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

*User's Guide*

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

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Power Supply Control Products

## Contents

|          |                                     |          |
|----------|-------------------------------------|----------|
| <b>1</b> | <b>Introduction</b>                 | <b>4</b> |
| <b>2</b> | <b>Caution</b>                      | <b>4</b> |
| <b>3</b> | <b>Schematic</b>                    | <b>5</b> |
| <b>4</b> | <b>Reference Design Layout</b>      | <b>6</b> |
| <b>5</b> | <b>Electrical Characteristics</b>   | <b>6</b> |
| <b>6</b> | <b>Reference Design Performance</b> | <b>7</b> |
| <b>7</b> | <b>List of Materials</b>            | <b>9</b> |

## 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.

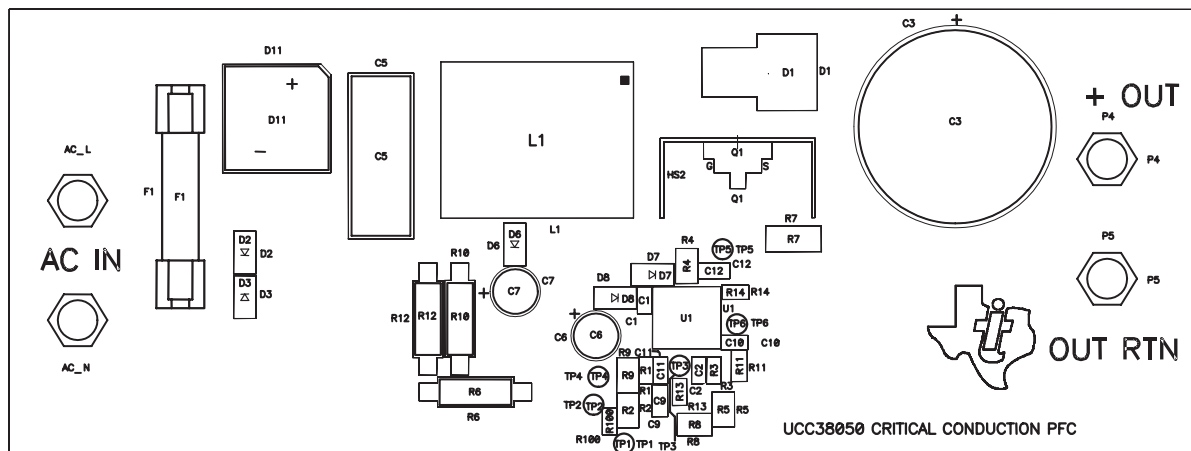
## 2 Caution

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.

[illegible]

100-W Universal Line Input PFC Boost Converter 5

## 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- $\mu$ H 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.

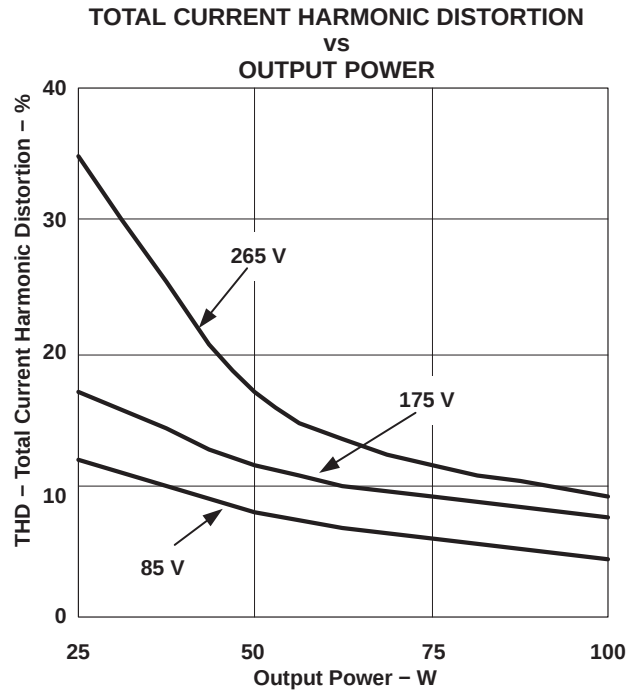


Figure 1

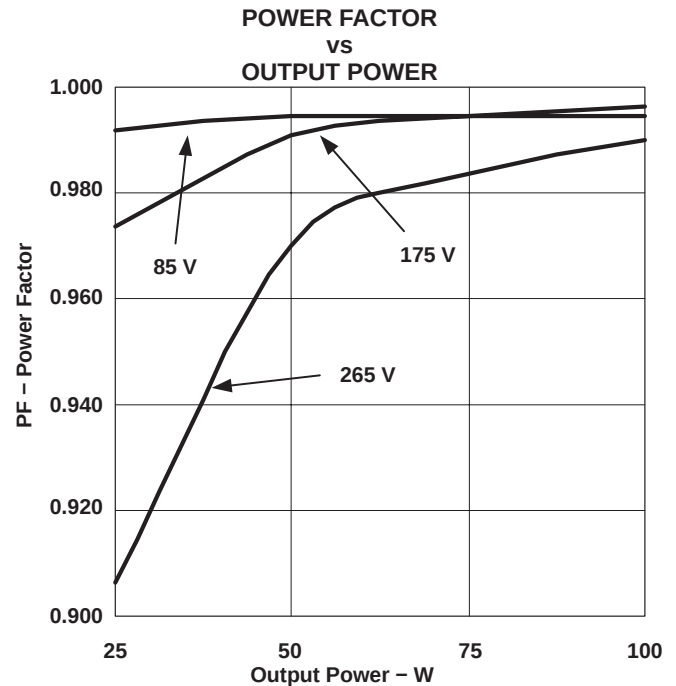


Figure 2

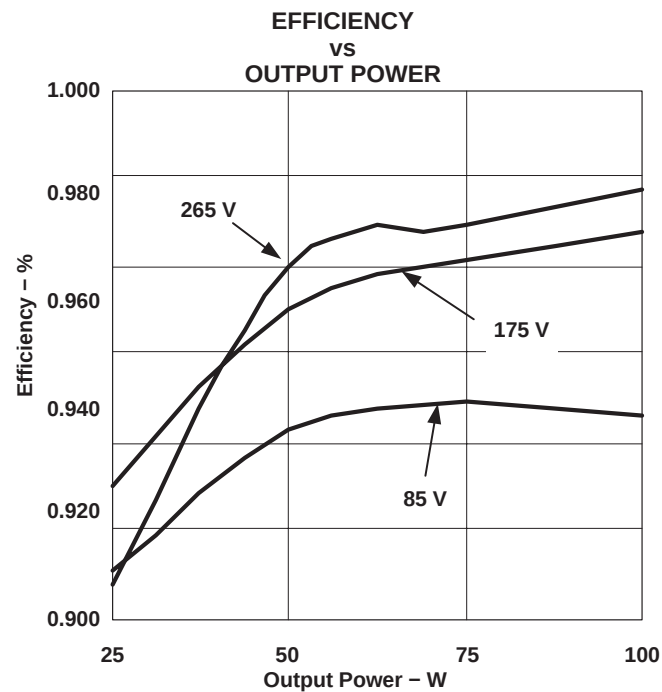


Figure 3

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

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

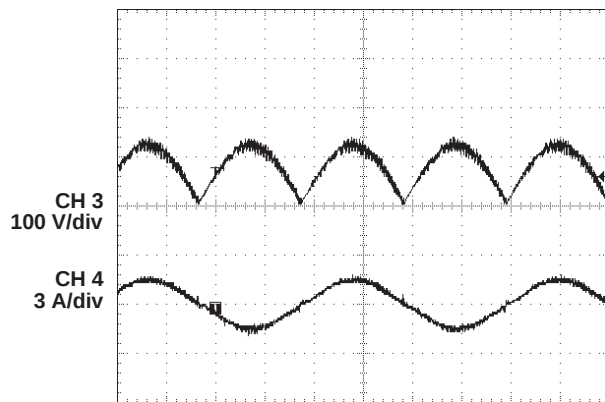


Figure 4

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

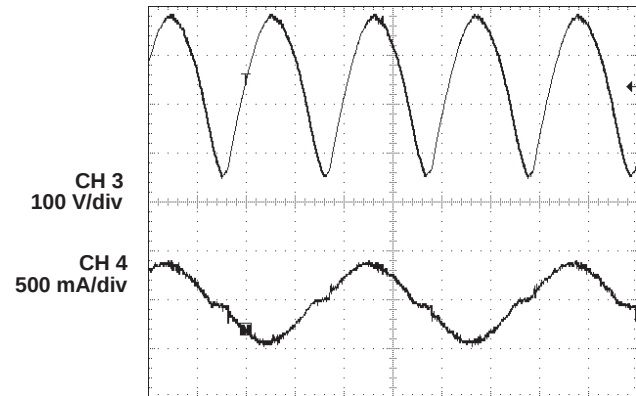


Figure 5

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

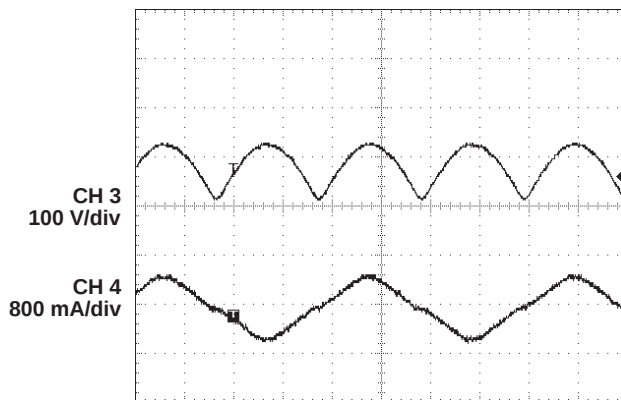


Figure 6

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

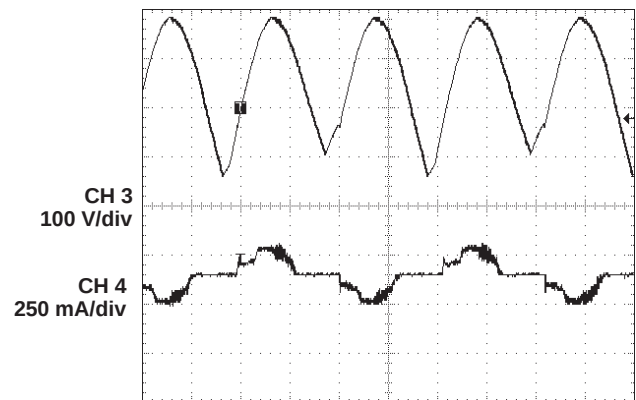


Figure 7

## 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 $\mu$ F, 450 V                                       | Panasonic                      | ECO-S2WB221DA     |
|             | C5        | 1   | Metal polypro, 0.56 $\mu$ F 400 V                              | Panasonic                      | ECW-F4564JB       |
|             | C6,C7     | 2   | Elec, 100 $\mu$ F, 35 V                                        | Panasonic                      | EEU-FC1V101       |
|             | C9        | 1   | Ceramic, 1 $\mu$ F 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 k $\Omega$ , 1/8 W 1%                                | Yageo America                  | 9C08052A6341FKHFT |
|             | R100      | 1   | 47 $\Omega$ , 1/10 W                                           | Panasonic                      | ERJ-6GEYJ470V     |
|             | R10       | 1   | 200 $\Omega$ , 1 W                                             | Huntington Electric Inc.       | ALSR-1-200-1%     |
|             | R11       | 1   | SMD, 330 $\Omega$ 1/4 W 1%                                     | Yageo America                  | 9C12063A3300FKHFT |
|             | R14       | 1   | SMD, 22.0 k $\Omega$ , 1/8 W, 1%                               | Yageo America                  | 9C08052A2202FKHFT |
|             | R4        | 1   | SMD, 10.0 $\Omega$ 1/4 W, 1%                                   | Susumu Co Ltd                  | RL1220S-100-F     |
|             | R13       | 1   | SMD, 11.5 k $\Omega$ 1/8 W, 1%                                 | BC Components                  | 23122567H53       |
|             | R2, R9    | 2   | SMD, 510 k $\Omega$ , 1/4 W, 1%                                | Yageo America                  | 9C12063A5103FKHFT |
|             | R3        | 1   | SMD, 30.1 k $\Omega$ , 1/8 W, 1%                               | Std.                           | Std.              |
|             | R6,R12    | 2   | 51 k $\Omega$ , 1 W, 5%                                        | BC Components                  | 5073NW51K00J12AFX |
|             | R7        | 1   | Power metal strip, 0.4 $\Omega$ , 1 W 1%                       | Std.                           | Std.              |
|             | R8,R5     | 2   | 1.1 M $\Omega$ 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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