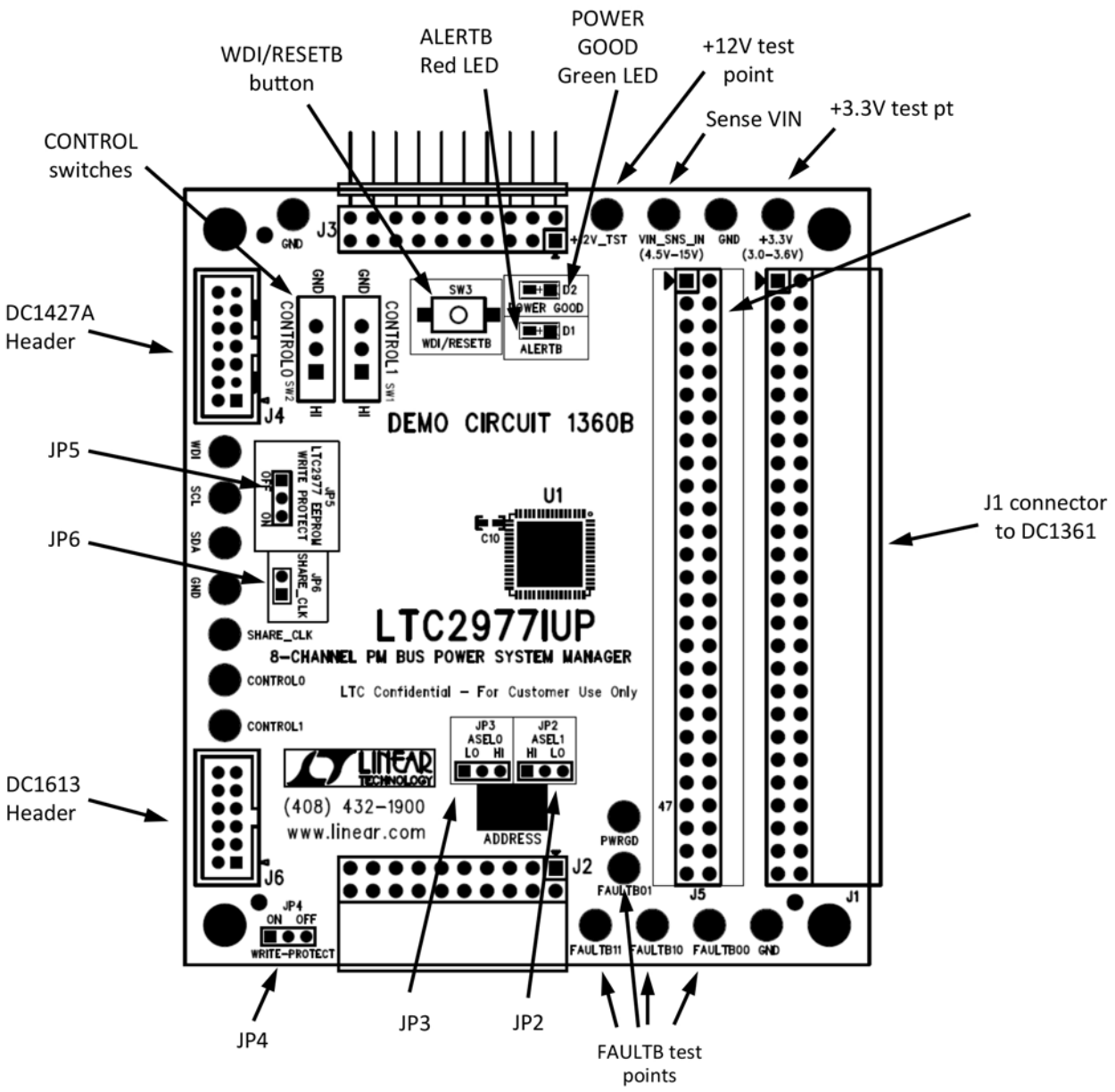


Figure 6. DC1360B Top Side

Table 3. DC1360B - Default Jumper Configuration. Use ASEL's to Select I^2C Address.

JP2 ASEL1	JP3 ASEL0	JP4 Write-Protect	JP5 LTC2977 Write Protect	JP6 Share_CLK
LO	LO	ON	OFF	Installed

DC1360B DETAILS - BOTTOM SIDE

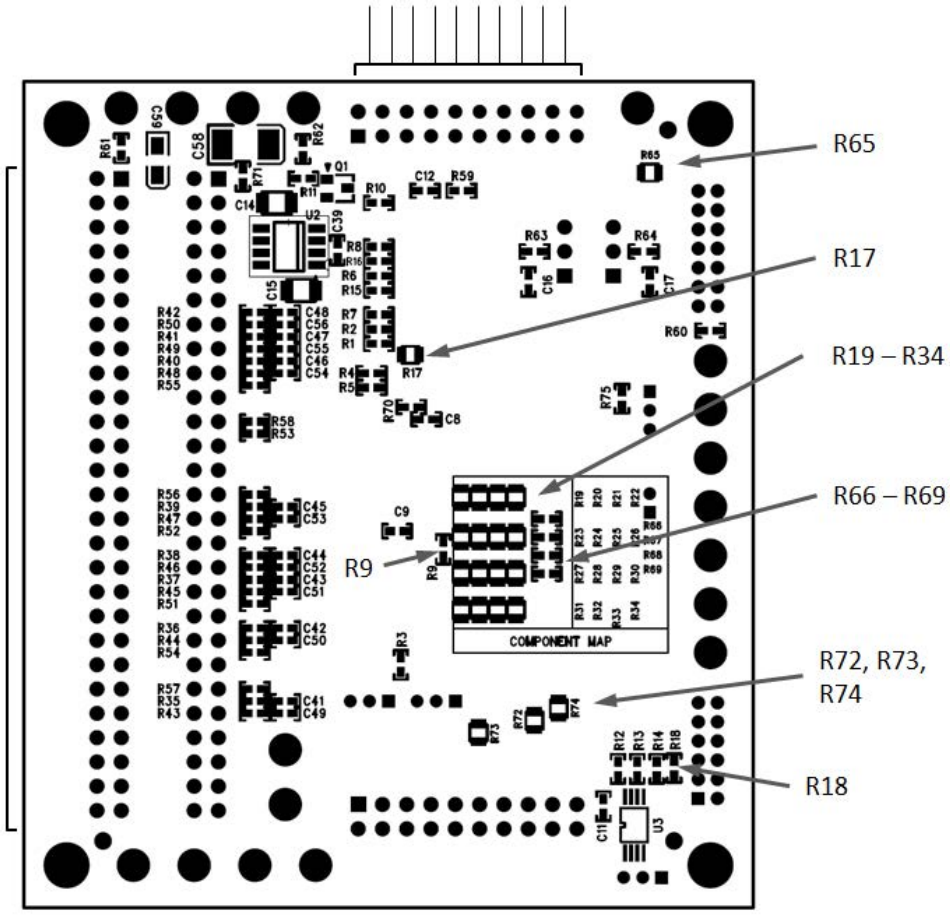


Figure 7. DC1360B Bottom Side Configuration Resistors

Configuration resistors are on the bottom side. They allow multiple ways to make fault dependencies between boards.

Table 4. Optional Configuration Resistors

REF Des	Signal	Usage	Default	Comment
R9	FAULTB10 to FAULTB01	Connect Fault Zone 0 to Fault Zone 1	INSTALLED	Allows Fault Zone 0 to Connect to Fault Zone 1
R19, R24, R29, R34	FAULT1 to FAULT4 to FAULT00 to FAULT11	Connect LTC2977's FAULTB Pin to Demo Board FAULT Lines	INSTALLED	Allows Faults to Propagate Between Boards
R21, R22, R23, R25, R26, R27, R28, R30, R31, R32, R33	FAULT 1 to FAULT 4	Connect any FAULTB Pin to any of Fault Line: FAULT 1,2,3,4	OPEN	Allows Faults to Propagate Between Boards.
R17	ALERTB	Allow DC1427A to Receive ALERTB	OPEN	
R65	WDI/RESET	DC1427A Drives WDI/RESETB	OPEN	
R18	AUXP	DC1427A Sources BIGPWR	INSTALLED	BIGPWR + LGKPWR must be <= 100mA max TOTAL
R72	WDI/RESET	DC1427A Drives WDI/RESET	OPEN	
R73	CONTROL0	DC1427A Drives CONTROL0	OPEN	
R74	CONTROL1	DC1427A Drives CONTROL1	OPEN	

DC1360B DETAILS - BOTTOM SIDE

Setting the Device Address

The LTC2977 can be configured to respond to one of 9 addresses for a given MFR_I^{2}C_BASE_ADDRESS value (the factory default value base address is 7'h5C). In addition, the LTC2977 will always respond to its global address and the PMBus Alert Response address regardless of the state of the address select pins.

By connecting each of the address inputs to V_{DD33}, GND, or by floating them, the user determines the slave address, as shown in Table 5.

Table 5. Address Look-up Table

Description	HEX Device Address		Binary Device Address								Address Pins	
	7'h	8'h	6	5	4	3	2	1	0	R/W	ASEL1	ASEL0
Alert Response	0C	19	0	0	0	1	1	0	0	1	X	X
Global	5B	B6	1	0	1	1	0	1	1	0	X	X
*0	5C	B8	1	0	1	1	1	0	0	0	L	L
1	5D	BA	1	0	1	1	1	0	1	0	L	NC
2	5E	BC	1	0	1	1	1	1	0	0	L	H
3	5F	BE	1	0	1	1	1	1	1	0	NC	L
4	60	C0	1	1	0	0	0	0	0	0	NC	NC
5	61	C2	1	1	0	0	0	0	1	0	NC	H
6	62	C4	1	1	0	0	0	1	0	0	H	L
7	63	C6	1	1	0	0	0	1	1	0	H	NC
8	64	C8	1	1	0	0	1	0	0	0	H	H

H = Tie to V_{DD33}; NC = No Connect, Open or Float; L = Tie to GND; X = Don't Care
* MFR_I^{2}C_BASE_ADDRESS = 7'h5C (factory default). LO = L

DC1361B DETAILS - TOP SIDE

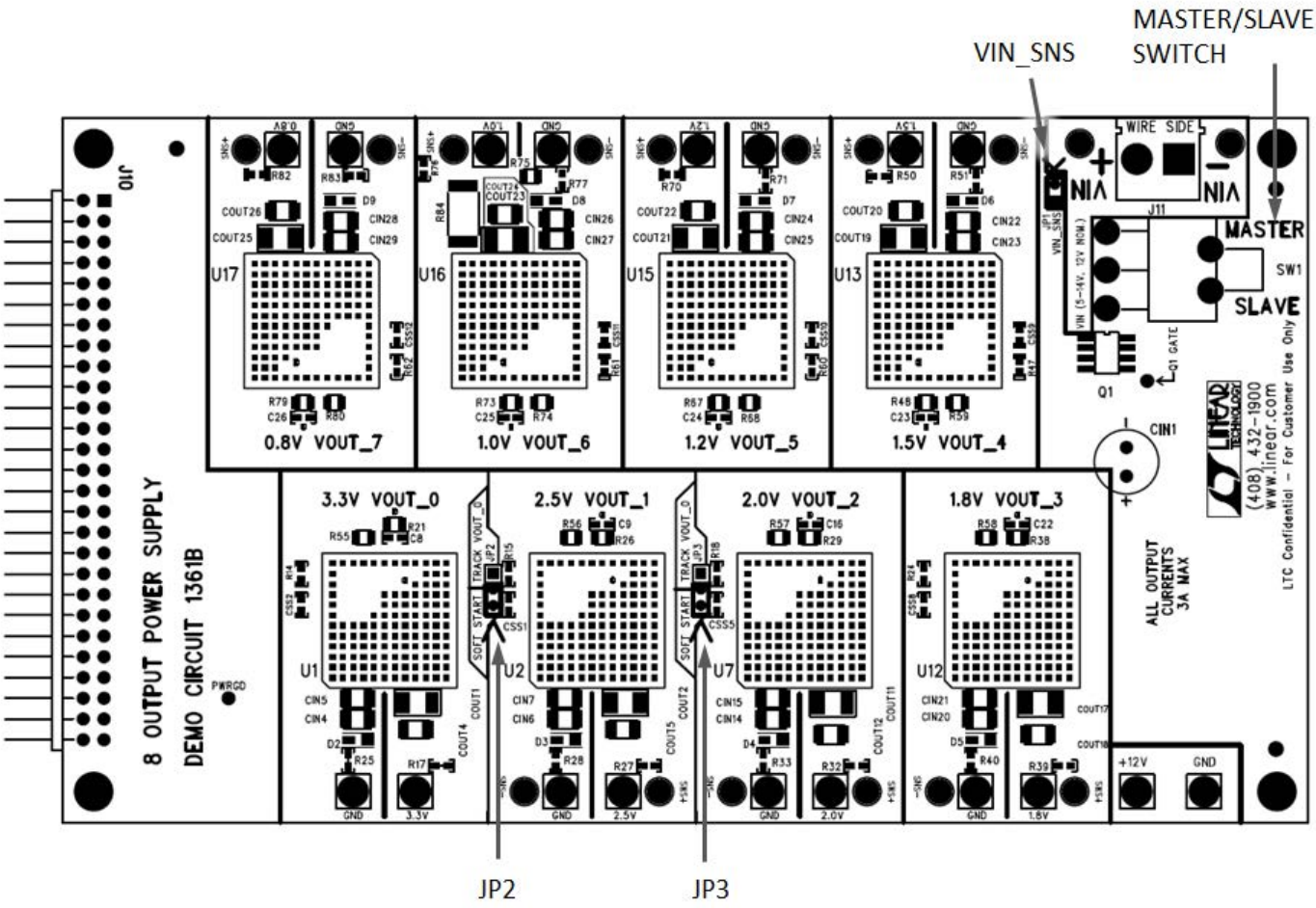


Figure 8. DC1361B Top Side

Table 6. DC1361B - Default Jumper and Switch Configurations

JP1 V_{IN_SNS}		JP2 Track V_{OUT_0}/Soft-Start	JP3 Track V_{OUT_0}/Soft-Start
Installed = Master	Removed = Slave	Soft-Start	Soft-Start

SW1	
Master	Slave

JP2, JP3 in soft start position allows V_{OUT1}, V_{OUT2} to start up with their turn on ramp determined by their soft-start caps. Their sequence position is determined by the LTC2977. In TRACK_V_{OUT_0} position, they coincident track to V_{OUT_0}. TON_DELAY for all tracking channels must be equal. SW1 in the MASTER position allows the Hot Swap circuit to ramp up the V_{IN} and also allows the LTC2977 to open the series MOSFET in case of an Overvoltage on any output. SW1 in SLAVE position defeats the hot swap and passes V_{IN} through so multiple DC1361Bs can be cascaded in an array.

DC1361B - CHANGING THE NOMINAL OUTPUT VOLTAGES

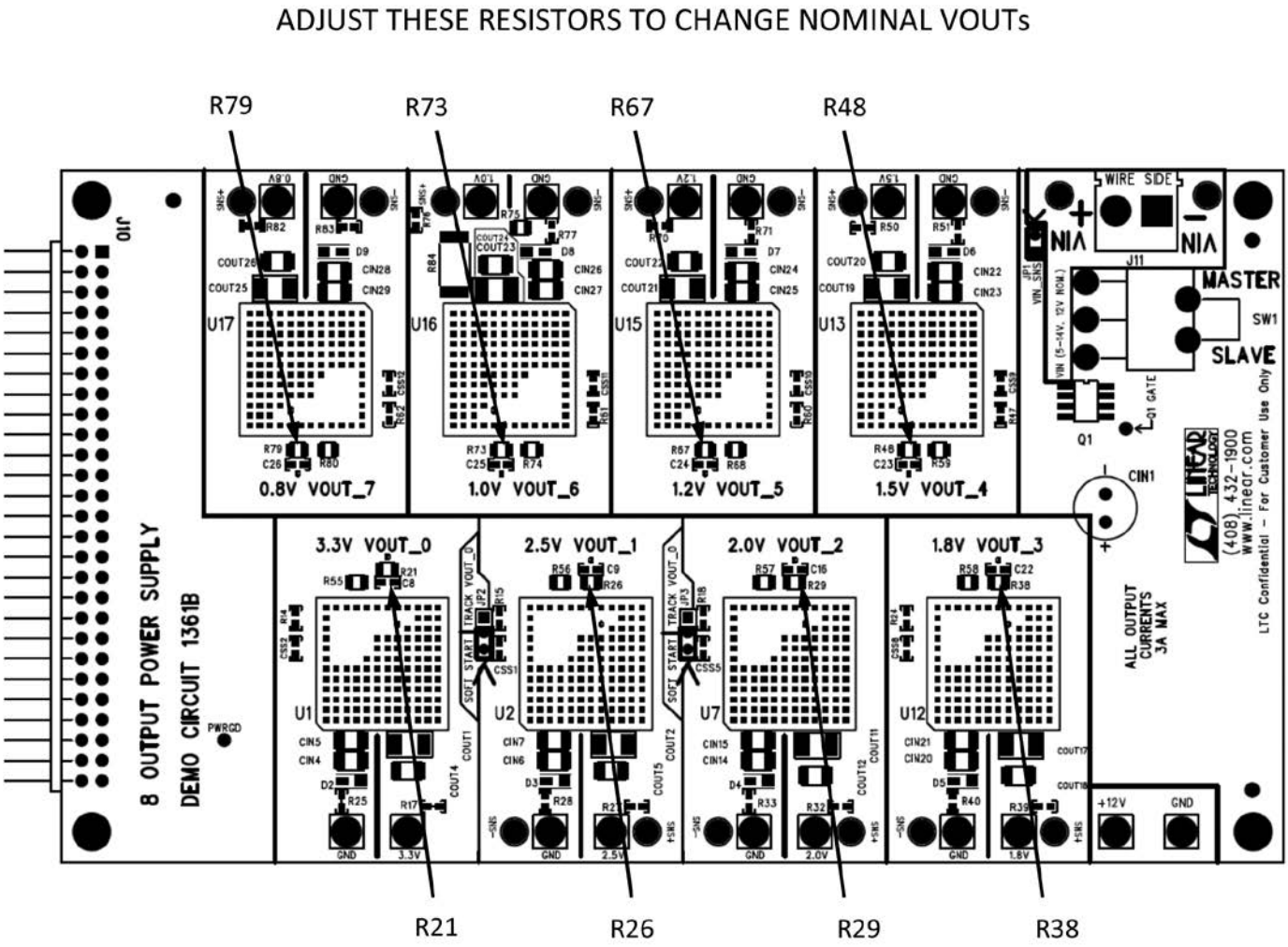


Figure 9. DC1361B Output Voltage Setting Resistor Locations

The Nominal V_{OUT} of any channel on the DC1361B can be changed by changing the R_{SET} resistor from V_{FB} to SGND. These are: R21, R26, R29, R38, R48, R67, R73, R79. See Figure 9. The value for the R_{SET} resistor is:

$R_{SET} = 60.4k/((V_{OUT}/0.6) – 1))$

See also the LTM4603 datasheet Table 2. V_{OUT0} may be adjusted up to 5V. The other channels may be adjusted up to 4V.

DC1361B – ADJUSTING THE MARGIN/TRIM RANGE AND RESOLUTION OF THE OUTPUT VOLTAGES

The resolution and range can be adjusted for any output on the DC1361B by simply replacing the below resistors. Use the LTC2977 Resistor Selection Tool (spreadsheet) for calculating resistors values and proper DAC range settings.

The design tool refers to R20. This is the upper divider resistor which is 60.4kΩ inside the LTM4603.

The design tool refers to R10. This is the lower divider resistor which is R_{SET} (See Figure 9).

The design tool refers to R30. This is the margin/trim adjustment resistor.

On the DC1361B, the lower divider resistors (R10) are = R_{SET} for each channel = R21, R26, R29, R38, R48, R67, R73, R79.

On the DC1361B, the adjustment resistors (R30) are = R55, R56, R57, R58, R59, R68, R74 and R80.

CHANGE THESE RESISTORS TO ADJUST THE MARGIN RANGE/RESOLUTION

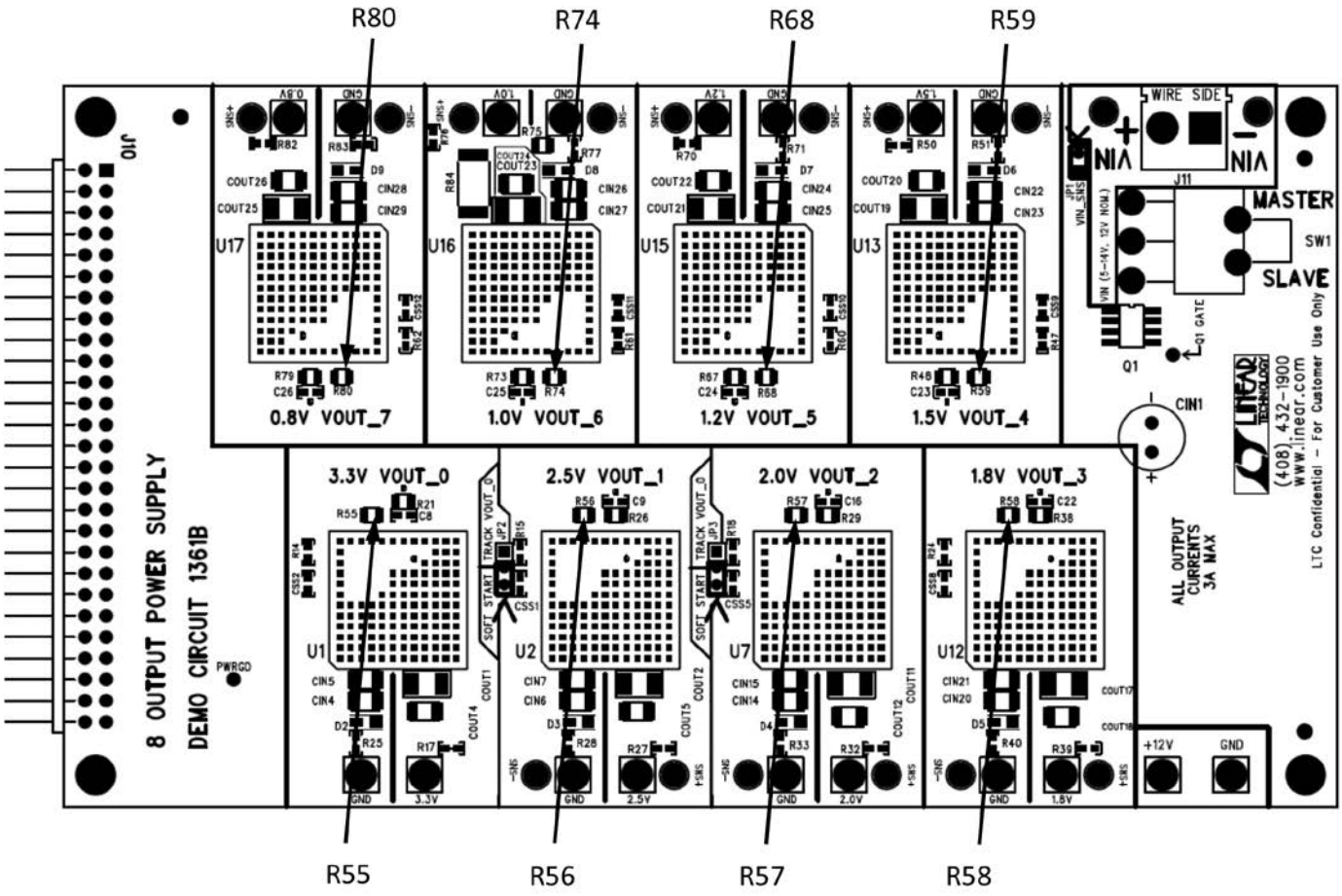
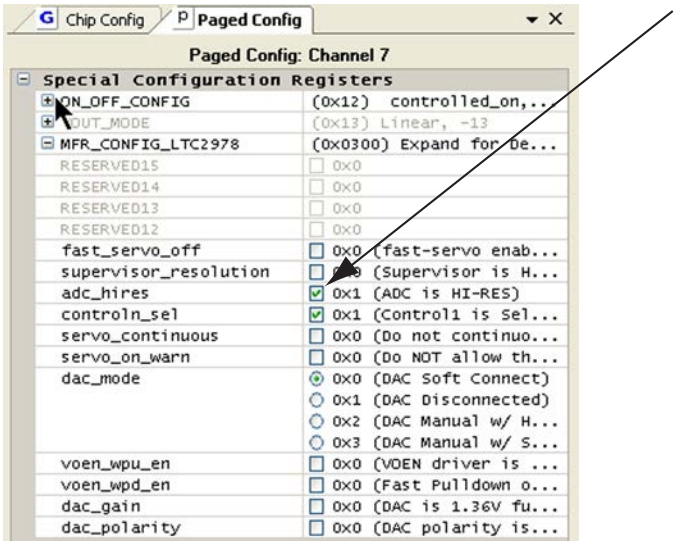


Figure 10. Margin/Trim Resistor Locations

MEASURING CURRENT

It is possible to measure the current on Channel 6 by using Channel 7 in “Hi Res” mode. Follow the instructions on pp.9 and 10 of DC1361B schematic. Remove R88, R89 and move them to R86, R87. Also remove the preload resistor R75 (top side) on DC1361B schematic p.9 to measure only the current going out of the board.

One simple checkbox in the GUI sets up Channel 7 to measure current. In the MFR_CONFIG_LTC2977 register check the box that says “adc_hires”. Apply a load between the big turrets 1.0V and GND on V_{OUT_6} and read the voltage across the 10mΩ current sense resistor by viewing the READ_VOUT register on Channel 7 in the GUI.



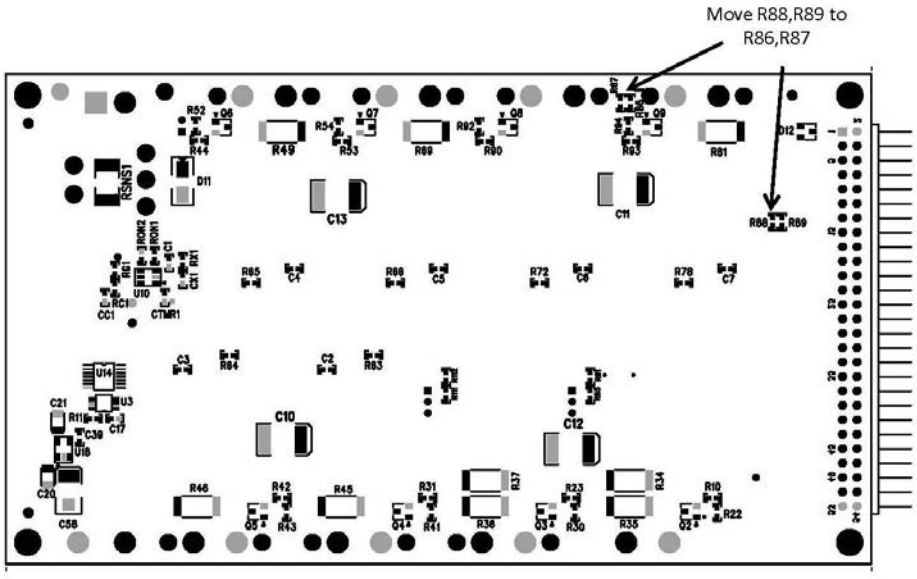


Figure 11. Current Sensing Modifications (Bottom Side of Board)

COMMON DEMO BOARD OPERATIONS

Reset the LTC2977

To reset the LTC2977 and reload the EEPROM contents into operating memory (RAM), press SW3.

DC1360B LEDs

The Red ALERTB LED indicates a fault has occurred. The Green LED indicates the status of the PWRGD signal.

DC1361B Remote Sense

Remote sense Test Points are included for channels 1-7. There is no remote sense for Channel 0.

Faulting an Output

Use a jumper wire or a coin to short any output. For an OV fault, short a lower voltage to a higher one momentarily.

Fault Sharing Setup in GUI

Use the Fault Sharing Diagram Tool to setup the fault sharing in the GUI. Before doing so, view the fault sharing Demo in the GUI. Go to Tools > Fault Sharing Diagram.

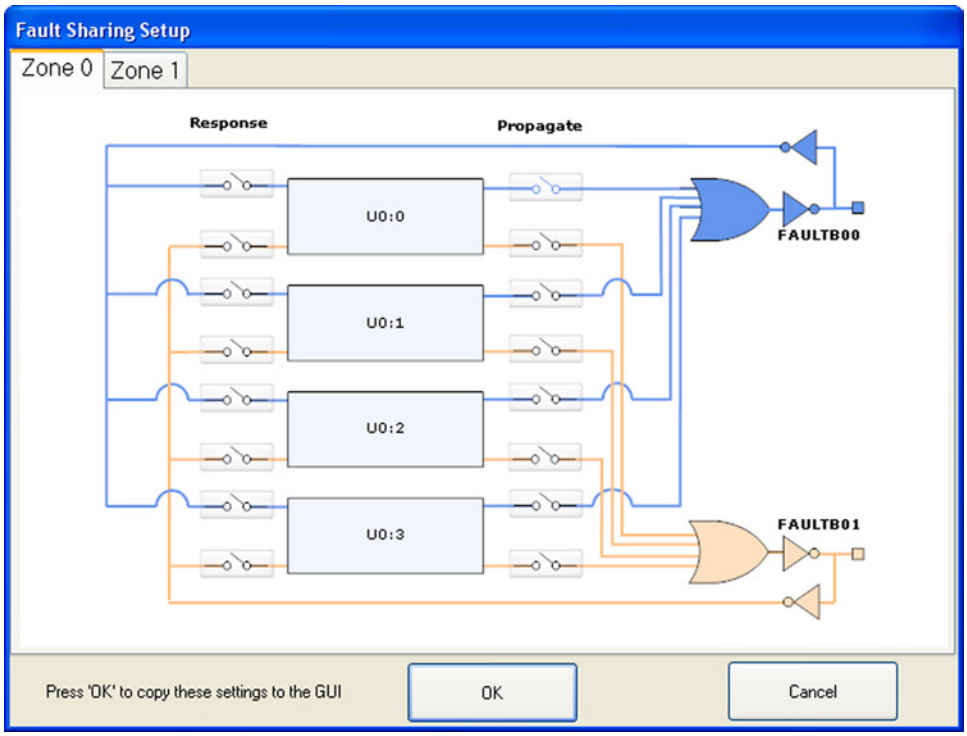


Figure 12. GUI Fault Sharing Setup Tool

FAULT ZONE CONFIGURATION AND FAULT PROPAGATION

The LTC2977 has four FAULTB pins within two fault zones. Each channel can pull FAULTB pins within its zone low. Also, any channel can shutdown in response to FAULTB pins within its zone, therefore, dependencies between any channel(s) can be established. See Applications section of the datasheet. See Figure below. Zone 0 and 1 are tied together on the DC1360B through R9. Therefore, any channel can shut off in response to any other channel on the LTC2977. Additionally, each FAULTBz pin ties to a FAULTn (n =1,2,3,4) line on the DC1360B which is bussed to other DC1360B's in a multiboard array. Therefore, it is possible for any channel in an array to shutoff in response to any other channel.

FAULTn lines are on p.2 DC1360B schematic J2, J3.

To disconnect Fault zone 0 from Fault zone 1, remove R9 on DC1360B.

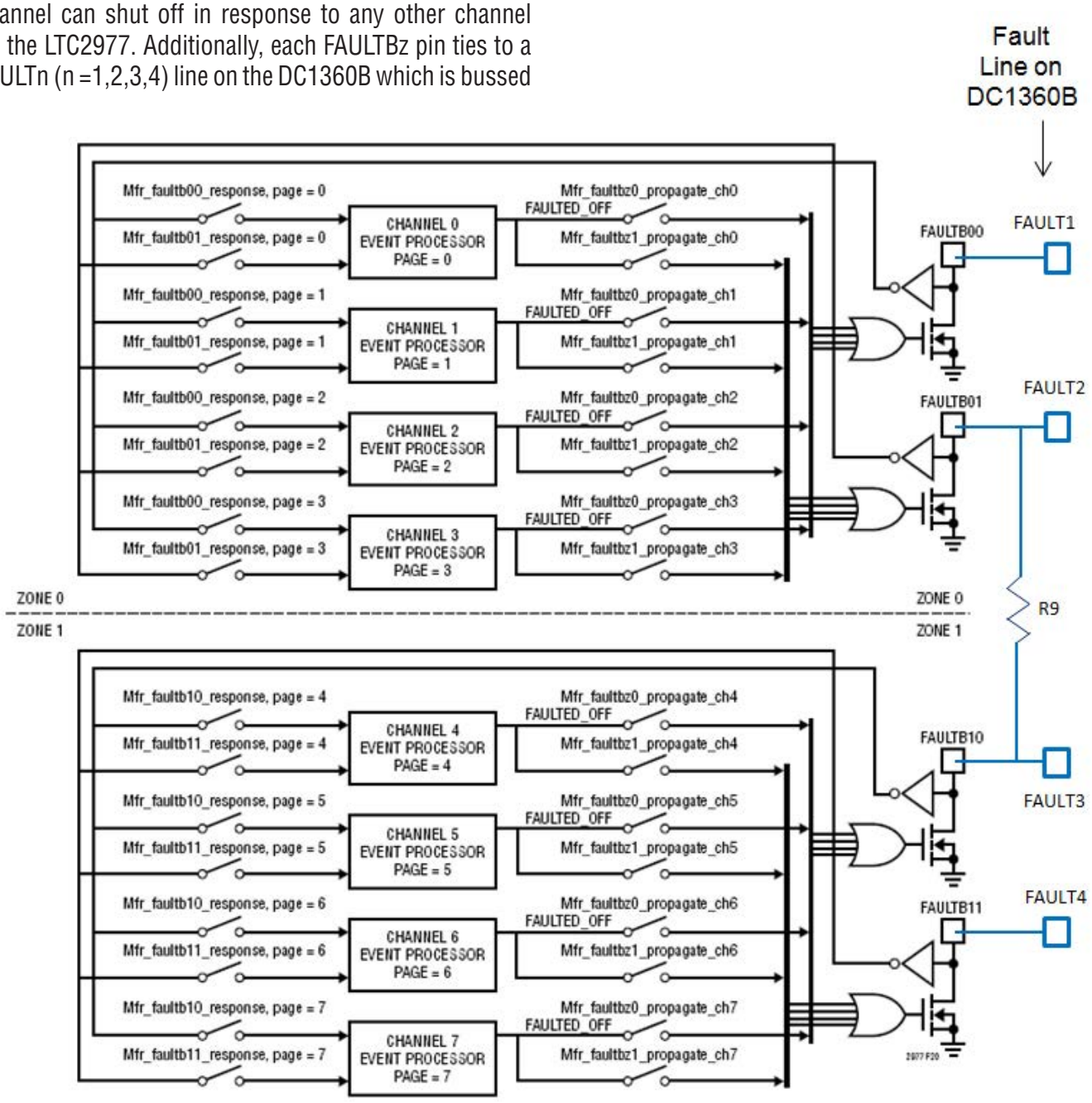


Figure 13. Fault Zones and Fault Pins on DC1360B

SETUP PROCEDURE FOR MULTI-BOARD ARRAYS

Multiple DC1540Bs can be combined to control as many output voltages as desired.

1. Connect DC1360B's to DC1361B's.
2. Solder wires from the +12V and GND turrets of Master DC1361B and connect into the terminal block of the Slave board.
3. Leave JP1 INSTALLED in the first (Master) board. Remove JP1 jumpers from all others (Slaves).
4. Plug DC1360B's together. J3 to J2.
5. Set the Master/Slave switch on the first DC1361B in the array to Master. Set other boards to Slave.
6. Set a unique address for each LTC2977 in the array using ASEL0 (JP3) and ASEL1 (JP2).
7. Plug the ribbon cable of the DC1427A into J4 OR DC1613 into J6 of any DC1360B.
8. Hook up power supply (5-14V, at least 0.5A times the number of boards) to J11 Terminal Block to power the array of modules.

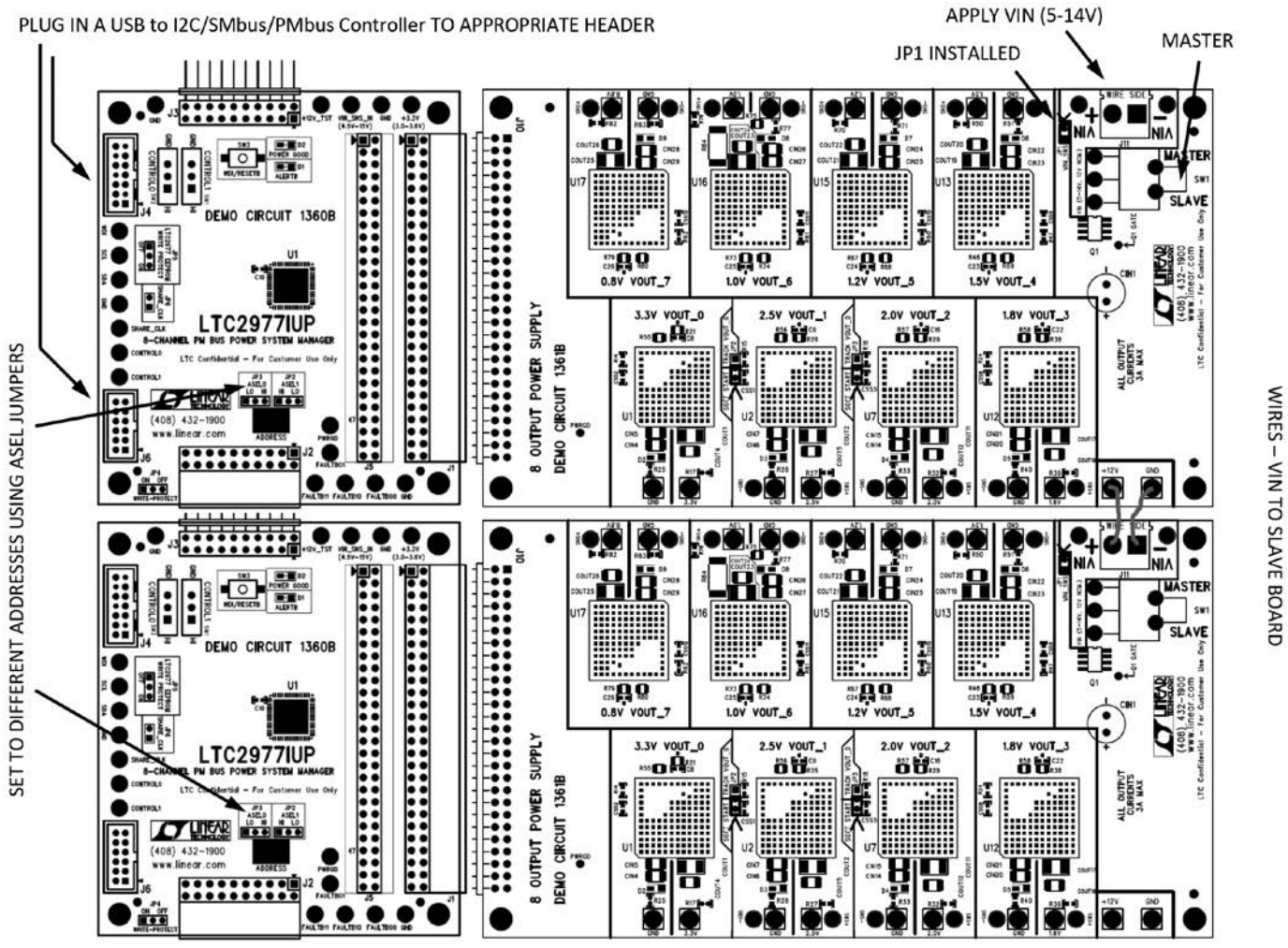


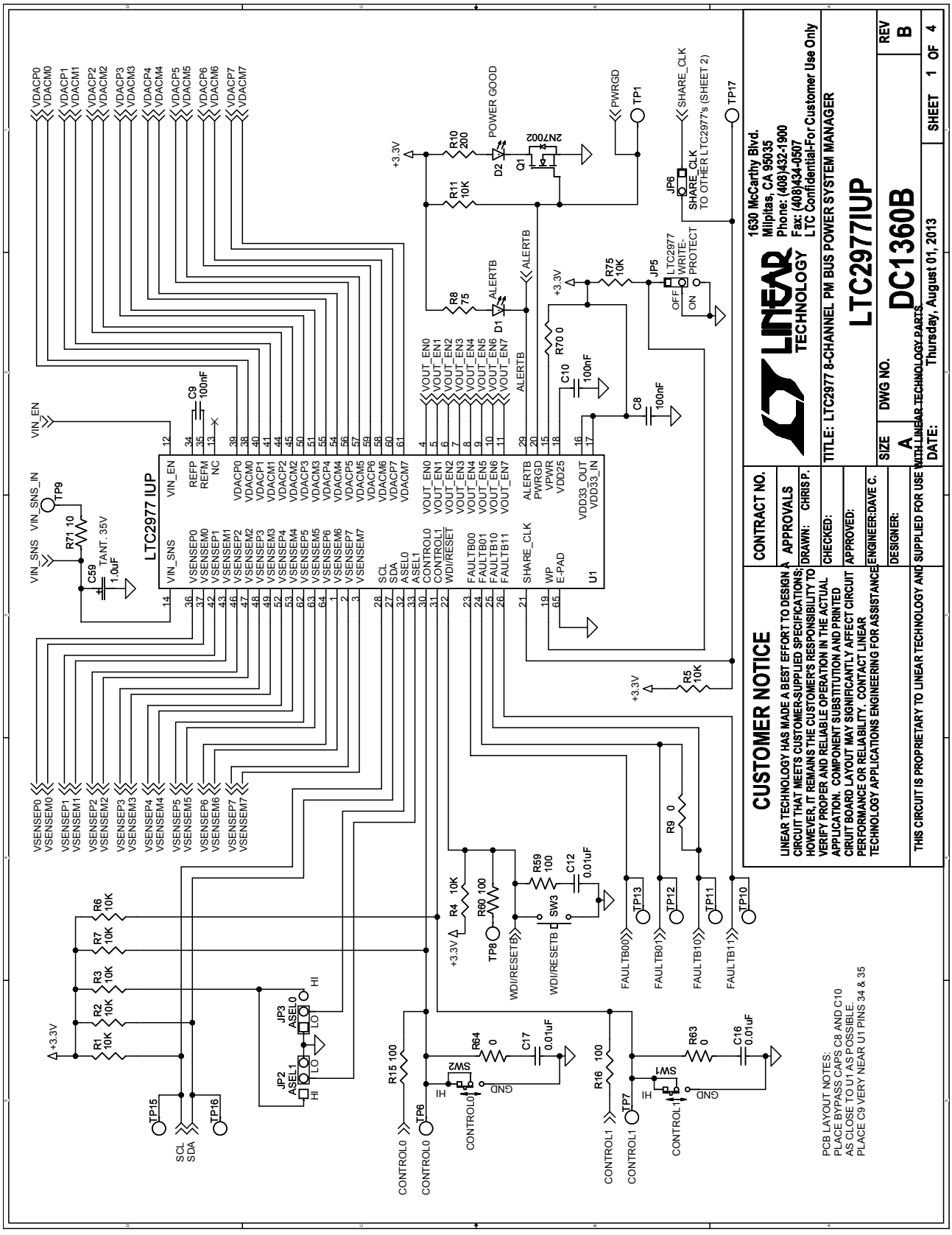
Figure 14. Array of Multiple Demo Boards

PARTS LIST

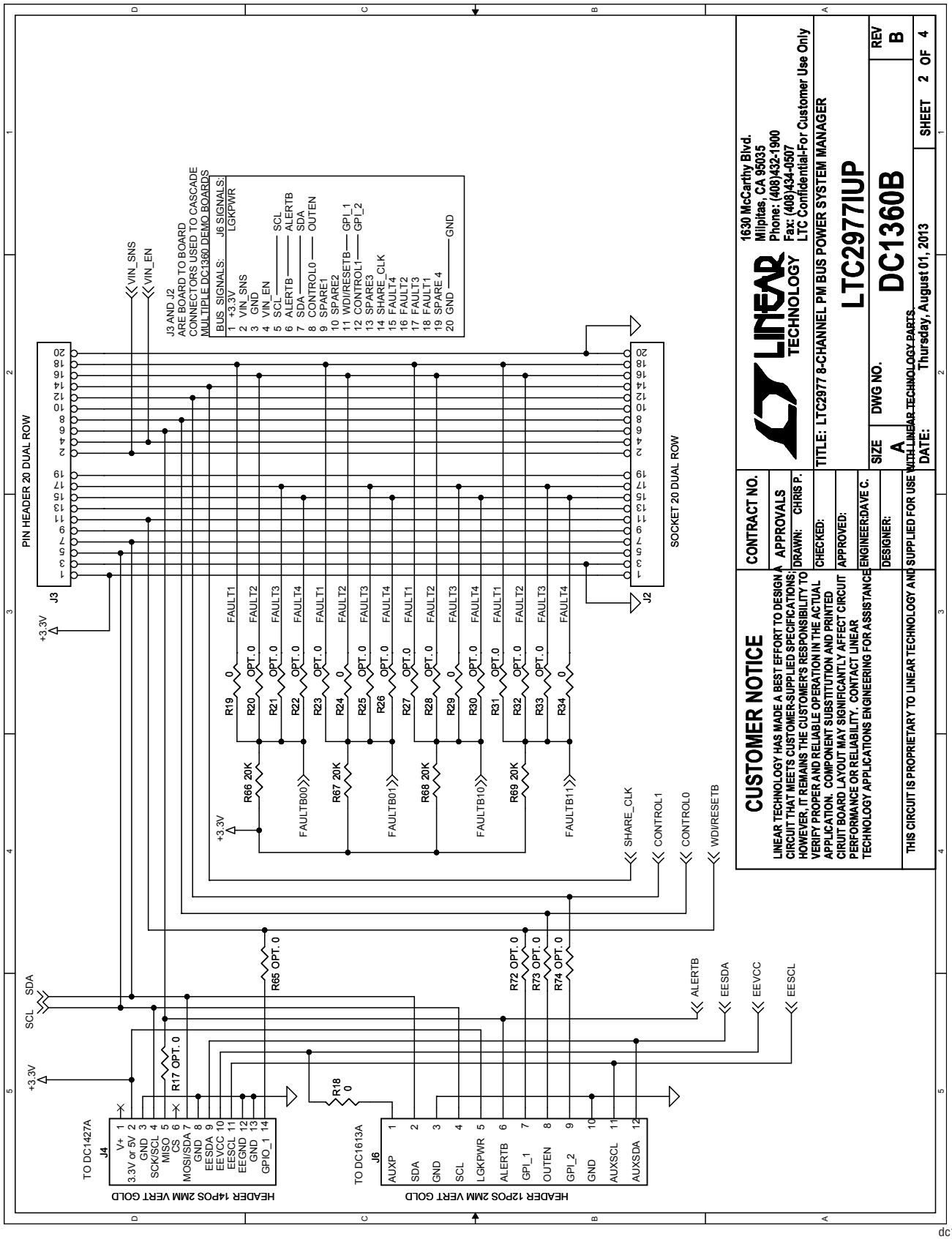
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components[1]				
1	1	U1	IC 8-CH PWR SYSTEM MANAGER 64-QFN	LINEAR TECH: LTC2977IUP
2	3	C8, C9, C10	CAP CERM 0.1µF 16V 20% X7R 0603	AVX: 0603YC104MAT2A
3	6	R1, R2, R4, R5, R11, R75	RES 10k 1/10W 5% 0603 SMD	VISHAY: CRCW060310K0JNEA
Additional Demo Board Circuit Components[2]				
4	1	C11	CAP CERM 0.1µF 16V 20% X7R 0603	AVX: 0603YC104MAT2A
5	4	C12, C16, C17, C39	CAP CERM 10nF 50V 10% X7R 0603	AVX: 06035C103KAT2A
6	2	C14, C15	CAP CERM 1µF 25V 10% X7R 1206	AVX: 12063C105KAT2A
7	2	C48, C56	CAP CERM 0.47µF 16V 10% X5R 0603	AVX: 0603YD474KAT2A
8	1	C58	CAP TANT 3.3µF 25V 20% SMD	AVX: TAJC335M025R
9	1	C59	CAP TANT 1µF 35V 20% SMD	KEMET: B45196H6105M109
10	1	D1	LED RED DIFF SMD 0805	PANASONIC: LN1271RTR
11	1	D2	LED GREEN CLEAR 0805 SMD	PANASONIC: LN1371SGTRP
12	1	Q1	MOSFET N-CH 60V 115MA SOT-23	FAIRCHILD: 2N7002_NL
13	3	R3, R6, R7	RES 10k 1/10W 5% 0603 SMD	VISHAY: CRCW060310K0JNEA
14	1	R8	RES 75Ω 1/10W 5% 0603 SMD	VISHAY: CRCW060375R0JNEA
15	20	R9, R18, R35, R36, R37, R38, R39, R40, R41, R43, R44, R45, R46, R47, R48, R49, R61, R63, R64, R70	RES 0.0Ω 1/10W 5% 0603 SMD	VISHAY: CRCW06030000Z0EA
16	1	R10	RES 200Ω 1/10W 1% 0603 SMD	VISHAY: CRCW0603200RFKEA
17	3	R12, R13, R14	RES 4.99k 1/10W 1% 0603 SMD	VISHAY: CRCW06034K99FKEA
18	15	R15, R16, R42, R50, R51, R52, R53, R54, R55, R56, R57, R58, R59, R60, R62	RES 100Ω 1/10W 1% 0603 SMD	VISHAY: CRCW0603100RFKEA
19	14	R17, R20, R21, R22, R23, R25, R26, R27, R28, R30, R31, R32, R33, R65 (OPT)	RES 0.0Ω 1/8W 5% 0805 SMD	VISHAY: CRCW08050000Z0EA
20	7	R19, R24, R29, R34, R72, R73, R74	RES 0.0Ω 1/8W 5% 0805 SMD	VISHAY: CRCW08050000Z0EA
21	4	R66, R67, R68, R69	RES 20k 1/10W 5% 0603 SMD	VISHAY: CRCW060320K0JNEA
22	1	R71	RES 10Ω 1/10W 1% 0603 SMD	VISHAY: CRCW060310RFKEA
23	2	SW1, SW2	SWITCH SLIDE SPDT 30V 0.2A PC MNT	E-SWITCH: EG1218
24	1	SW3	SWITCH TACT MINI PB SPST SLV GWING	C&K: KSR211GLFS
25	1	U2	IC REG 3.3V 100MA LDO LN SOT23-5	LINEAR TECH: LT1763CS8-3.3
26	1	U3	IC, SERIAL EEPROM	MICROCHIP: 24LC025-I/ST
Hardware—For Demo Board Only				
27	1	J1	CONN FEMALE 54POS DL 0.1 R/A TIN	SULLINS: PPTC272LJBN-RC
28	1	J2	CONN SOCKET 20 DUAL ROW RA	MILL-MAX: 803-93-020-20-001
29	1	J3	PIN HEADER 20 DUAL ROW RA	MILL-MAX: 802-40-020-20-001
30	1	J4	HEADER 14POS 2MM VERT GOLD	MOLEX: 87831-1420
31	1	J6	CONN HEADER 12POS 2MM STR DL PCB	FCI: 98414-G06-12ULF
32	5	JP2-SH, JP3-SH, JP4-SH, JP5-SH, JP6-SH	CONN SHUNT 2MM 2POS GOLD BLACK	SAMTEC: 2SN-BK-G
33	4	MTG1, MTG2, MTG3, MTG4	STAND-OFF NYLON 1/4" SNAP IN	KEYSTONE: 8831
34	18	TP01, TP02, TP03, TP04, TP05, TP06, TP07, TP08, TP09, TP10, TP11, TP12, TP13, TP15, TP16, TP17, TP18, TP19	TP TURRET SMALL FOR 0.063 HOLE	MILL-MAX: 2308-2-00-44-00-00-07-0
35	0	OPTIONAL	CONN HEADER BRKWAY (OPT)	OPTION

Notes:
1. Required Circuit Components are those parts that are required to implement the circuit function.
2. Additional Demo Board Circuit Components are those parts that provide added functionality for the demo board but are not required in the actual circuit.

SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



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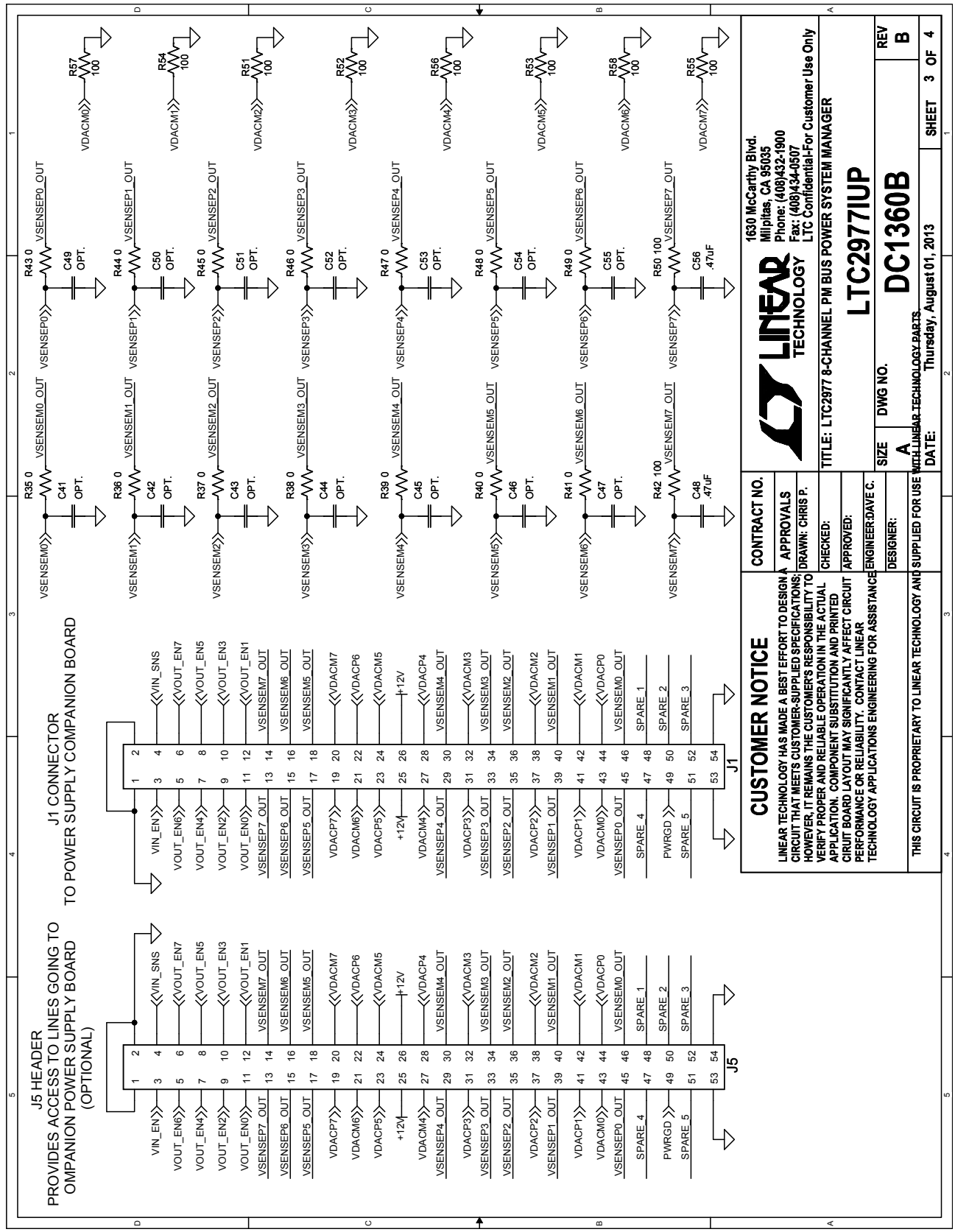
SCHEMATIC DIAGRAM



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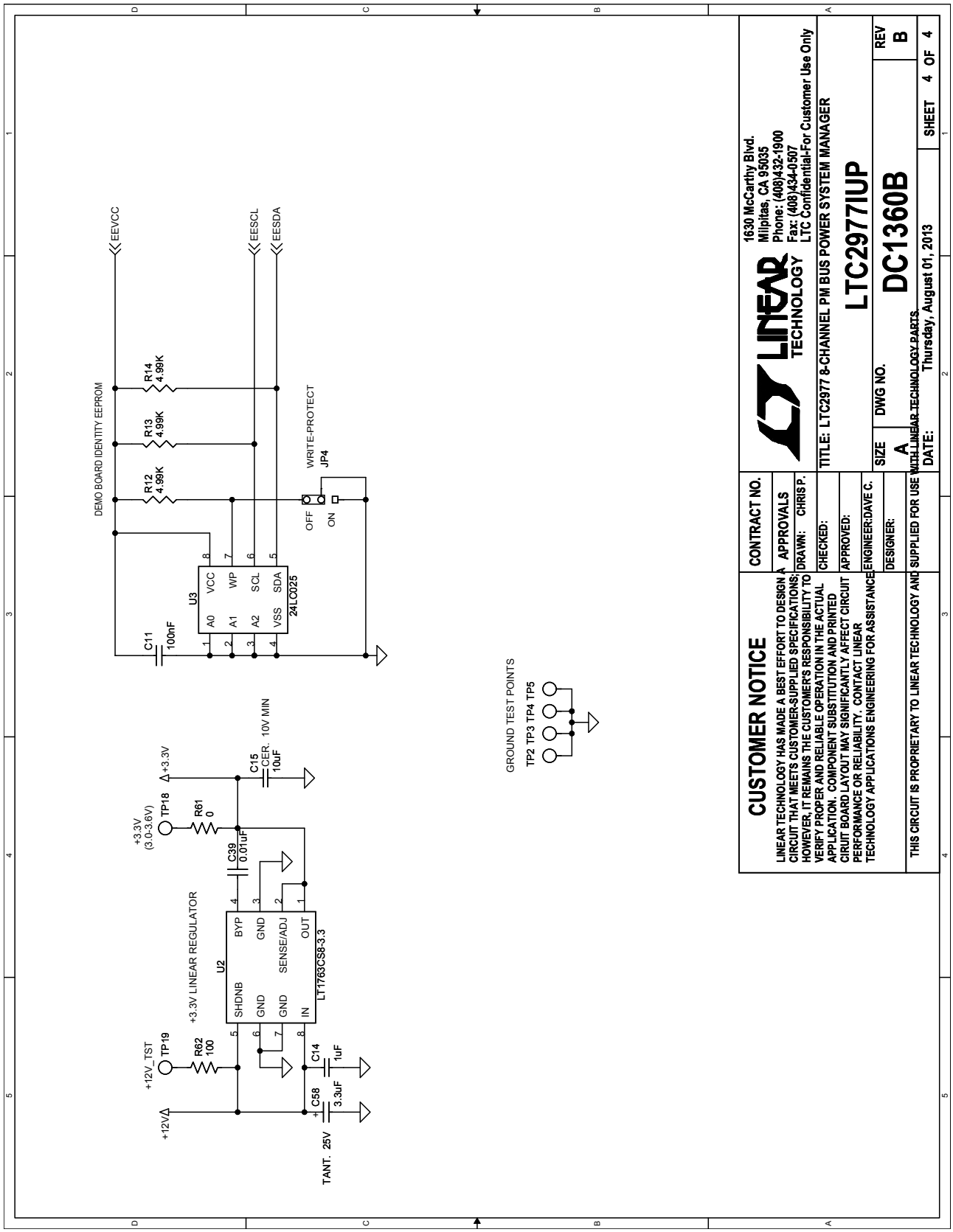


PARTS LIST

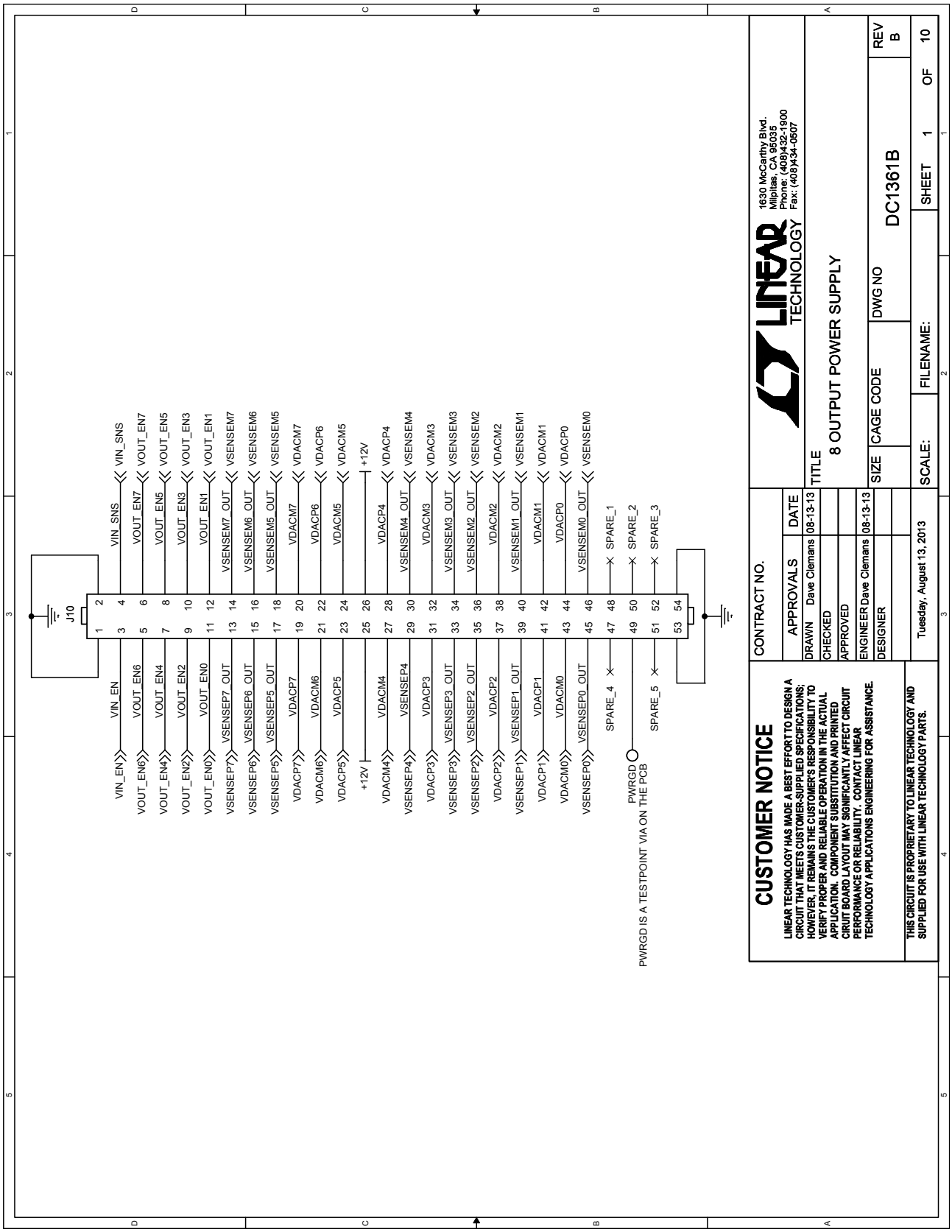
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components[1]				
	DC1361B is only a companion board to the DC1360B. None of these parts are required for LTC2977 operation.			
Additional Demo Board Circuit Components[2]				
1	1	C1	CAP CER 1000pF 50V 10% X7R 0603	AVX: 06035A102KAT2A
2	8	C8, C9, C16, C22, C23, C24, C25, C26	CAP CER 100pF 25V 10% NPO 0603	AVX: 06033A101KAT2A
3	4	C10, C11, C12, C13	CAP TANT 47µF 16V 20% SMD 7343-31	KEMET: T520D476M016ATE035
4	2	C17, Cx1	CAP CER 0.1µF 25V 20% X5R 0603	AVX: 06033D104MKAT2A
5	1	C20	CAP CER 1µF 16V 10% X7R 1206	AVX: 1206YC105KAT2A
6	25	C21, COUT4, CIN4, COUT5, CIN5, CIN6, CIN7, COUT12, CIN14, CIN15, COUT18, COUT20, CIN20, CIN21, COUT22, CIN22, CIN23, COUT24, CIN24, CIN25, COUT26, CIN26, CIN27, CIN28, CIN29	CAP CER 10µF 16V 20% X7R 1206	TDK: C3216X7R1C106M
7	10	C39, CC1, CSS1, CSS2, CSS5, CSS8, CSS9, CSS10, CSS11, CSS12	CAP CER 10nF 25V 20% X7R 0603	MURATA: GRM188R71E103KA01D
8	1	C58	CAP TANT 3.3µF 25V 20% SMD	AVX: TAJC335M025R
9	1	CIN1	CAP ALUM 150µF 35V 20%	SANYO: 35ME150WXV+TS
10	8	COUT1, COUT2, COUT11, COUT17, COUT19, COUT21, COUT23, COUT25	CAP CER 100µF 6.3V X5R 1210	AVX: 12106D107KAT2A
11	1	Ctmr1	CAP CER 2.2µF 10V X7R 0603	MURATA: GRM188R71A225KE15D
14	8	D2, D3, D4, D5, D6, D7, D8, D9	LED GREEN 565NM 0805 SMD	PANASONIC: LN1371SGTRP
12	1	D11	TVS UNIDIRECT 14V 400W SMA	DIODES INC.: SMAJ14A-13-F
13	1	D12	DIODE SCHOTTKY 30V 200MW SOT23	DIODES INC.: BAT54-7-F
15	1	Q1	MOSFET N-CH 30V 8.9A SOIC8	VISHAY: Si4894BDY
16	8	Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9	MOSFET N-CH 60V 300MA SOT-23	VISHAY: 2N7002K-T1-E3
17	8	R10, R23, R31, R42, R44, R53, R90, R93	RES 200Ω 1/10W 5% 0603 SMD	YAGEO: RC0603JR-07200RL
18	1	R11	RES 59.0k 1/10W 1% 0603 SMD	VISHAY: CRCW060359K0FKEA
19	1	R17, R25	RES 0.0Ω 1/10W 5% 0603 SMD	VISHAY: CRCW06030000Z0EA
20	1	R21	RES 13.3k 1/10W 1% 0805 SMD	VISHAY: CRCW080513K3FKEA
21	8	R22, R30, R41, R43, R52, R54, R92, R94	RES 10k 1/10W 5% 0603 SMD	YAGEO: RC0603JR-0710KL
22	1	R26	RES 19.1k 1/8W 1% 0805 SMD	VISHAY: CRCW080519K1FKEA
23	14	R27, R28, R32, R33, R39, R40, R50, R51, R70, R71, R76, R77, R82, R83	RES 1.0Ω 1/10W 5% 0603 SMD	VISHAY: CRCW06031R00JNEA
24	1	R29	RES 26.1k 1/8W 1% 0805 SMD	VISHAY: CRCW080526K1FKEA
25	4	R34, R35, R36, R37	RES 43.2Ω 1W 1% 2512 SMD	PANASONIC: ERJ-1TNF43R2U
26	1	R38	RES 30.1k 1/8W 1% 0805 SMD	VISHAY: CRCW080530K1FKEA
27	5	R45, R46, R49, R69, R81	RES 20.0Ω 1W 1% 2512 SMD	PANASONIC: ERJ-1TNF20R0U
28	1	R48	RES 40.2k 1/8W 1% 0805 SMD	VISHAY: CRCW080540K2FKEA
29	1	R55	RES 71.5k 1/8W 1% 0805 SMD	PANASONIC: ERJ-6ENF7152V
30	1	R56	RES 95.3k 1/8W 1% 0805 SMD	PANASONIC: ERJ-6ENF9532V
31	1	R57	RES 107k 1/8W 1% 0805 SMD	VISHAY: CRCW0805107KFKEA
32	1	R58	RES 121k 1/8W 1% 0805 SMD	VISHAY: CRCW0805121KFKEA
33	1	R59	RES 147k 1/8W 1% 0805 SMD	VISHAY: CRCW0805147KFKEA
34	1	R67	RES 60.4k 1/8W 1% 0805 SMD	VISHAY: CRCW080560K4FKEA
35	2	R68, R79	RES 182k 1/8W 1% 0805 SMD	VISHAY: CRCW0805182KFKEA
36	1	R73	RES 90.9k 1/8W 1% 0805 SMD	VISHAY: CRCW080590K9FKEA
37	1	R74	RES 280k 1/8W 1% 0805 SMD	VISHAY: CRCW0805280KFKEA
38	1	R75	RES 20Ω 1/8W 5% 0805 SMD	VISHAY: CRCW080520R0JNEA
39	1	R80	RES 287k 1/8W 1% 0805 SMD	VISHAY: CRCW0805287KFKEA
40	1	R84	RESISTOR 0.010Ω 1W 1% 2512	PANASONIC: ERJ-M1WSF10MU

SCHEMATIC DIAGRAM

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
41	1	R85	RES 19.1k 1/10W 1% 0603 SMD	VISHAY: CRCW060319K1FKEA
42	2	R86, R87 (OPT.)	RES 0.0Ω 1/10W 5% 0603 SMD	VISHAY: CRCW06030000Z0EA
43	2	R88, R89	RES 0.0Ω 1/10W 5% 0603 SMD	VISHAY: CRCW06030000Z0EA
44	2	R91, R112	RES 60.4k 1/10W 1% 0603 SMD	VISHAY: CRCW060360K4FKEA
45	1	R111	RES 26.1k 1/10W 1% 0603 SMD	VISHAY: CRCW060326K1FKEA
46	1	Rc1	RES 68Ω 1/10W 5% 0603 SMD	VISHAY: CRCW060368R0JNEA
47	1	Rg1	RES 100Ω 1/10W 5% 0603 SMD	VISHAY: CRCW0603100RJNEA
48	1	Ron1	RES 24.3k 1/10W 1% 0603 SMD	VISHAY: CRCW060324K3FKEA
49	15	Ron2, R14, R15, R18, R24, R47, R60, R61, R62, R63, R64, R65, R66, R72, R78	RES, 10k 1/10W 1% 0603 SMD	VISHAY: CRCW060310K0FKEA
50	1	Rsns1	RES 0.007Ω 1W 1% 2512 SMD	VISHAY: WSL25127L000FEA
51	1	Rx1	RES 10Ω 1/10W 5% 0603 SMD	VISHAY: CRCW060310R0JNEA
52	8	U1, U2, U7, U12, U13, U15, U16, U17	IC, µMODULE, POWER SUPPLY	LINEAR TECH: LTM4603EV
53	1	U3	IC, µCIRCUIT	LINEAR TECH: LTC6902IMS
54	1	U10	IC, µCIRCUIT	LINEAR TECH: LTC4210-1CS6
55	1	U14	IC, HEX SCHMITT-TRIG INV 14TSSOP	TEXAS INST: SN74AHC14PWR
56	1	U18	IC, µCIRCUIT	LINEAR TECH: LT1761ES5-3.3
Hardware – For Demo Board Only				
57	18	E6, E7, E8, E9, E10, E11, E12, E13, E14, E15, E16, E17, E18, E19, E20, E21, E30, E51	TURRET, TESTPOINT	MILL-MAX 2501-2-00-80-00-00-07-0
58	16	E35, E37, E39, E41, E43, E46, E49, E36, E38, E40, E42, E44, E47, E50, E52, E53	TURRET, TESTPOINT	MILL-MAX 2308-2-00-80-00-00-07-0
59	1	J10	CONN HEADER 54POS 0.100 R/A 15GOLD	FCI: 68021-254HLF
60	1	J11	TERMINAL BLOCK 5MM 2POS PCB	ON-SHORE-TECH: ED700/2
61	1	JP1	CONN HEADER 2MM MALE 1ROW 2POS	COMM CON: 2802S-02G2
62	2	JP2, JP3	CONN HEADER 2MM MALE 1ROW 3POS	COMM CON: 2802S-03G2
63	3	JP1-SH, JP2-SH, JP3-SH	SHUNT 2MM	SAMTEC: 2SN-BK-G
64	4	MTG1, MTG2, MTG3, MTG4	STAND-OFF NYLON 1/4" SNAP IN	KEYSTONE: 8831
65	1	SW1	SWITCH TOG. SPDT RT ANGLE	C&K: E101MD1AQE

Notes:
1. Required Circuit Components are those parts that are required to implement the circuit function.
2. Additional Demo Board Circuit Components are those parts that provide added functionality for the demo board but are not required in the actual circuit.

SCHEMATIC DIAGRAM



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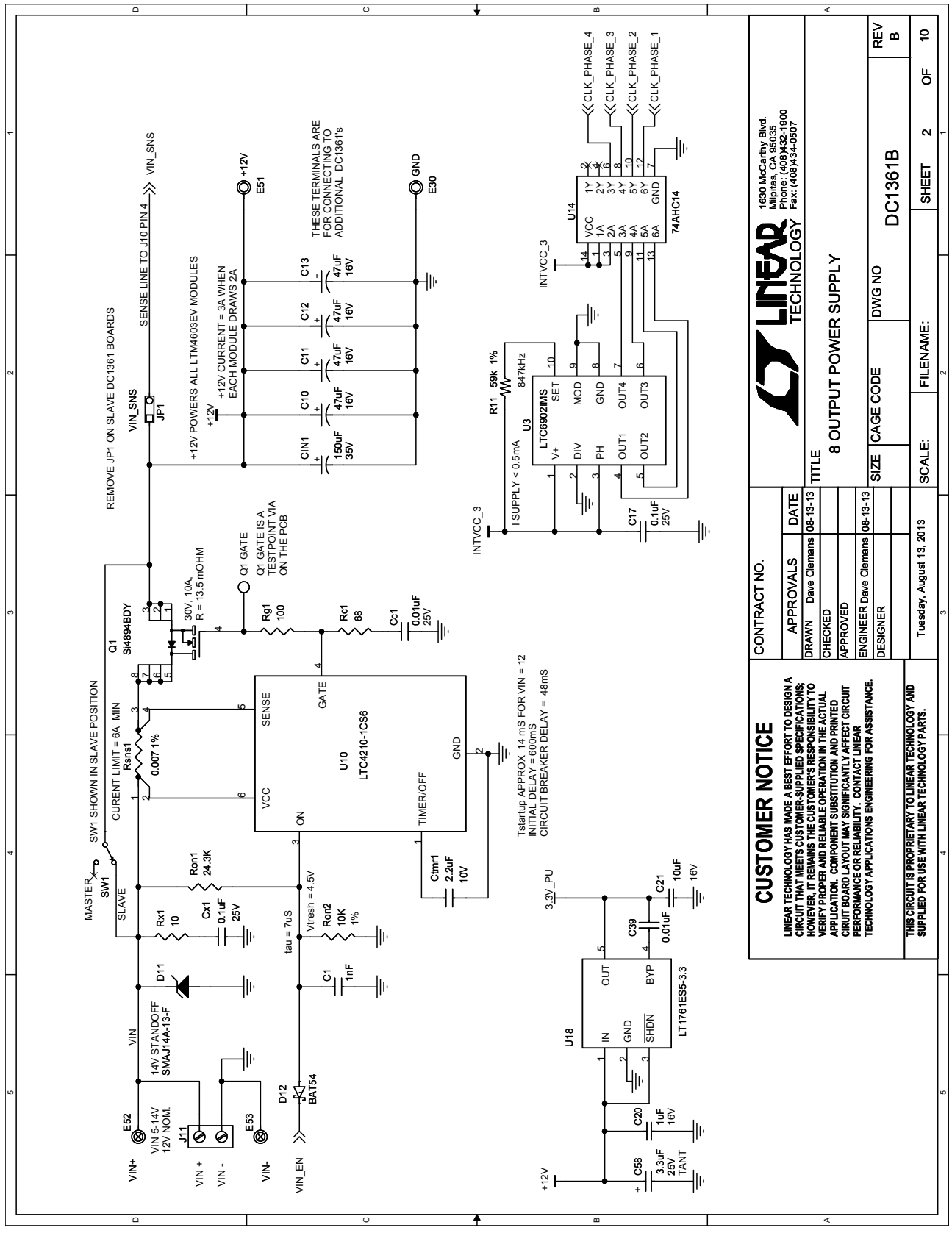

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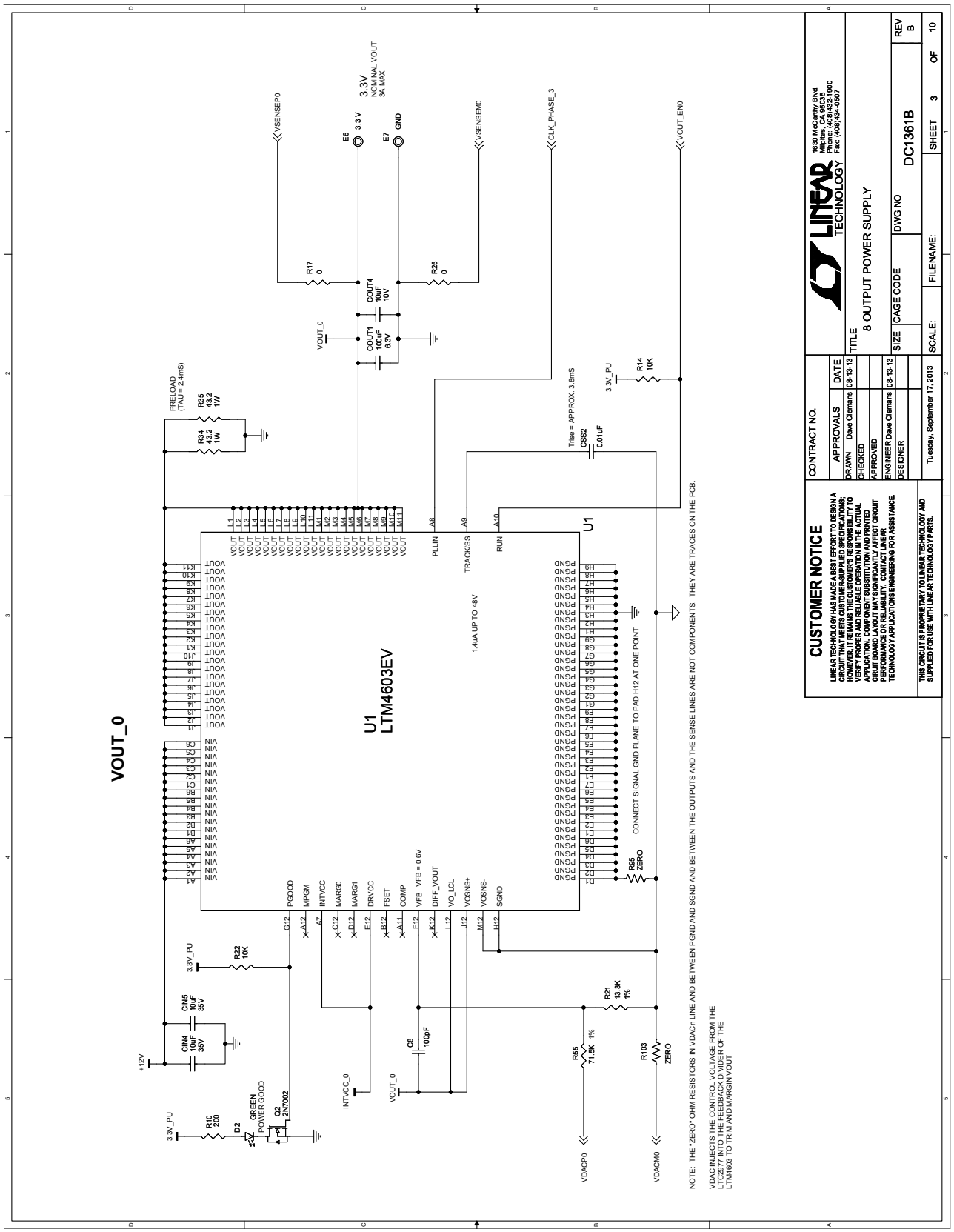

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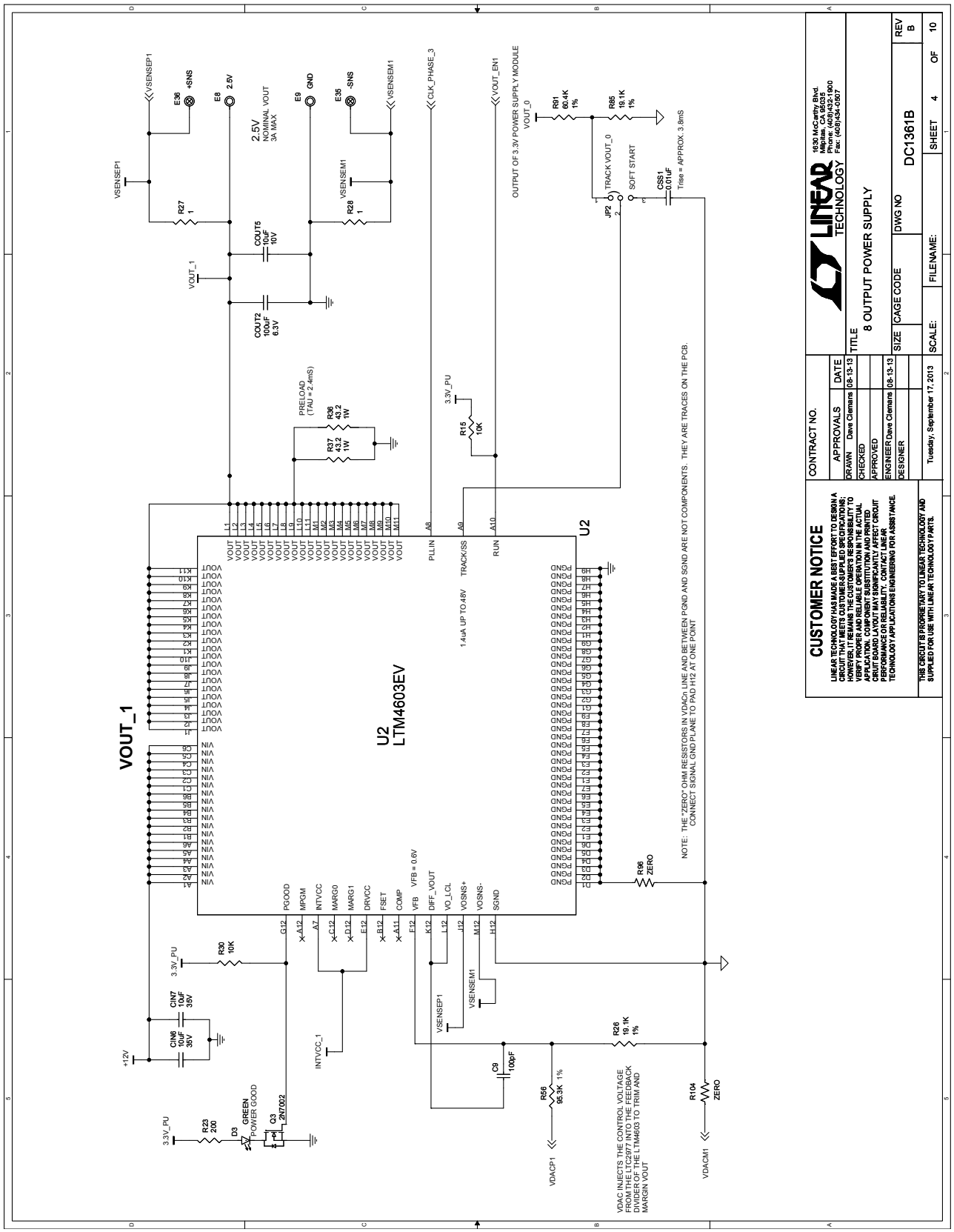

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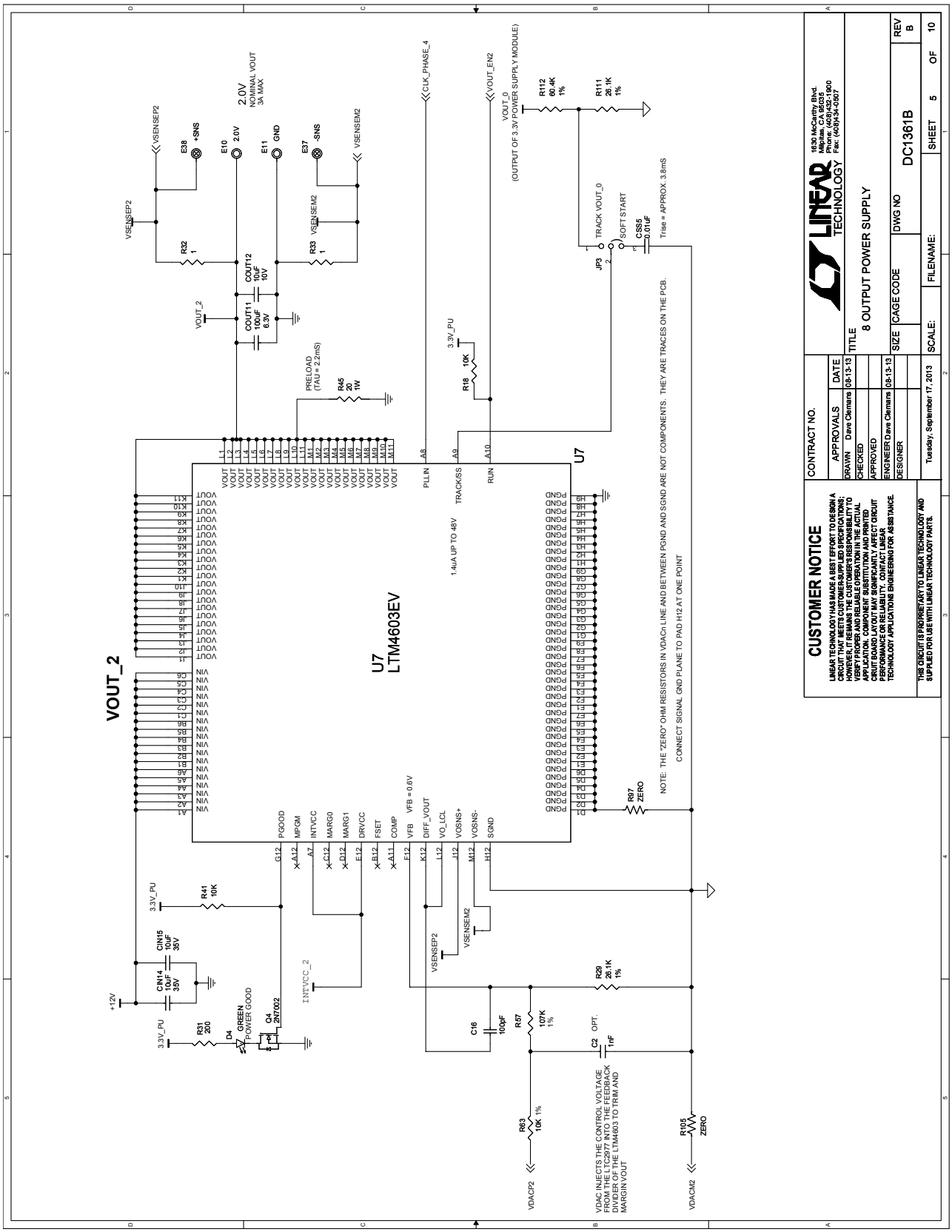

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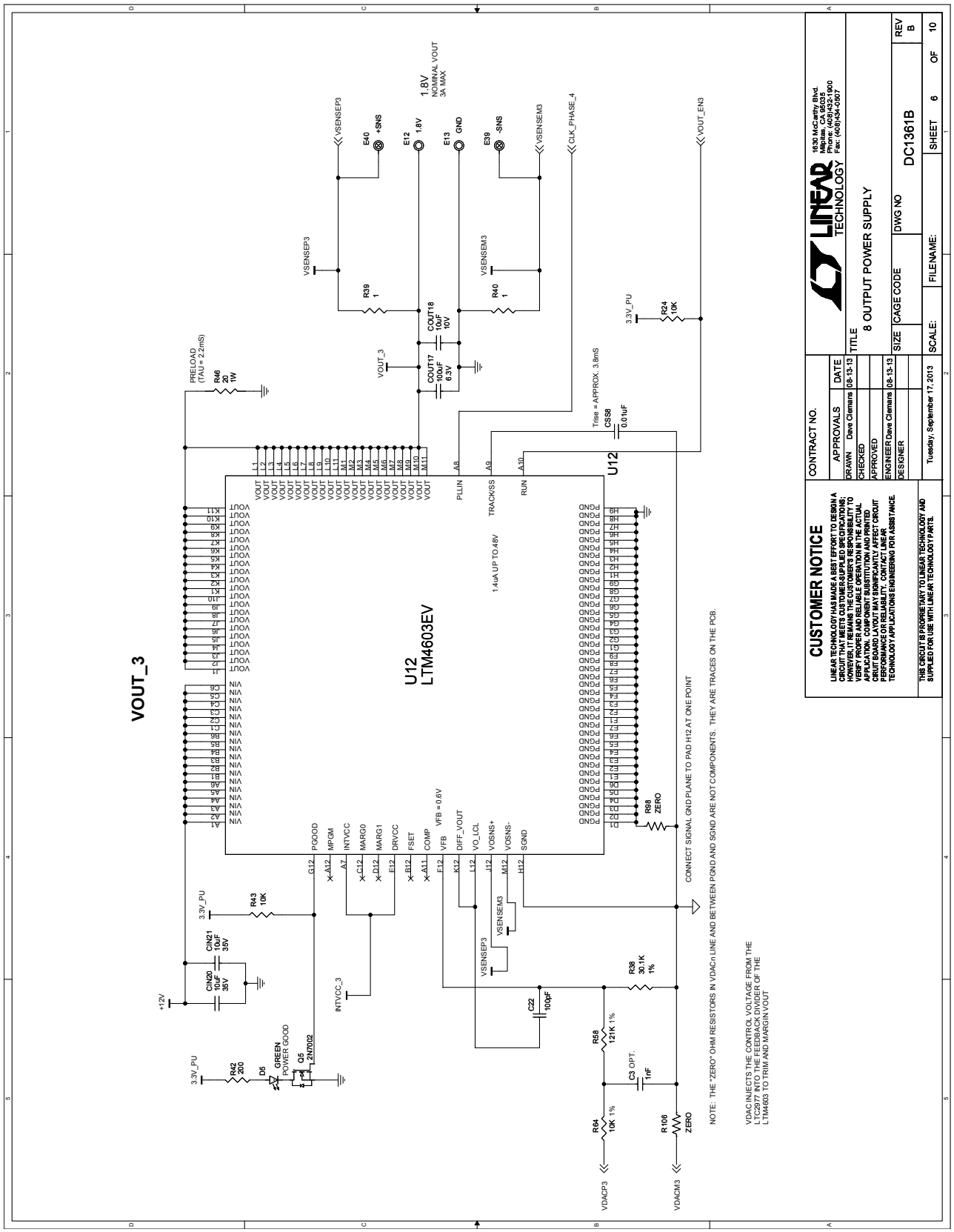

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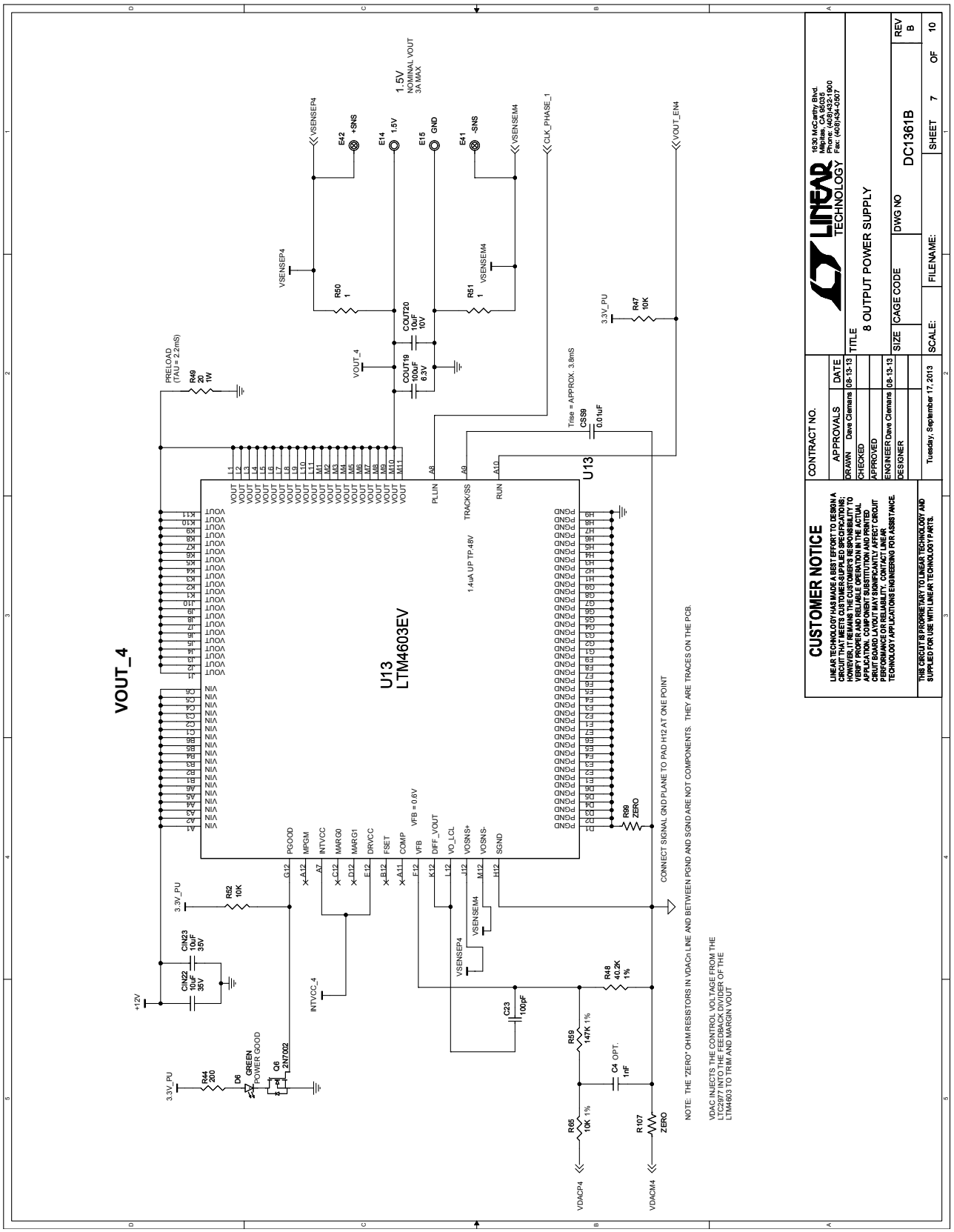

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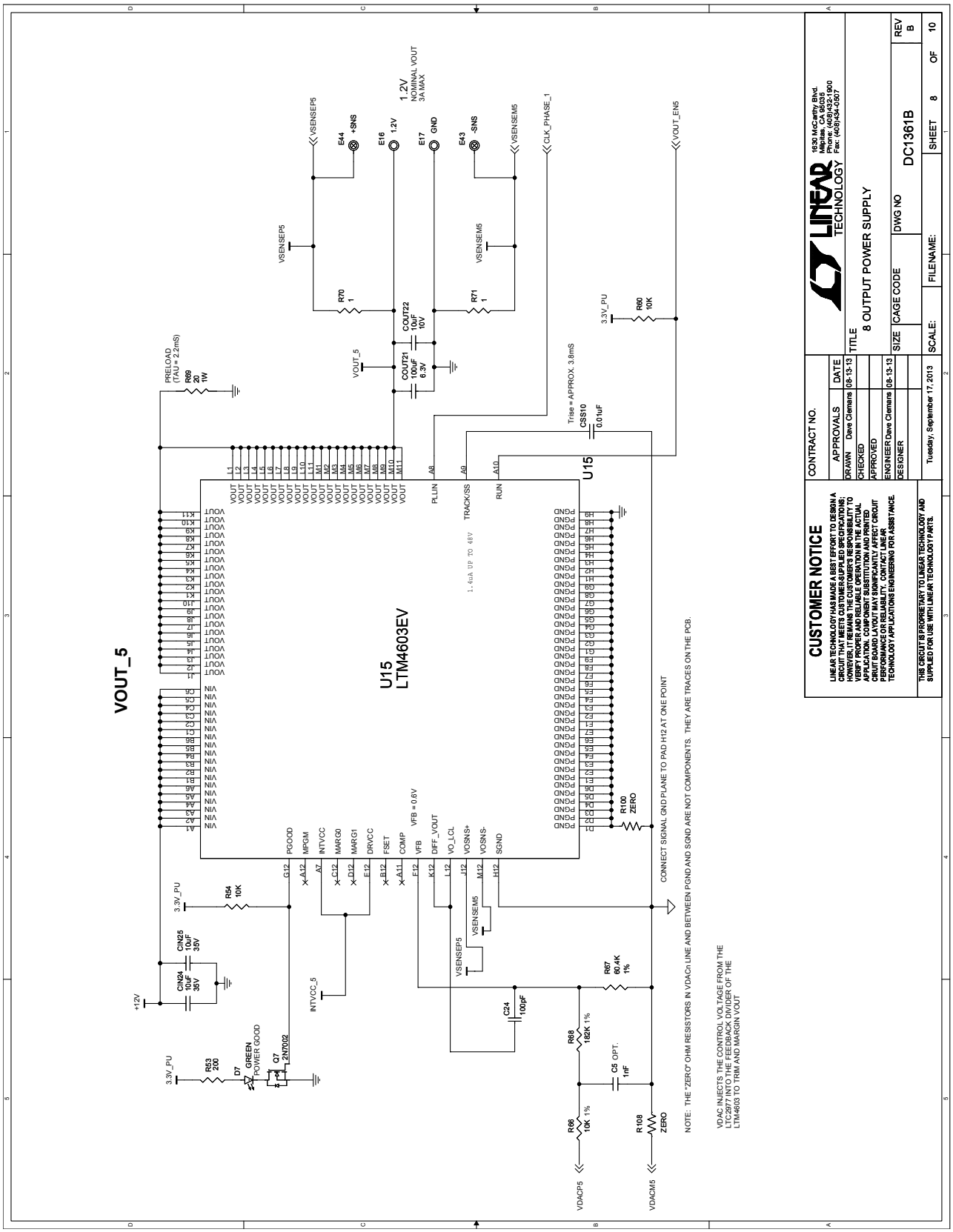

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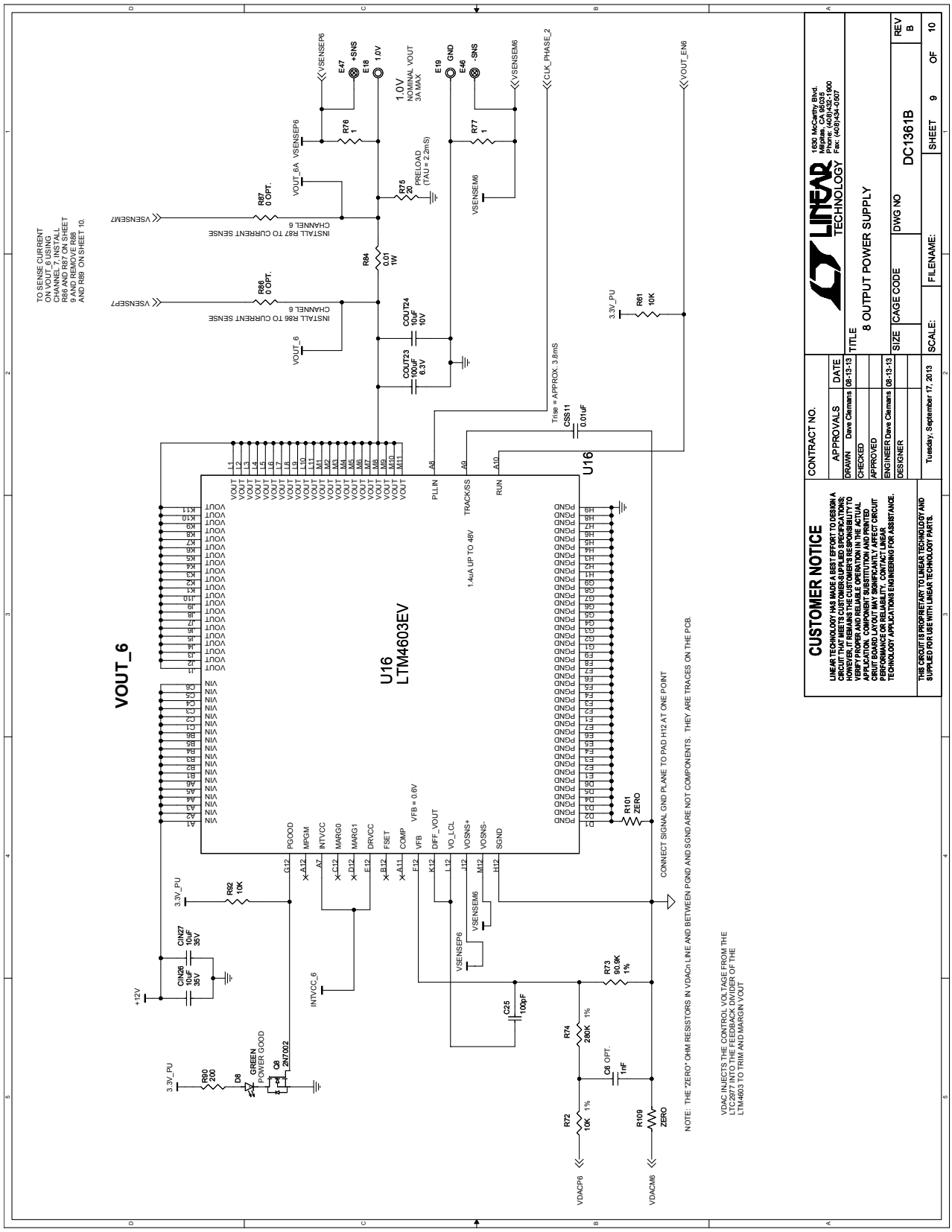

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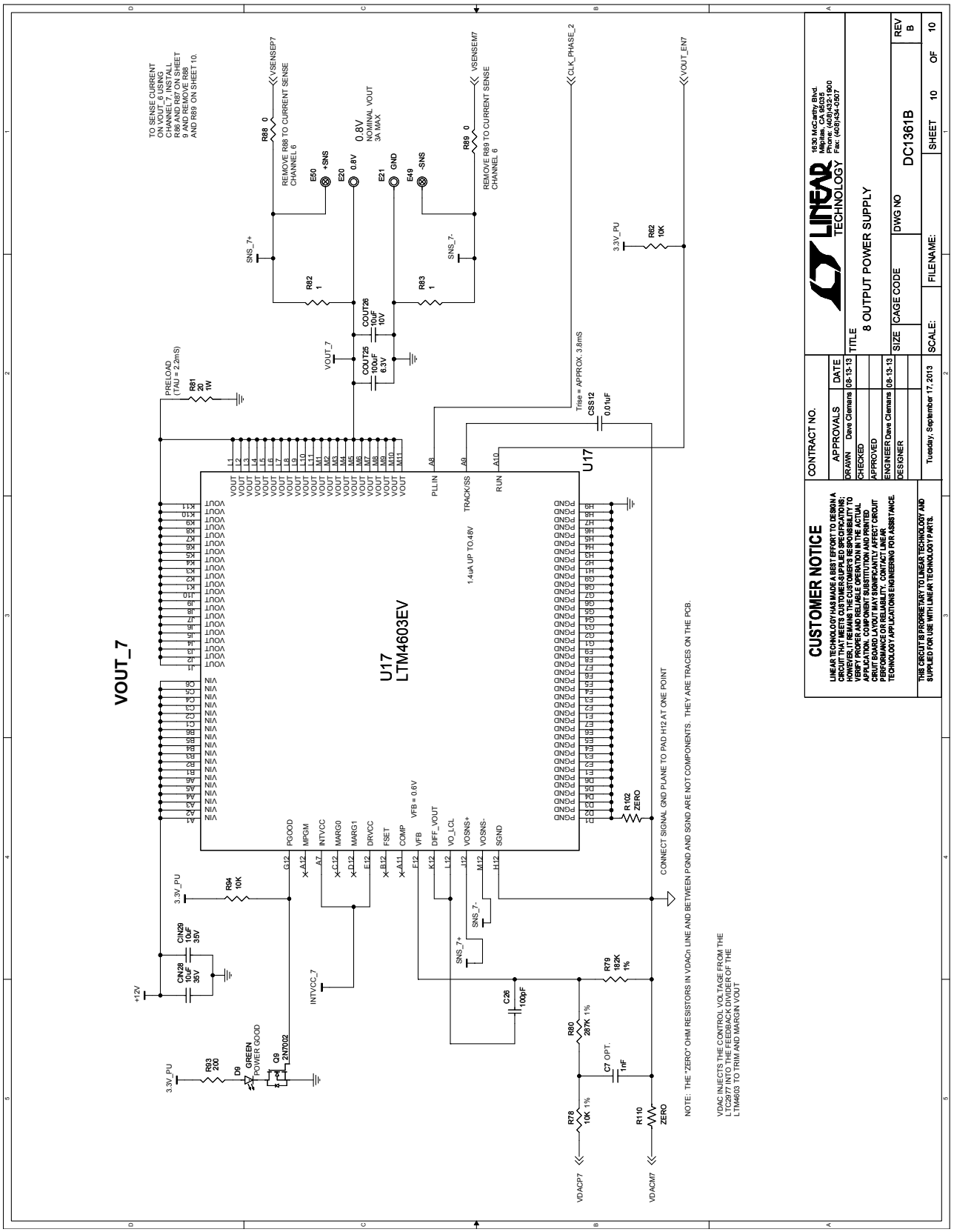

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This demonstration board (DEMO BOARD) kit being sold or provided by Linear Technology is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not provided by LTC for commercial use. As such, the DEMO BOARD herein may 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.).

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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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OCEAN CHIPS
Океан Электроники
Поставка электронных компонентов

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Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «**JONHON**», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «**FORSTAR**».

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(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).

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