Important Notice

Restrictions in Use

IDT's ZSLS7031KIT-D1 Demonstration Kit hardware is designed for ZSLS7031 evaluation, demonstration, laboratory setup, and module development only. The ZSLS7031KIT-D1 Demonstration Kit hardware must not be used for module production or production test setups.

Disclaimer

IDT shall not be liable for any damages arising out of defects resulting from

(i) delivered hardware and software
(ii) non-observance of instructions contained in this manual and in any other documentation provided to user, or
(iii) misuse, abuse, use under abnormal conditions or alteration by anyone other than IDT.

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Important Safety Warning: These procedures can result in high currents, which can cause severe injury or death and/or equipment damage. Only trained professional staff should connect hardware and operate the board. For safety, ensure that these instructions and the ZSLS7031 data sheet have been read by all kit users and remain readily available for reference.

Any use other than as specified in this document is not allowed and dangerous. Any misuse, abuse, use under abnormal conditions, or noncompliance with the current-related safety restrictions could result in life-threatening situations; e.g., short-circuit, fire, explosion, electric shock.

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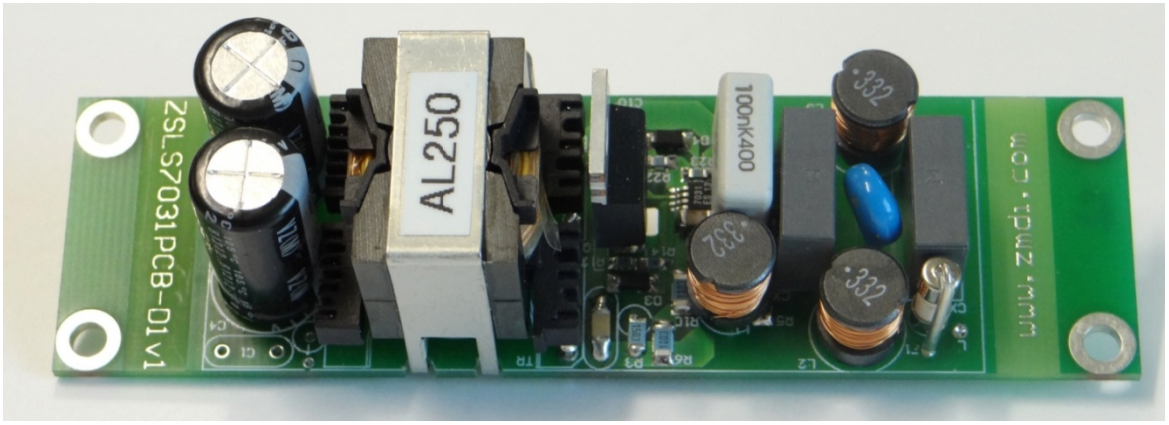
1 Kit Contents

The ZSLS7031KIT-D1 Demonstration Kit includes the following:

- ZSLS7031PCB-D1 Demonstration Board – 17W Flyback Converter
- ZSLS7031ZI1R (MSOP8 3x3mm) 5 IC samples
- ZSLS7031KIT-D1 Start-Up Information

The ZSLS7031KIT-D1 Demonstration Kit is fully assembled and ready for immediate operation.

Figure 1.1 ZSLS7031PCB-D1 Demo Board



2 Safety Advice

Important: The ZSLS7031PCB-D1 Demonstration Board delivered in this kit contains freely accessible parts which might be energized with high electrical voltages during and *after* operation. Users operating the Demonstration Board could have contact with these parts and must consider this life-threatening hazard if touching the Demonstration Board. Any use of the Demonstration Board requires strict observance of the standards and safety regulations for electrical engineering. Line-power-driven circuits must only be operated by trained staff observing national safety rules. All applicable rules for working with line power must be followed!

If the Demonstration Board is operated in Germany, the appropriate VDE rules must be followed, particularly VDE 0100, VDE 0550/0551, VDE 0700, VDE 0711, and VDE 0860. In any other countries, these VDE restrictions must be considered as applicable.

Also observe the following safety advice:

- The Demonstration Board could generate life-threatening high electrical voltage even when operated with low supply voltages (e.g., 24V); therefore also take adequate safety measures even with low supplies.
- For evaluation purposes, isolating transformers must be used.
- If there is any evidence that the Demonstration Board is malfunctioning, it must be put out of operation, especially in the case when an optical inspection shows damages (e.g., tape tracks) or if there are loosely or incorrectly mounted components.

- Operation of the AC/DC converters or DC/DC converters could result in intensely heated parts, so the risk of burn hazards must be considered.
- Do not leave the Demonstration Board unattended during operation. Important: Before leaving the workplace unattended, disconnect the board from its power supply and ensure that the board cannot be energized unintentionally. When the Demonstration Board is not being used, secure it to prevent unintended use.
- Do not operate the Demonstration Board in an environment that contains or might contain inflammable gas, explosive vapors, or dust.
- Repairs must be done only by educated staff observing the relevant safety rules. Broken parts must not be replaced with parts that are not original spare parts.

3 Kit Description

3.1. ZSLS7031 Overview

The ZSLS7031 LED driver IC is designed to work in buck-boost and fly-back topologies. The circuit operates with peak current detection and in constant frequency mode.

The ZSLS7031KIT-D1 application demonstrates the following features:

- Universal supply voltage range (85VAC to 265VAC can be applied)
- Active power factor correction to power factor values of typically over 90%
- High efficiency of typically over 85%
- Few external components
- Over-current, over-voltage, and over-temperature protection
- 15 W constant power output
- Loads from 9 (about 24V forward voltage) to 19 (52V) LEDs; if operating with 230VAC, loads down to 6 LEDs (17V) can be used
- Quick start

3.1.1. Recommended Equipment

- 85VAC to 265VAC / 50Hz to 60Hz power supply (isolating transformer)
- LED string of about 37V forward voltage and 400mA current capability
- Emergency main power switch
- True RMS multimeter
- Eye protection for all persons exposed to the power LED light from the Demonstration Board during operation

3.1.2. Maximum Ratings

If the following maximum ratings are exceeded, the Demonstration Board may be damaged or the output will be limited:

- Supply voltage ≤ 265VAC
- LED load < 54V forward voltage

3.2. ZSLS7031PCB-D1 Demonstration Board Schematic and Layout

Figure 3.1 gives the schematic for the Demonstration Board and Figure 3.2 shows its layout.

Figure 3.1 Schematic for ZSLS7031PCB-D1 Demonstration Board

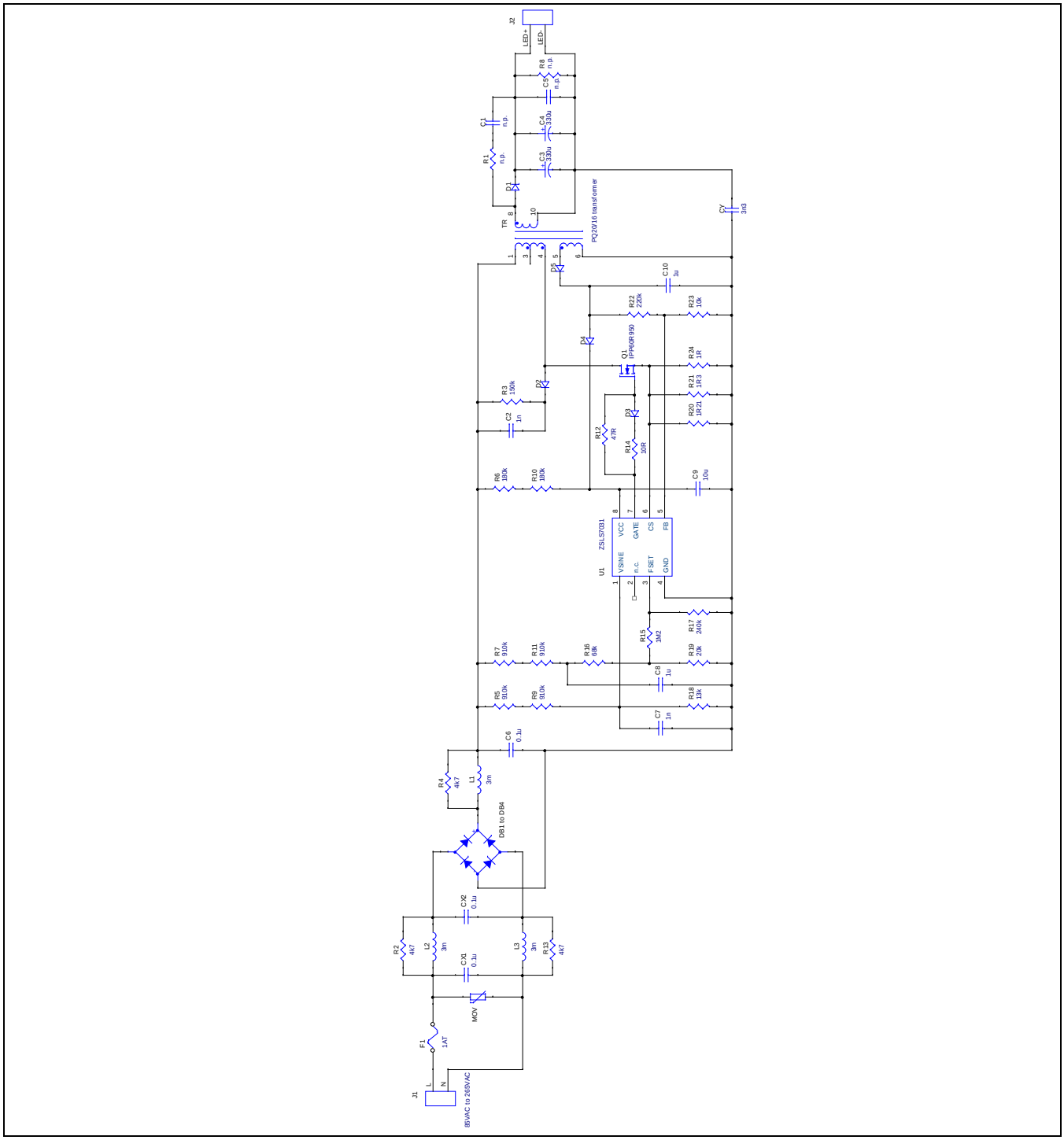
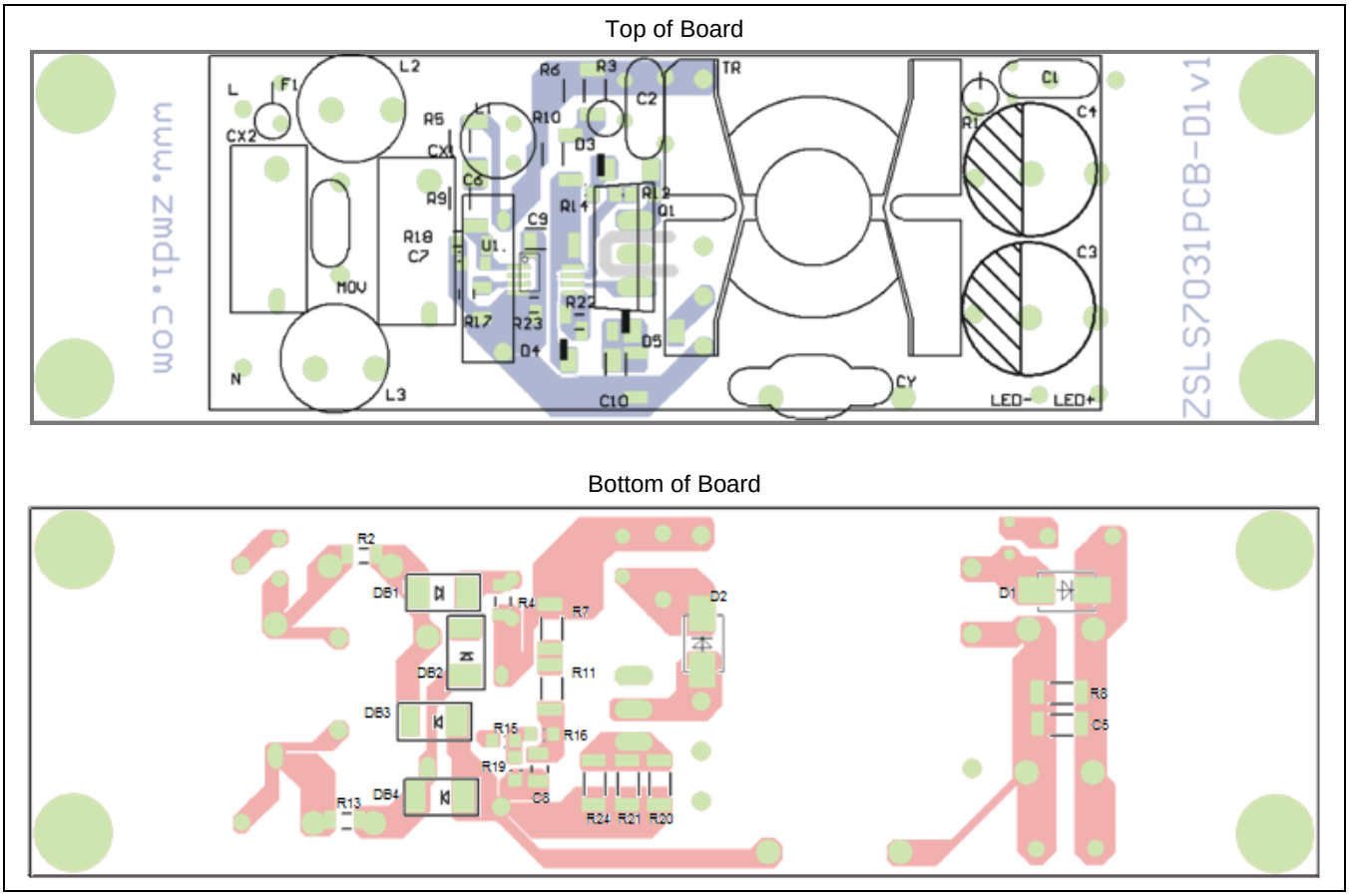


Figure 3.2 ZSLS7031PCB-D1 Demonstration Board Layout



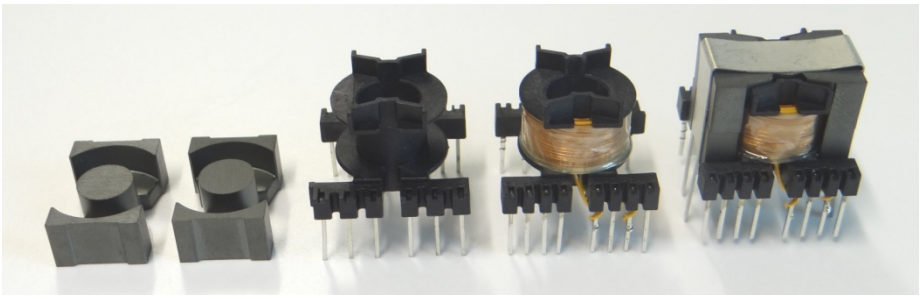
3.3. ZSLS7031PCB-D1 Demonstration Board Components

3.3.1. Transformer Data

The TR transformer included on the Demonstration Board meets the following specifications:

- Primary inductance LP 650µH @ 10kHz
- Primary leakage inductance LK < 20µH @ 10kHz
- Electrical strength 3kV, 50/60Hz, 1 min

Figure 3.3 PQ16/20 Transformer



Core Halves Bobbin Bobbin with Winding Complete Transformer

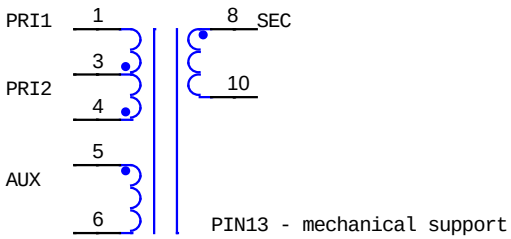
Table 3.1 Transformer Components

ITEM	TYPE	MANUFACTURER	REMARKS
Bobbin	CPVPQ20161S14P	Ferroxcube	
Winding PRI & AUX	CuL Grade 2 IEC 317-20 MW 79	Elektrisola	
Winding SEC	TEX-E wire	Furukawa	
Isolation Tape	CMC 10260/ 3M 1350F, CMC	Volz	
Core (Option 1)	PQ20/16-3C95	Ferroxcube	AL250 nH
Core (Option 2)	PQ20/16-3C94	Ferroxcube	AL260 nH
Core Clamp	CLMPPQ2016		

Table 3.2 Winding Parameters

WINDING	No. of TURNS	No. of PLIES	WIRE DATA	No. of PLIES	TAPE
PRI1	25	2	0.3mm-2-UEW	2	0.02mmx4mm
SEC	22	2	0.4mm-TEX	3	0.02mmx4mm
PRI2	25	2	0.3mm-2-UEW	2	0.02mmx4mm
AUX	9	1	0.13mm-2-UEW	3	0.02mmx4mm

Figure 3.4 Transformer Pin Assignment



3.3.2. Bill of Materials

In the following table, “n.p.” refers to positions that are not populated on the Demonstration Board.

Table 3.3 Bill of Materials for the ZSLS7031PCB-D1 Demonstration Board

Reference	Qty.	Component	Type/Value	Footprint	Manufacturer	Order Code
U1	1	LED driver IC	ZSLS7031	MSOP8	IDT	ZSLS7031ZI1R
Q1	1	nFET	IPP60R950C6	TO220	Infineon	IPP60R950C6
DB1,2,3,4	4	Diode	1A, 600V	SMA	Vishay	SF4007
D1	1	Diode	2A, 200V, Ultrafast	SMA	Diodes	ES2D
D2	1	Diode	1A, 600V, Ultrafast	SMA	Diodes	ES1J
D3, 4, 5	3	Diode	150mA, 100V	SOD-80	Vishay	LL4148
CX1, 2	2	Film cap, X2	0.1µF, 275VAC	13mmx6mm radial grid 10mm	Kemet	R46KF310000P1M
C1	*n.p.*	Film cap		8mmx3mm radial grid 5mm		
C2	1	MLCC	1nF, 1000V, X7R	1206	AVX	1206AC102K
C3, 4	2	e-cap	330µF, 63V	d10mmx20mm radial grid 5mm	Nichicon	UVZ1J331MPD
C5	*n.p.*	MLCC		1206		
C6	1	Film cap	100nF, 400V	13mmx5mm radial grid 10mm	Kemet	MMK10104K400A3LTR
C7	1	MLCC	1nF, 16V, X7R	0603	Kemet	C0603C102K5R
C8	1	MLCC	1µF, 50V, X7R	0805	TaiyoYuden	UMK212B7105KG-T
C9	1	MLCC	10µF, 25V, X7R	1206	TaiyoYuden	TMK316B7106KL-TD
C10	1	MLCC	1.0µF, 50V, X7R	1206	TaiyoYuden	TMK316B7105KL-T

Reference	Qty.	Component	Type/Value	Footprint	Manufacturer	Order Code
CY	1	Film cap, Y2	3.3nF, 250VAC	13.5mmx4mm radial grid 10mm	WIMA	MP3Y23300/250/20
TR	1	Transformer	custom wound	PQ20/16		see section 11 for details
L1, 2, 3	3	Inductor	3mH, 300mA sat	d8mmx10mm radial grid 5mm	Wurth	744772332
R1	*n.p.*	Resistor		0207 axial		
R2, 4, 13	3	Chip resistor	4.7kΩ 5%	0805	KOA	RK73B2ATTD472J
R3	2	Chip resistor	150kΩ 5%	1206	KOA	RK73H2BTTD1503F
R5, 7, 9, 11	4	Chip resistor	910kΩ 1%	1206	KOA	HV732BTTD9103F
R6, 10	2	Chip resistor	180kΩ 5%	1206	KOA	RK73H2BTTD1803F
R8	*n.p.*	Chip resistor		1206		
R12	1	Chip resistor	47Ω 5%	0603	KOA	RK73H1JTTD47R0F
R14	1	Chip resistor	10Ω 5%	0603	KOA	RK73H1JTTD10R0F
R15	1	Chip resistor	1.2MΩ 1%	0603	KOA	RK73H1JTTD1204F
R16	1	Chip resistor	68kΩ 1%	0603	KOA	RK73H1JTTD6802F
R17	1	Chip resistor	240kΩ 1%	0603	KOA	RK73H1JTTD2403F
R18	1	Chip resistor	13kΩ 1%	0805	KOA	RK73H1JTTD1302F
R19	1	Chip resistor	20kΩ 1%	0603	KOA	RK73H1JTTD2002F
R20	1	Chip resistor	1.21Ω 1%	1206	KOA	RK73H2BTTD1R21F
R21	1	Chip resistor	1.3Ω 1%	1206	KOA	RK73H2BTTDD1R30F
R22	1	Chip resistor	220kΩ 1%	0603	KOA	RK73H1JTTD2203F
R23	1	Chip resistor	10kΩ 1%	0603	KOA	RK73H1JTTD1002F
R24	1	Chip resistor	1Ω 1%	1206	KOA	RK73H2BTTD1R00F
F1	1	Fuse	1A, 250VAC	d3.6mmx10mm axial		0875001.MXEP
MOV	1	MOV	7D471K	d7mm radial grid 5mm	Bourns	MOV-07D471K
	1	PCB		98mmx28mm		

4 ZSLS7031KIT-D1 Operation

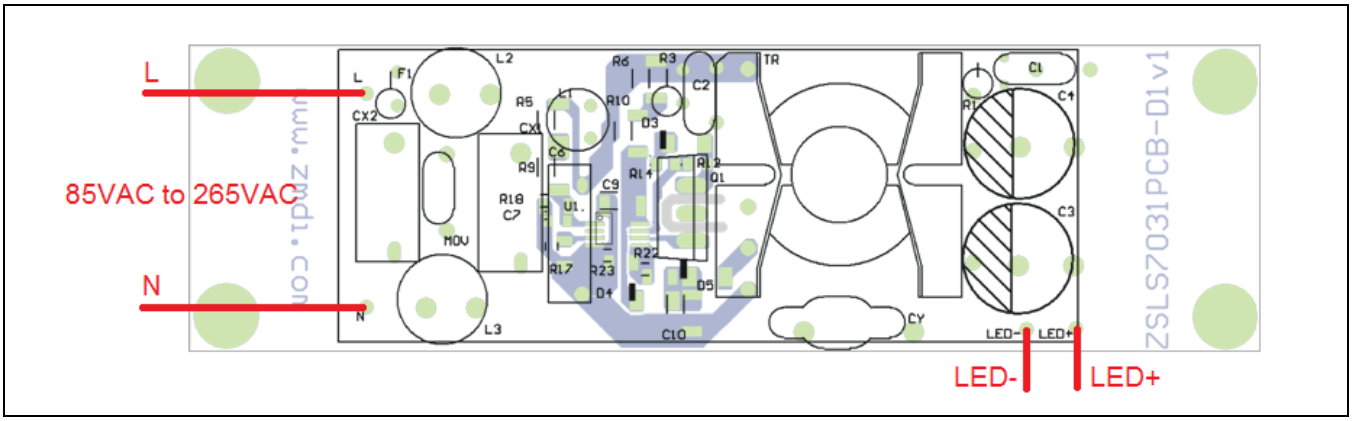
Always follow the safety advice in section 2. The complete setup must be placed on an isolating work space.

- Select an appropriate LED string.
- Connect the positive (anode) terminal of the LED string to the LED+ terminal of the board.
- Connect the negative (cathode) terminal of the LED string to the LED- terminal of the board.
- Connect the power supply via main power switch to the supply terminals L and N of the board.

Important: Before applying power, ensure that everyone in the vicinity of the Development Board has adequate eye protection from the light of the power LEDs.

- Turn on the power supply.

Figure 4.1 ZSLS7031PCB-D1 Connection Diagram



5 Typical Measurement Results

The following typical measurement results have been taken on a ZSLS7031PCB-D1 board based on a AL250nH transformer core connected to various LED loads.

Table 5.1 Typical Measurement Results with a AL250nH Transformer Core

No. of LEDs	VACin (V)	V_{LED} (V)	I_{LED} (mA)	Pin (W)	Pout (W)	Eff (%)	PF
9	85	25.5	558	17.1	14.2	83%	99.97%
9	110	25.5	571	17	14.5	85%	99.87%
9	127	25.4	575	16.9	14.6	86%	99.75%
9	230	25.3	556	16.2	14.1	87%	96.50%
9	265	25.3	594	17.5	15.1	86%	94.75%
10	85	28.2	520	17.4	14.6	84%	99.98%
10	110	28.1	531	17.4	14.9	86%	99.88%
10	127	28.1	526	16.9	14.8	87%	99.75%
10	230	28.0	515	16.5	14.4	87%	96.53%
10	265	28.0	542	17.5	15.2	87%	94.79%
14	85	39.0	375	17.2	14.6	85%	99.98%
14	110	39.0	388	17.4	15.1	87%	99.88%
14	127	39.0	387	17.1	15.1	88%	99.75%
14	230	38.8	375	16.5	14.6	88%	96.58%
14	265	38.9	400	17.7	15.6	88%	94.84%
15	85	42.0	352	17.3	14.8	85%	99.98%
15	110	42.0	362	17.4	15.2	87%	99.88%
15	127	41.9	360	17.1	15.1	88%	99.75%
15	230	41.8	353	16.7	14.8	88%	96.66%
15	265	41.9	372	17.7	15.6	88%	94.84%
16	85	44.4	334	17.3	14.8	86%	99.98%
16	110	44.4	344	17.4	15.3	88%	99.88%
16	127	44.4	342	17.2	15.2	88%	99.75%
16	230	44.3	335	16.7	14.8	89%	96.67%
16	265	44.3	353	17.7	15.6	88%	94.85%
18	85	49.9	297	17.3	14.8	86%	99.97%
18	110	49.9	306	17.4	15.3	88%	99.88%
18	127	49.9	305	17.2	15.2	88%	99.75%
18	230	49.8	298	16.7	14.8	89%	96.69%

No. of LEDs	VACin (V)	V_{LED} (V)	I_{LED} (mA)	Pin (W)	Pout (W)	Eff (%)	PF
18	265	49.9	314	17.7	15.7	89%	94.87%

6 Ordering Information

Ordering Code	Description	Package
ZSLS7031KIT-D1	ZSLS7031PCB-D1 Demonstration Board, 5 ZSLS7031 ICs	Kit

7 Related Documents

Document
ZSLS7031 Datasheet

Visit www.IDT.com/ZSLS7031 or contact your nearest sales office for the latest version of these documents.

8 Glossary

Term	Description
LED	Light Emitted Diode
PCB	Printed Circuit Board
MSOP8	8-Pin Mini Small-Outline Package

9 Document Revision History

Revision	Date	Description
1.00	May 20, 2013	First release.
1.01	June 3, 2013	Minor update for kit contents list.
	April 19, 2016	Changed to IDT branding.

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