

LT8500/LT3595A 48-Channel LED Driver with PWM Generator and Serial Interface

DESCRIPTION

This demonstration circuit showcases the LT8500, a 48-channel LED driver with a PWM generator and serial interface. It operates from a 30V to 45V input power supply and drives 48 channels of LED strings at 30mA and up to 32V each, although it can be adjusted for 50mA per string. The LT8500 drives 48 PWM channels that are tied directly to the PWM inputs of the three separate LT3595As. The LT3595A is a 16-channel step-down LED driver that can operate up to 45V input and up to 50mA per channel. The input to the LT8500 is a serial interface that can run up to 50MHz. The DC1552A has both an input and output connector and can be cascaded in a chain of two or more while being driven from a single serial interface. DC1552A is assembled as a solo 48-channel LED driver, but with a few simple modifications, it can be turned into one of the elements in a cascaded chain of DC1552As.

The LT8500 is a pulse width modulation (PWM) generator with 48 independent channels. Each channel has an individually adjustable 12-bit (4096-step) PWM register and a 6-bit (64-step) $\pm 50\%$ correction register. All controls are programmable via a simple serial data interface. Three banks of 16-channels each can be configured such that they operate 120 degrees out-of-phase with each other.

The LT8500 features two diagnostic information flags: synchronization error and open LED. The flags are sent, with additional state information, on the serial data interface

during status read back. The 50MHz cascadable serial data interface includes buffering and skew-balancing, making the chip suitable for PWM intensive applications such as large screen LCD dynamic backlighting and mono-, multi- and full-color LED displays. The LT8500 is also ideally suited to control three LT3595A LED drivers.

The LT3990 is a small 350mA step-down regulator with integrated power switch and diodes that operates up to 62V_{IN}. Its 3mm × 3mm 16 pin MSOP and integrated components are a good housekeeping power supply to be used for 3.3V power on the LT8500 and it's surrounding logic buffers.

The LT8500, LT3595A, and LT3990 data sheets give complete descriptions of the parts, operation and applications information. The data sheets must be read in conjunction with this demo manual for DC1552A. The LT8500 and LT3595A are both assembled in 56 pin (5mm × 9mm × 0.75mm) QFN packages. Proper board layout is essential for both maximum thermal performance and signal noise immunity. See the layout considerations sections in the data sheets for more details.

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

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DEMO MANUAL DC1552A

QUICK START PROCEDURE

Demonstration circuit 1552A is easy to set up to evaluate the performance of the LT8500 and LT3595A. Follow the procedure for testing a single DC1552A without chaining multiple boards together.

NOTE: Make sure that the P_{VIN} DC input voltage does not exceed 45V. A hot-plugged input above 40V can result in damage to the IC with input voltage ringing.

1. Connect a panel of LEDs to the output connector P1 of DC1552A. The LED strings should be between 2 LEDs per string up to about 32V of LEDs per string. There is room for 48 strings of LEDs to be connected to a single DC1552A.
2. Connect the serial data interface to connector P3.

3. With power off, connect the P_{VIN} power supply to the P_{VIN} and GND connection on P2.
4. Turn the P_{VIN} power supply on.
5. Begin sending and receiving serial data from the serial interface.
6. Observe the LED string running at the programmed LED current and the patterns on the LED panel.

In order to tie multiple DC1552A LED drivers together in a chain, follow the recommended component setup in Table 1. Repeat the Quick-Start Procedure, but connect the serial output of one DC1552A PCB to the serial input of the next in the chain with a cable from the P4 output on the PCB to the P3 input of the next PCB before power-up.

HARDWARE SETUP

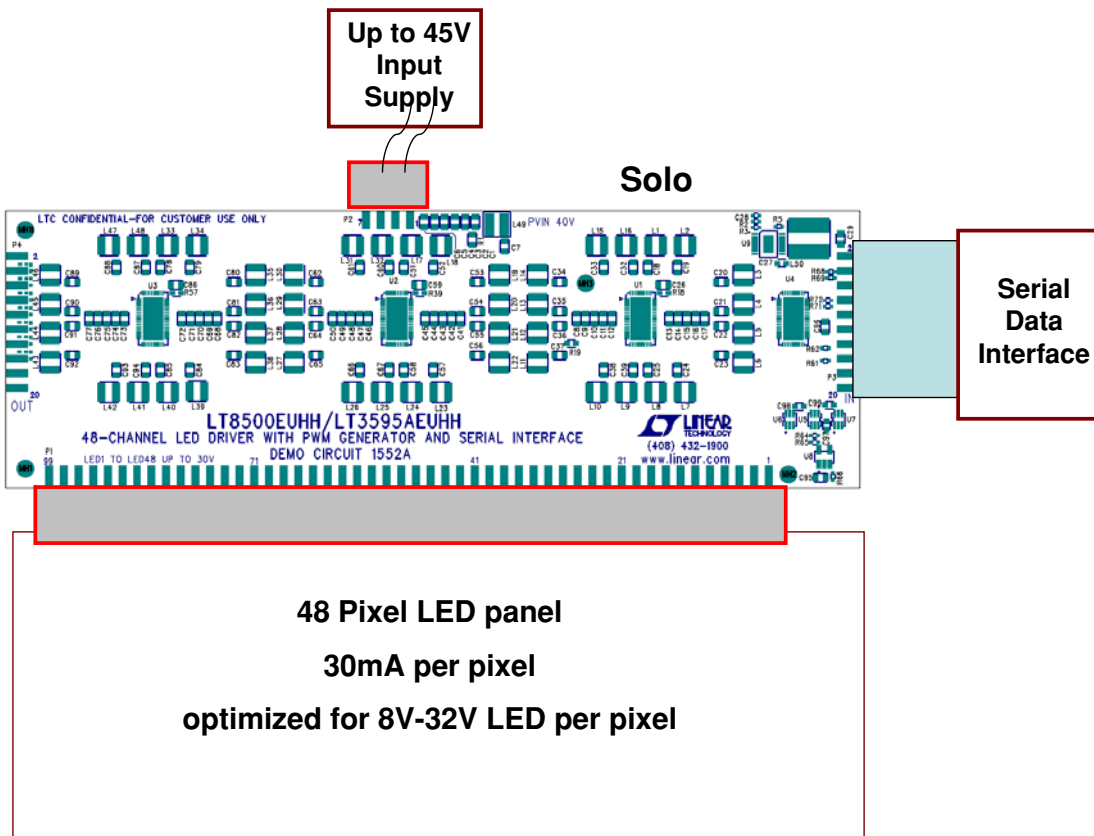


Figure 1. Typical Hardware Setup for Testing a Single DC1552A as a 48 Pixel LED Driver

HARDWARE SETUP

DC1552A Solo (as Assembled without Chaining)

DC1552A is assembled as a solo PCB. It is setup to be run with a serial interface and not cascaded in a chain without making a few resistor changes. When setup as solo or the first element in a chain, a clock needs to be provided for

the pwm clock signal. The LTC1799 is placed on the solo or first cascaded PCB, but does not have to be present on ensuing PCBs in a chain. Output signals and serial data output is returned to the serial interface directly from the solo PCB as assembled.

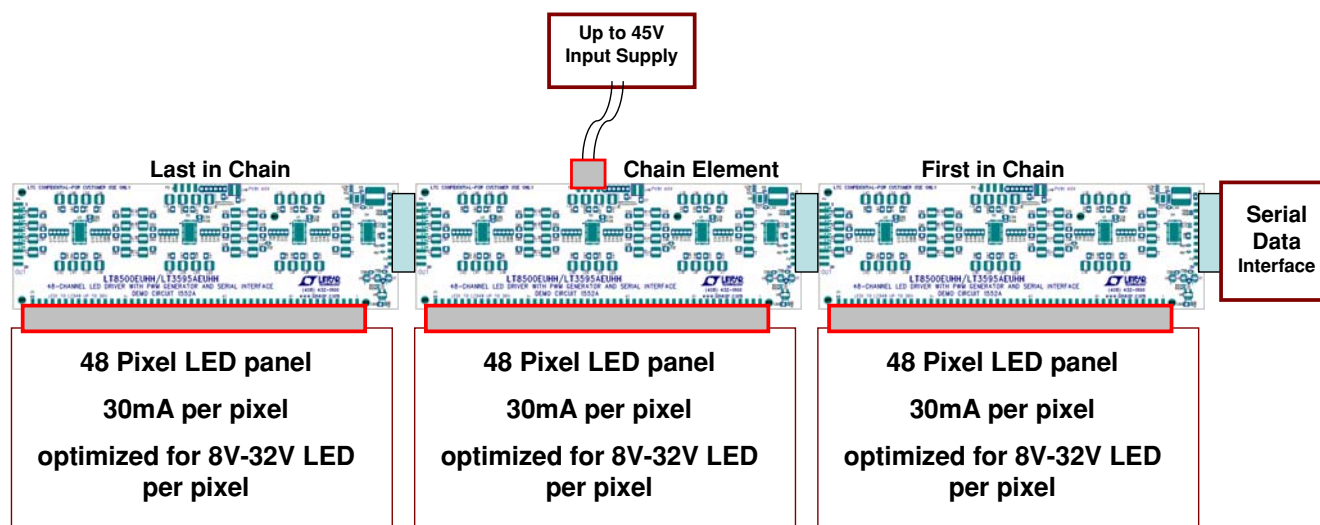


Figure 2. Hardware Setup for Testing the DC1552A in a Chain for Driving 144 Pixels of LEDs

DC1552A Cascaded in Chain

If more than one DC1552A is needed for a cascaded chain, the PCBs can be tied together. The main power can be derived from a single input since the 40V power is passed from one DC1552A to another next to the serial connection. Alterations to several components should be made to DC1552A to change the PCB from solo setup as assembled to a chain setup. A different set of changes should be made to change the PCB from solo to first in chain, last in chain, or to an element in the chain that is not first or last.

To change DC1552A from solo (as assembled) to first in chain, last in chain or a cascaded chain element, please follow the recommendations in the table below. The first in chain must have the PWM clock to be provided for all of the PCBs down the chain. The last element in the chain must take the output data and send it back to the previous PCB.

Table 1. Recommended Component Changes for Chaining Multiple DC1552As Together

| | U8, R65, R66, C95 | R61, R68 | R62, R69 | U5, C97 | R64 | U6, C98, R72 | R71 | U7, C99 |
|----------------------------|--------------------------|----------|----------|-----------------|-----|---------------------|-----|-----------------|
| Solo (as Assembled) | LTC1799, 0Ω, 24.9kΩ, 1μF | OPT | 0Ω | NC7WZ17P6X, 1μF | OPT | OPT | 0Ω | OPT |
| First in Chain | LTC1799, 0Ω, 24.9kΩ, 1μF | 0Ω | OPT | NC7WZ17P6X, 1μF | OPT | NC7WZ17P6X, 1μF, 0Ω | OPT | NC7WZ17P6X, 1μF |
| Chain Element | OPT | 0Ω | OPT | NC7WZ17P6X, 1μF | 0Ω | NC7WZ17P6X, 1μF, 0Ω | OPT | NC7WZ17P6X, 1μF |
| Last in Chain | OPT | OPT | 0Ω | NC7WZ17P6X, 1μF | 0Ω | OPT | 0Ω | OPT |

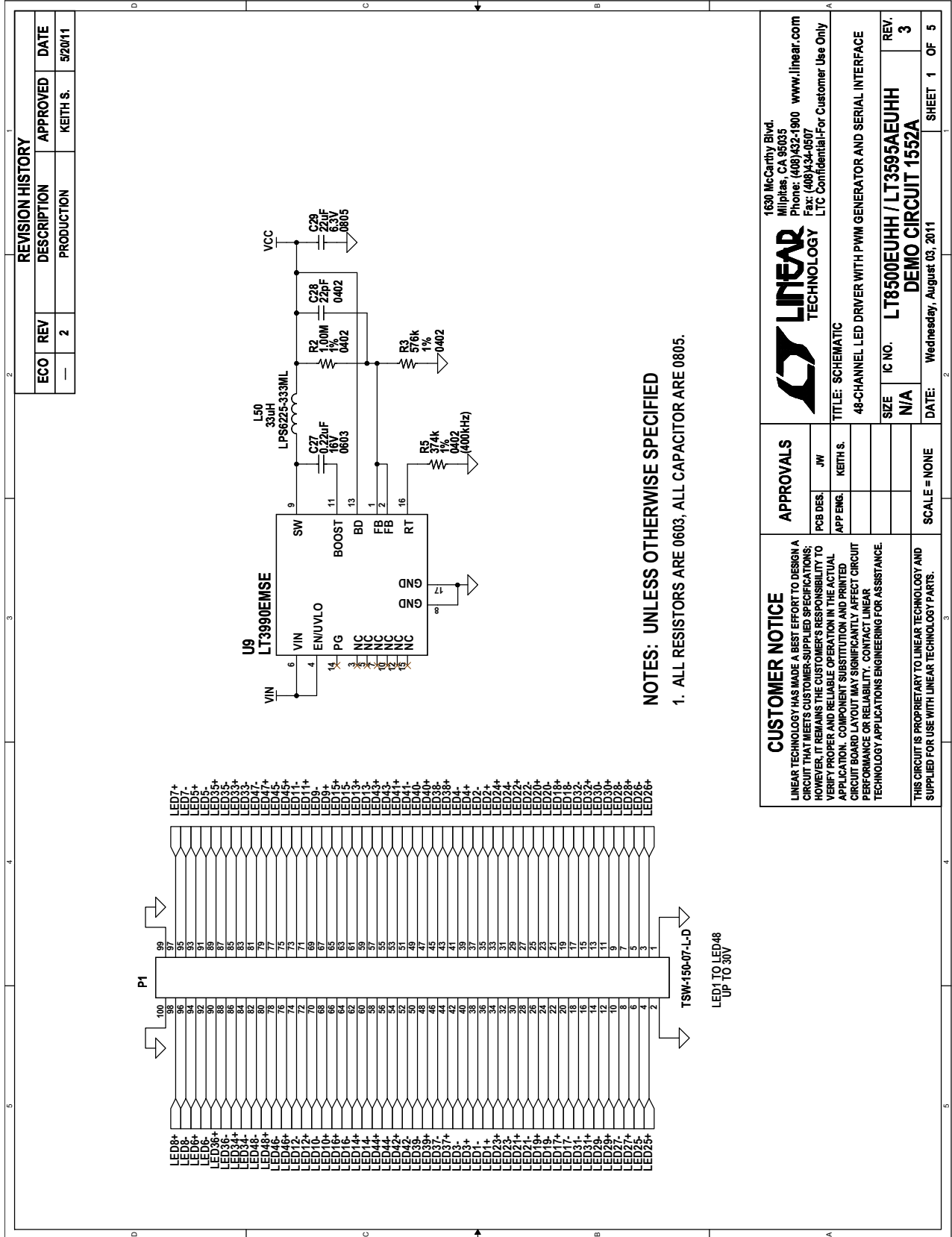
OPT = Optional, do not stuff

DEMO MANUAL DC1552A

PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|------------------------------------|-----|--|--|------------------------------|
| Required Circuit Components | | | | |
| 1 | 7 | C1-C7 | CAP., X7R, 0.33µF, 50V, 10%, 0805 | MURATA, GRM219R71H334KA88D |
| 2 | 78 | C8-C25, C32-C39, C41-C58, C60-C85, C87-C94 | CAP., X7R, 0.47µF, 50V, 10%, 0805 | MURATA, GRM21BR71H474KA88L |
| 3 | 4 | C26, C59, C86, C96 | CAP., X7R, 10µF, 10V, 10%, 0805 | MURATA, GRM21BR71A106KE51L |
| 4 | 1 | C27 | CAP., X5R, 0.22µF, 16V, 10%, 0603 | TAIYO YUDEN, EMK107BJ224KA-T |
| 5 | 1 | C28 | CAP., C0G, 22pF, 25V, 10%, 0402 | AVX, 04023A220KAT2A |
| 6 | 1 | C29 | CAP., X7R, 22µF, 6.3V, 20%, 0805 | TAIYO YUDEN, JDK212BJ226MD-T |
| 7 | 1 | C95 | CAP., X7R, 1µF, 10V, 10%, 0805 | MURATA, GRM21BR71A105KA01L |
| 8 | 1 | C97 | CAP., X7R, 1µF, 6.3V, 20%, 0603 | AVX, 06036C105MAT2A |
| 9 | 0 | C98, C99 (OPT) | CAP., 0603 | |
| 10 | 1 | L49 | IND. PWR, 10µH, L-LPO3310 | COILCRAFT, LPO3310-103MLC |
| 11 | 48 | L1-L48 | IND., 100µH, 1212 | MURATA, LQH3NPN101MG0L |
| 12 | 1 | L50 | IND., 33µH | COILCRAFT, LPS6225-333ML |
| 13 | 1 | P1 | HEADER, 2X50, 0.100" | SAMTEC, TSW-150-07-L-D |
| 14 | 1 | P2 | HEADER, 2X4, 0.100" | SAMTEC, TSW-104-07-L-D |
| 15 | 2 | P3, P4 | HEADER, 2X10, 0.100" | SAMTEC, TSW-110-07-L-D |
| 16 | 1 | R1 | RES., 4.99Ω, 1/8W, 1%, 0805 | VISHAY, CRCW08054R99FNEA |
| 17 | 1 | R2 | RES., 1.00M, 1/16W, 0402, 1% | VISHAY, CRCW04021M00FKED |
| 18 | 1 | R3 | RES., 576k, 1/16W, 1%, 0402 | VISHAY, CRCW0402576KFKED |
| 19 | 1 | R5 | RES., 374k, 1/16W, 0402, 1% | VISHAY, CRCW0402374KFKED |
| 20 | 3 | R18, R39, R57 | RES., 49.9k, 1/10W, 1%, 0603 | VISHAY, CRCW060349K9FKEA |
| 21 | 0 | R61, R64, R68, R72 (OPT) | RES., 0603 | |
| 22 | 1 | R19 | RES., 33k, 1/10W, 1%, 0603 | VISHAY, CRCW060333K0FKEA |
| 23 | 4 | R62, R65, R69, R71 | RES., 0Ω, 1/10W, 0402 | VISHAY, CRCW04020000Z0EA |
| 24 | 1 | R66 | RES., 24.9k, 1/16W, 1%, 0402 | VISHAY, CRCW040224K9FKED |
| 25 | 3 | U1-U3 | IC., LT3595AEUHH, QFN56UHH-5X9 | LINEAR TECH., LT3595AEUHH |
| 26 | 1 | U4 | IC., LT8500EUHH, QFN56UHH-5X9 | LINEAR TECH., LT8500EUHH |
| 27 | 1 | U5 | IC., TinyLogic UHS Dual Buffer, SC70-6 | FAIRCHILD SEMI., NC7WZ17P6X |
| 28 | 0 | U6, U7 (OPT) | IC., TinyLogic UHS Dual Buffer, SC70-6 | |
| 29 | 1 | U8 | IC., LTC1799CS5, SOT23-5 | LINEAR TECH., LTC1799CS5 |
| 30 | 1 | U9 | IC., LT3990EMSE, MSE16 (1rl.+2 tubes) | LINEAR TECH., LT3990EMSE |
| 31 | 1 | | FAB, PRINTED CIRCUIT BOARD | DEMO CIRCUIT 1552A |
| 32 | 1 | | STENCIL TOP SIDE ONLY | STENCIL 1552A |

SCHEMATIC DIAGRAM



NOTES: UNLESS OTHERWISE SPECIFIED

- 1. ALL RESISTORS ARE 0603, ALL CAPACITOR ARE 0805.

LINEAR TECHNOLOGY

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TITLE: SCHEMATIC

48-CHANNEL LED DRIVER WITH PWM GENERATOR AND SERIAL INTERFACE

SIZE: N/A IC NO: LT8500EUHH / LT3595AEUHH REV: 3

DATE: Wednesday, August 03, 2011 SHEET 1 OF 5

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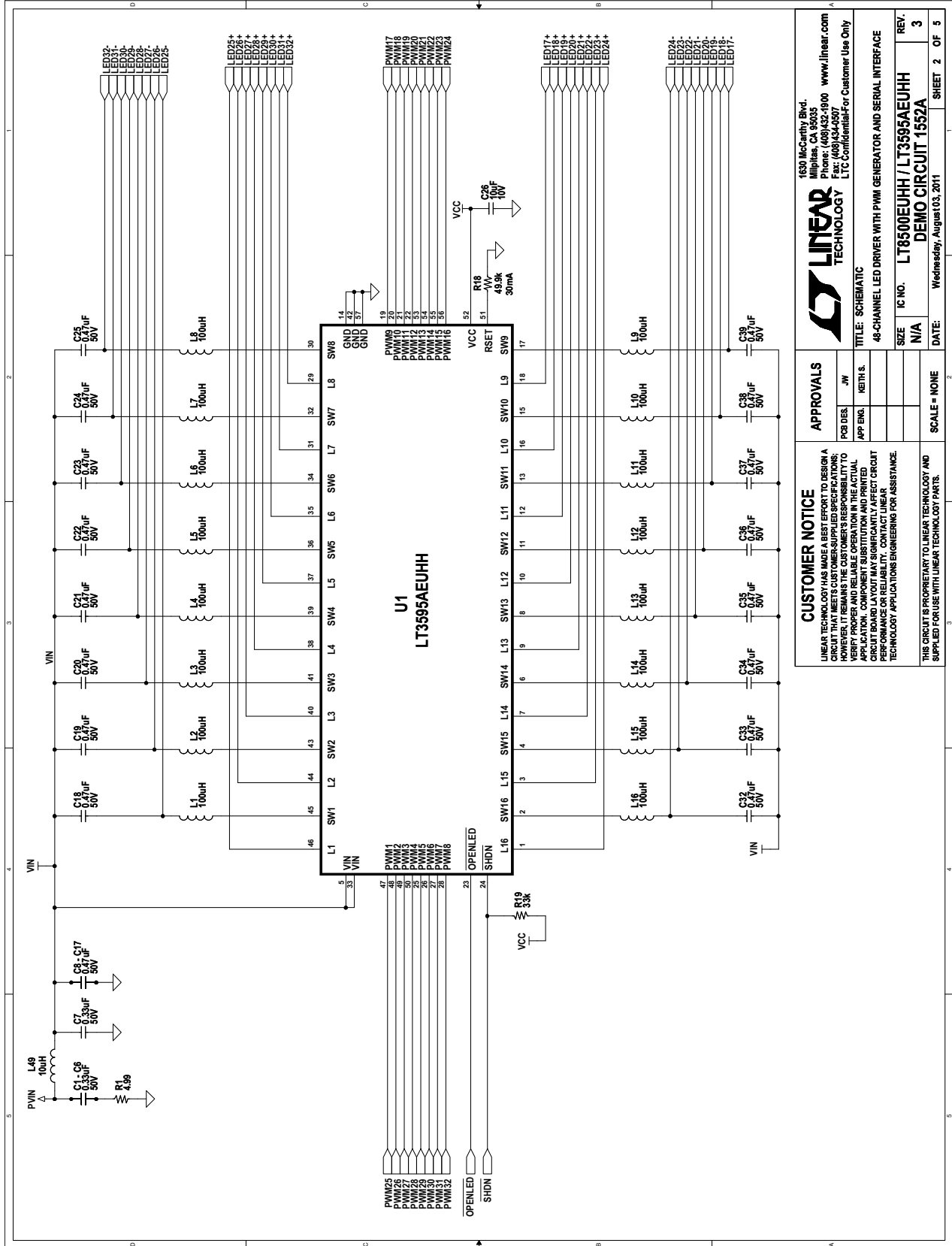
THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.

APPROVALS

| | |
|--------------|----------|
| PCB DES. | JW |
| APP ENG. | KEITH S. |
| SCALE = NONE | |



SCHEMATIC DIAGRAM



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LINEAR TECHNOLOGY

TITLE: SCHEMATIC
 48-CHANNEL LED DRIVER WITH PWM GENERATOR AND SERIAL INTERFACE

IC NO. LT8500EUHH / LT3959AEUHH REV. 3
 DEMO CIRCUIT 1552A

DATE: Wednesday, August 10, 2011 SHEET 2 OF 5

SCALE = NONE

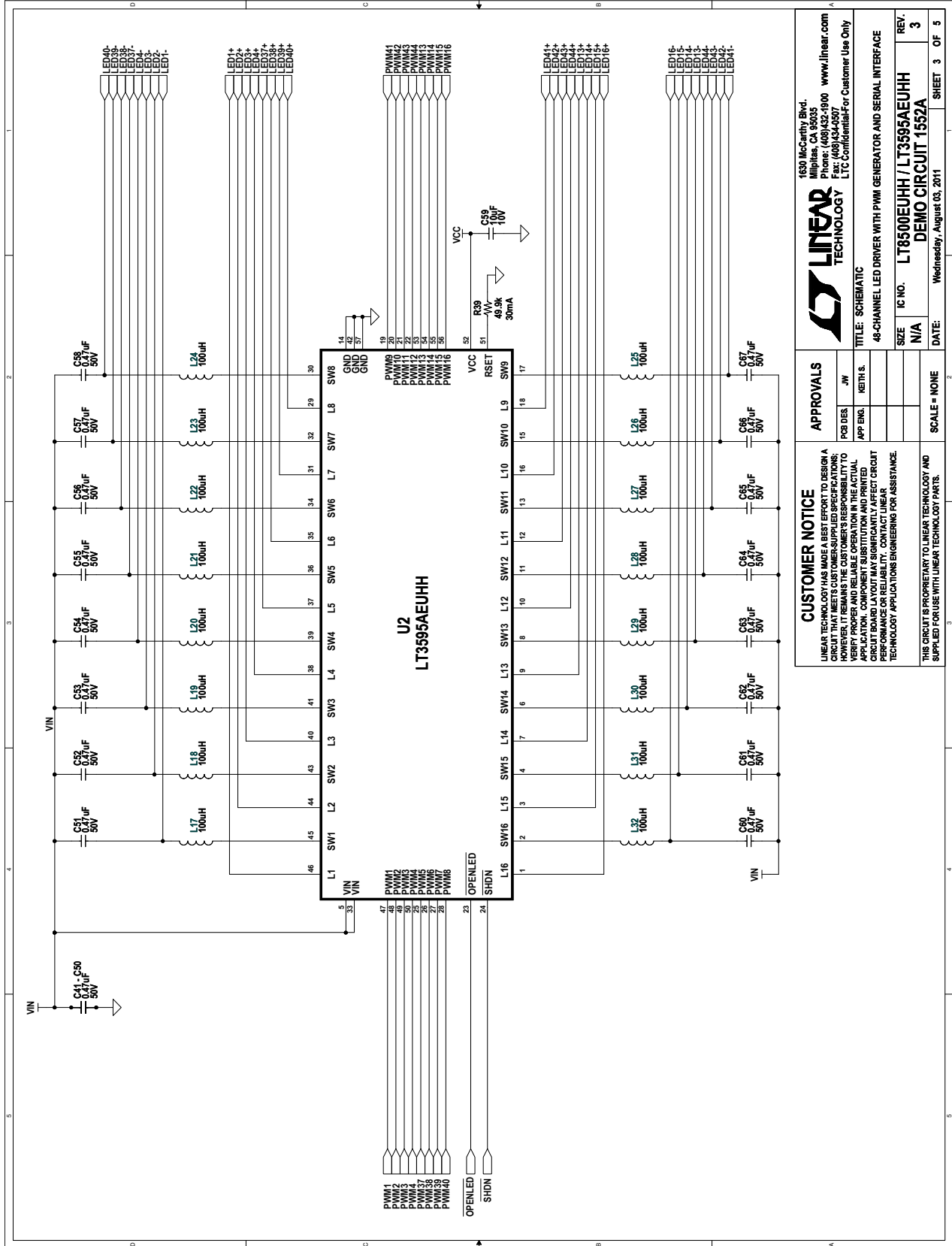
APPROVALS

| | |
|----------|----------|
| POB DES. | JW |
| APP ENG. | KEITH S. |

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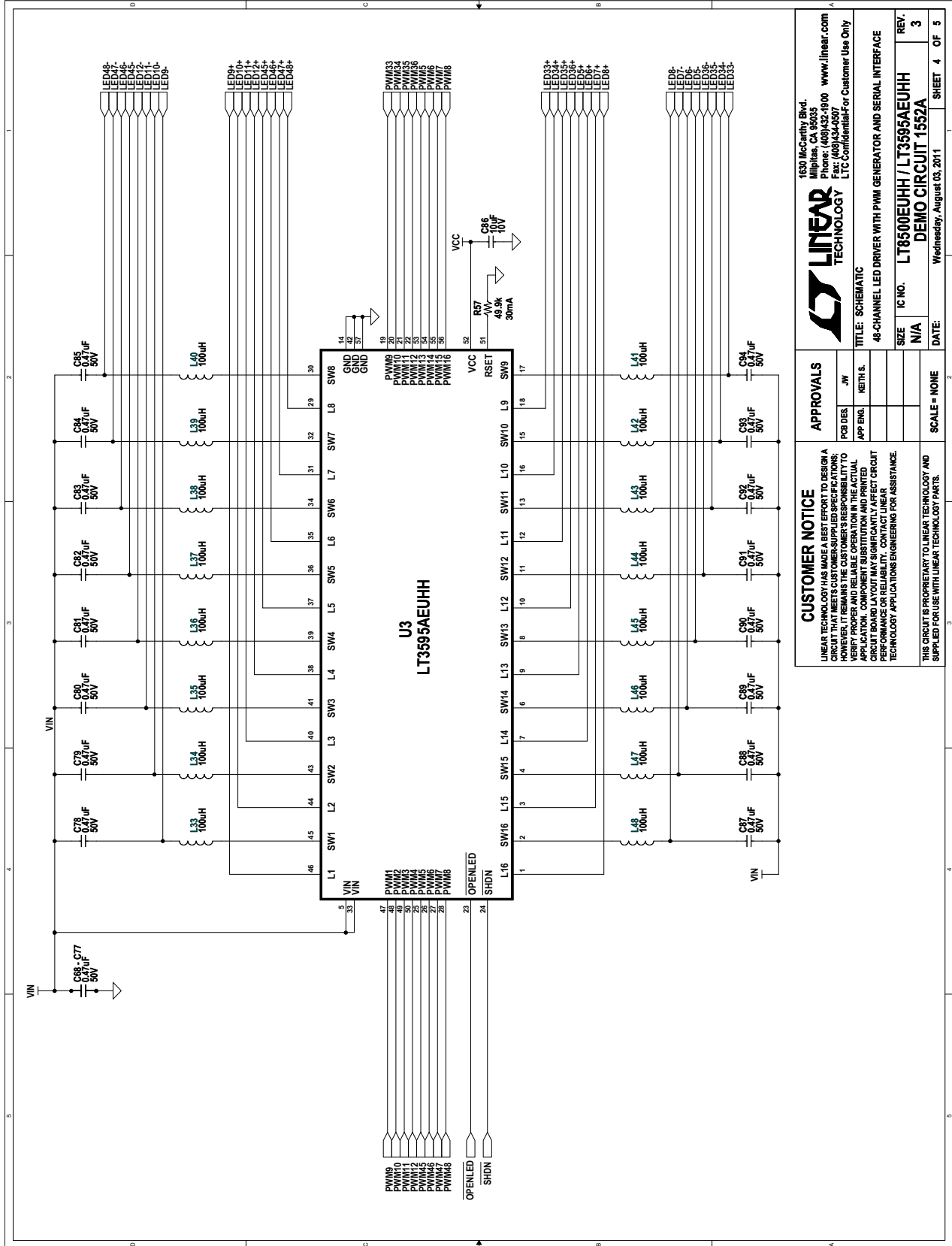
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SCHEMATIC DIAGRAM

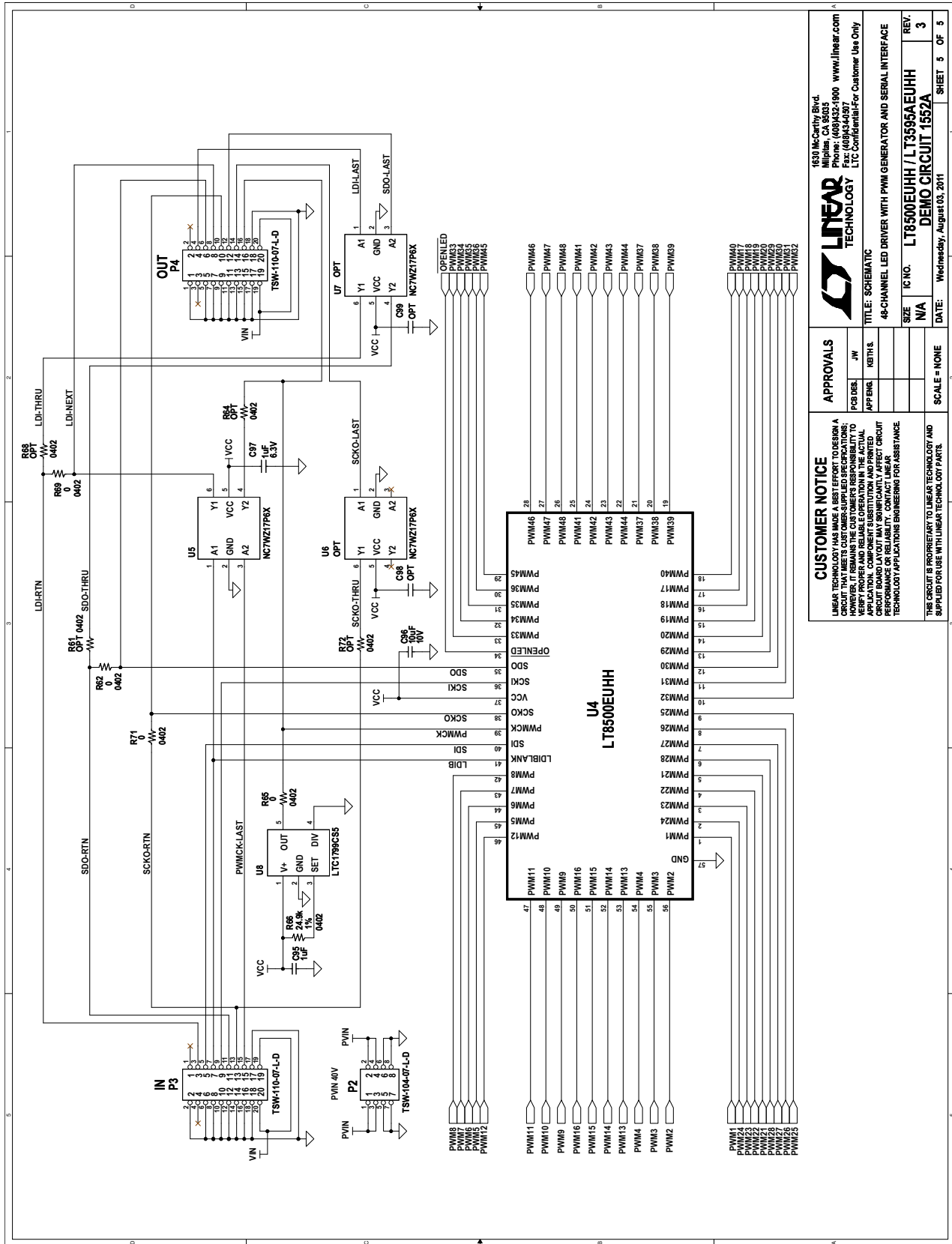


DEMO MANUAL DC1552A

SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



| | | | |
|--|--------------------------|--|----------------------------|
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| SIZE | IC NO. | REV. | DATE |
| NA | LT8500EUIH / LT8595AEUIH | 3 | Wednesday, August 03, 2011 |
| SCALE = NONE | | SHEET 5 OF 5 | |

DEMO MANUAL DC1552A

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