TEXAS INSTRUMENTS

100-W Universal Line Input PFC Boost Converter Using the UCC38050

User's Guide

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DYNAMIC WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the maximum input voltage ranges of 85 Vac to 265 Vac.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

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During normal operation, some circuit components may have case temperatures greater than 50°C. The EVM is designed to operate properly with certain components above 50°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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Mike O'Loughlin   *Power Supply Control Products*

Contents

1   Introduction

The UCC38050 reference design is a 100-W offline ac-to-dc voltage converter with power factor correction (PFC). The power module was designed to show how the UCC38050 could be configured in an off line power factor corrected preregulator. The module was design to operate over a universal input range of 85 V to 265 V with a 400-V dc regulated output.

For this design to function correctly the output needs a minimum load of 25 W.

2   Caution

High-voltage levels are present on the evaluation module whenever it is energized. Proper precautions must be taken when working with this power module. The output has a large energy storage capacitor and must be completely discharged before the module can be handled. Serious injury can occur if proper safety precautions are not followed.

3   Schematic
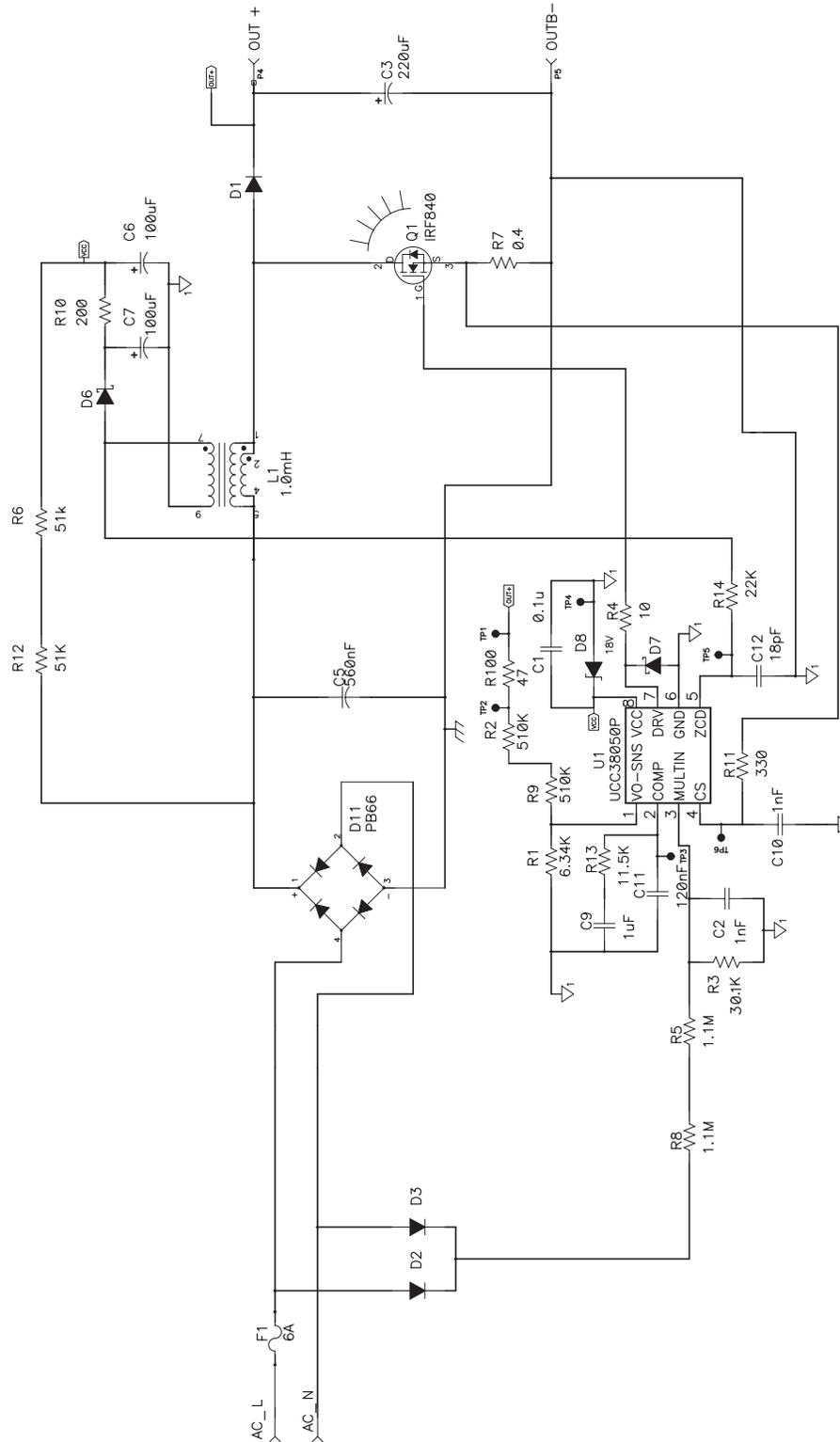
During normal operation, some circuit components may have voltages in excess of 75 V dc and 85 V ac.

4   Reference Design Layout
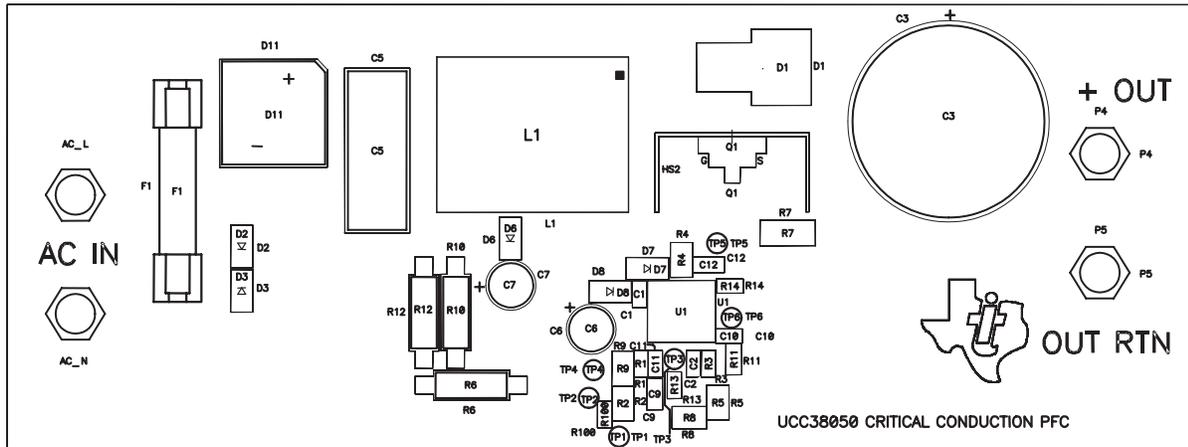
5   Electrical Characteristics

	MIN	TYP	MAX	UNITS
V_{IN}	85		265	V_{RMS}
Output	375	400	425	V
Output Power	25		100	W
Output Ripple			10	V

6   Reference Design Performance

The following figures show the reference design's performance.

Note: To achieve these results requires a 560-µH differential mode EMI filter. The data was taken with an ac source to achieve reliable results. If a variable autotransfer, (VARIAC), ac source is used the performance of the converter will look better than these results do to the high inductance of the VARIAC.
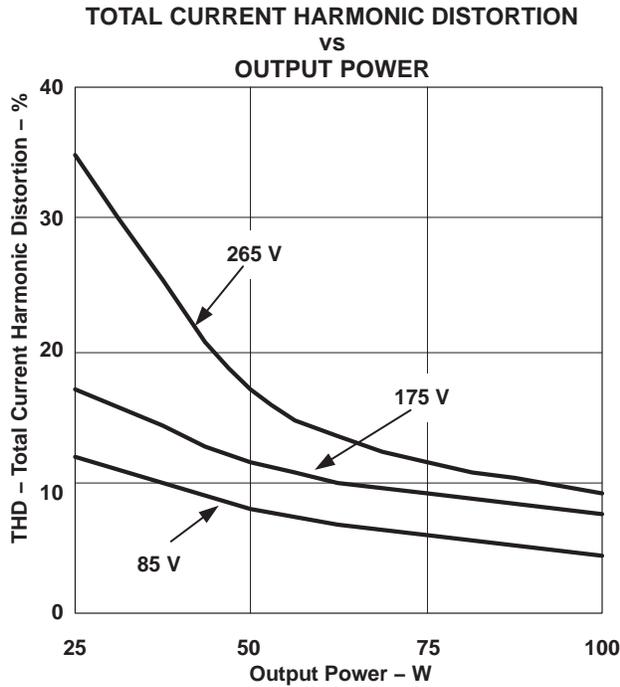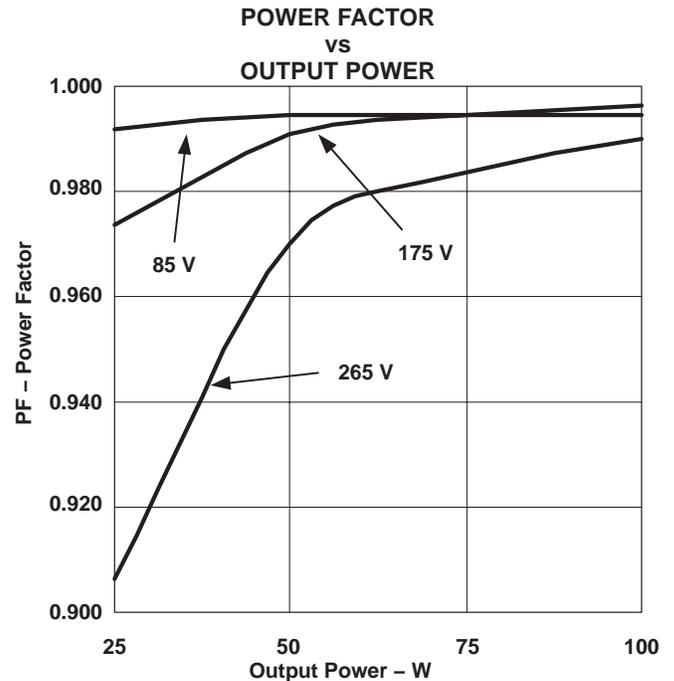
TOTAL CURRENT HARMONIC DISTORTION
vs
OUTPUT POWER

Figure 1

POWER FACTOR
vs
OUTPUT POWER

Figure 2

EFFICIENCY
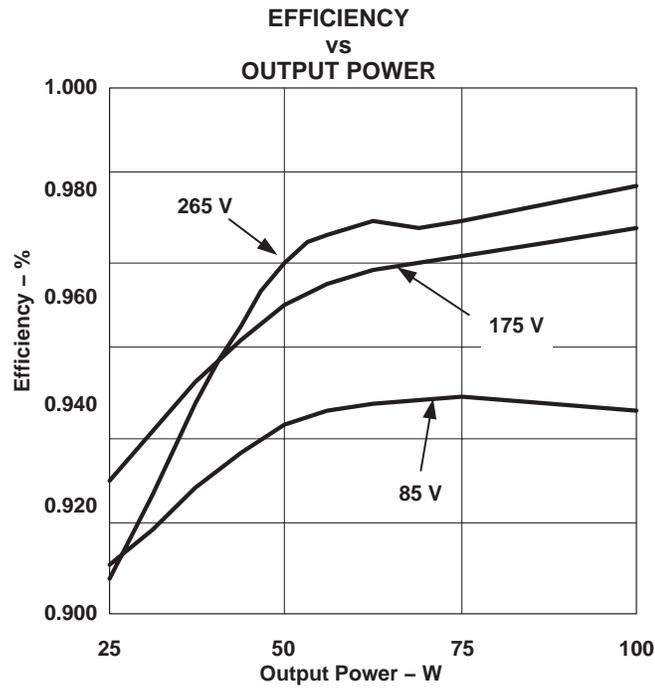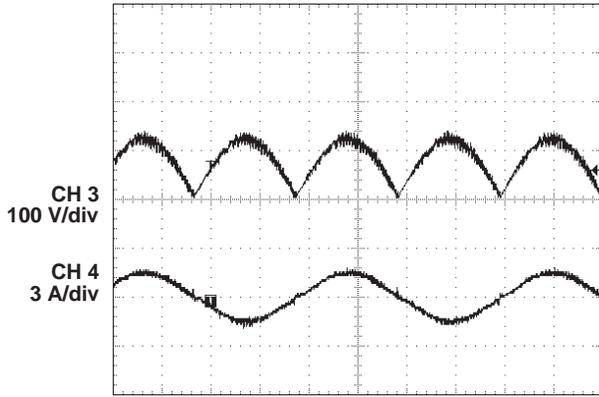**vs**
OUTPUT POWER

Figure 3

The following graphs show the input current and rectified line for the power module.

- Channel 3 = Rectified Line Voltage
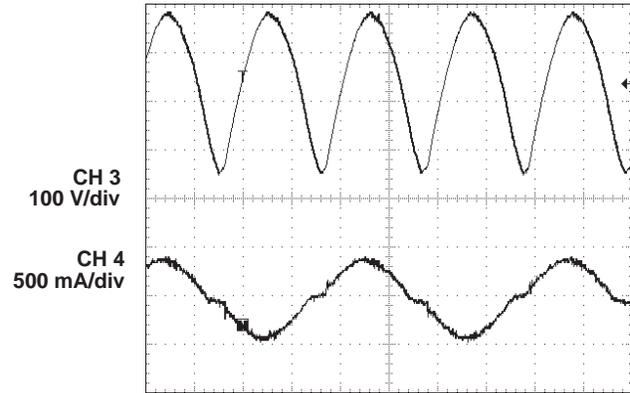- Channel 4 = Power Module Input Current

V_{IN} = 85 V, P_{OUT} = 100 W

CH 3
100 V/div

CH 4
3 A/div

t – Time – 4 ms/div

Figure 4

V_{IN} = 265 V, P_{OUT} = 100 W

CH 3
100 V/div

CH 4
500 mA/div

t – Time – 4 ms/div

Figure 5

V_{IN} = 85 V, P_{OUT} = 25 W

CH 3
100 V/div

CH 4
800 mA/div
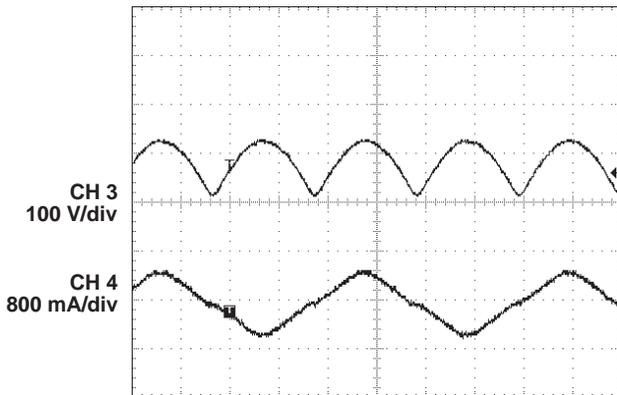
t – Time – 4 ms/div

Figure 6

V_{IN} = 265 V, P_{OUT} = 25 W

CH 3
100 V/div

CH 4
250 mA/div
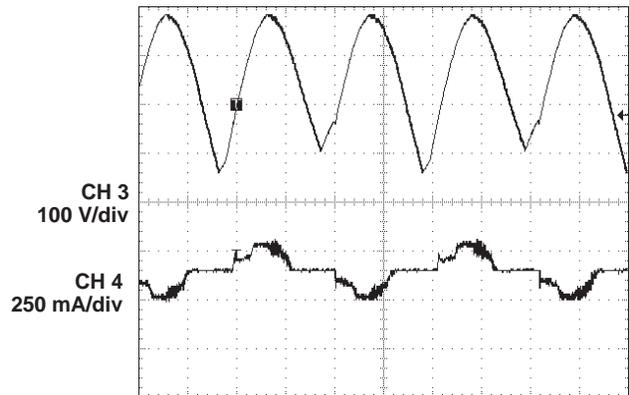
t – Time – 4 ms/div

Figure 7

7   List of Materials

	Reference	Qty	Description	Manufacturer	Part Number
Capacitor	C1	1	Ceramic, 100 nF 50 V	Yageo America	0805CG104J9B200
	C10, C2	1	Ceramic, 1000 PF 50 V	Yageo America	0805CG102J9B200
	C11	1	Ceramic, 20 nF 25 V	Panasonic	ECJ–2YB1E124K
	C12	1	Ceramic, 18 PF 50 V NPO 1206	Yageo America	1206CG180J9B200
	C3	1	Elec, 220 µF, 450 V	Panasonic	ECO–S2WB221DA
	C5	1	Metal polypro, 0.56 µF 400 V	Panasonic	ECW–F4564JB
	C6,C7	2	Elec, 100 µF, 35 V	Panasonic	EEU–FC1V101
	C9	1	Ceramic, 1 µF 16 V	Yageo America	12062R105K7BBOD
Rectifier	D2, D3	2	Standard, 1.5 A, 600 V	Vishay	BYG10J
Diode	D1	1	Hexfred, 600 V, 8 A, D2PAK	International Rectifier	HFA08TB60STRR
Rectifier	D6	1	Schottky, 1.5 A, 90 V	Vishay	BYS11–90
Diode	D7	1	Schottky, 1.5 A, 25 V	Vishay	BYS10–25
	D8	1	Zener SMD 18 V, 1 W SMA	Diodes Inc	SMAZ18–13
Rectifier	D11	1	Bridge, 6 A, 600 V	Diodes Inc	PB66
Fuse Clip	F1	1	Glass Fast Acting *Cartridge Type, 6 A, 250 V, 3 AG 1.25"x.25"	Littlefuse	312 006
	FH1, FH2	2	3 AG, for 1.25"x.25"	Cooper Electronic Technologies	1A1907–06
Heat Sink	HS1	1	TO–220	AVVID	593002 B 0 00 00
Inductor	L1	1	Coupled 12:1, 1 mH	Cooper Electronic Technologies	CTX16–15954
HEX/MOS	Q1	1	N–Channel, 500 A, 8 A, TO–220AB	International Rectifier	IRF840
Resistor	R1	1	SMD, 6.34 kΩ, 1/8 W 1%	Yageo America	9C08052A6341FKHFT
	R100	1	47 Ω, 1/10 W	Panasonic	ERJ–6GEYJ470V
	R10	1	200 Ω, 1 W	Huntington Electric Inc.	ALSR–1–200–1%
	R11	1	SMD, 330 Ω 1/4 W 1%	Yageo America	9C12063A3300FKHFT
	R14	1	SMD, 22.0 kΩ, 1/8 W, 1%	Yageo America	9C08052A2202FKHFT
	R4	1	SMD, 10.0 Ω 1/4 W, 1%	Susumu Co Ltd	RL1220S–100–F
	R13	1	SMD, 11.5 kΩ 1/8 W, 1%	BC Components	23122567H53
	R2, R9	2	SMD, 510 kΩ, 1/4 W, 1%	Yageo America	9C12063A5103FKHFT
	R3	1	SMD, 30.1 kΩ, 1/8 W, 1%	Std.	Std.
	R6,R12	2	51 kΩ, 1 W, 5%	BC Components	5073NW51K00J12AFX
	R7	1	Power metal strip, 0.4 Ω, 1 W 1%	Std.	Std.
	R8,R5	2	1.1 MΩ 1/4 W, 5%	Panasonic	8GEYJ115V
	U1	1	Critical conduction PFC controller	Texas Instruments	UCC38050P
Screw	X1 @ Q1	1	Pan head #4–40 X 7/16 (steel)		
Nut	X2 @ Q1	1	#4X40 (steel)		
Washer	X3 @ Q1	1	Nylon shoulder, #4		
	X4 @ Q1	1	Flat #4 (steel)		
	X5 @ Q1	1	Split lock #4 (steel)		
Thermal Pad	X6 @ Q1	1	Silicon TO220	BERQUIST	SP900S–58

NOTE: The values of these components are to be determined by the user in accordance with the application requirements.

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