

ISL6730BEVAL1Z, ISL6730DEVAL1Z1876

Boost CCM PFC for 300W Universal Input Adaptors

AN1876  
Rev 0.00  
July 29, 2013

**Introduction**

This application note describes the design and implementation of a 390V, 300W, Continuous Conduction Mode (CCM) Boost PFC converter using the ISL6730B, ISL6730D. The converter exhibits high power factor, Low THD and high conversion efficiency. The ISL6730B, ISL6730D are voltage mode power factor correction (PFC) controllers designed to drive cost-effective converters to meet input line harmonic regulations. The IC can be ISL6730B (Fixed Skip threshold) or ISL6730D (non-Skip). A detailed design procedure can be found in the datasheet ([FN8258](#)).

**Application**

The pre-regulator for AC/DC adaptors, such as Desktop/laptop Computer adaptors, or ATX power supply for the servers of networks or date centers, brick converters for telecom, flat-panel TVs, etc.

**Design Specifications**

- Input Voltage,  $V_{IN}$ : 85V - 265V<sub>AC</sub>
- Output Voltage,  $V_O$ : 390V<sub>DC</sub>
- Output Current,  $I_O$ : 0.77A (300W)
- Switching Frequency: 64kHz
- Efficiency: Full Load, 96% @ 115V<sub>AC</sub>; 98% @ 230V
- PF: Full Load, 0.999 @ 115V<sub>AC</sub>; 0.996 @ 230V<sub>AC</sub>
- THD: Full Load, 2% @ 115V<sub>AC</sub>, 2.5% @ 230V<sub>AC</sub>
- Board Dimension: 124×92×43 mm<sup>3</sup>(L×W×H)

Figure 3 on page 2 shows the test setup.

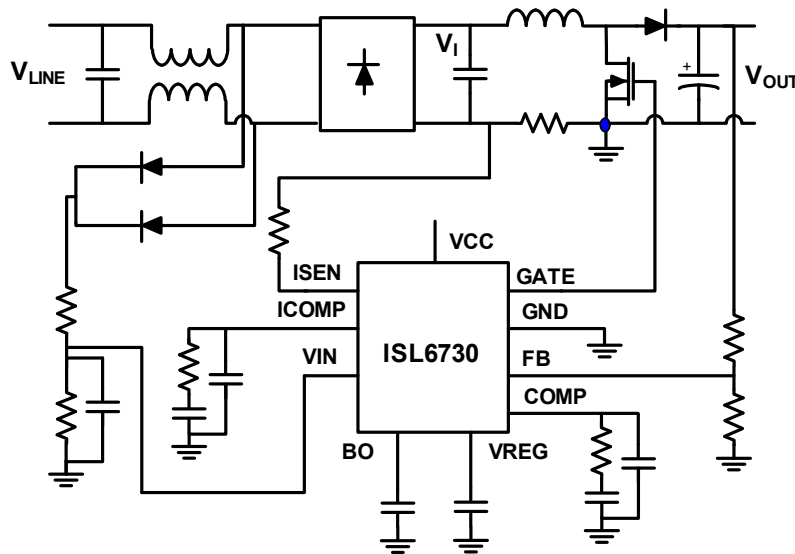


FIGURE 1. SIMPLIFIED SCHEMATIC

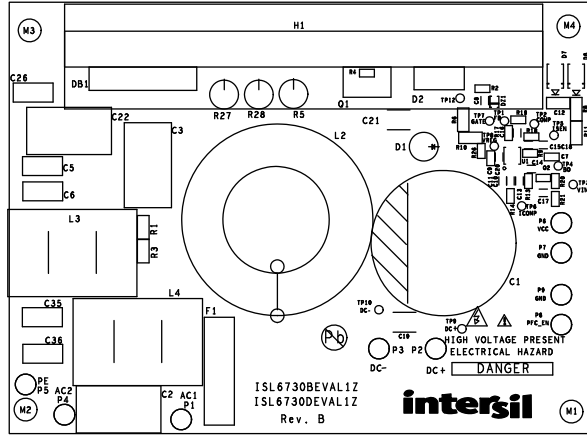


FIGURE 2. TOP VIEW OF THE EVALUATION BOARD

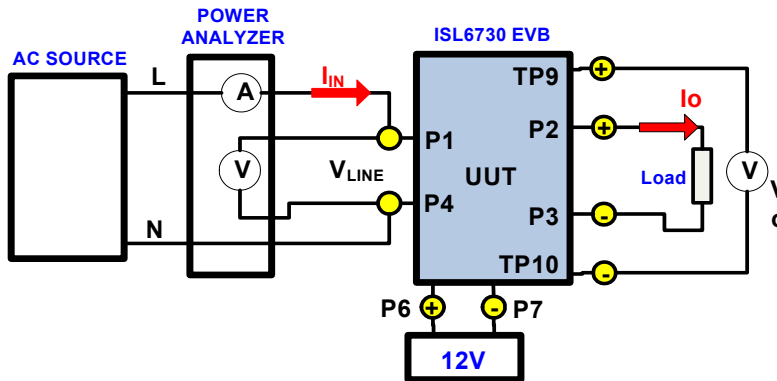


FIGURE 3. TEST SETUP

## Performance Curves and Typical Waveforms

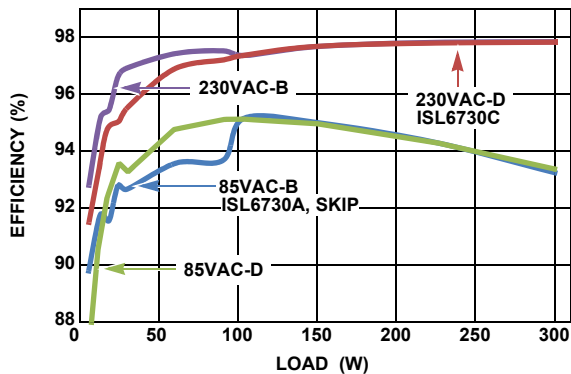


FIGURE 4. EFFICIENCY vs LOAD (85V, 230V)

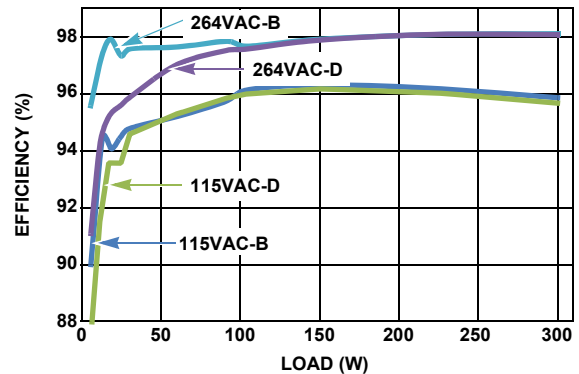


FIGURE 5. EFFICIENCY vs LOAD (115V, 264V)

# Performance Curves and Typical Waveforms (Continued)

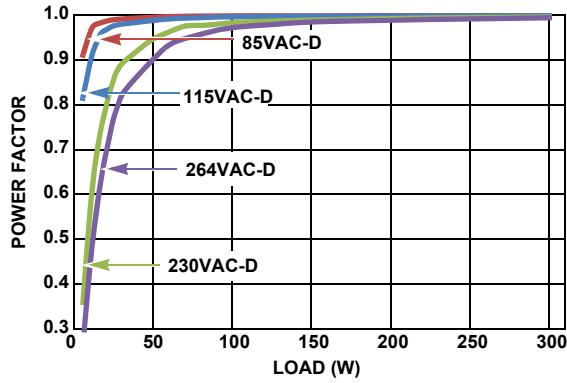


FIGURE 6. POWER FACTOR vs LOAD

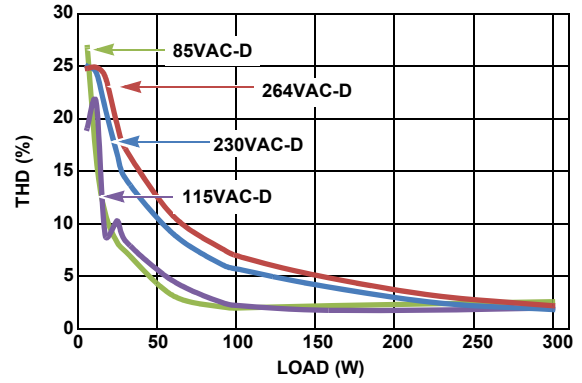


FIGURE 7. THD vs LOAD

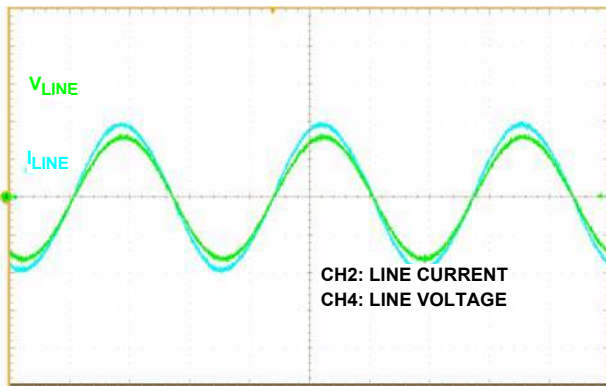


FIGURE 8. WAVEFORMS OF LINE CURRENT AND VOLTAGE (115V/300W)

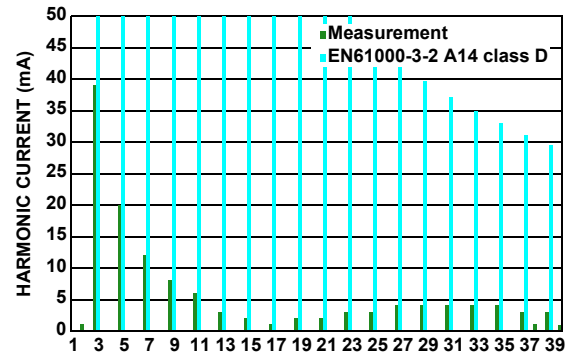


FIGURE 9. HARMONIC CURRENTS (115V/300W)

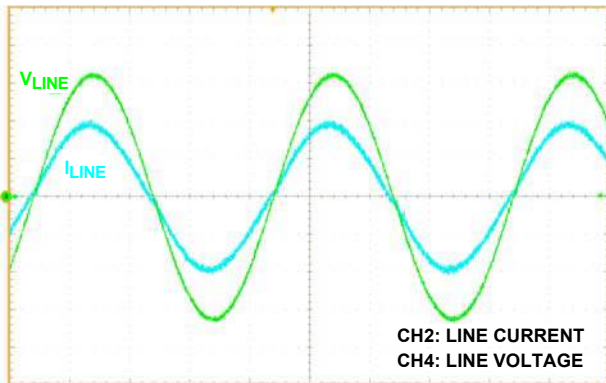


FIGURE 10. WAVEFORMS OF LINE CURRENT AND VOLTAGE (230V/300W)

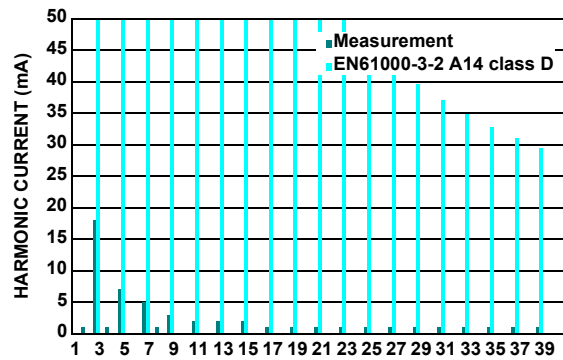


FIGURE 11. HARMONIC CURRENT OF LINE CURRENTS (230V/300W)

# Schematic

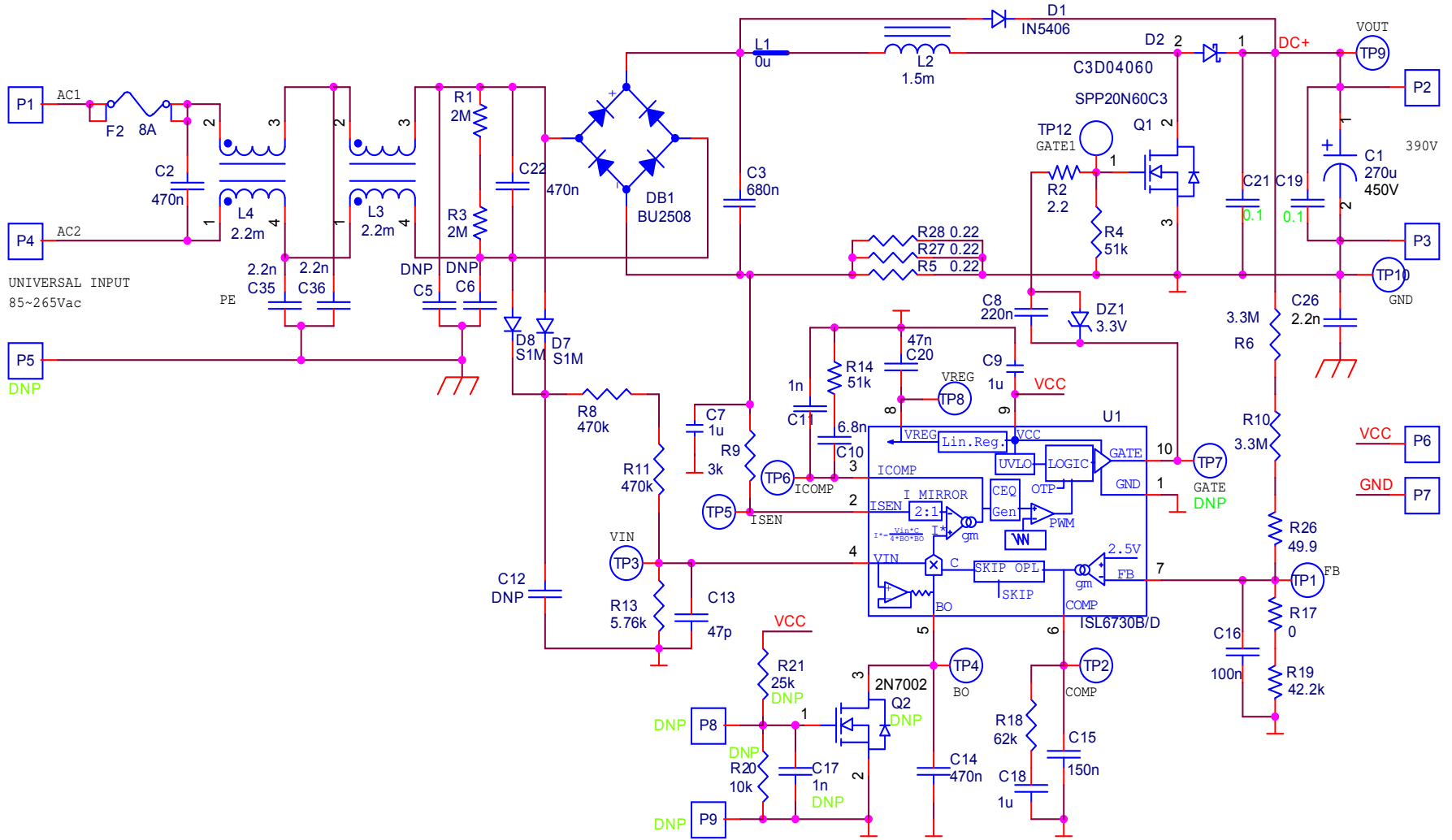


FIGURE 12. SCHEMATIC OF EVALUATION BOARD

TABLE 1. BILL OF MATERIALS

QTY	REFERENCE DESIGNATOR	TYPE/PACKAGE	VALUE	VOL/TOL/MAT	MANUFACTURER	MANUFACTURER PART #
1	C1	Cap, TH	270 $\mu$	450V, 20%, ELECT, Aluminum	Panasonic	EETUQ2W271DA
2	C2, C22	Cap, TH, Radial	470n	X2, 20%, EMI, X2-class	EPCOS	B32922C3474M
1	C3	Cap, TH, Radial	680n	450V, 20%, Metallized Polyester Film	EPCOS	B32672P4684K
5	C5, C6, C35, C36, C26	Cap, TH, Radial	2.2n	Y1, 20%, EMI, Y1-class	TDK	CS11-E2GA222MYNS
2	C7, C9	Cap, SM, 0603	1 $\mu$	50V, 20%, X7R	TDK	
1	C8	Cap, SM, 0603	220n	25V, 20%, X7R	TDK	
1	C10	Cap, SM, 0603	6.8n	25V, 10%, X7R	TDK	
1	C11	Cap, SM, 0603	1n	25V, 10%, X7R	TDK	
1	C13	Cap, SM, 0603	47p	16V, 5%, NPO	TDK	
1	C14	Cap, SM, 0603	470n	16V, 10%, X7R	TDK	
1	C15	Cap, SM, 0603	150n	50V, 10%, X7R	TDK	
1	C16	Cap, SM, 0603	100n	50V, 10%, X7R	TDK	
1	C18	Cap, SM, 0603	1 $\mu$	16V, 10%, X7R	TDK	
2	C19, C21	Cap, SM, SM1812	0.1	630V, 10%	Murata	GRM43DR72J104KW01L
1	C20	Cap, SM, 0603	47n	25V, 10%; X7R	TDK	
1	DB1	Diode, SM	BU2508		Diodes Inc	
1	DZ1	Zener, SM, SOD323	3.3V	5%, Zener	NXP	BZX384-B3V3
1	D1	Diode, SM, DO-201AD	IN5406	800V, 3A, Standard Recovery	Micro Commercial Co	IN5406-TP
1	D2	Diode, SM, DPAK	C3D04060	600V, 3A, SiC Schottky	Cree	
2	D7, D8	Diode, SM, SMA	S1M	1kV, 1A, Standard Recovery	Diodes Inc	S1M-13-F
1	F2	Fuse, TH, 5x20mm	8A	250V, fast acting, ceramic	Bel Fuse	5HF8-R
1	L1	Bare Wire				
1	L2	Ind, TH	1.5m	Core: Magmetics 0077071-A7 HT22, Wire: AWG20(or 0.8mm) 110T		Customized
2	L3, L4	CMC, TH	2.2m	Common Mode Choke	Würth	744824622
7	P1, P2, P3, P4, P5, P6, P7	TP, TH			KEYSTONE	1514-2
1	Q1	MOSFET, TH, to220_std	SPP20N60C3	600V, N-Chan	Infineon	
2	R1, R3	Res, SM, 1206	2M	5%, Thick Film	Panasonic-ECG	ERJ-8GEYJ205
1	R2	Res, SM, 0603	2.2	1%, Thick Film	Yageo	
2	R4, R14	Res, SM, 0603	51k	1%, Thick Film	Yageo	
3	R5, R27, R28	Res, TH, Axial	0.22	1W, 5%, metal oxide	Yageo	KNP100JR-73-OR22
2	R6, R10	Res, SM, 1206	3.3M	1%, Thick Film	Yageo	RC1206FR-073M3L
2	R8, R11	Res, SM, 1206	470k	1%, Thick Film	Yageo	
1	R9	Res, SM, 0603	3k	1%, Thick Film	Yageo	
1	R13	Res, SM, 0603	5.76k	1%, Thick Film	Yageo	
1	R17	Res, SM, 0603	0	1%, Thick Film	Yageo	
1	R18	Res, SM, 0603	62k	1%, Thick Film	Yageo	
1	R19	Res, SM, 0603	42.2k	1%, Thick Film	Yageo	
1	R26	Res, SM, 0603	49.9	1%, Thick Film	Yageo	
10	TP1~6, TP8~10, TP12	Pole, TH			KEYSTONE	5007
1	U1	IC, SM, MSOP10	ISL6730B/D	CCM PFC Controller	Intersil	ISL6730BFUZ or ISL6730DFUZ
0	C12, TP7; C17, R20, R21, P8, P9, Q2		DNP			

## PCB Layout

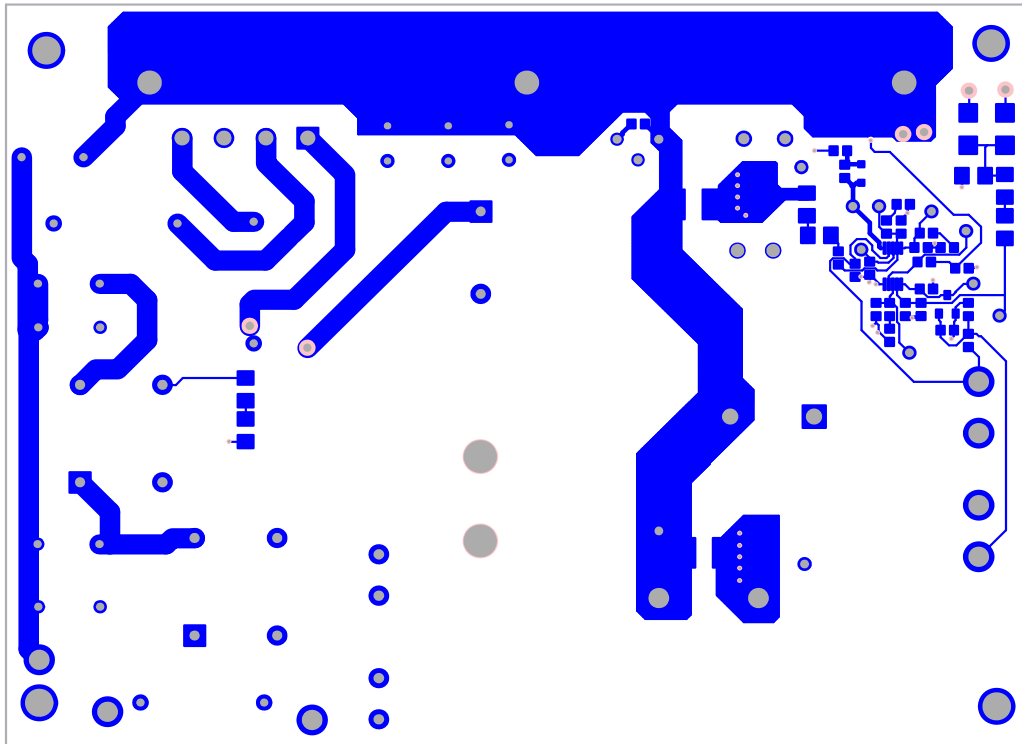


FIGURE 13. TOP LAYER

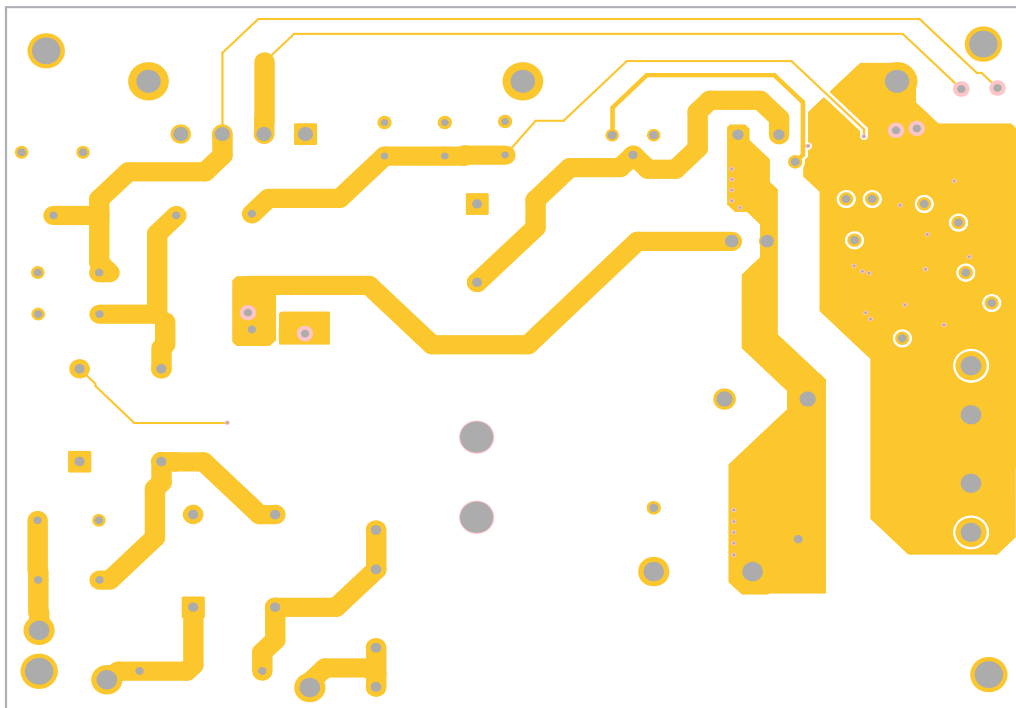


FIGURE 14. BOTTOM LAYER

# Assembly Drawing

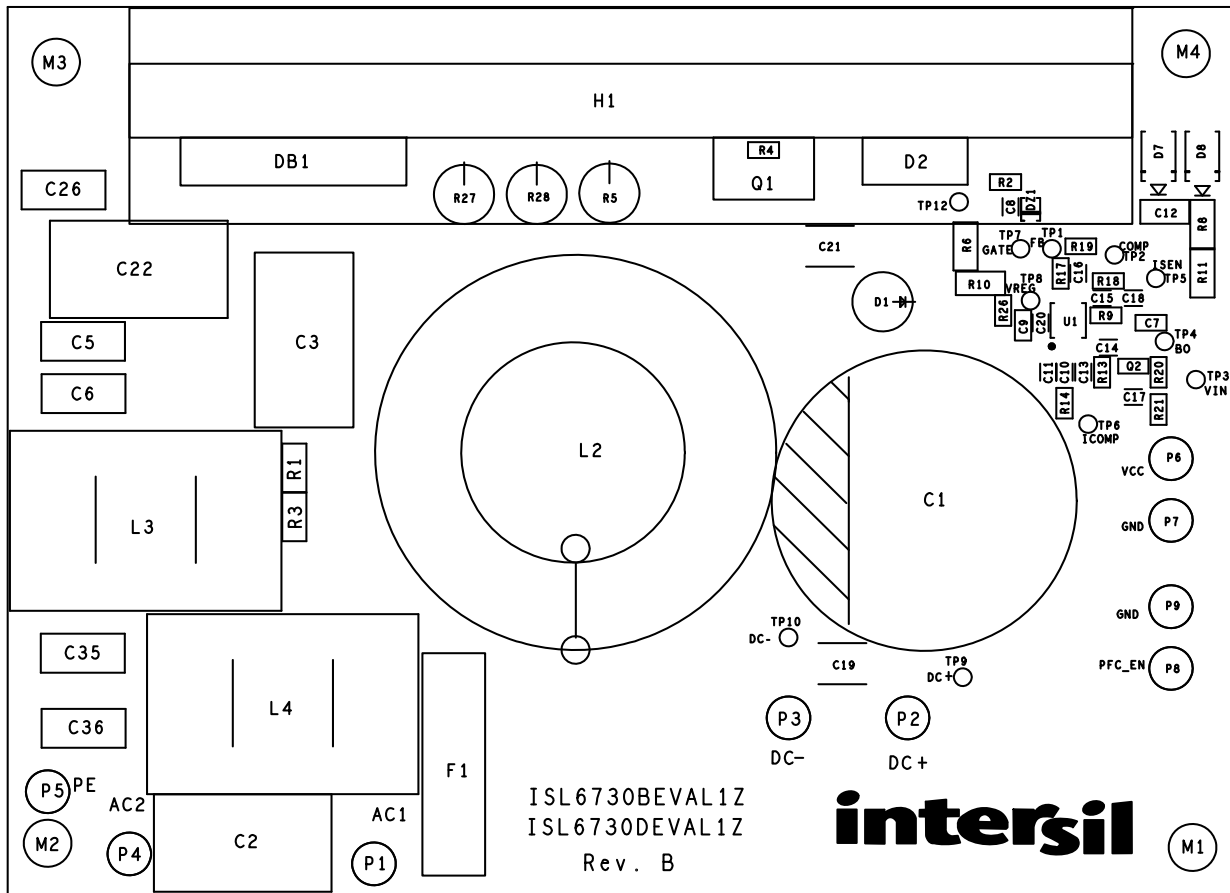


FIGURE 15. ASSEMBLY ON TOP

## Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.  
"Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.  
"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.  
Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user's manual or other Renesas Electronics document.
6. When using Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
7. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
10. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.  
(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.  
(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.4.0-1 November 2017)



### SALES OFFICES

Renesas Electronics Corporation

<http://www.renesas.com>

Refer to "<http://www.renesas.com/>" for the latest and detailed information.

**Renesas Electronics America Inc.**  
1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.  
Tel: +1-408-432-8888, Fax: +1-408-434-5351

**Renesas Electronics Canada Limited**  
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3  
Tel: +1-905-237-2004

**Renesas Electronics Europe Limited**  
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.  
Tel: +44-1628-651-700, Fax: +44-1628-651-804

**Renesas Electronics Europe GmbH**  
Arcadiastrasse 10, 40472 Düsseldorf, Germany  
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

**Renesas Electronics (China) Co., Ltd.**  
Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China  
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

**Renesas Electronics (Shanghai) Co., Ltd.**  
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China  
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

**Renesas Electronics Hong Kong Limited**  
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong  
Tel: +852-2265-6688, Fax: +852-2886-9022

**Renesas Electronics Taiwan Co., Ltd.**  
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan  
Tel: +886-2-8175-9600, Fax: +886-2-8175-9670

**Renesas Electronics Singapore Pte. Ltd.**  
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949  
Tel: +65-6213-0200, Fax: +65-6213-0300

**Renesas Electronics Malaysia Sdn.Bhd.**  
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia  
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

**Renesas Electronics India Pvt. Ltd.**  
No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India  
Tel: +91-80-67208700, Fax: +91-80-67208777

**Renesas Electronics Korea Co., Ltd.**  
17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea  
Tel: +82-2-558-3737, Fax: +82-2-558-5338