



UCC28521 EVM User's Guide

User's Guide

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It is important to operate this EVM within the maximum input voltage ranges specified in section 6.

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.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

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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Power Supply Control Products

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1 Introduction

The UCC28521 module is a 100-W offline ac-to-dc voltage converter with power factor correction (PFC). The prototype was designed to show how the UCC28521 could be configured to control a dc-regulated output offline with one control integrated circuit. The module was designed to operate over a universal input range of 85 V to 265 V with a regulated 12-V, 100-W output.

To correctly operate this EVM a fan is required to keep the component temperature at or below 60°C. Not keeping the temperature at or below 60°C could damage the EVM.

2 Caution

High-voltage levels are present on the evaluation module whenever it is energized. Proper precautions must be taken when working with the module. The evaluation module 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.

The schematic can be found in Figure 1, 2 and 3.



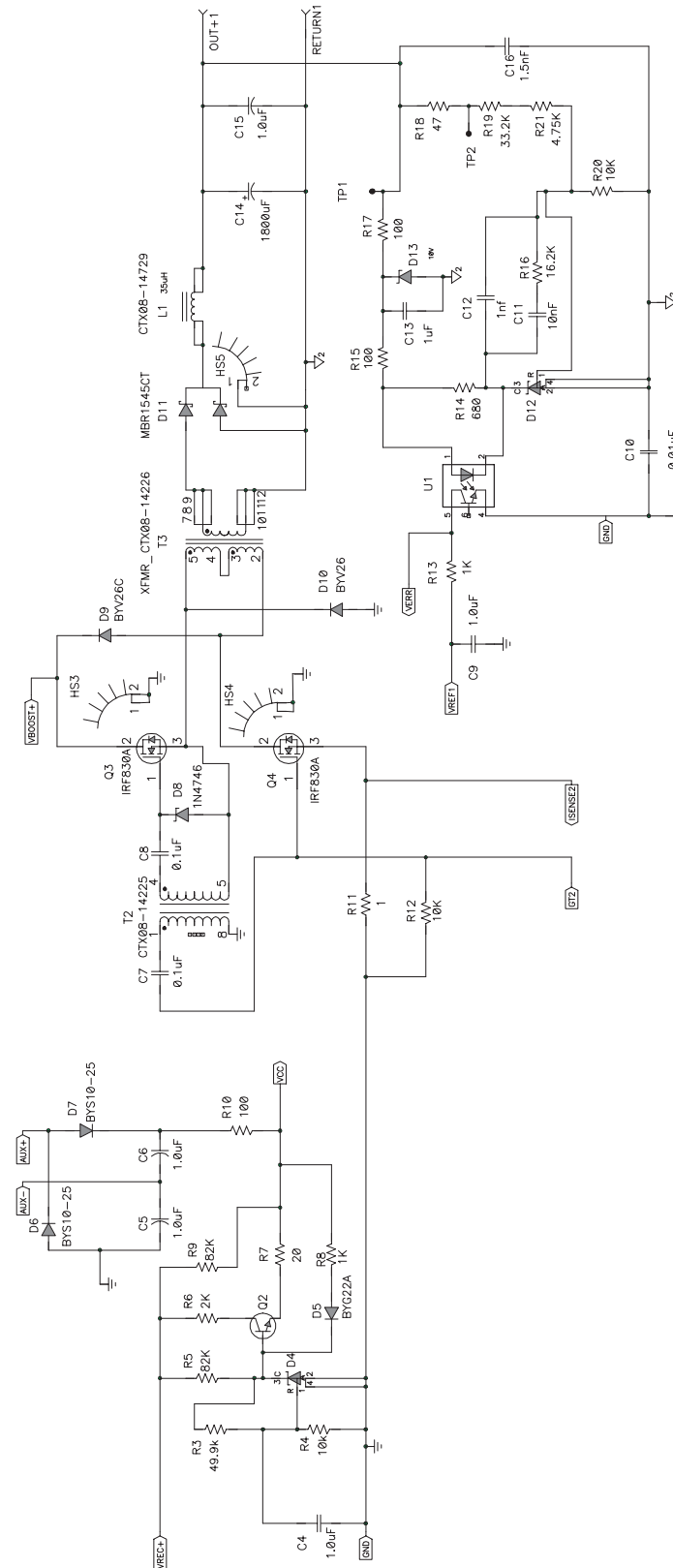


Figure 2. Mother Board Part 2

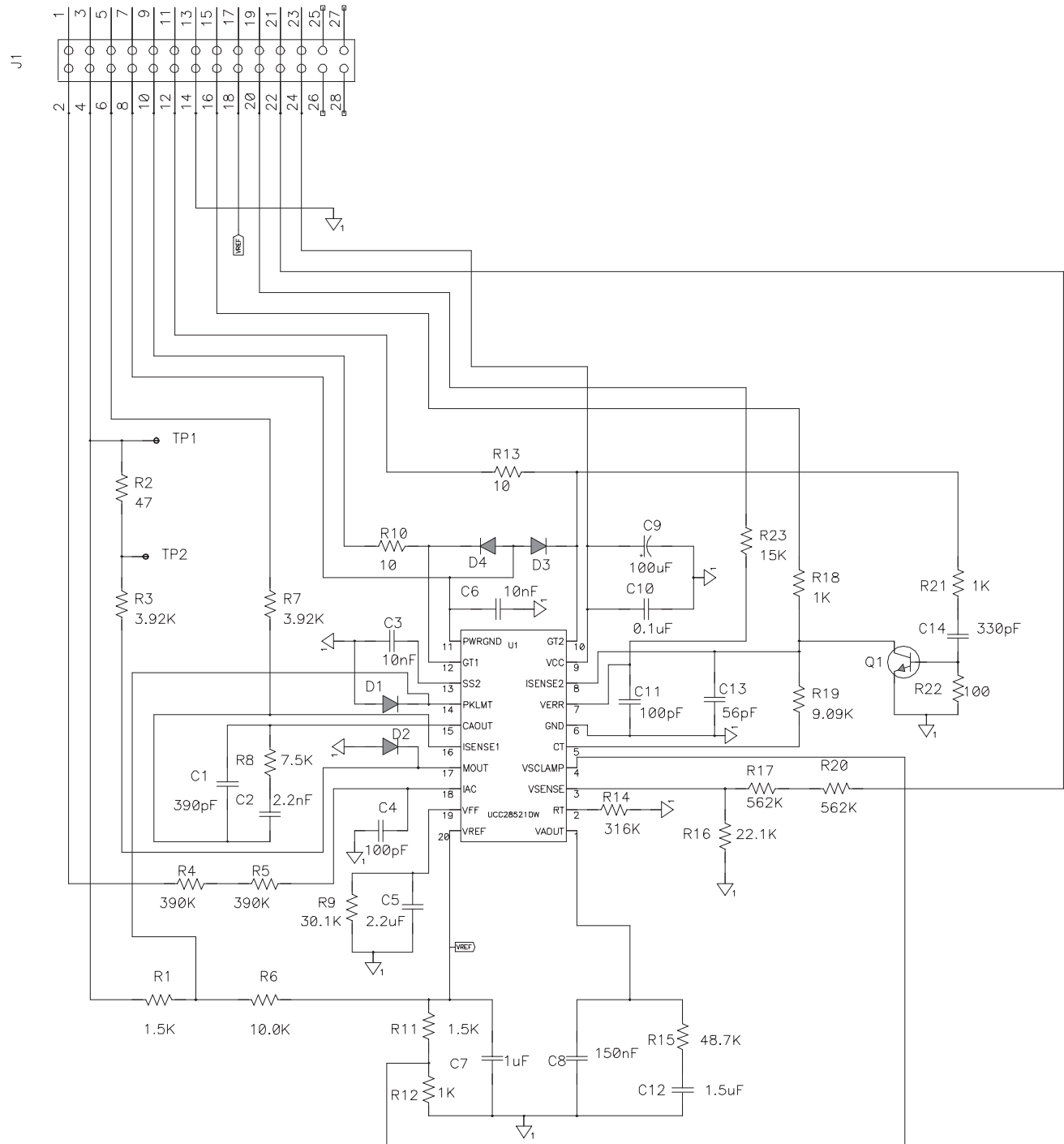


Figure 3. Daughter Board

4 List of Materials

Table 1 lists the components used in this design. With minor component tweaks this design could be modified to meet a wide range of applications.

Table 1. HPA114 Mother Board List of Materials

REFERENCE	QTY	DESCRIPTION	MANUFACTURER	PART NUMBER
AC_L1	0	Connector, binding post, insulated, for standard banana plug, black, 15 A, 141860	Johnson	111-0703-001
AC_N1	0	Connector, binding post, insulated, for standard banana plug, red, 15 A, 141860	Johnson	111-0702-001
C1	1	Capacitor, film, 0.047 μ F, 300 V _{AC} , $\pm$ 20%, 0.236 x 0.591	Panasonic	ECQU3A473MG
C2	1	Capacitor, polyester, .047 μ F, 630 V, 10%, 0.256 x 0.650	Panasonic	ECQ-E6473KZ
C3	1	Capacitor, electrolytic, 100 μ F, 450 V, TS series	Panasonic	ECO-S2WB101BA
C4, C9	2	Capacitor, ceramic, 1 μ F, 25 V, X7R, 10%, 1206	Panasonic	ECJ-3YB1E105K
C5, C6, C15	3	Capacitor, film, 1.0 μ F, 50 V, 5%, 7380	Panasonic	ECQ-V1H105JL
C7, C8	2	Capacitor, ceramic, 0.1 μ F, 50 V, X7R, $\pm$ 10%, 43200	Panasonic	ECU-S1H104KBB
C10	1	Capacitor, film, 0.01 μ F, 300 V _{AC} , $\pm$ 20%, 0.197 x 0.591	Panasonic	ECQU3A103MG
C11	1	Capacitor, ceramic, 0.01 μ F, 50 V, X7R, 10%, 1206	Panasonic – ECG	ECU-V1H103KBM
C12	1	Capacitor, ceramic, 1 nF, 50 V, X7R, 10%, 0805	Panasonic	ECU-V1H102KBN
C13	1	Capacitor, ceramic, 1 μ F, 50 V, X7R, 10%, 1206	Panasonic	ECJ-3YB1E105K
C14	1	Capacitor, electrolytic, 1800 μ F, 35 V,	Panasonic	EEUFC1E1825C
C16	1	Capacitor, ceramic, 0.0015 μ F, 50 V, X7R, 10%, 0805	Panasonic	ECJ-2VB2D152K
Daughter Board Assembly	1	Controller board plugs into J1	Any	HPA115
D1	1	Bridge rectifier, 6 A, 600 V, GBJ series	General Semiconductor	PB66
D2	1	Diode, 600 V, 6 A, 400 A peak surge, 252000	Diodes Inc	6A6-T
D3	1	Diode, ultra fast, 8 A, 600 V, 5 mA	International Rectifier	HFA08TB60
D4, D12	2	Adjustable precision shunt regulator, SOT-89	Texas Instruments	TL431CPK
D5	1	Diode, rectifier, 2 A, 50 V, SMA	Vishay	BYG22A
D7, D6	2	Diode, schottky, 1.5 A, 25 V, SMA	Vishay	BYS10-25
D8	1	Diode, zener, 18 V, 83 mA, 1 W, DO-41	On Semi	1N4746
D10, D9	2	Diode, fast recovery, SOD-57	Phillips	BYV26
D11	1	Diode, dual schottky, 15 A, 45 V, TO220	OnSemi	MBR1545
D13	1	Diode, zener, 10 V, 35 mA, 350 mW, SOT23	Diodes Inc	BZX84C10-7
F1	1	Fuseholder, 1/4 fuses, 0.42	Cooper/Bussman	BK/1A1907-06
Fuse at F1	1	6 A, 250 V, 3AG Glass Fast Acting *Cartridge Type, 1.25" x 0.25"	Littlefuse	312 006
HS1	1	Heatsink, TO-220, vertical mount, 5°C/W, 0.5 x 1.38in.	Aavid	513201
HS2	1	Heatsink, TO-220, Vertical mount, 0.98 x 0.44	Aavid	579402B00000
HS3, HS4, HS5	3	Heatsink, TO-220, Vertical mount, 15°C/W, 0.5" x 0.95"	Aavid	593002B33402
J1**	1	Receptacle, female 28 pins, 0.197 x 1181	Hirose Electric	DF11-28DS-2DSA(xx)
L1**	1	Inductor, 35 μ H, 9 A	Cooper	CTX08-14729
OUT+1	0	Connector, binding post, insulated, for standard banana plug, black, 15 A, 141860	Johnson	111-0703-001
PCB	1	Mother board	Any	HPA013
Q1, Q3, Q4**	3	MOSFET, N-channel, 500 V, 5 A, 1500 m Ω , TO-220	International Rectifier	IRF830A
Q2**	1	Bipolar, NPN, 400 V, 1 A, 15 W, DPAK	On Semi	MJD50

REFERENCE	QTY	DESCRIPTION	MANUFACTURER	PART NUMBER
R1	1	Resistor, wirewound, 3 W, axial, 187500	Huntington Electric	ALSR-3-.33-1%
R2, R4	2	Resistor, chip, 10 k Ω , 1/4 W, 1%, 1210	Panasonic	ERJ-14NF1002U
R3	1	Resistor, chip, 49.9 k Ω , 1/4 W, 1%, 1210	Panasonic	ERJ-14NF4992U
R5	1	Resistor, power metal film, 500 V, 3 W, 5 $\pm$ %, 1,000 X 0.200	BCcomponents	5093NW82K00J08AFX
R6	1	Resistor, power metal film, 2 k Ω , 3 W, 5 $\pm$ %, 1,000 X 0.200	BCcomponents	5093NW2K00J08AFX
R7	1	Resistor, chip, 20 Ω , 1/4 W, 5%, 1210	Panasonic	ERJ-14YJ200U
R8, R13, R20	3	Resistor, chip, 1 k Ω , 1/10 W, 1%, 0805	Panasonic	ERJ-6ENF1001V
R9	1	Resistor, power metal film, 82 k Ω , 3 W, 5 $\pm$ %, 1,000 X 0.200	BCcomponents	5093NW82K00J08AFX
R10	1	Resistor, chip, 100 Ω , 1/4 W, 5%, 1210	Panasonic	ERJ-14YJ101U
R11	1	Resistor, metal oxide, 1.0 Ω , 1 W, 5%, 0.150 x 0.700	Yageo	RSF100JB-1R0
R12	1	Resistor, chip, 10 k Ω , 1/10 W, 1%, 0805	Panasonic	ERJ-6ENF1002V
R14	1	Resistor, chip, 680 Ω , 1/10 W, 1%, 0805	Yageo America	9C8052A6800FKHFT
R15, R17	2	Resistor, chip, 100 Ω , 1/10 W, 1%, 0805	Std	Std
R16	1	Resistor, chip, 16.2 k Ω , 1/10 W, 1%, 0805	Std	Std
R18	1	Resistor, chip, 47 Ω , 1/10 W, 1%, 0805	Panasonic	ERA-S27J470V
R19	1	Resistor, chip, 33.2 k Ω , 1/10 W, 1%, 0805	Std	Std
R21	1	Resistor, chip, 4.75 k Ω , 1/10 W, 1%, 0805	Std	Std
RETURN1	0	Connector, binding post, insulated, for standard banana plug, black, 15 A, 141860	Johnson	111-0703-001
T1**	1	Boost Inductor, 20 primary, 1 secondary, 1.7 mH, 2.5 A, 1,260 x 1,220	Cooper	CTX16-16364
T2**	1	XFMR, 100 kHz, 750 μ H, toroid, ferrite	Coiltronics, Inc	CTX08-14225
T3**	1	Transformer, 10.8 primary, 1 secondary	Cooper	CTX08-14226
TP1, TP2	0	Jack, test point, circle	Farnell	240-3xx
U1**	1	Optocoupler, 5300 V, 100% center, SMD	Fairchild	4N36S
X1 at HS1, HS3, HS4, HS5	4	Thermal pad silicon TO220	BERQUIST	3223-07FR-51
X1 at HS1, HS3, HS4, HS5	4	Nut #6X32 (steel)		
X1 at HS1, HS3, HS4, HS5	4	Split lock washer #6(steel)		
X1 at HS1, HS3, HS4, HS5	4	Flat washer #6 (steel)		
X1 at HS1, HS3, HS4, HS5	4	Nylon shoulder washer #6	Keystone	3122
X1 at HS1, HS3, HS4, HS5	4	Pan head screw #6-32X7/16 (steel)		
Mother Board	1	PCB	Any	HPA114

- NOTES: (1) These assemblies are ESD sensitive, ESD precautions shall be observed.
(2) These assemblies must be clean and free from flux and all contaminants. Use of no clean flux is not acceptable.
(3) These assemblies must comply with workmanship standards IPC-A-610 Class 2.
(4) Reference designators marked with an asterisk (**) cannot be substituted. All other components can be substituted with equivalent MFG's components.

Table 2. HPA115 Daughter Board List of Materials

REFERENCE	QTY	DESCRIPTION	MANUFACTURER	PART NUMBER
C1	1	Capacitor, ceramic, 390 pF, 50 V, X7R, 10%, 0805	Panasonic	ECU-V1H391KBN
C2	1	Capacitor, ceramic, 2.2 nF, 50 V, X7R, 10%, 0805	Panasonic	ECJ-2VB1H222K
C3, C6	2	Capacitor, ceramic, 10 nF, 50 V, X7R, 10%, 0805	Panasonic	ECJ-2VB1H103K
C4, C11	2	Capacitor, ceramic, 100 pF, 50 V, X7R, 10%, 0805	Panasonic	ECJ-2VC1H101J
C5	1	Capacitor, ceramic, 2.2 μ F, 16 V, X7R, 10%, 1206	muRata	ECJ-3YB1C225K
C7	1	Capacitor, ceramic, 1 μ F, 50 V, X7R, 10%, 1206	Panasonic	ECJ-3YB1E105K
C8	1	Capacitor, ceramic, 150 nF, 50 V, X7R, 10%, 0805	Panasonic	ECJ-2YB1E154K
C9	1	Capacitor, aluminum, 100 μ F, 25 V, 20% (FC Series), 0.2	Panasonic	EEU-FC1E101S
C10	1	Capacitor, ceramic, 0.1 μ F, 50 V, X7R, 10%, 0805	Panasonic	ECJ-2YB1H104K
C12	1	Capacitor, ceramic, 1.5 μ F, 16 V, X7R, 10%, 1206	Panasonic	ECJ-3YB1C155K
C13	1	Capacitor, ceramic, 56 pF, 50 V, X7R, 10%, 0805	Panasonic	ECJ-2VC1H560J
C14	1	Capacitor, ceramic, 330 pF, 50 V, X7R, 10%, 0805	Yageo America	08052R331K9B20D
D1, D2, D3, D4	4	Diode, schottky, 500 mA, 25 V, SMA	Vishay Telefunken	BYS10-25
J1	1	Header, right angle 100 mil, 12 pin , 0.495 x 1,200	Hirose Electronic	DF11-28DP-2DS(22)
Q1	1	Bipolar, NPN, SOT23	Vishay Telefunken	MMBT2222A
R1, R11	2	Resistor, chip, 1.5 k Ω , 1/10 W, 1%, 0805	Panasonic	ERJ-6ENF1501V
R2	1	Resistor, chip, 47 Ω , 1/10 W, 1%, 0805	std	std
R3, R7	2	Resistor, chip, 3.92 k Ω , 1/10 W, 1%, 0805	Panasonic	ERJ-6ENF3921V
R4, R5	2	Resistor, chip, 390 k Ω , 1/2 W, 1%, 2010	Std	Std
R6	1	Resistor, chip, 10 k Ω , 1/10 W, 1%, 0805	Panasonic	ERJ-6ENF1002V
R8	1	Resistor, chip, 7.5 k Ω , 1/10 W, 1%, 0805	Panasonic	ERJ-6ENF7501V
R9	1	Resistor, chip, 30.1 k Ω , 1/10 W, 1%, 0805	Panasonic	ERJ-6ENF3012V
R10, R13	2	Resistor, chip, 10 Ω , 1/4 W, 1%, 1210	Panasonic	ERJ-14NF10R0U
R12, R18, R21	3	Resistor, chip, 1 k Ω , 1/10 W, 1%, 0805	Panasonic	ERJ-6ENF1001V
R14	1	Resistor, chip, 316 k Ω , 1/10 W, 1%, 0805	Std	Std
R15	1	Resistor, chip, 48.7 k Ω , 1/10 W, 1%, 0805	Panasonic	ERJ-6ENF4872V
R16	1	Resistor, chip, 22.1 k Ω , 1/4 W, 1%, 1210	Panasonic	ERJ-14NF2212U
R17, R20	2	Resistor, chip, 562 k Ω , 1/4 W, 1%, 1210	Panasonic	ERJ-8ENF5623V
R19	1	Resistor, chip, 9.09 k Ω , 1/10 W, 1%, 0805	Std	Std
R22	1	Resistor, chip, 100 Ω , 1/10 W, 1%, 0805	std	std
R23	1	Resistor, chip, 15 k Ω , 1/10 W, 1%, 0805	std	std
TP1, TP2	0	Jack, test point, Clr,	Farnell	240-3xx
U1	1	IC, Bi CMOS PFC\PWM Controller, 273600	TI	UCC28521DW

- NOTES: (1) These assemblies are ESD sensitive, ESD precautions shall be observed.
 (2) These assemblies must be clean and free from flux and all contaminants. Use of no clean flux is not acceptable.
 (3) These assemblies must comply with workmanship standards IPC-A-610 Class 2.
 (4) Ref designators marked with an asterisk (***) cannot be substituted. All other components can be substituted with equivalent MFG's components.

5 Reference Design Layout

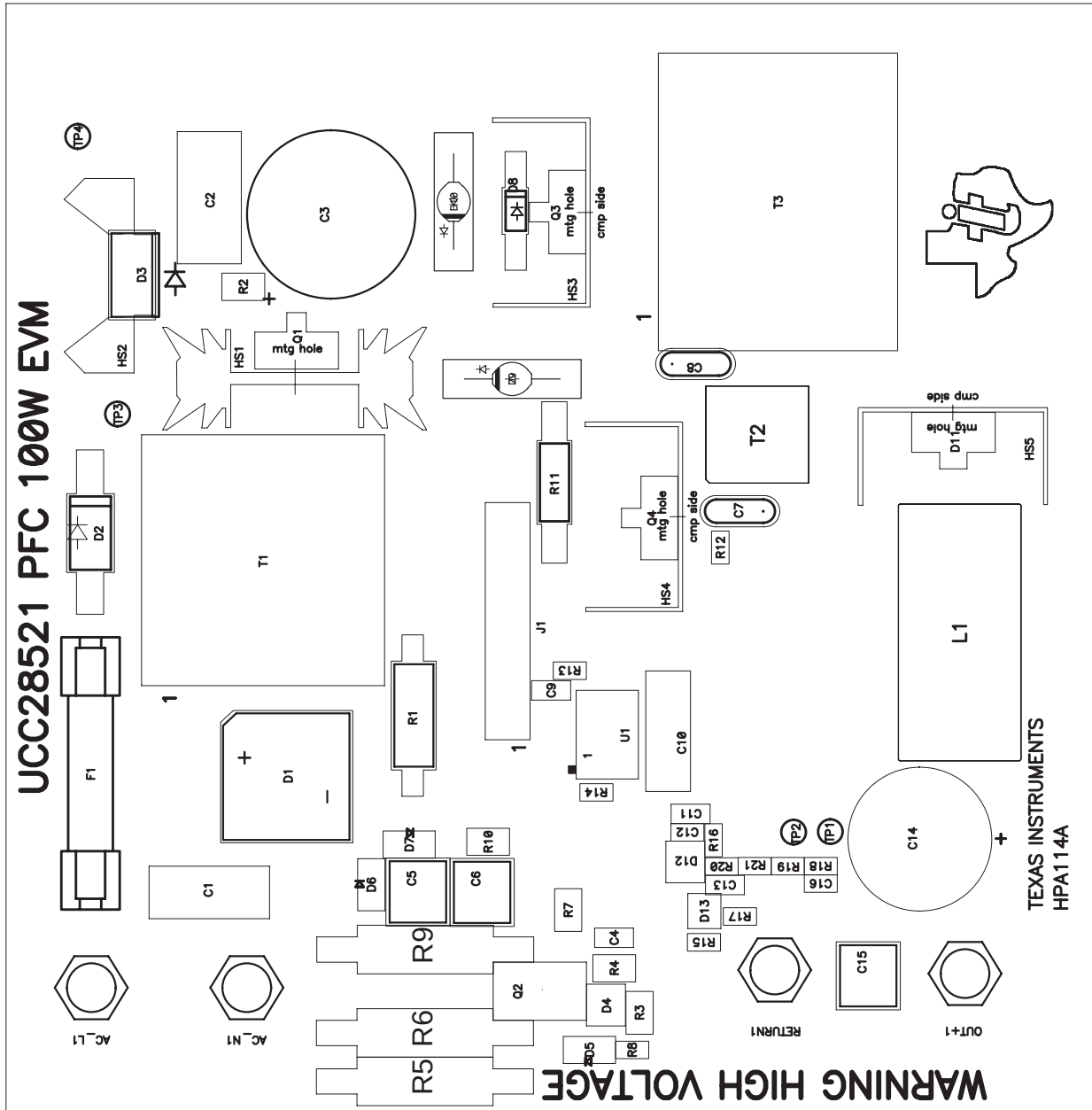
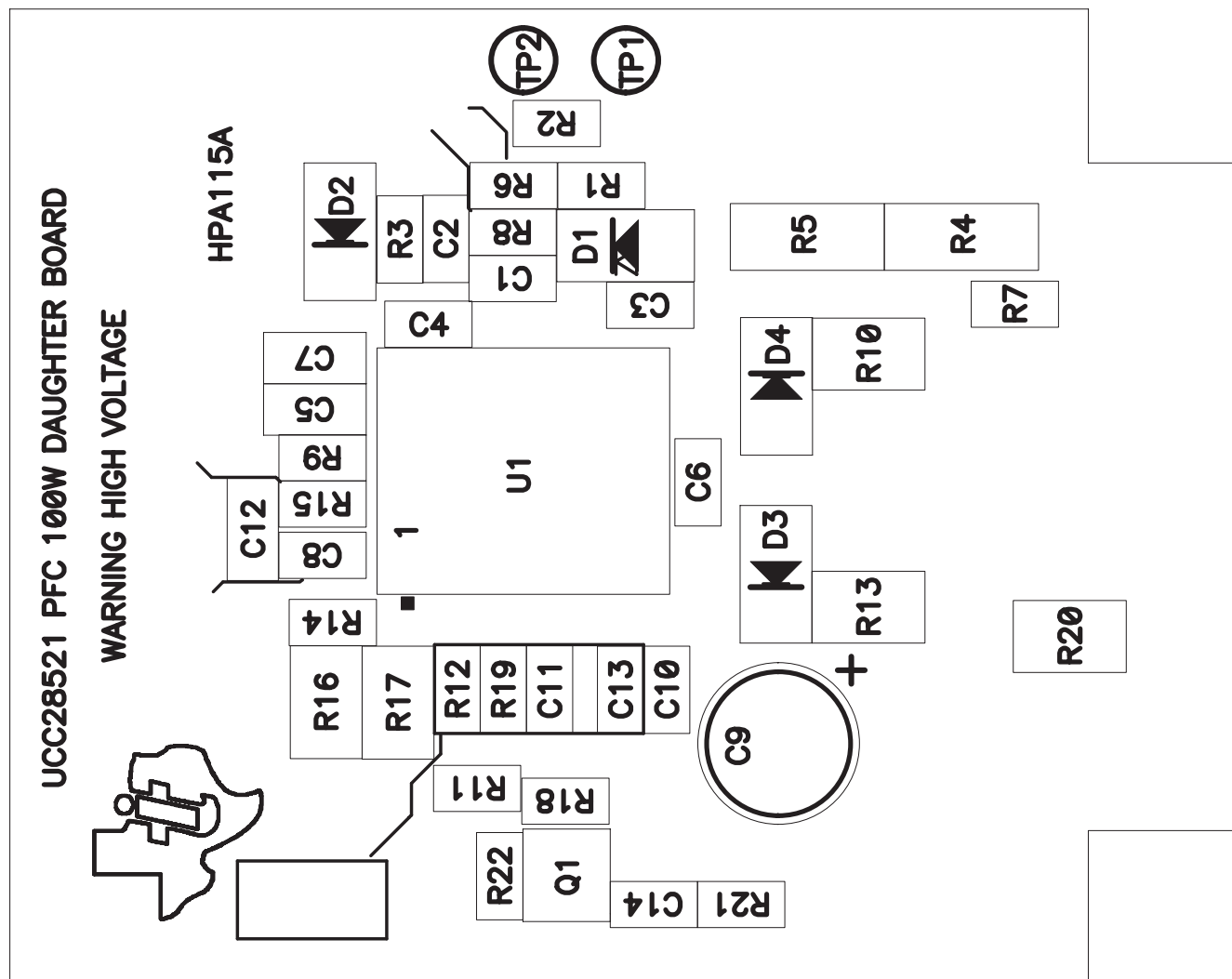


Figure 4. Mother Board



NOTE: R23 can be found on the back of the daughter board.

Figure 5. Daughter Board

6 Electrical Characteristics

	MIN	TYP	MAX	UNITS
V_{IN}	85		265	V_{RMS}
Output	11.4	12	12.6	V
P_{OUT}	10		100	W
Output Ripple A			500	mV

7 Reference Design Performance

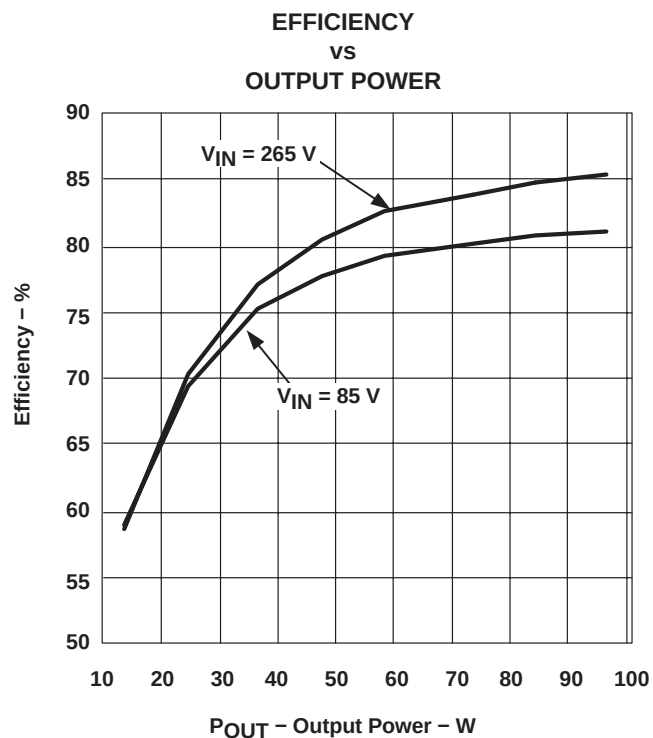


Figure 6

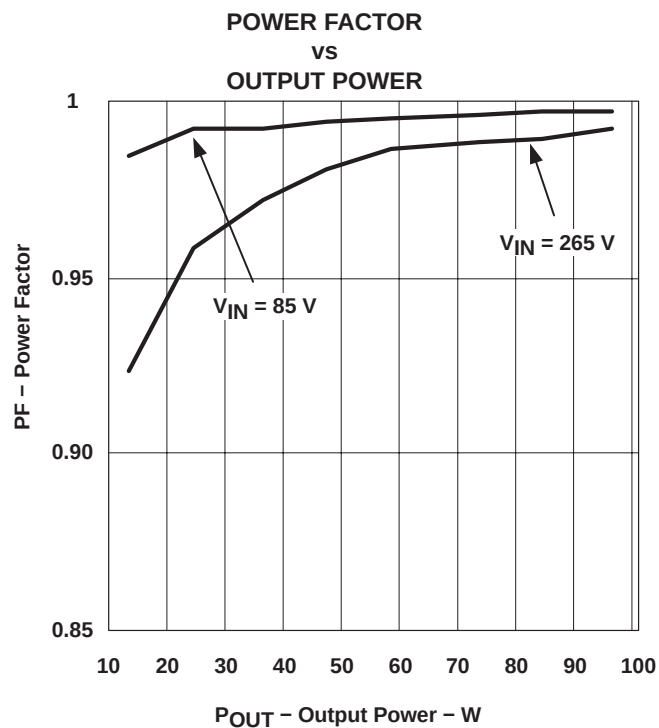


Figure 7

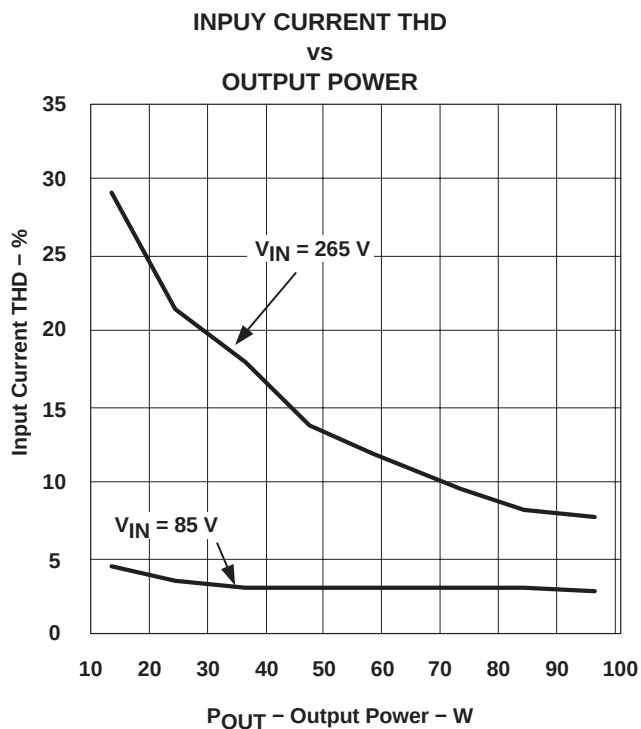


Figure 8

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