



ON Semiconductor

NCP1340+NCP43080 5.25V8A

Device	Application	Input Voltage	Output Power	Topology	I/O Isolation
NCP1340B3 NCP43080D	Smart phone charger	90 Vac to 264 Vac	42W	Flyback	Isolated (3 kV)

Output Specification	
Output Voltage	5.25V
Nominal Current	8A
Max Current	8A
Min Current	zero

Avg. Efficiency	>91% at 115Vac and 230Vac
Standby Power	<30mW
Ripple	<100mV
Protection	OCP, SCP, Open Loop, OTP
Power Density	1.25W/cm ³
Size	40mmx40mmx21mm

Circuit Description

This design note describes a 42 watt, universal AC input, constant voltage power supply intended for smart phone charger, where isolation from the AC mains is required, and low cost, high efficiency, and low standby power are essential.

The featured power supply is a simple QR flyback topology utilizing ON Semiconductor's NCP1340B3 HF PWM controller, NCP43080D synchronous rectified controller. This Design Note provides the complete circuit schematic details, PCB and BOM for 42W NCP1340+NCP43080 5.25V8A solution which supports 5.25V8A output. The NCP1340B3 is used as an error amplifier provides for excellent line and load regulation with high input-to-output safety isolation.

Performance characteristics for efficiency, output ripple, Startup and Rise time, Drain Voltage, OCP, Synchronic drive, Primary & Secondary MOSFET drain voltage, Transient

Response Test and Thermal Image are shown in the figures and plots below.

Key Features

- Universal AC input range (90 – 264 Vac)
- Very low standby power consumption
- Very low ripple and noise
- Inherent SCP and OCP protection
- Adjustable Overpower Protection
- High power density (1.25 W/cm³)
- Built in 4ms soft start
- Quasi-Resonant current mode control with Valley Switching
- Valley lockout avoids audible noise at valley jumping operation
- Fixed or Adjustable Maximum Frequency Clamp
- Frequency Jittering for Reduced EMI Signature
- Output OCP, SCP, controller OTP function
- Abnormal Overcurrent Fault Protection for Winding Short Circuit or saturation Detection
- Provide open loop protection
- Brown out detection
- Board size: 40mmx40mmx21mm

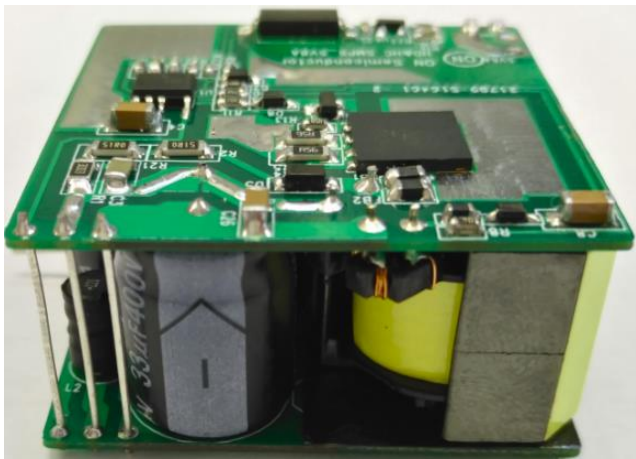


Figure 1, Side view of demoboard



Figure 2, Side view of demoboard

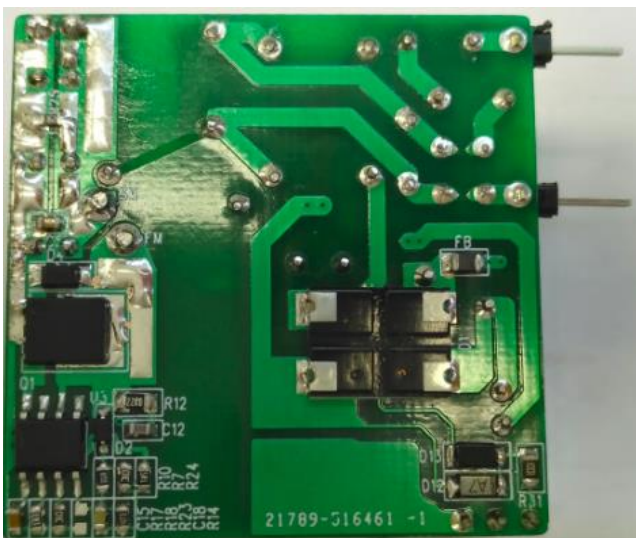


Figure 3, Bottom view of demoboard



Figure 4, Bottom view of demoboard

Circuit Schematic

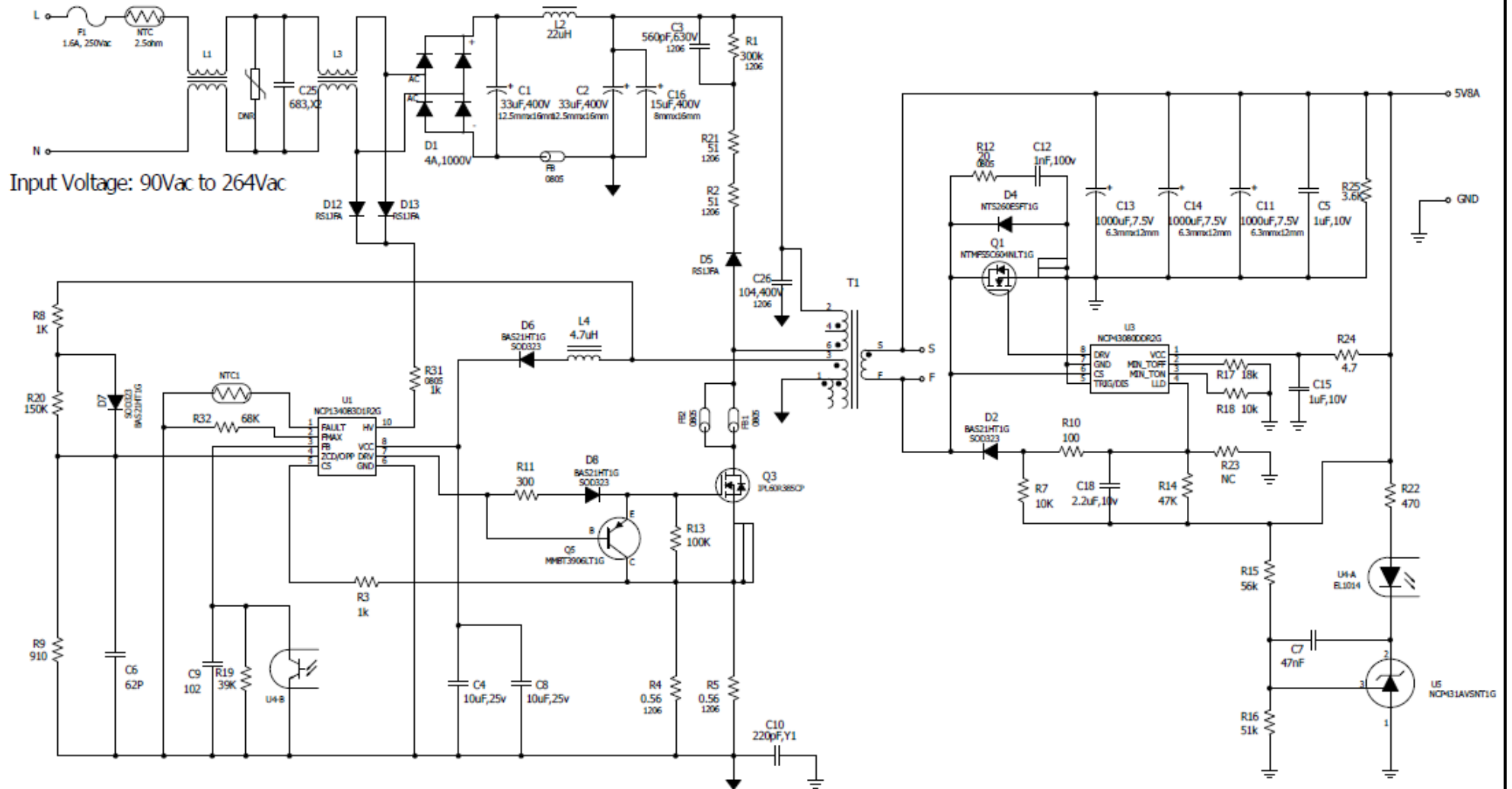


Figure 5, Schematic

DN05101/D PCB

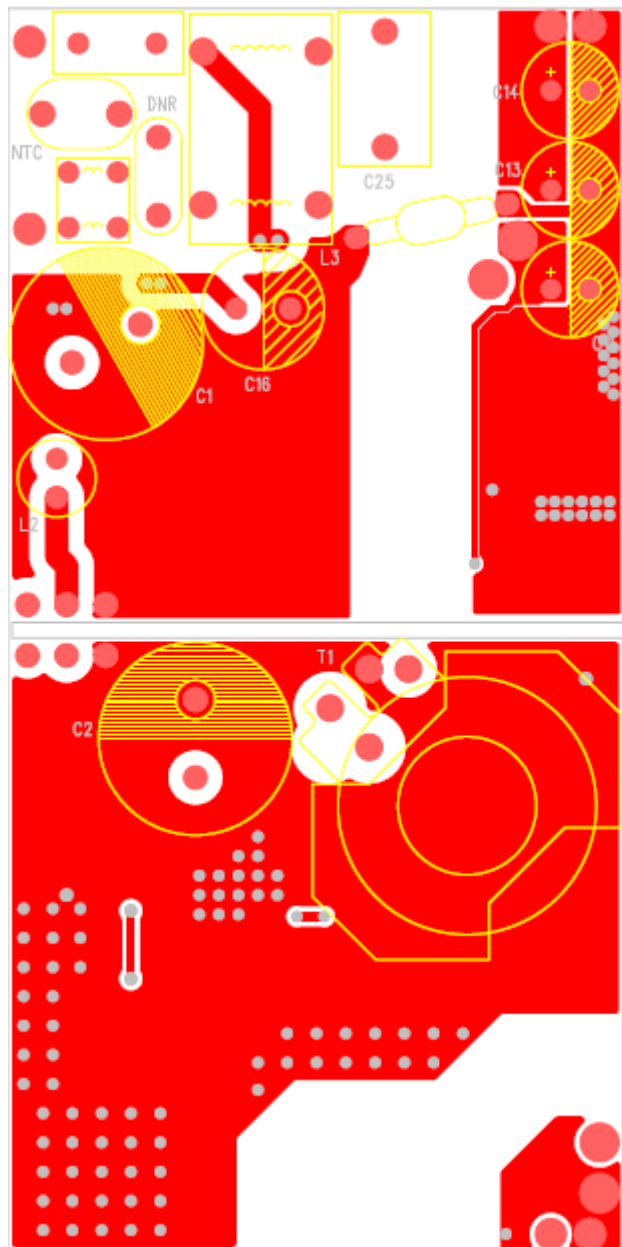


Figure 6, Top View of NCP1340+NCP43080_5V8A's PCB

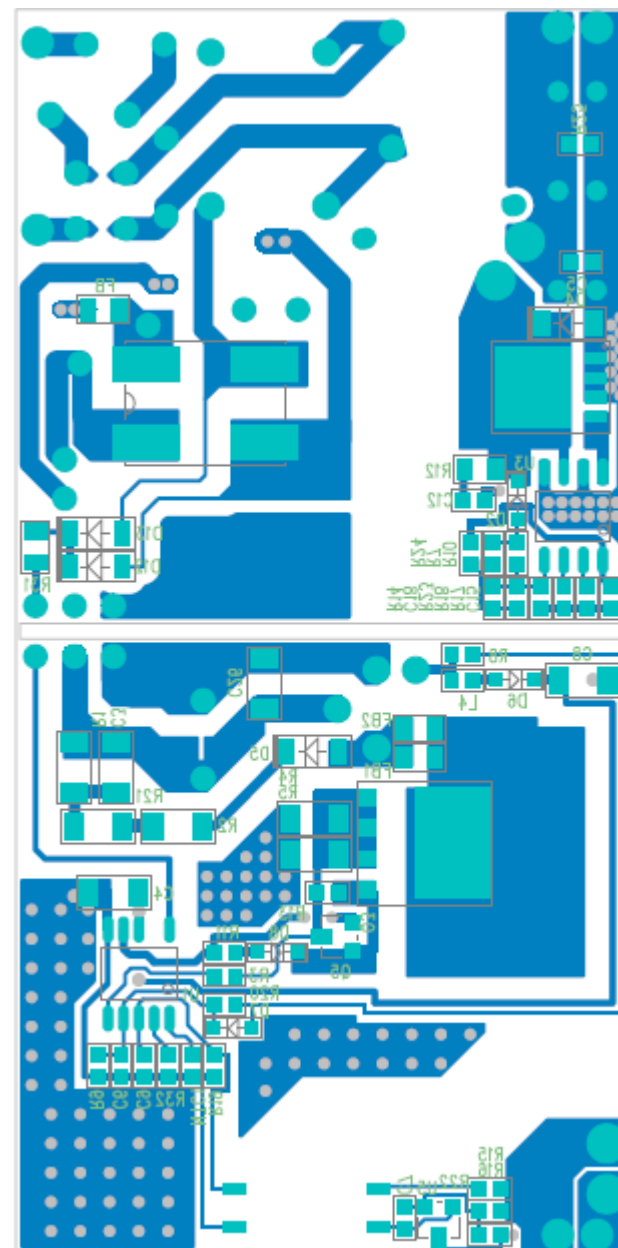


Figure 7, Bottom View of NCP1340+NCP43080_5V8A's PCB

T1 Transformer Designs (Available from Wurth Electronics)

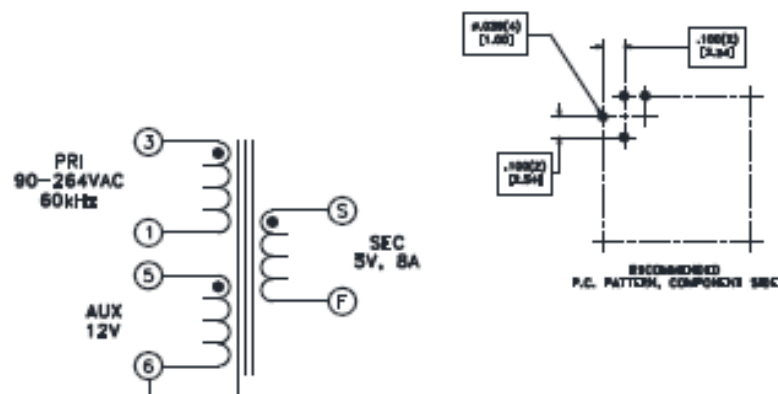
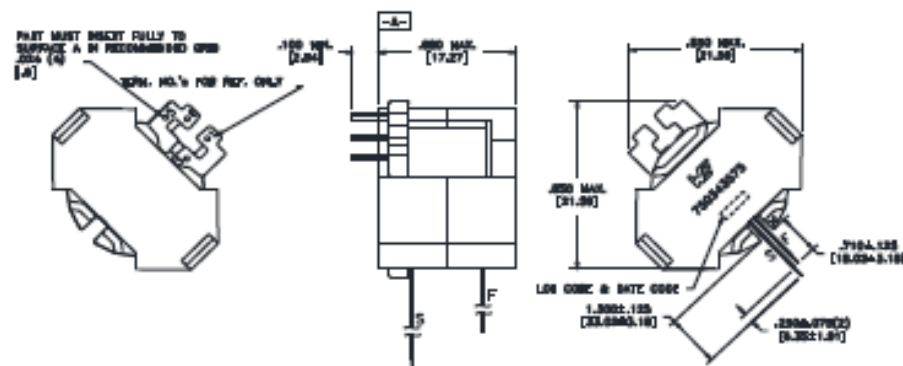
CUSTOMER TERMINAL	RoHS	LEAD(Pb)-FREE
Sn 98%, Ag 4%	Yes	Yes

more than you expect



ELECTRICAL SPECIFICATIONS @ 25°C unless otherwise noted:

PARAMETER	TEST CONDITIONS	VALUE
D.C. RESISTANCE	3-1 @ 20°C	0.437 ohms max.
D.C. RESISTANCE	3-F @ 20°C	0.010 ohms max.
D.C. RESISTANCE	5-6 @ 20°C	0.262 ohms max.
INDUCTANCE	3-1 10kHz, 1.0V, Ls	360.00µH ±10%
LEAKAGE INDUCTANCE	3-1 tie(3-F+5+6), 100kHz, 1.0V, Ls	10.0µH max.
DIELECTRIC	1-3 tie(1+5), 3750VAC, 1 second	3000VAC, 1 minute
URNS RATIO	(3-1):(3-F)	12.67:1, ±2%
URNS RATIO	(3-1):(5-6)	6.33:1, ±2%



GENERAL SPECIFICATIONS:

OPERATING TEMPERATURE RANGE: -40°C to +125°C including temp rise.

Designed to comply with the following requirements as defined by IEC60050-1,

EN60950-1, UL60950-1/CSA60950-1 and AS/NZS60950.1:

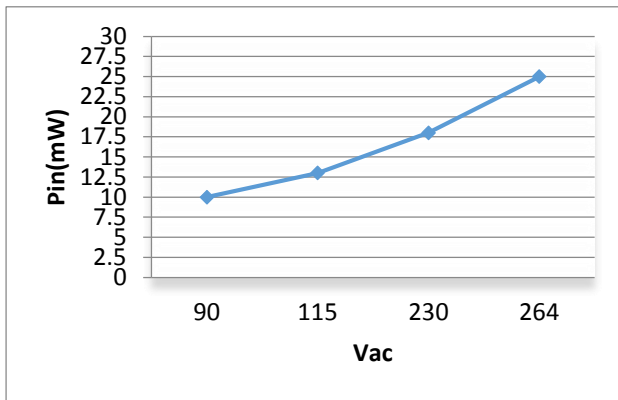
- Reinforced insulation for a primary circuit at a working voltage of 265Vrms, 400Vpeak, Overvoltage Category II.

Wire insulation & RoHS status not affected by wire color. Wire insulation color may vary depending on availability.

DFM	Packaging Specifications	 CONVENTION PLACEMENT	Tolerances unless otherwise specified: Angles: ±1° Decimals: ±.005 [.13] Fractions: ±1/64 Footprint: ±.001 [.03] This drawing is dual dimensioned. Dimensions in brackets are in millimeters.	DRAWING TITLE TRANSFORMER	PART NO. 750343575
DATE	Method: Tray				
ENG	PKG-1137				
REV.	00				
DATE	11/17/2017				

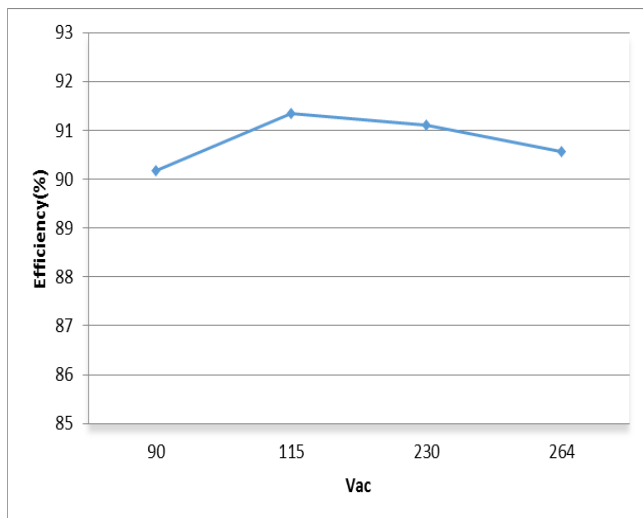
Standby Power at 5V Output (Cable unplug) @ 90 Vac to 264 Vac Input

Test condition: all efficiency are tested at board end



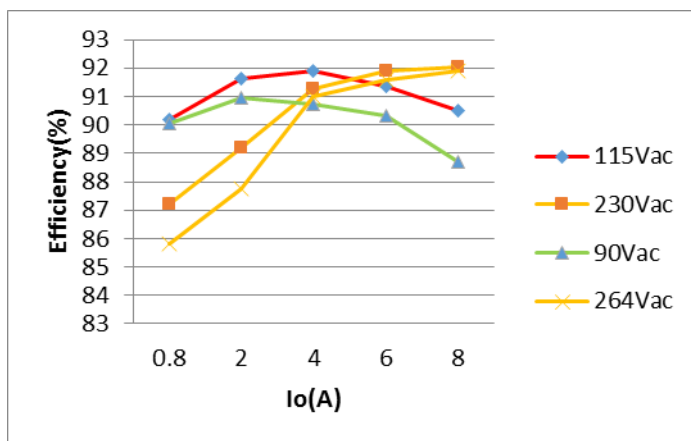
Average Efficiency at 5V Output @ 90 Vac to 264 Vac Input

Test condition: all efficiency are tested at board end

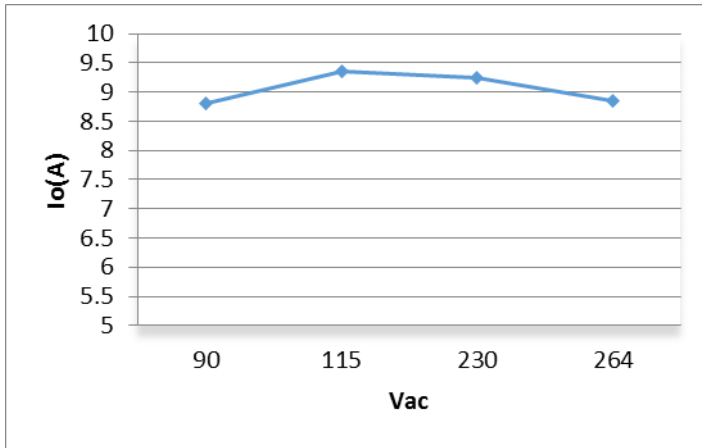


Efficiency Load Curve at 5V Output @ 90 Vac to 264 Vac Input

Test condition: all efficiency are tested at board end

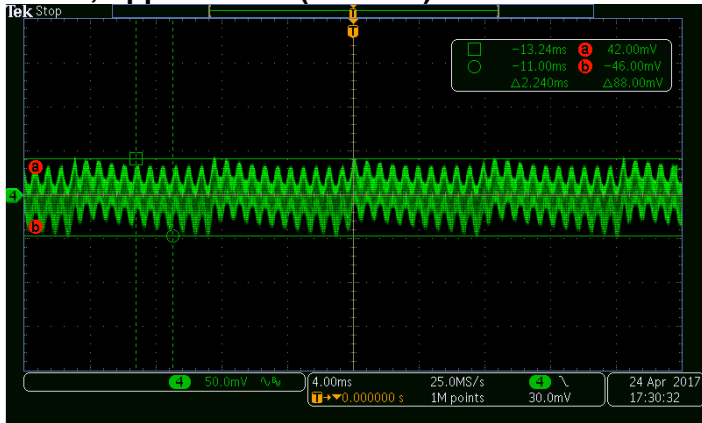


OCV Value @ 90 Vac to 264 Vac Input

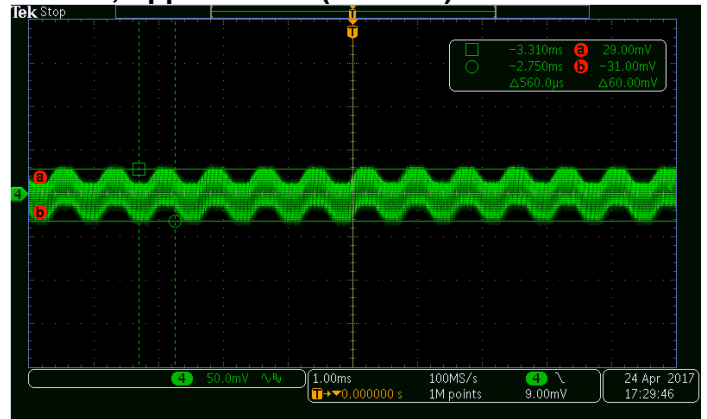


Output Ripple @ 90 Vac to 264 Vac Input, 8A Output

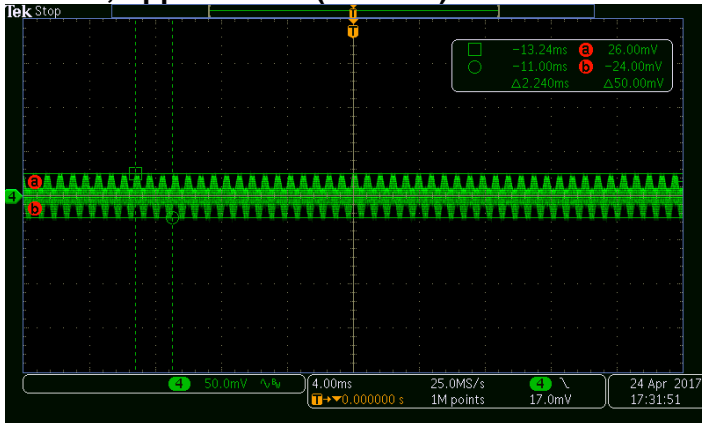
90Vac, ripple: 88 mV (CH4: Vo)



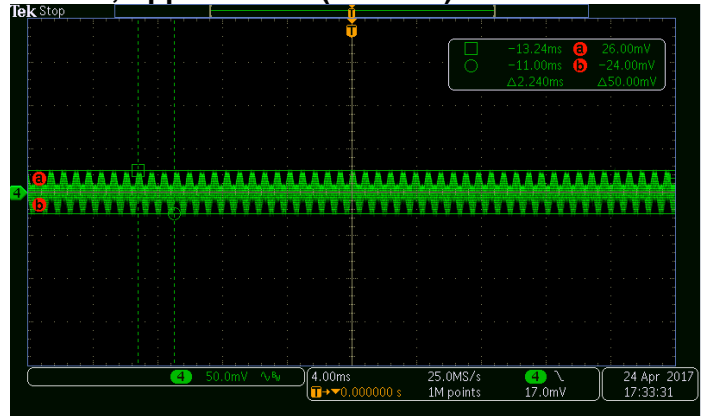
115Vac, ripple: 60 mV (CH4: Vo)



230Vac, ripple: 50 mV (CH4: Vo)

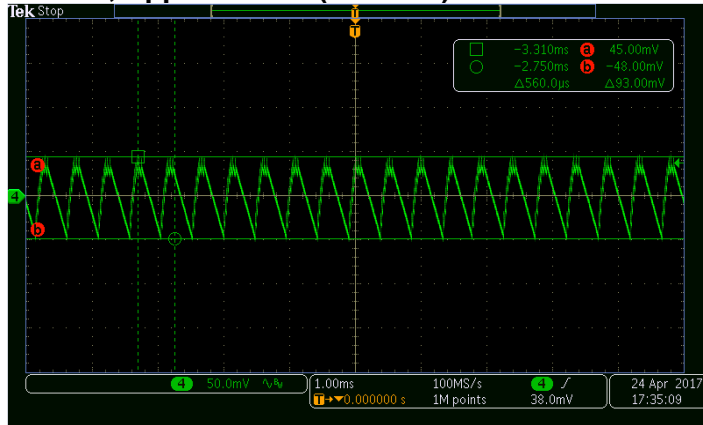


264Vac, ripple: 50 mV (CH4: Vo)



Output Ripple @ 264 Vac Input, 0.8A Output

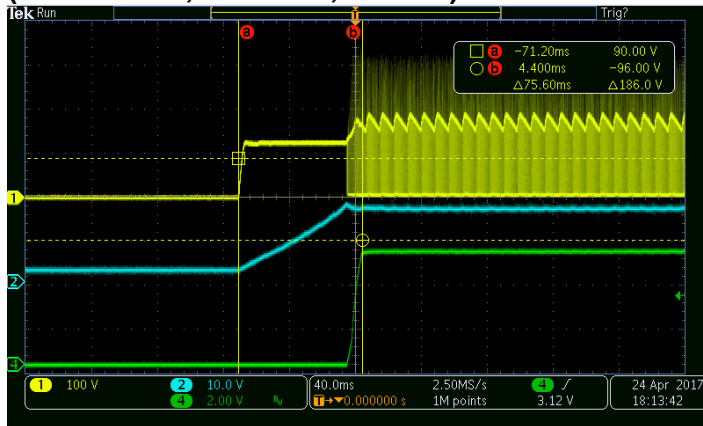
264Vac, ripple: 93 mV (CH4: Vo)



Startup and Rise Time @ 90 Vac Input, 8A Output

Rise Time: 75ms

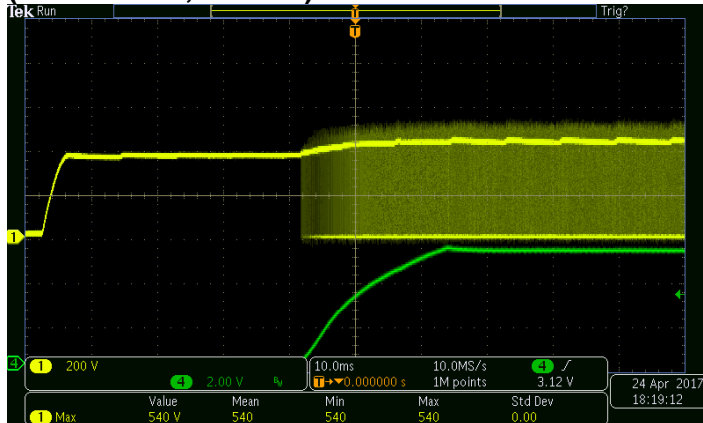
(CH1: Vdrain, CH2: Vcc, CH4: Io)



Drain Voltage @ 264 Vac Input, 8A Output

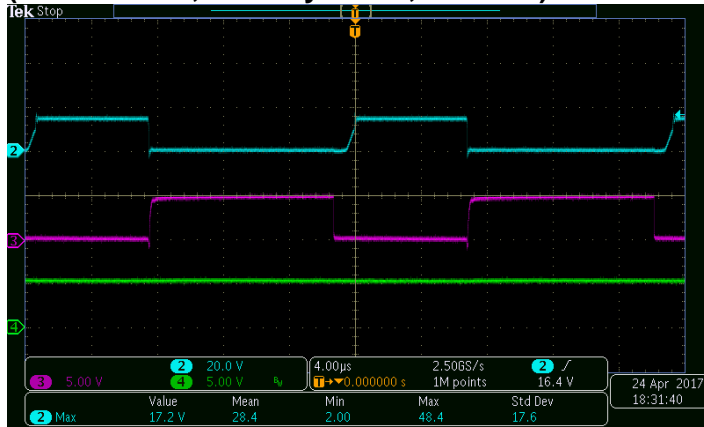
Max Drain Voltage: 540V

(CH2: Vdrain, CH4: Io)



Synchronic Drive @ 90 Vac Input, 8A Output

(CH2: Vtr sec, CH3: Syn DRV, CH4: Vo)



Max Primary MOSFET Voltage @ 264 Vac Input, 8A Output

Max Drain Volyage: 540 V

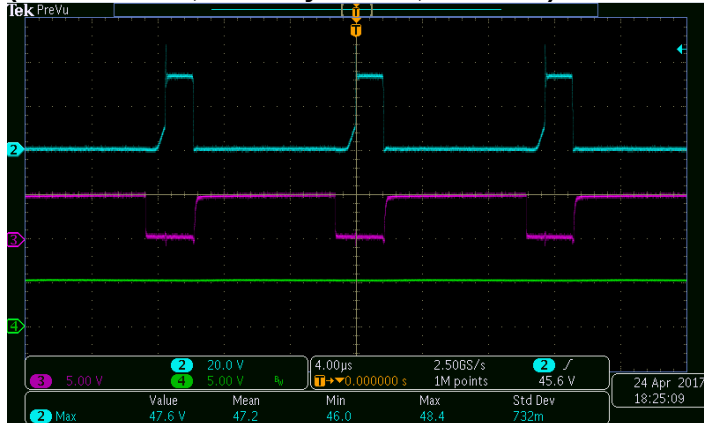
(CH1: Vdrain, CH4: Vo)



Max Synchronic MOSFET Voltage @ 264 Vac Input, 8A Output

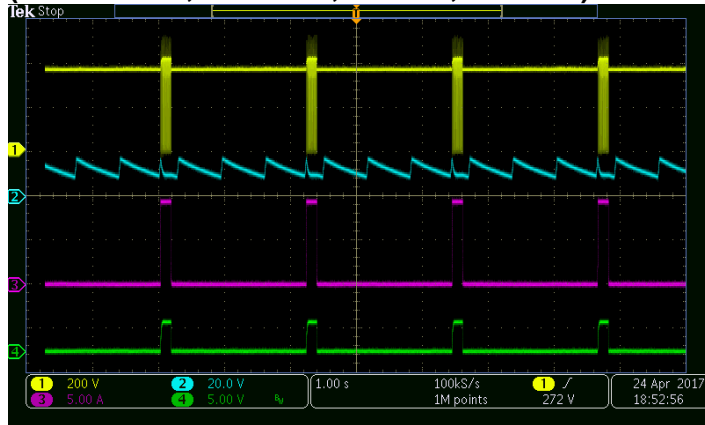
Max Drain Volyage: 48 V

(CH2: Vtr sec, CH3: Syn drive, CH4: Vo)



OCF @ E-load End

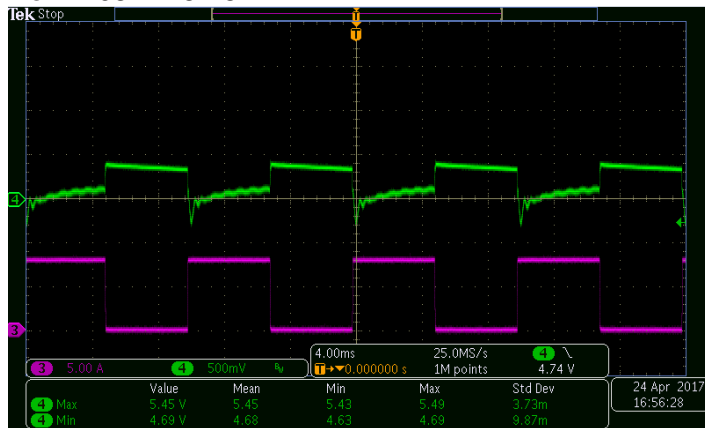
(CH1: Vdrain, CH2: Vcc, CH3: Io, CH4: Vo)



Transient Reponse Test

Test 1 (CH3: Io, CH4: Vo)

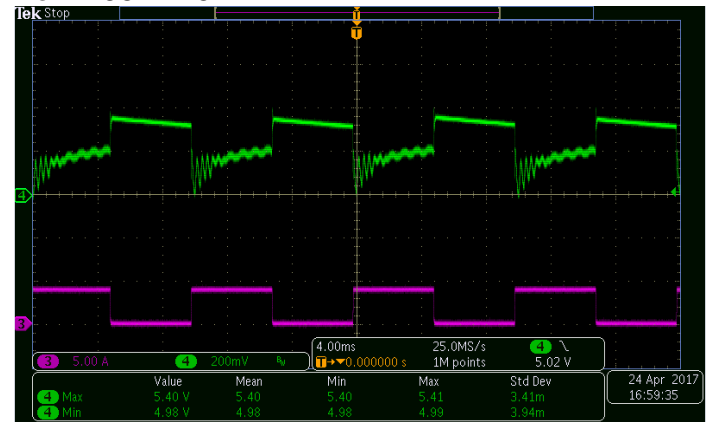
Vo : 4.69V – 5.45V



Test condition: 0-8A, 10ms cycle and 250mA/us, 115Vac

Test 2 (CH3: Io, CH4: Vo)

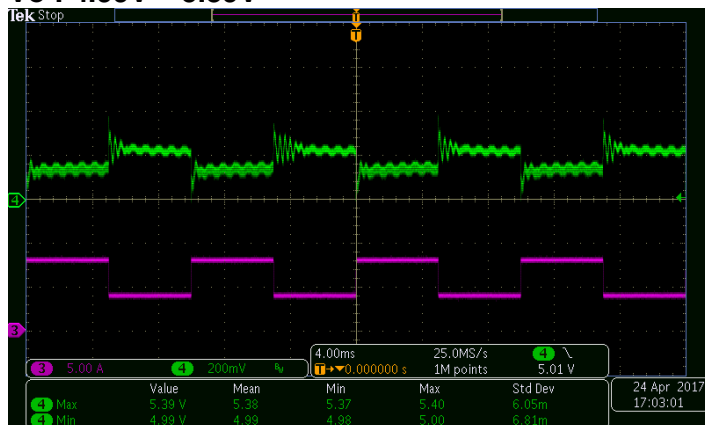
Vo : 4.98 V – 5.4V



Test condition: 0-4A, 10ms cycle and 250mA/us, 115Vac

Test 3 (CH3: Io, CH4: Vo)

Vo : 4.99V – 5.39V



Test condition: 4-8A, 10ms cycle and 250mA/us, 115Vac

Test 4 (CH3: Io, CH4: Vo)

Vo : 4.83V – 5.47V



Test condition: 0.1A-8A, 10ms cycle and 250mA/us, 115Vac

Thermal Image @ 8A Output

Input	Bridge Side	Primary FET side
90 Vac	<p>FLUKE 79.8°C 自动 2 93.7 最大 92.9 最小 23.2 75.9 22.2 $\epsilon=0.95$ BG=22.0 T=100% 12/15/16 12:19:42 PM</p>	<p>FLUKE 80.6°C 自动 2 98.1 最大 99.5 最小 25.0 65.9 24.4 $\epsilon=0.95$ BG=22.0 T=100% 12/15/16 12:20:18 PM</p>
115 Vac	<p>FLUKE 70.5°C 自动 2 85.8 最大 85.4 最小 24.5 70.1 23.4 $\epsilon=0.95$ BG=22.0 T=100% 12/15/16 12:00:31 PM</p>	<p>FLUKE 72.7°C 自动 2 87.0 最大 87.9 最小 24.5 58.8 24.2 $\epsilon=0.95$ BG=22.0 T=100% 12/15/16 12:00:08 PM</p>
230 Vac	<p>FLUKE 64.4°C 自动 1 78.9 最大 78.5 最小 25.5 58.8 23.7 $\epsilon=0.95$ BG=22.0 T=100% 12/15/16 12:43:02 PM</p>	<p>FLUKE 68.1°C 自动 1 79.2 最大 79.0 最小 26.9 57.0 25.7 $\epsilon=0.95$ BG=22.0 T=100% 12/15/16 12:42:49 PM</p>
264 Vac	<p>FLUKE 54.8°C 自动 1 78.7 最大 78.0 最小 25.9 39.3 24.4 $\epsilon=0.95$ BG=22.0 T=100% 12/15/16 01:05:14 PM</p>	<p>FLUKE 67.1°C 自动 2 84.1 最大 83.7 最小 21.6 57.0 21.6 $\epsilon=0.95$ BG=22.0 T=100% 12/15/16 01:05:35 PM</p>

DN05101/D BOM

Item	Qty	Reference	Type	Part Name	MFR	Value	Package	Description
1	1	C10	Ceramic Capacitor	CS65-B2GA221KYNKA	TDK	220pF, Y1	Lead type	HV Ceramic Capacitor, safety standard approved, 10
2	1	C9	Ceramic Capacitor	Std	std	102	603	Capacitor, Ceramic, 50V, 10%
3	1	C26	Ceramic Capacitor	C3216C0G2J561J	TDK	104, 400V	1206	Capacitor, Ceramic, Chip, 5%
4	2	C4 C8	Ceramic Capacitor	C3216X7R1E106K	TDK	10uF, 25v	1206	Capacitor, Ceramic, 25V, 10%
5	1	C12	Ceramic Capacitor	C1608C0G2A102J	TDK	1nF, 100v	603	Capacitor, Ceramic, SMD, 5%
6	1	C5 C15	Ceramic Capacitor	C1608X7R1A105K	TDK	1uF, 10V	603	Capacitor, Ceramic, 10V, 10%
7	1	C18	Ceramic Capacitor	C1608X7R1A225K	TDK	2.2uF, 10v	603	Capacitor, Ceramic, 10V, 10%
8	1	C7	Ceramic Capacitor	Std	std	47nF	603	Capacitor, Ceramic, 50V, 10%
9	1	C3	Ceramic Capacitor	C3216C0G2J561J	TDK	560pF, 630V	1206	Capacitor, Ceramic, Chip, 5%
10	1	C6	Ceramic Capacitor	Std	std	62P	603	Capacitor, Ceramic, 50V, 10%
11	1	C25	X2 cap	8.90334E+11	WE	683, X2	THT, 7.5mm, 10m	X2 CAP
12	1	D1	Bridge rectifier	Z4GP40MH	ZOWIE	4A, 1000V	Z4PAK	Bridge Rectifier, 1000V, 4A
13	1	DNR	Varistor	820573011	WE	10D471K	lead type	Varistor, 10D471K
14	3	D2 D6 D7 D8	Switching diode	BAS21HT1G	ON	0.2A, 200V	SOD323	Switching diode, SMD
15	3	D5 D12 D13	Standard rectifier	RS1JFA	ON	1A, 1000V	SOD123FL	Standard Rectifier, 1A, 1000V
16	1	D4	Schottky rectifier	NTS260ESFT1G	ON	2A, 60V	SOD123FL	Schottky Rectifier, 2A, 60V
17	3	FB FB1 FB2	Ferrite bead	UPZ2012E102-1R5TF/7	Sunlord/WE		805	1000ohm@100MHz
18	1	L3	Common filter	Customized CM filter	Jeplus	15mH	TH type, Pin di	T type core, T14*8*7, 0.5mm wire, 15mH
19	1	L1	Common filter	150-1327	Wurth-Midcon	500uH	T type, T6.3*3*	CM filter, T6.3*3*3, 10T
20	1	F1	Fuse	20T-016H	Hollyfuse	1.6A, 250Vac	Axial lead	Micro Fuse, 1.6A/250V
21	1	Q5	NPN	MMBT3906LT1G	ON		SOT23	GENERAL PURPOSE PNP SILICON TRANSISTOR
22	1	U5	Precision reference	NCP431AVSNT1G	ON		SOT23	PROGRAMMABLE PRECISION REFERENCE
23	1	U3	Syn. rectified cont	NCP43080DDR2G	ON		S08	Syn. Rectified Controller
24	1	U1	PWM controller	NCP1340B3D1R2G	ON		SOIC9	PWM controller
25	1	NTC1	NTC	std	MuRata	13k	603	NTC, 0603, replaced by resistor
26	1	NTC	NTC	SPNL09D2R5MBI	Sunlord	2.5ohm	lead type	5mm Die, 10ohm
27	1	U4	Optical coupler	EL1014	EL		SOP4	optical coupler, wide SOP package
28	1	L2	Axial leaded fixed	7447462220	Wurth	22uH	5mmx8mm	Axial leaded fixed inductor
29	1	L4	Inductor	MCL1608S4R7MG	Sunlord	4.7uH	603	Inductor, SMD
30	1	Q3	MOSFET	IPL60R385CP	Infineon		THINKPAK-8X8	MOSFET, Nchan, 600V
31	1	R10	Resistor	Std	Std	100	603	Resistor, Chip, 1/8W, 1%
32	1	R13	Resistor	Std	Std	100K	603	Resistor, Chip, 1/8W, 1%
33	1	R7	Resistor	Std	Std	10K	603	Resistor, Chip, 1/8W, 1%
34	1	R18	Resistor	Std	Std	10k	603	Resistor, Chip, 1/8W, 1%
35	1	R20	Resistor	Std	Std	150K	603	Resistor, Chip, 1/8W, 1%
36	1	R17	Resistor	Std	Std	18k	603	Resistor, Chip, 1/8W, 1%
37	1	R8	Resistor	Std	Std	1K	603	Resistor, Chip, 1/8W, 1%
38	1	R3	Resistor	Std	Std	1k	603	Resistor, Chip, 1/8W, 1%
39	1	R25	Resistor	Std	Std	3.6K	603	Resistor, Chip, 1/8W, 1%
40	1	R11	Resistor	Std	Std	300	603	Resistor, Chip, 1/8W, 1%

DN05101/D
BOM (Continued)

[illegible]

References

ON Semiconductor data sheet for NCP1340/43080, NTMFS5C604

ON Semiconductor Design Notes DN05043

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Design note created by; e-mail: david.dou@onsemi.com