LT3799
TRIAC Dimmable Off-Line Isolated LED Driver with PFC

DESCRIPTION

Demonstration circuit 1775A is an off-line isolated flyback LED driver featuring the LT®3799. The demo board provides a constant-current output of 0.5A over an LED string voltage of 20V and 30V. It is optimized to operate over a wide AC input voltage range (90VAC to 270VAC). LED current typically stays within ±4% over the whole input voltage range. The DC1775A provides a steep decline in LED current with decreasing TRIAC dimming angle, to achieve a wide TRIAC dimming range. It is designed to comply with IEC 61000-3-2 Class C harmonics standard and EN55015B conducted EMI standard.

The LT3799 controls an isolated flyback converter in boundary mode. Its unique bleeder circuit makes the LED driver compatible with TRIAC dimmers without additional components. Its novel current sensing scheme delivers a well-regulated output current to the secondary side without using an opto-coupler. Open- and shorted-LED protection ensures long-term reliability.

The LT3799 is available in a low profile, thermally-enhanced 16-lead MSOP package.

The LT3799 data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this quick start guide for demo circuit 1775A.

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

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PERFORMANCE SUMMARY (T_A = 25°C)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Range	Line Frequency, 47Hz to 63Hz	90	120	270	VAC
Output Current	V_{IN} = 120VAC, V_{LED} = 28V		0.5		A
Output Voltage		20	28	30	V
Open LED Voltage	(Note 1)		34		V

Note 1: For applications with low LED string voltage, FB pin divider resistor R6 and output clamp D3 can be adjusted to reduce the open voltage limit. See Protection from Open LED and Shorted LED Faults section in the LT3799 data sheet for details.

QUICK START PROCEDURE

IMPORTANT NOTE TO CUSTOMERS:

HIGH VOLTAGES ARE PRESENTED ON THE DEMO CIRCUIT, AND CAN LEAD TO LETHAL INJURIES TO HUMAN BODY. ONLY QUALIFIED PERSONNEL SHOULD OPERATE IT. IT IS STRONGLY RECOMMENDED TO USE SAFETY GLASSES AND AN ISOLATION TRANSFORMER.

NOTE. IMPROPER COMPONENTS REPLACEMENT ON THE DEMO CIRCUIT CAN CAUSE PERFORMANCE DETERIORATIONS, CIRCUIT MALFUNCTION, PROPERTY DAMAGE, AND EVEN LIFE-THREATENING INJURIES. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERS FOR PROPER COMPONENT REPLACEMENT.

Demonstration circuit 1775A is easy to set up to evaluate the performance of the LT3799. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

1. Connect a 0.5A LED string with forward voltage less than 30V, but greater than 20V, between LED$^+$ and LED$^-$ terminals.
2. With power off, connect the input power supply to line (L) input and neutral (N) input.
3. Turn on the power at the input.

   Note: Make sure that the input voltage does not exceed the maximum input voltage (270VAC).
4. Check for the proper output current.

Once the proper output current is established, adjust the input voltage and/or the load and observe the output current regulation, efficiency, power factor and other parameters.

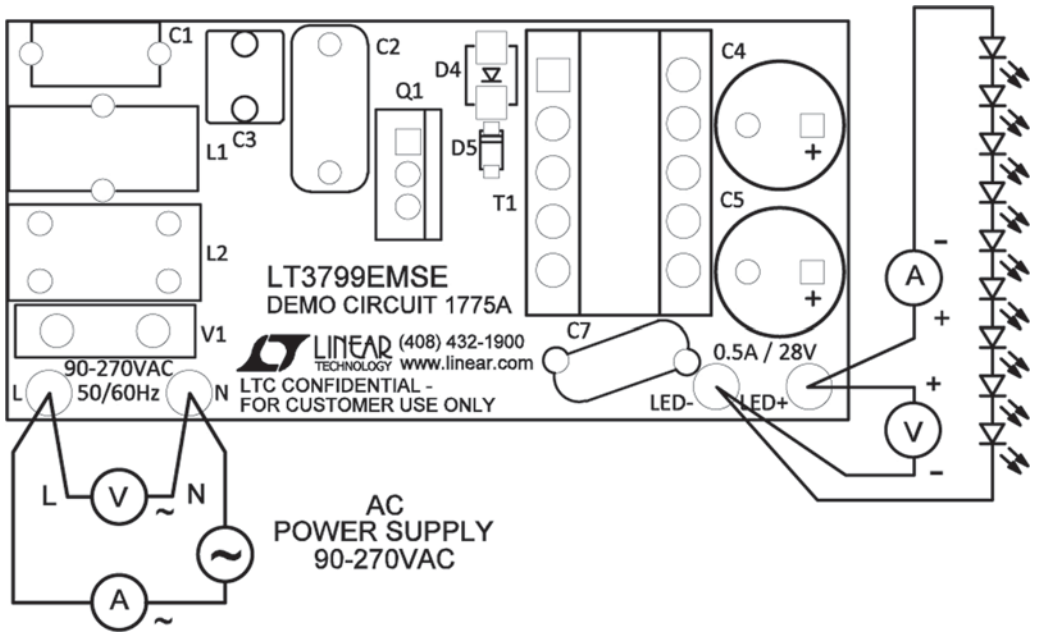


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

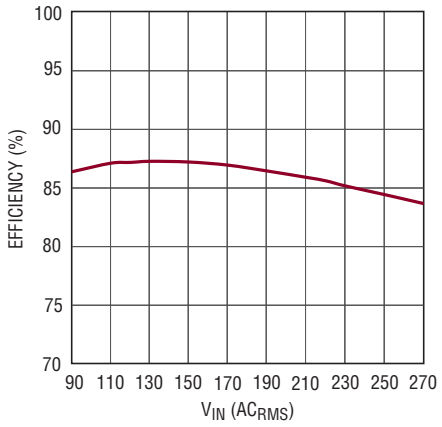


Figure 2. Efficiency vs Input Voltage

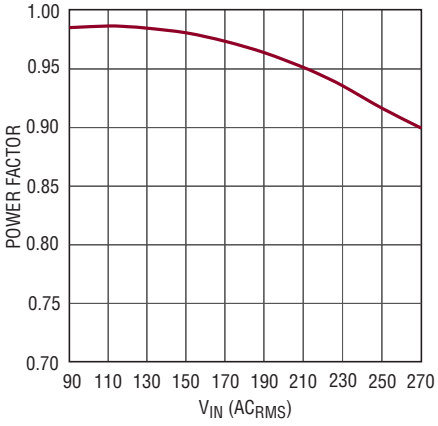


Figure 3. Power Factor vs Input Voltage

Input Line Voltage and Current

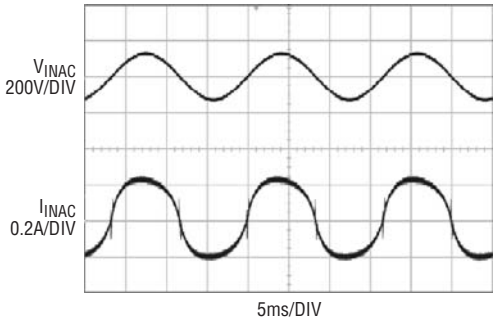


Figure 4. V_{IN} = 90VAC

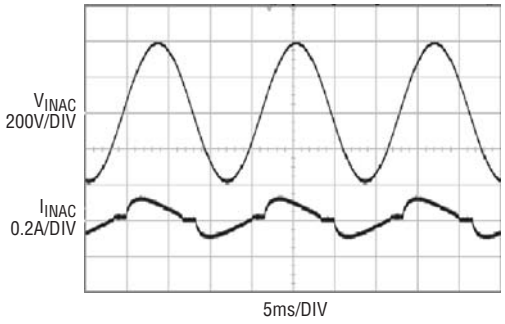


Figure 5. V_{IN} = 270VAC

Switch Node Voltage

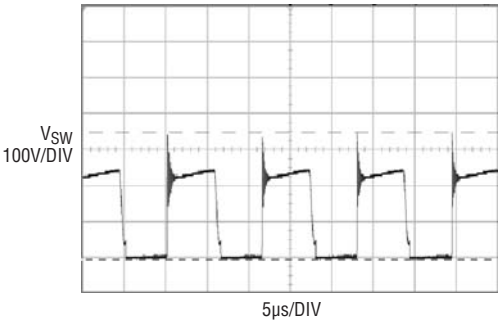


Figure 6. V_{IN} = 90VAC

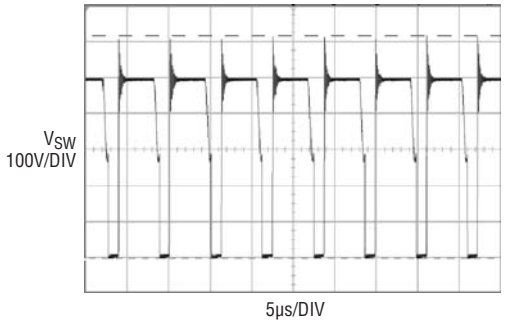


Figure 7. V_{IN} = 270VAC

QUICK START PROCEDURE

Output Voltage and Switch Node Voltage During Output Open

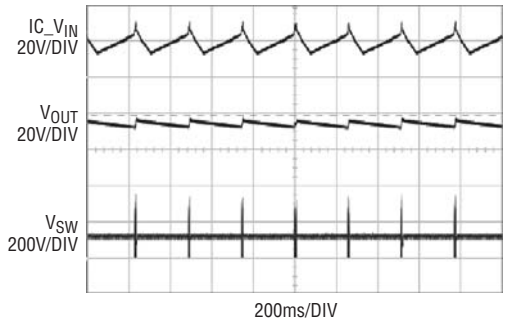


Figure 8. V_{IN} = 90VAC

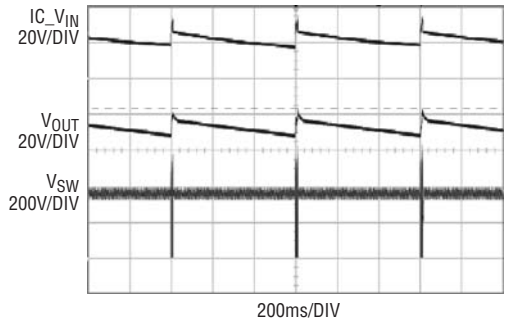


Figure 9. V_{IN} = 270VAC

Output Current and Switch Node Voltage During Output Short

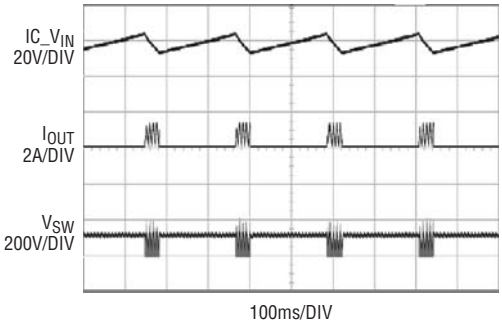


Figure 10. V_{IN} = 90VAC

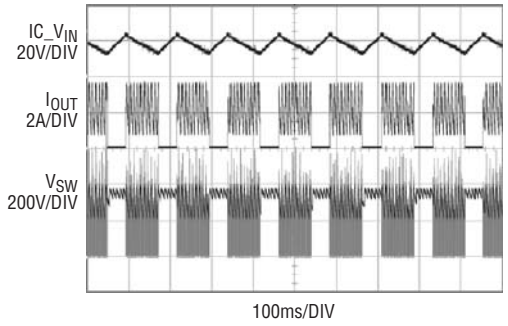


Figure 11. V_{IN} = 270VAC

LED Current vs TRIAC Dimming Angle

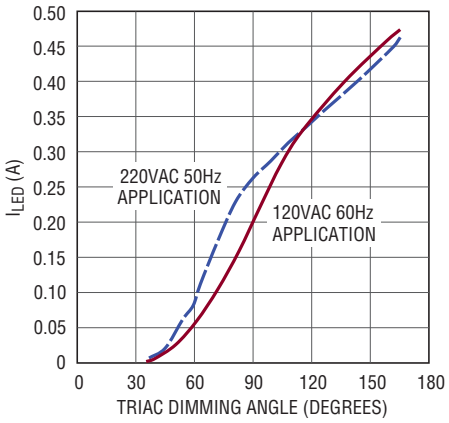


Figure 12. LED Current vs TRIAC Dimming Angle: Solid Line, 120VAC 60Hz; Dot Line, 220VAC 50Hz. Note: For Different Types of TRIAC Dimmers, the Maximum and/or Minimum Dimming Angle May Vary, Which Gives Different Maximum and/or Minimum LED Current

QUICK START PROCEDURE

Input Voltage and Switch Node Voltage with 120VAC, 60Hz TRIAC Dimmer

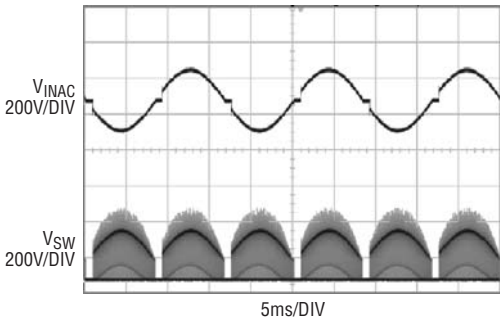


Figure 13. 165 Degree TRIAC Dimming Angle

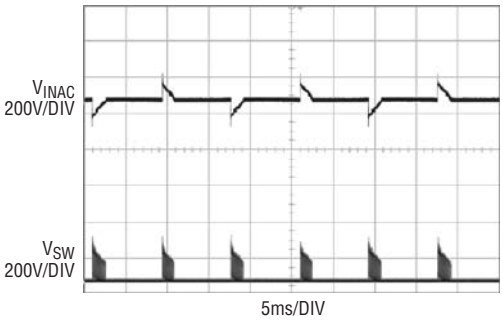


Figure 14. 35 Degree TRIAC Dimming Angle

Input Voltage and Switch Node Voltage with 220VAC, 50Hz TRIAC Dimmer

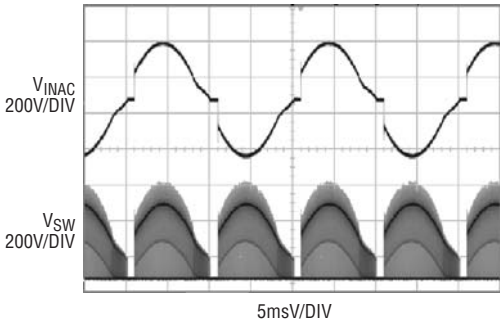


Figure 15. 165 Degree TRIAC Dimming Angle

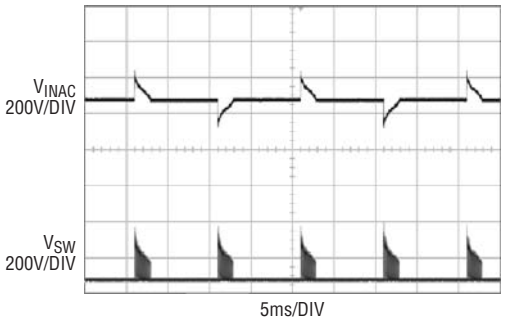
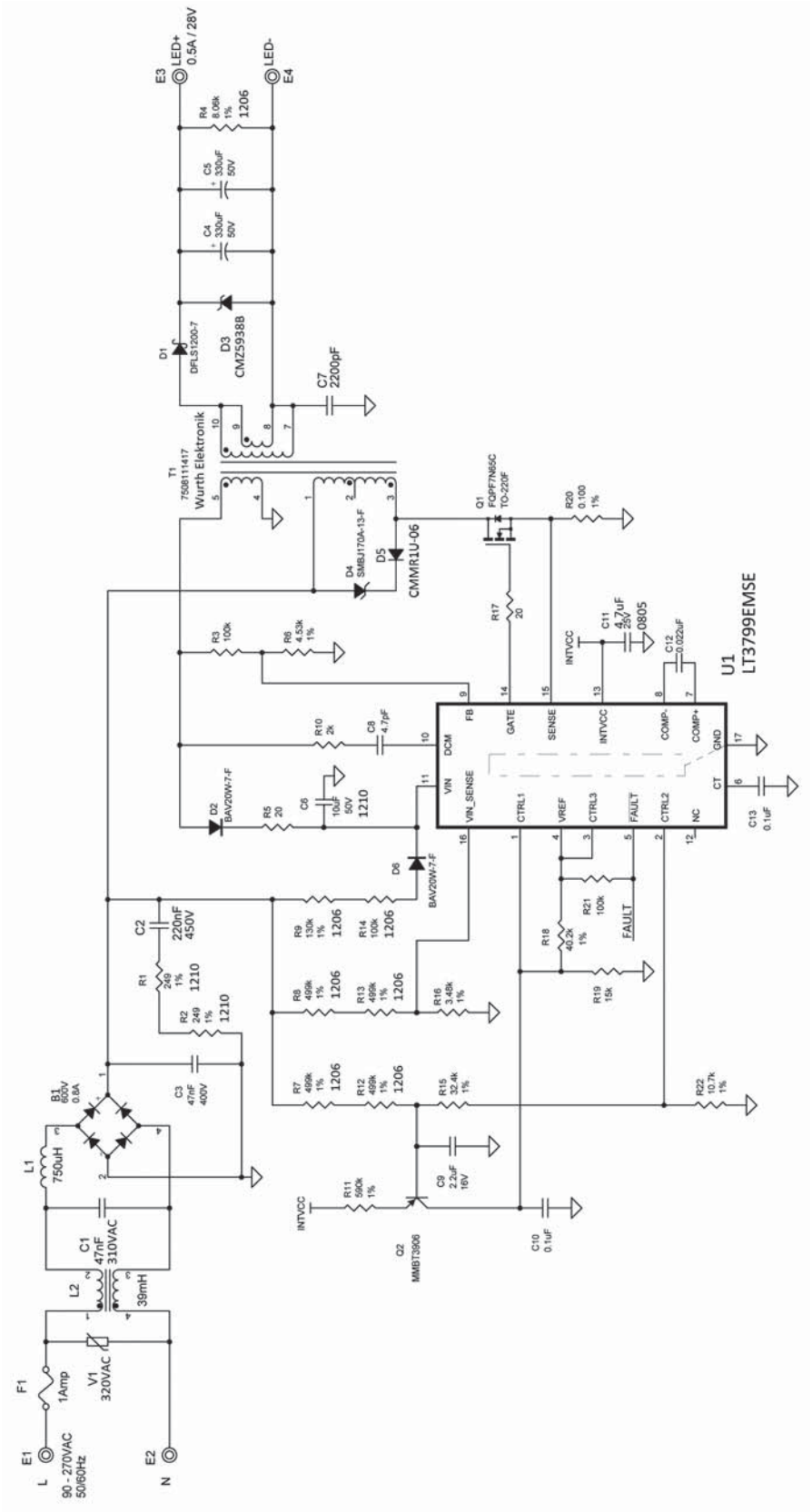


Figure 16. 35 Degree TRIAC Dimming Angle

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	B1	RECTIFIER, BRIDGE GP 600V 0.8A MINIDIP	DIODES INC., HD06-T
2	1	C1	CAP., MKP 0.047µF 310VAC 20%	VISHAY, BFC233921473
3	1	C2	CAP., POLY 220nF 450V 10%	RUBYCON, 450MMK224K
4	1	C3	CAP., POLYESTER FILM 47nF 400V 10%	VISHAY, BFC237051473
5	2	C4, C5	CAP., ALUM 330µF 50V 20% RADIAL	PANASONIC, EEU-FR1H331L
6	1	C6	CAP., CERAMIC 10µF 50V 10% 1210	MURATA, GRM32ER71H106KA12L
7	1	C7	CAP., Y5U 2200pF 400VAC 20%	VISHAY, 440LD22-R
8	1	C8	CAP., NPO 4.7pF 50V ±0.25PF 0603	AVX, 06035A4R7CAT2A
9	1	C9	CAP., X5R 2.2µF 16V 20% 0603	TDK, C1608X5R1C225M
10	2	C10, C13	CAP., X7R 0.1µF 16V 10% 0603	AVX, 0603YC104KAT2A
11	1	C11	CAP., X5R 4.7µF 25V 10% 0805	AVX, 08053D475KAT2A
12	1	C12	CAP., X7R 0.022µF 25V 10% 0603	AVX 06033C223KAT1A
13	1	D1	DIODE, SCHOTTKY 1A/200V POWERDI-123	DIODES INC., DFLS1200-7
14	2	D2, D6	DIODE, SWITCH 400MA 150V SOD123	DIODES INC., BAV20W-7-F
15	1	D3	DIODE, ZENER 1.5W	CENTRAL SEMI, CMZ5938B TR
16	1	D4	TVS UNIDIRECT 600W 170V SMB	DIODES INC., SMBJ170A-13-F
17	1	D5	DIODE, ULTRAFAST RECOVERY RECTIFIER SOD123	CENTRAL SEMI., CMMR1U-06
18	1	F1	FUSE, 1A	COOPER BUSSMANN, 1025FA1-R
19	1	L1	IND, 750µH	WURTH, 750311431
20	1	L2	IND, 39mH COMMON MODE CHOKE	WURTH, 744821039
21	1	Q1	MOSFET N-CHAN., 650V/7A TO-220F	FAIRCHILD SEMI., FQPF7N65C
22	1	Q2	TRANS., PNP 40V 300MW SMD SOT23-3	DIODES INC., MMBT3906-7-F
23	2	R1, R2	RES., CHIP 249Ω 0.5W 1% 1210	VISHAY, CRCW1210249RFKEA
24	2	R3, R21	RES., CHIP 100k 0.06W 5% 0603	YAGEO, RC0603JR-07100KL
25	1	R4	RES., CHIP 8.06k 0.25W 1% 1206	YAGEO, RC1206FR-078K06L
26	2	R5, R17	RES., CHIP 20Ω 0.06W 5% 0603	YAGEO, RC0603JR-0720RL
27	1	R6	RES., CHIP 4.53k 0.06W 1% 0603	YAGEO, RC0603FR-074K53L
28	4	R7, R8, R12, R13	RES., CHIP 499k 0.25W 1% 1206	YAGEO, RC1206FR-07499KL
29	1	R9	RES., CHIP 130k 0.25W 1% 1206	VISHAY, CRCW1206130KFKEA
30	1	R10	RES., CHIP 2k 0.06W 5% 0603	YAGEO, RC0603JR-072KL
31	1	R11	RES., CHIP 590k 0.06W 1% 0603	VISHAY, CRCW0603590KFKEA
32	1	R14	RES., CHIP 100k 0.25W 5% 1206	VISHAY, CRCW1206100KJNEA
33	1	R15	RES., CHIP 32.4k 0.06W 1% 0603	VISHAY, CRCW060332K4FKEA
34	1	R16	RES., CHIP 3.48k 0.06W 1% 0603	YAGEO, RC0603FR-073K48L
35	1	R18	RES., CHIP 40.2k 0.06W 1% 0603	VISHAY, CRCW060340K2FKEA
36	1	R19	RES., CHIP 15k 0.06W 5% 0603	YAGEO, RC0603JR-0715KL
37	1	R20	RES., CHIP 0.1Ω 0.25W 1% 1206	YAGEO, PT1206FR-070R1L
38	1	R22	RES., CHIP 10.7k 0.06W 1% 0603	VISHAY, CRCW060310K7FKEB
39	1	T1	XFMR., 700µH, 10kHz ±10%	WURTH ELEKTRONIK, 7508111417
40	1	U1	IC, TRIAC DIMMABLE OFFLINE LED DRIVER	LINEAR TECH., LT3799EMSE#PBF
41	1	V1	VARISTOR 320V_{RMS} 13.5MM RADIAL	VISHAY, VDRS10P320BSE
42	1		FAB, 1775A REV 4. PCB	DEMO CIRCUIT 1775A
Hardware-For Demo Board Only:				
1	4	E1, E2, E4, E5	TURRET, TESTPOINT	MILL MAX, 2501-2-00-80-00-00-07-0
2			STENCIL (TOP AND BOTTOM)	STENCIL DC1775A

SCHEMATIC DIAGRAM



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

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