50-W Push-Pull Converter Reference Design Using the UCC38083 (PR100B)

Reference Design

50-W Push-Pull Converter Reference Design Using the UCC38083 (PR100B)

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Contents

1 Introduction

The following reference design is a 50-W push-pull converter using the UCC38083, a current-mode controlled PWM with programmable slope compensation. This design controls a push-pull synchronous rectified topology which generates 15 A of current at 3.3 V from 24-V nominal input voltage. The module is designed to operate at a range between 18.5 V and 35 V and provides a 3.3 V_{DC} regulated output. The operating frequency is 200 kHz.

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. Serious injury can occur if proper safety precautions are not followed.

3 Schematic

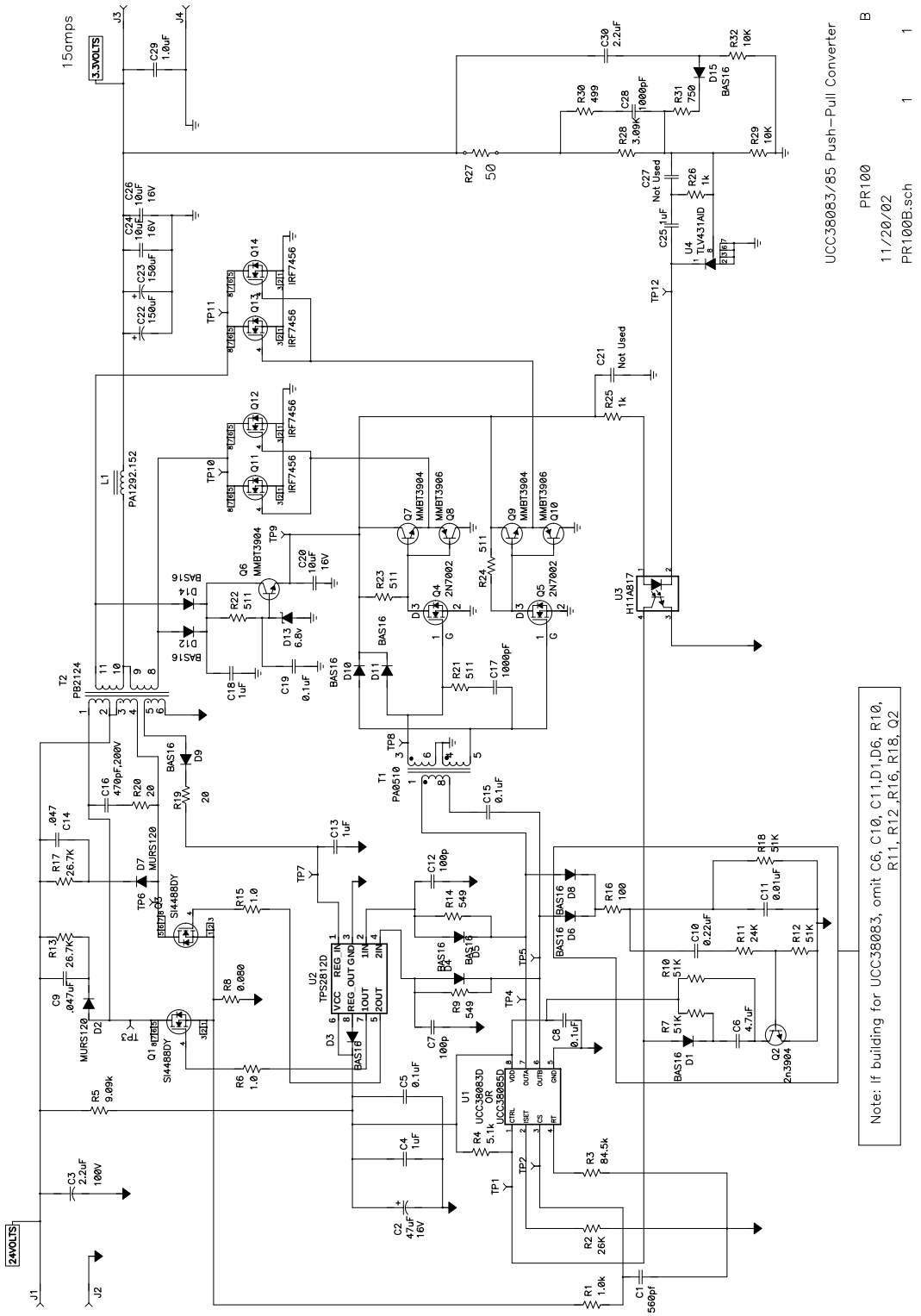

Figure 1. Reference Design Schematic

4 List of Materials

	Reference	Qty	Description	Manufacturer	Part Number
Capacitor	C1	1	Ceramic, 560 pF, 50 V, X7R, 0603	Yageo America	06032R561K9B20D
	C2	1	Aluminum, 47 μF, 16 V, 20%, HA Series, 0.335 x 0.374	Panasonic	EEV–HA1C470P
	C3	1	Ceramic, 2.2 μF, 100 V, ST3827	ITW Pakrton	225K100ST3827
	C4	1	Ceramic, 1.0 μF 16 V, X7R, 1206	Panasonic	12062R105K7BB0D
	C5, C8, C19	3	Ceramic, 0.1 μF 50 V, X7R, 0805	Panasonic	ECJ–2YB1H104K
	C6	1	Ceramic, 4.7 μF 16 V, X5R, 1206	Kemet	C1206C475K4PACT
	C7, C12	2	Ceramic, 100 pF 50 V, NPO, 0603	Yageo America	0603CG101J9B200
	C9, C14	1	Ceramic, 47000 pF 50 V, X7R, 1206	muRata	C1206C473K5RACTU
	C10	1	Ceramic, .22 μF, 25 V, X7R, 0805	Panasonic	ECJ–2YB1E224K
	C11	1	Ceramic, 0.01 μF, 25 V, X7R, 0603	TDK	C1608X7R1H103K
	C13, C18, C25	3	Ceramic, 1.0 μF, 16 V, X7R, 0805	TDK	C2012X7R1C105J
	C15	1	Ceramic, .1 μF, 16 V, X7R, 10%, 0603	muRata	GRM39X7R104K16A
	C16	1	Ceramic, 470 pF 200 V, X7R, 0805	Panasonic	ECJ–2VB2D471K
	C17	1	Ceramic, 1000 pF 50 V, X7R, 0603	Yageo America	06032R102K9B20D
	C21, C27	2	0805		
	C28	1	Ceramic, 1000 pF, 50 V, COG, 0805	Kemet	C0805C102J5GAC
	C29	1	Ceramic, 1.0 μF 10 V, X7R, 0805	Kemet	C0805C105K8RACTU
	C30	1	Ceramic, .2 μF 6.3 V, X5R, 0805	Panasonic	ECJ–2YB0J225K
	C20, C24, C26	3	Ceramic, 10 μF, 16 V, X5R, 1210	Taiyo Yuden	EMK325BJ106MN
	C22, C23	2	POSCAP, 150 μF, 6.3 V, 55 mΩ, 20%, 7343 (D)	Sanyo	6TPB150ML
Diode	D2, D7	2	UltraFast rectifier, 1 A, 200 V, SMB	On Semi	MURS120T3
	D1, D3, D4, D5, D6, D8, D9, D10, D11, D12, D14, D15	12	Switching, 10 mA, 85 V, 350 mW, SOT23	Vishay–Liteon	BAS16
	D13	1	ZENER, 6.8 V, 350 MW, SOT23	Diodes, Inc.	BZX84C6V8–7
Connector	J1, J2, J3, J4	4	Banana jack, uninsulated, 0.500 dia”	Pomona	3267
Inductor	L1	1	SMT, 1.5 μH, 21 A, 0.78 mΩ, 0.770x0.780	Pulse	PA1292.152
MOSFET	Q1, Q3	2	N–channel, 150 V, 5 A, 50 mΩ, SO8	Vishay–Siliconix	SI4488DY
	Q2, Q6, Q7, Q9	4	TRANS GP, NPN, 40 V, 0.2 A, SOT23	Fairchild	MMBT3904FS
	Q4, Q5	2	N–channel, 60 V 7.5 Ω , SOT23	Fairchild	2N7002
	Q8, 10	2	Bipolar, PNP, –40 V, –200 mA, SOT23	Fairchild	MMBT3906
	Q11, Q12, Q13, Q14	4	N–channel, 20 V, 16 A, 6.5 mΩ, SO8	International Rectifier	IRF7456

	Reference	Qty	Description	Manufacturer	Part Number
Resistor	R1, R25, R26	3	Chip, 1.0 kΩ, 1/16 W, 1%, 0603	Std	Std
	R2	1	Chip, 26 kΩ, 1/16 W, 1%, 0603	Std	Std
	R3	1	Chip, 84.5 kΩ, 1/16 W, 1%, 0603	Std	Std
	R4	1	Chip, 5.1 kΩ, 1/16 W, 1%, 0603	Std	Std
	R5	1	Chip, 9.09 kΩ, 1/8 W, 1%, 1206	Std	Std
	R6, R15	2	Chip, 1.0 Ω, 1/10 W, 1%, 0805	Std	Std
	R7, R10, R12, R18	4	Chip, 51 kΩ, 1/16 W, yy%, 0603	Std	Std
	R8	1	Chip, 0.08 Ω, 1 W, 1%, 2512	Dale	WSL–2512 .08 1%
	R9,14	2	Chip, 549 Ω, 1/16 W, 1%, 0603	Std	Std
	R11	1	Chip, 24 kΩ, 1/16 W, 1%, 0603	Std	Std
	R13,17	2	Chip, 26.7 kΩ, 1 W, 1%, 2512	Dale	CRCW25122672F
	R16	1	Chip, 100 Ω, 1/16 W, yy%, 0603	Std	Std
	R19	1	Chip, 20 Ω, 1/16 W, 1%, 0603	Std	Std
	R20	1	Chip, 20 Ω, 1/8 W, 1%, 1206	Std	Std
	R21, R22, R23, R24	4	Chip, 511 Ω, 1/16 W, 1%, 0603	Std	Std
	R27	1	Socket pins, 0.020–0.032 pins (Qty: 2)”, 0.1 x 0.5	Mill–Max	0338–0–15–01–15–14 –10–0
	R28	1	Chip, 3.09 kΩ, 1/16 W, 1%, 0603	Std	Std
	R29	1	Chip, 1.87 kΩ, 1/16 W, 1%, 0603	Std	Std
	R30	1	Chip, 499 Ω, 1/10 W, 1%, 0805	Std	Std
	R31	1	Chip, 750 Ω, 1/16 W, 1%, 0603	Std	Std
	R32	1	Chip, 10 kΩ, 1/10 W, 1%, 0805	Std	Std
Transformer	T1	1	Gate drive, 3950 μH, 1500 V_{DC} isolation, 0.340 x 0355	Pulse	P0544
	T2	1	3 primary, 2 secondary push pull, 1160 x 1524	GCI	PB2124
Test Point	TP1–TP12	12	O.050” Hole	None	
IC	U1*	1	Current mode push-pull PWM with programmable slope compensation, SO8	Texas Instruments	UCC38085D
	U1*	1	Current mode push-pull PWM with programmable slope compensation, SO8	Texas Instruments	UCC38083D
	U2	1	MOSFET driver, dual channel buffer with regulator, SO8	Texas Instruments	TPS2812D
	U3	1	Optocoupler, 5300 V, 50% to 600% CTR, 0.380 x 0.180	QT Optoelectronics	H11A817
	U4	1	Adj shunt regulator, 100 mA, 36 V, SO8	Texas Instruments	TLV431AID

NOTE 1: If building for UCC38083, omit C6, C10, C11, D1,D6, D8, R10, R11, R12 ,R16, R18, Q2 and install UCC38083 for U1.
NOTE 2: If building for UCC38085, include C6, C10, C11, D1,D6, D8, R10, R11, R12 ,R16, R18, Q2 and install UCC38085 for U1.

5 Reference Design Layout

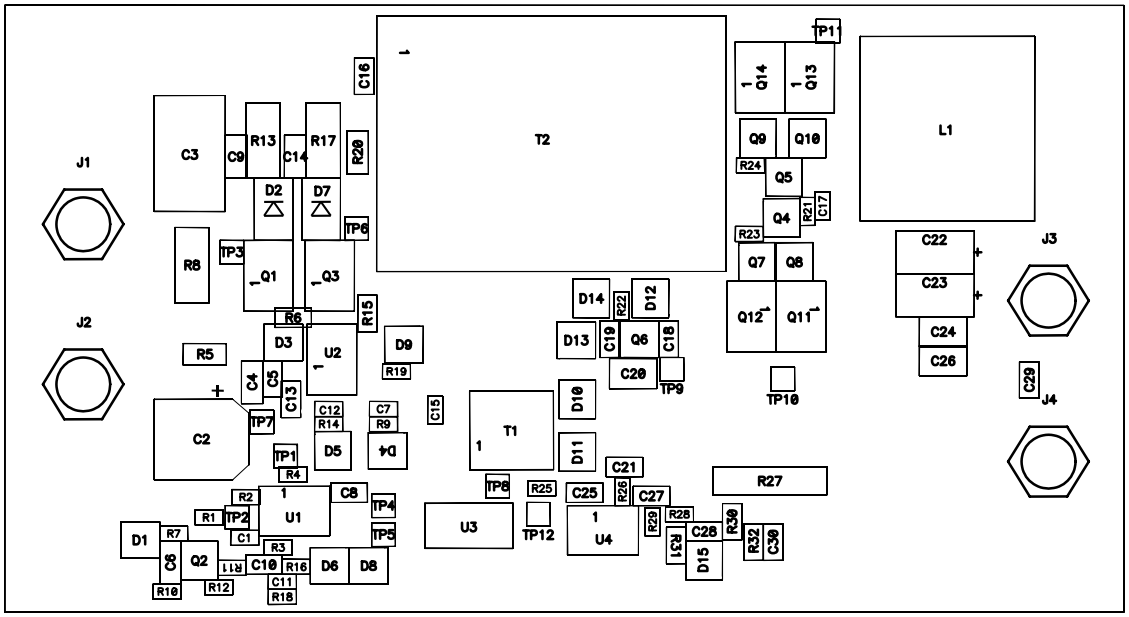

Figure 2. Reference Design Layout

6 Electrical Characteristics

T_A = 0°C to 70°C. All voltages are with respect to load ground unless otherwise indicated.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}, input voltage		18	24	35	V
V_{OUT}, output voltage		3.25	3.3	3.5	
P_{OUT}, output power		0	25	50	W
Turn-on overshoot voltage				0	V
Efficiency	V_{IN} = 24 V, I_{LOAD} = 10 A		88.5%		
	V_{IN} = 24 V, I_{LOAD} = 15 A		86.3%		

7 Reference Design Performance

The following figures illustrate this reference design's performance.

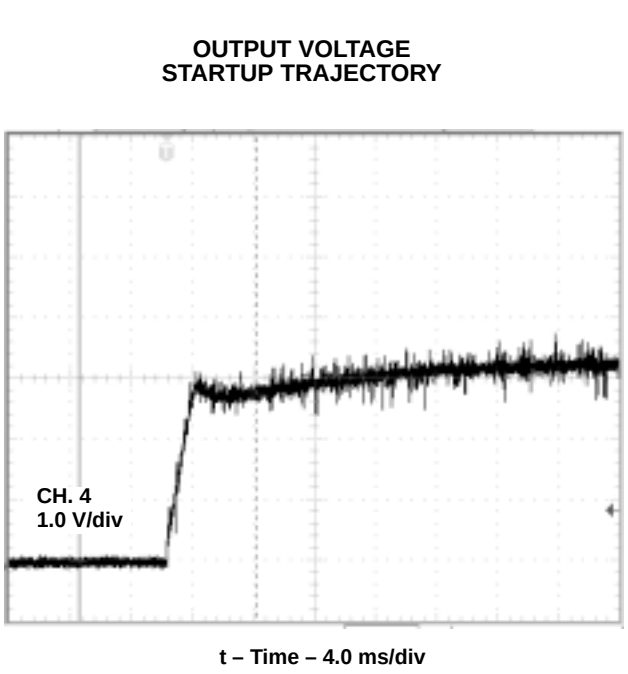

Figure 3

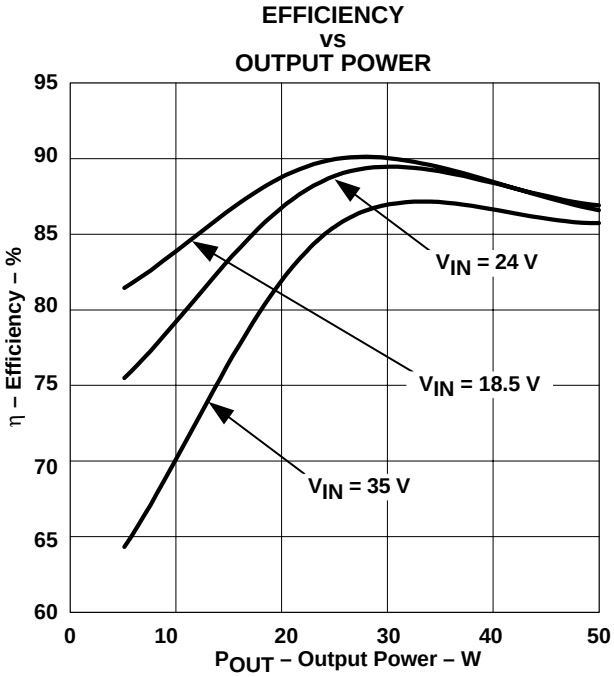

Figure 4

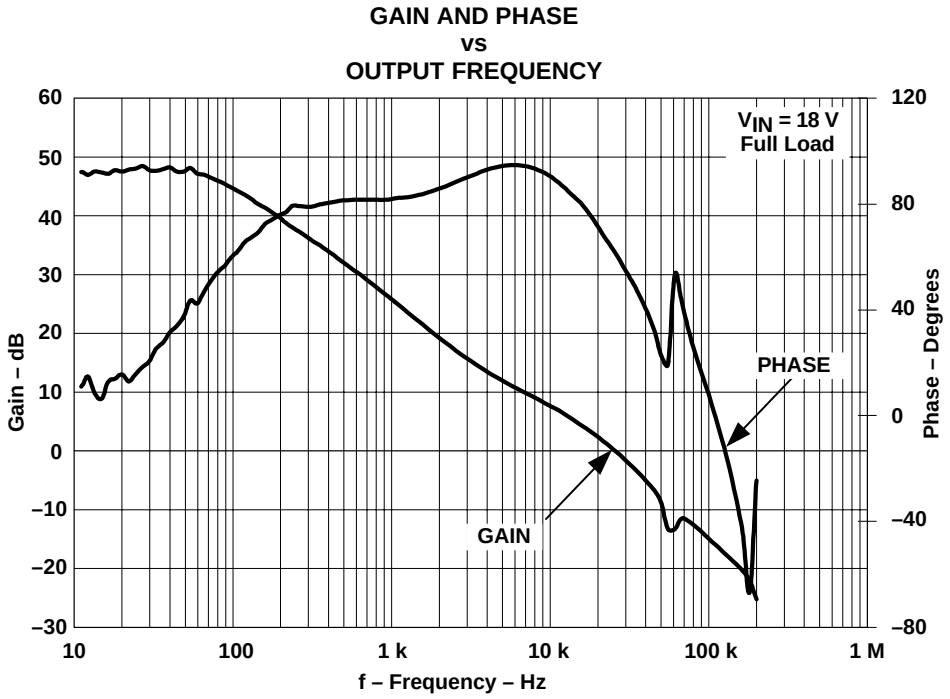

Figure 5. Phase and Gain Response

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