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Design Note – DN05081/D

Universal AC Input, 12 V0.35A Output, 4.2 Watt Non-isolated Power Supply

Device	Application	Input Voltage	Output Power	Topology	I/O Isolation
NCP1063AP06	White Goods, Industry etc.	90 to 264 Vac	3.6W Nominal 4.2W Maximum	Non-isolated Buck	No

	Output Specification
Output Voltage	12 Vdc
Ripple	<120mV@ full load
Nominal Current	0.3A
Max Current	0.35A
Min Current	0

Efficiency	>65% from 30mA to 350mA
Input Protection	Fuse
Operating Temp. Range	0 to +50°C
Cooling Method	Convection
Standby Power	<60mW in universal

Circuit Description

This design note describes a simple 4.2 watt, universal AC input, Non-isolated buck converter for industrial equipment, or white goods where non-isolation from the AC mains is required, and simple, low cost, high efficiency, and low standby power are essential.

The featured power supply is a simple non-isolated buck topology utilizing ON Semiconductor's new NCP1063 monolithic switcher with integrated 11.4 ohm MOSFET in a DIP7 package (U1). This Design Note provides the complete circuit schematic details and BOM for 12 volt, 0.35 amp power supply. This design also reserves a 5 volt output and a MC7805CT (U2) can be used for this output. 5V output maximum current is set by MC7805CT (U2) thermal performance and total system current; total current of 5 V and 12 V cannot exceed total system output current.

This design used half-wave rectifier and a common neutral for input and output, so it is very useful in some white goods application.

Rectifier, filter and EMC circuit formed by D1, C2, C3, L1, DNR1 is varistor to provide inrush protection, buck switching component formed by U1, D2, L2, C6 and C8. D2, C7 formed boost circuit to boost output voltage to switcher as Vcc and feedback, R3 and R4 is resistor divider of feedback network, C4 is feedback compensation capacitor, R2 is used to set maximum peak current, R1 is dummy load and used to decrease high output voltage at no load. R1 can be also replaced by a 15V zener in order to reduce standby power

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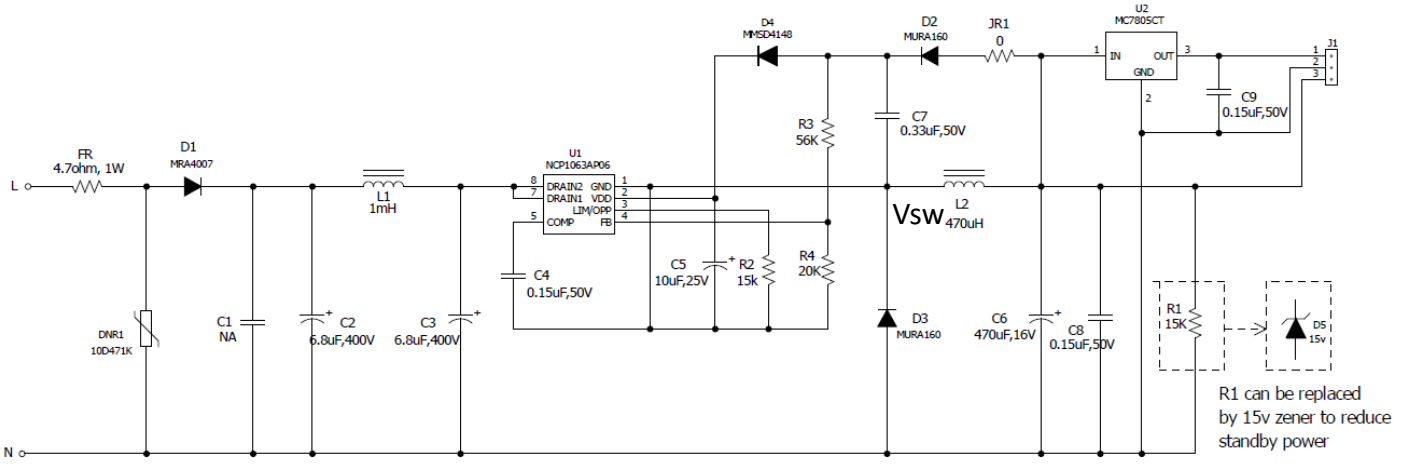
Key Features

- Universal AC input range (90 – 264 Vac).
- Input filter for conducted EMI attenuation.
- Very low standby (no load) power consumption.
- Frequency foldback improves efficiency at light load
- Inherent over-current, over-voltage and over temperature protection.
- Frequency Jittering for Better EMI Signature.
- Adjustable peak current improves OCP performance.

DN05081/D
Circuit Schematic



L1: 7447462102

Vendor: Wurth electronic

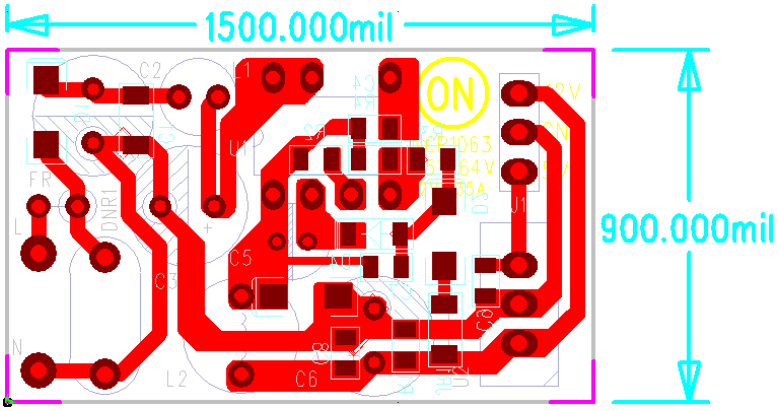
Order Code	Version	L (µH)	I_R (A)	I_{sat} (A)	$R_{DC\ typ}$ (Ω)
7447462102	Heat Shrinking Tube	1000	0.25	0.27	4.38

L2: 744772471

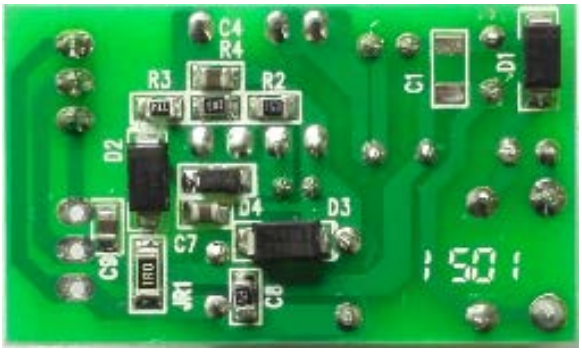
Vendor: Wurth electronic

Order Code	Version	L (µH)	I_R (A)	I_{sat} (A)	$R_{DC\ typ}$ (Ω)
744772471	unshielded	470	0.43	0.8	0.807

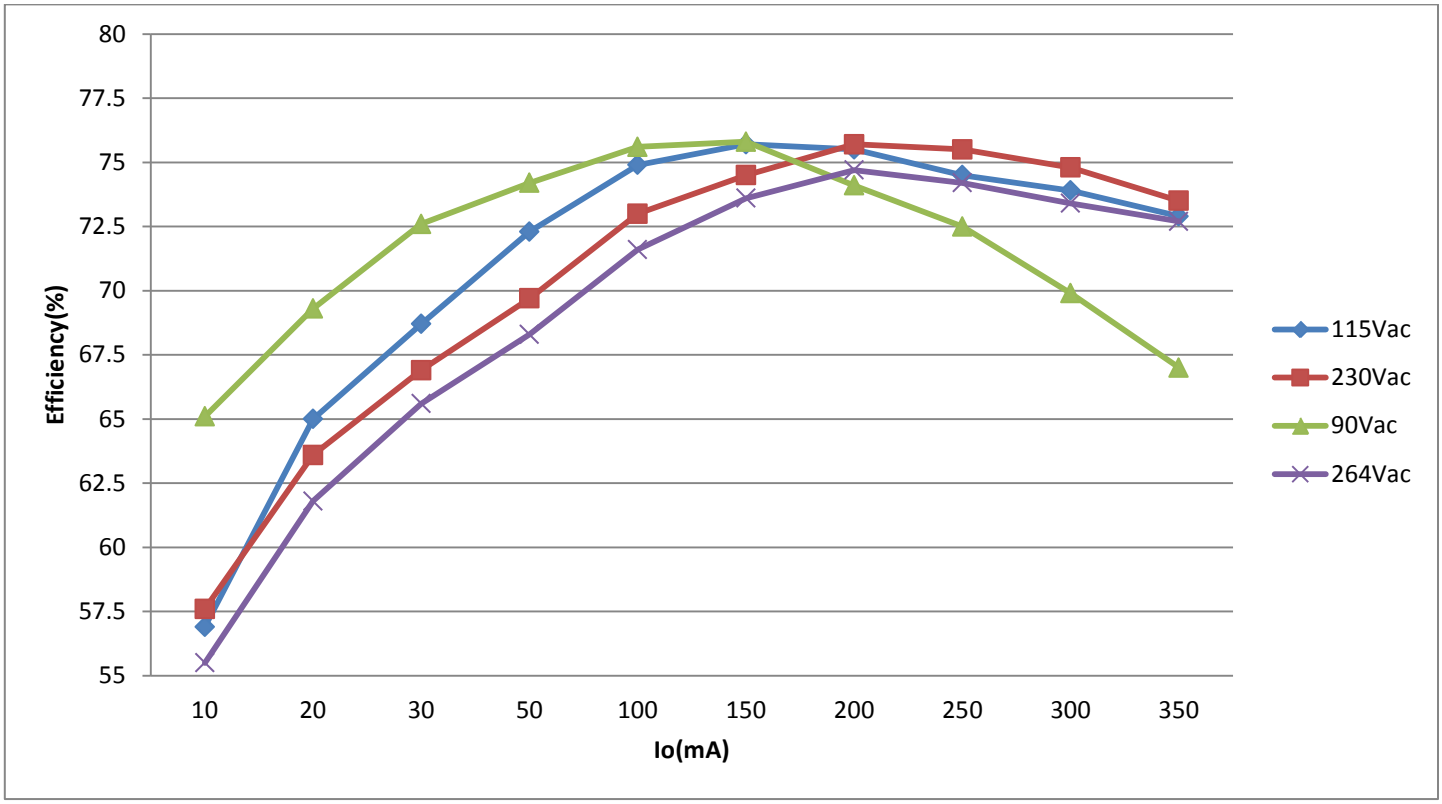
PCB layout



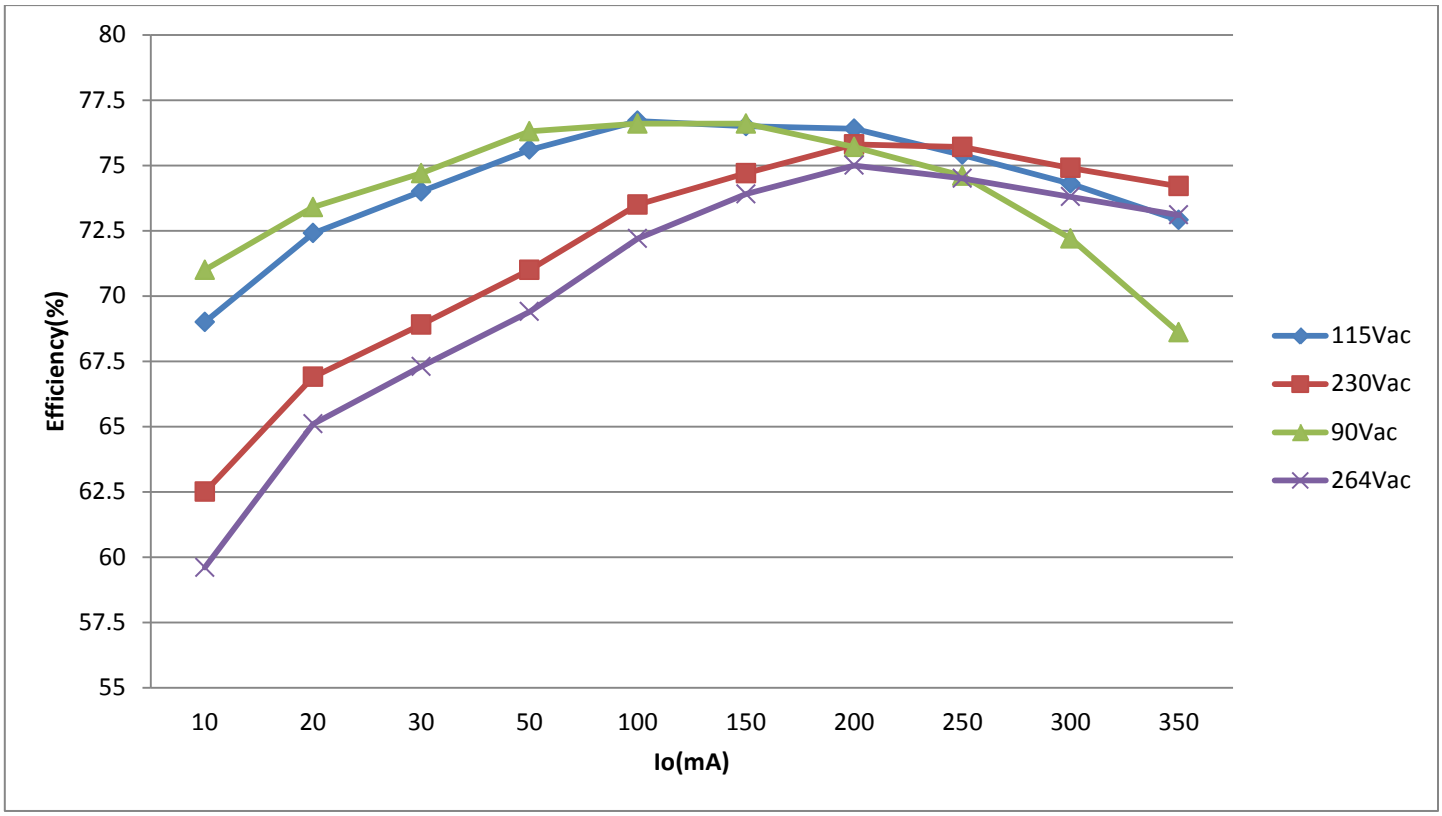
Demoboard Photo



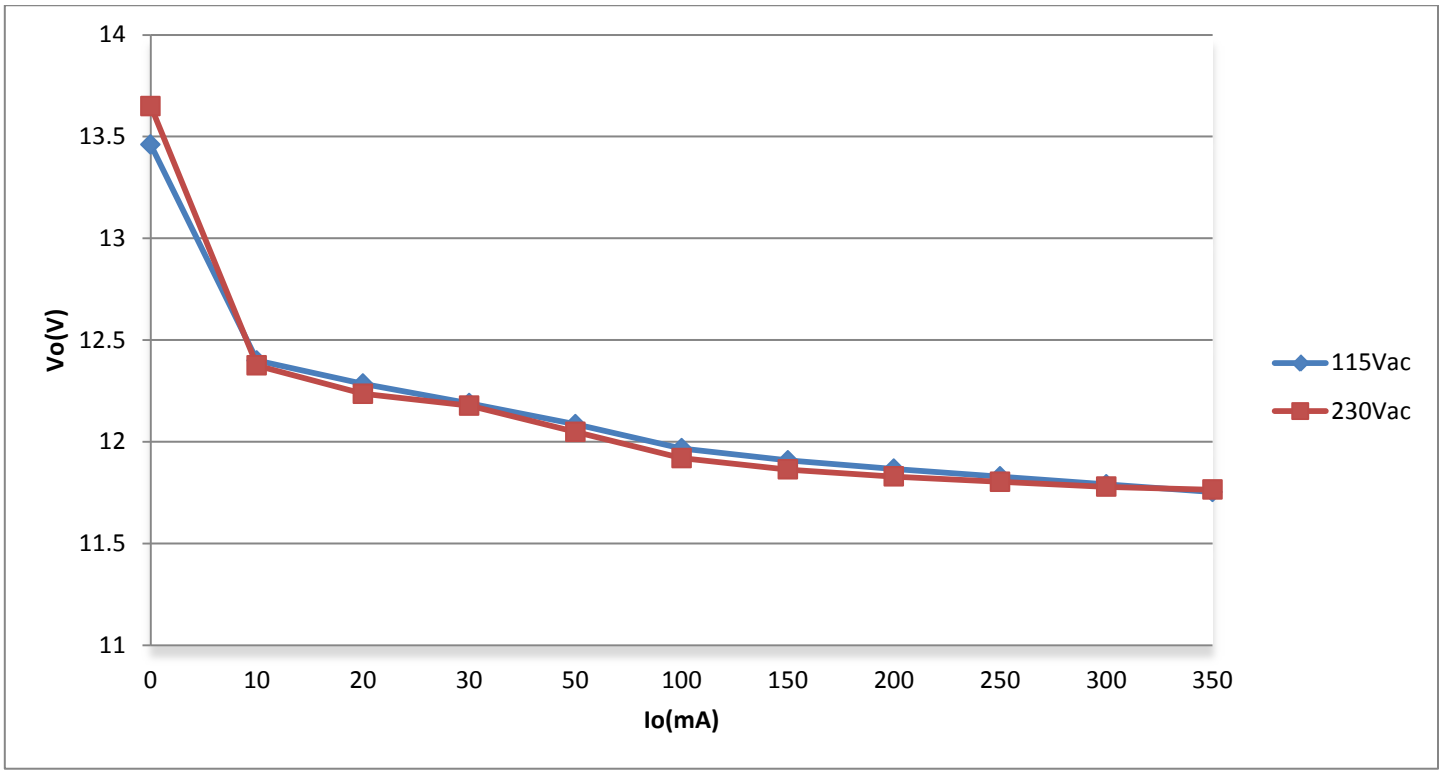
12 Volt Efficiency vs Output Load Curves



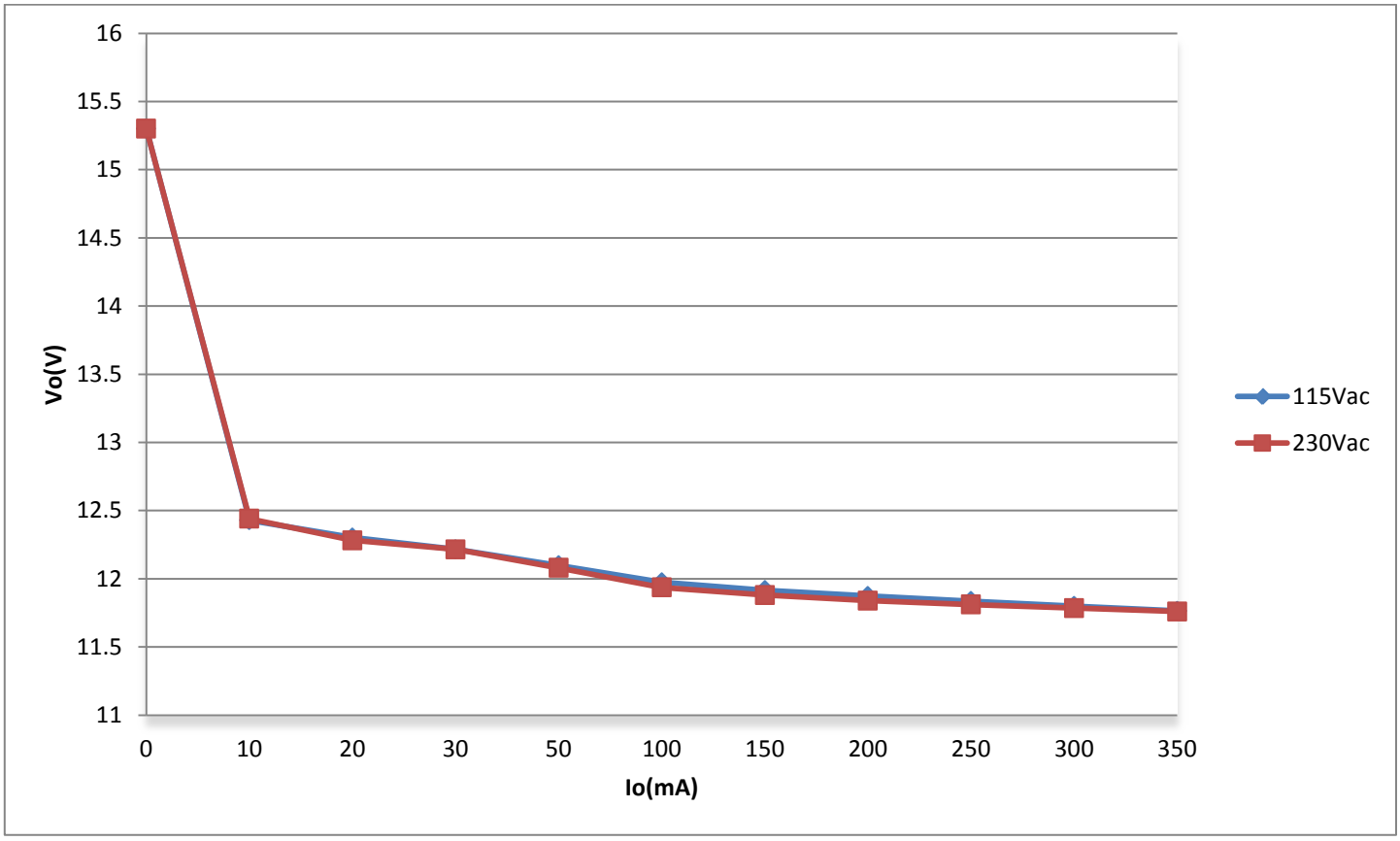
12 Volt Efficiency vs Output Load Curves(R1 replaced by 15v zener)



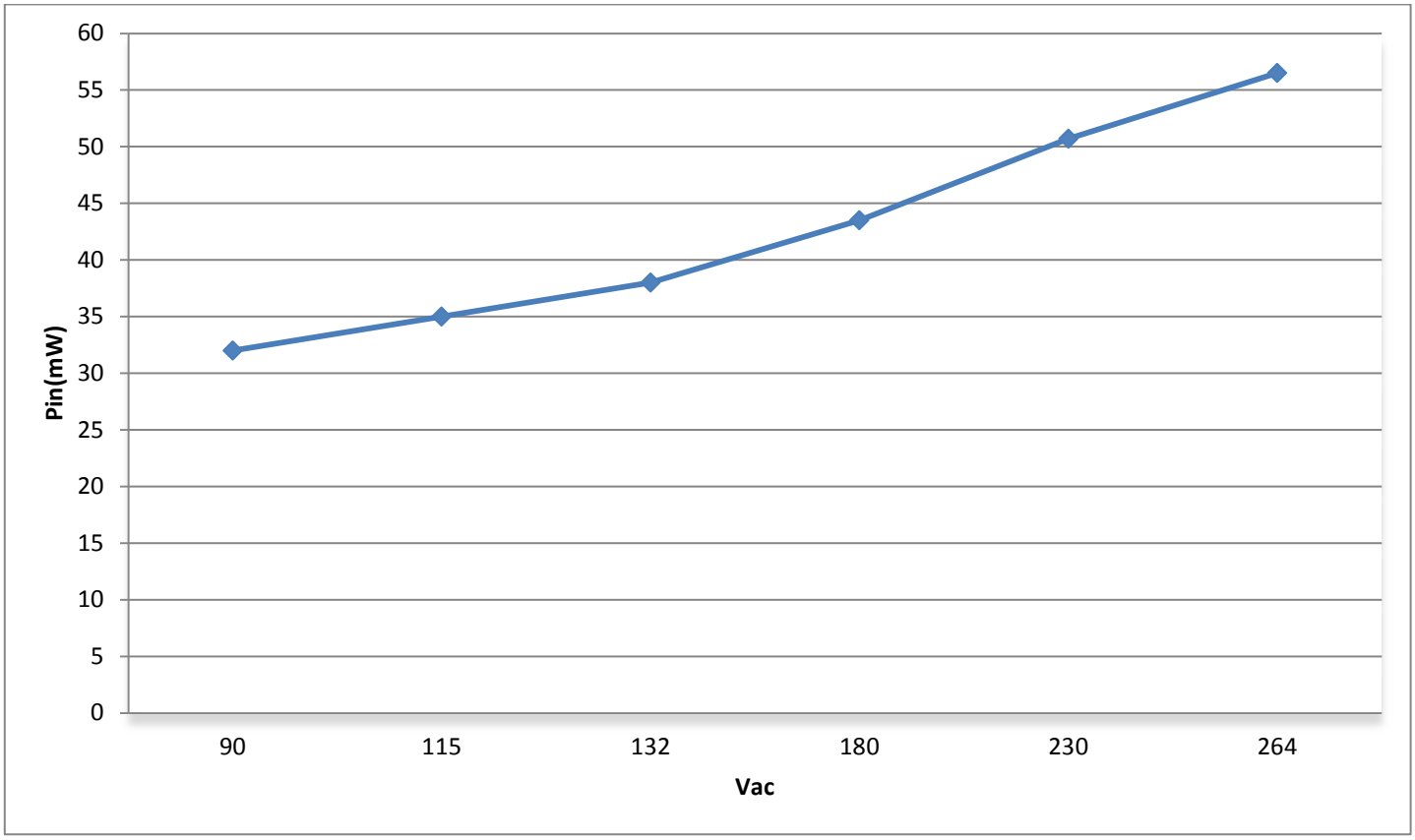
Output Voltage vs Output Load Curves



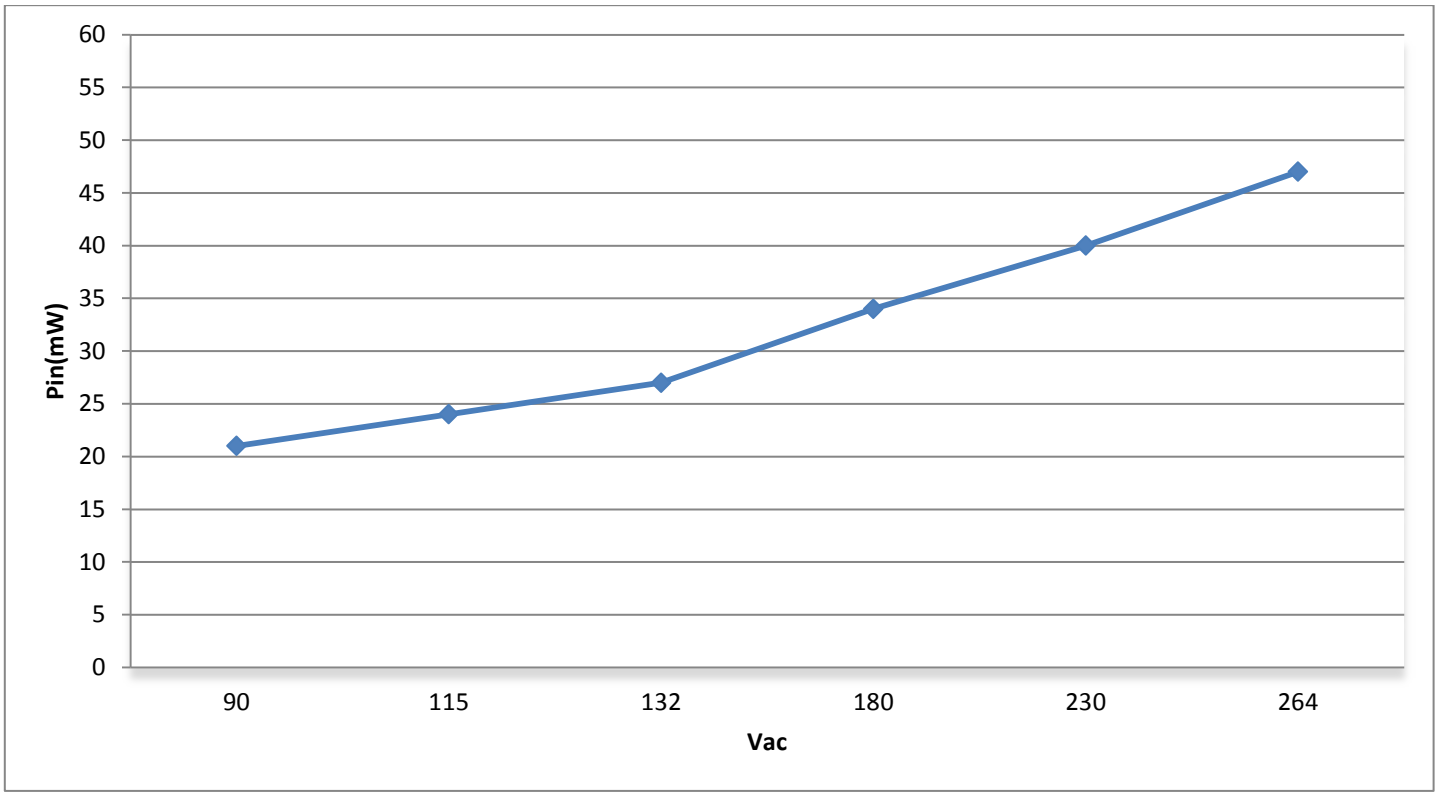
Output Voltage vs Output Load Curves(R1 replaced by 15v zener)



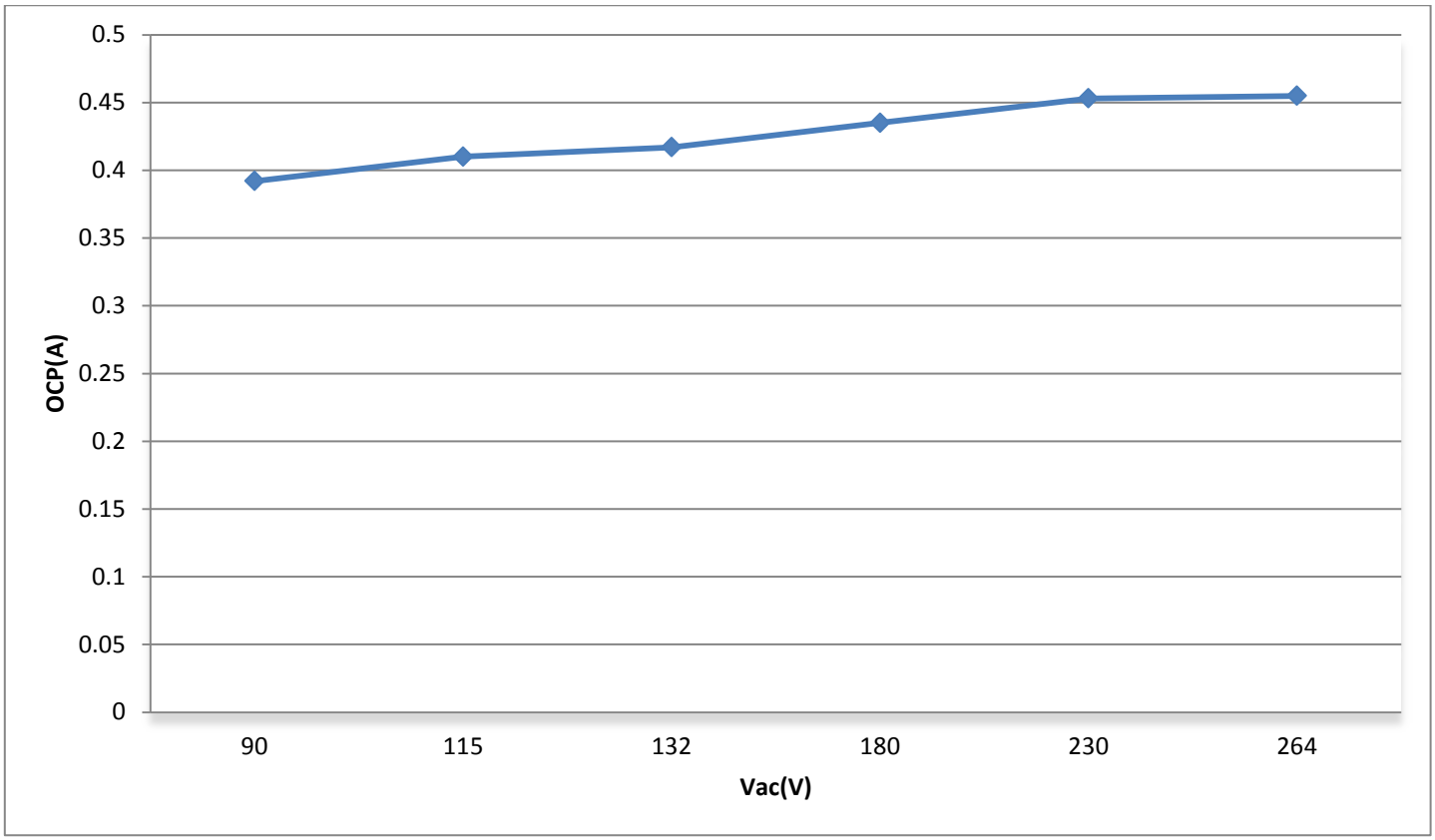
Standby Power vs line Input Curves



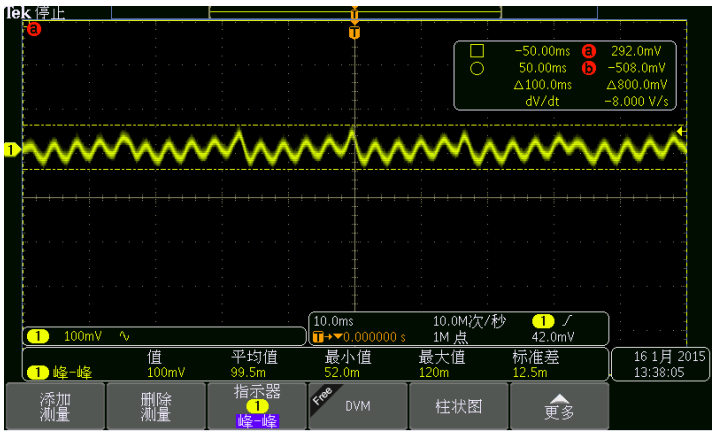
Standby Power vs line Input Curves(R1 replaced by 15v zener)



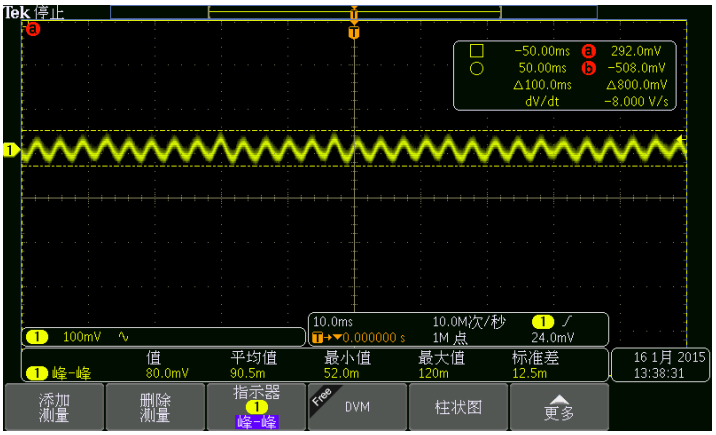
OCP Current vs Line Input Curves



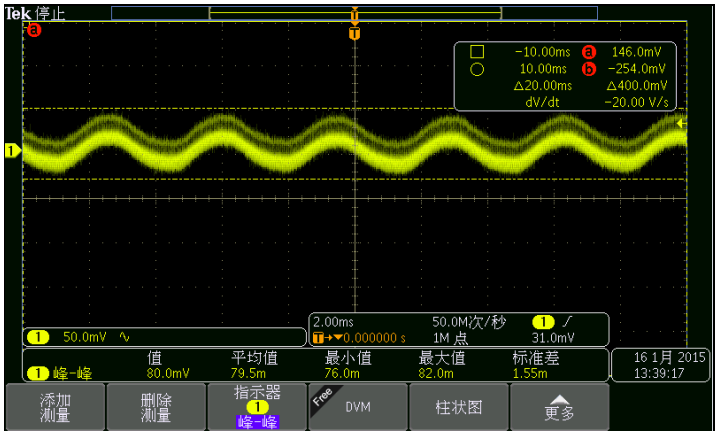
Output Ripple Voltage



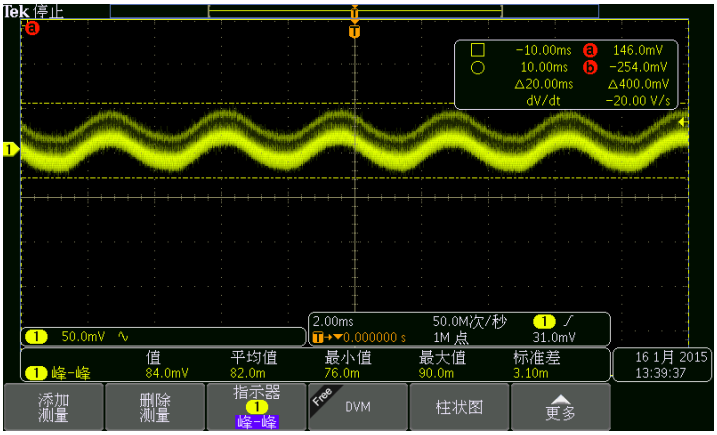
90Vac and 0.35A load



115Vac and 0.35A load

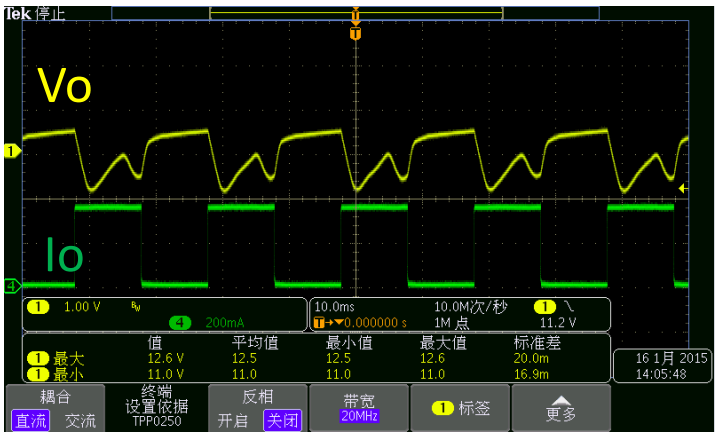


230Vac and 0.35A load

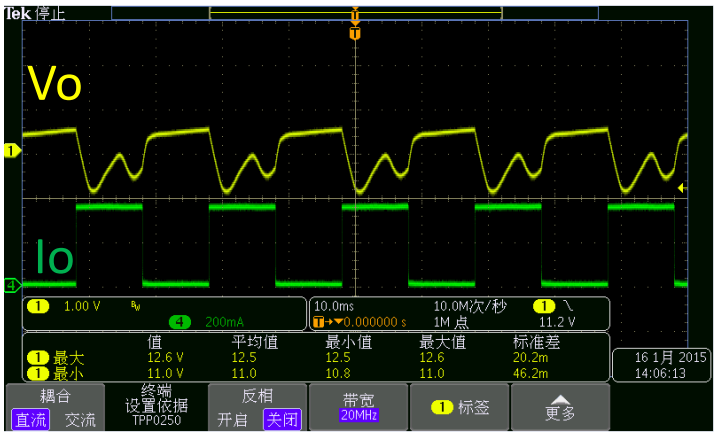


264Vac and 0.35A load

Transient Response

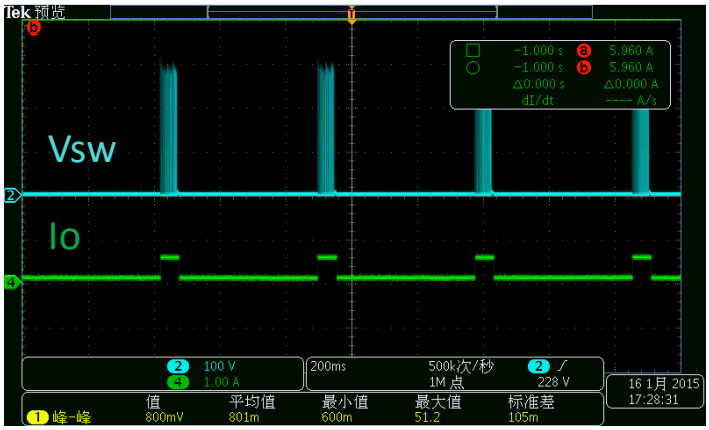


Test Condition: 0-350mA, 100mA/us 20ms cycle, 115Vac



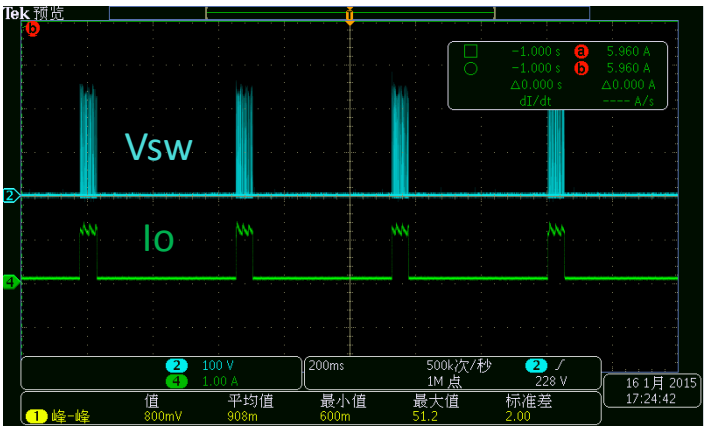
Test Condition: 0-350mA, 100mA/us 20ms cycle, 230Vac

OCP



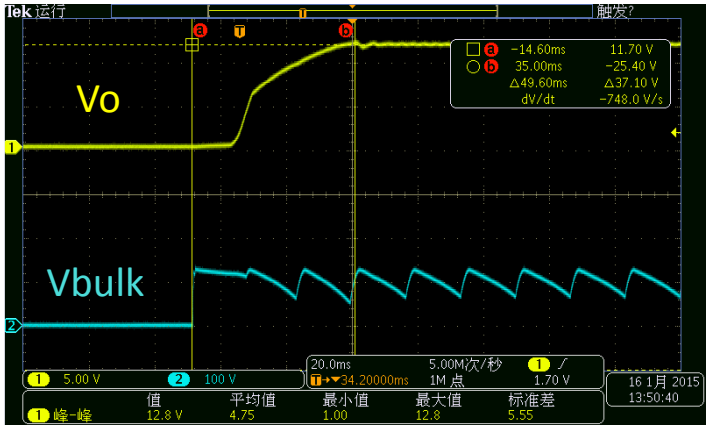
Pi=0.97W at 264Vac

SCP

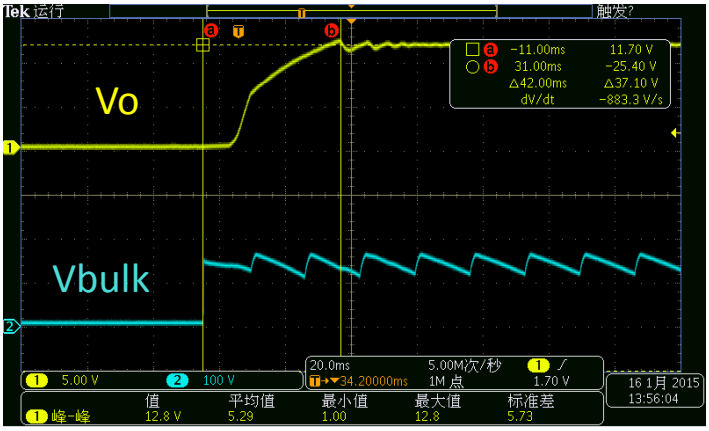


Pi=1W at 264Vac and SCP at Board end

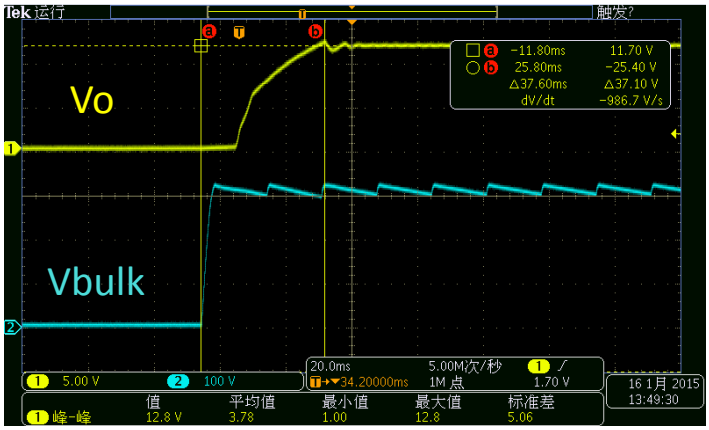
Startup Time



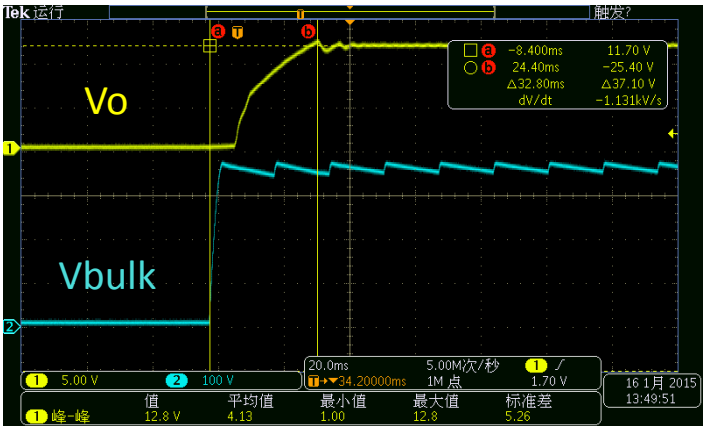
90Vac and 0.35A CC load



115Vac and 0.35A CC load

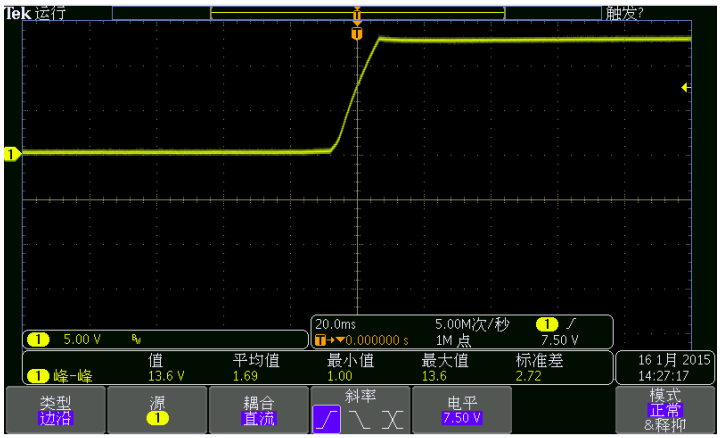


230Vac and 0.35A CC load

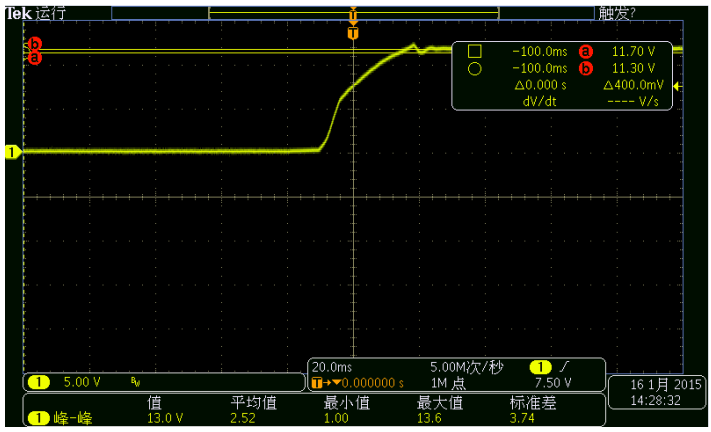


264Vac and 0.35A CC load

Output Voltage Rise Time

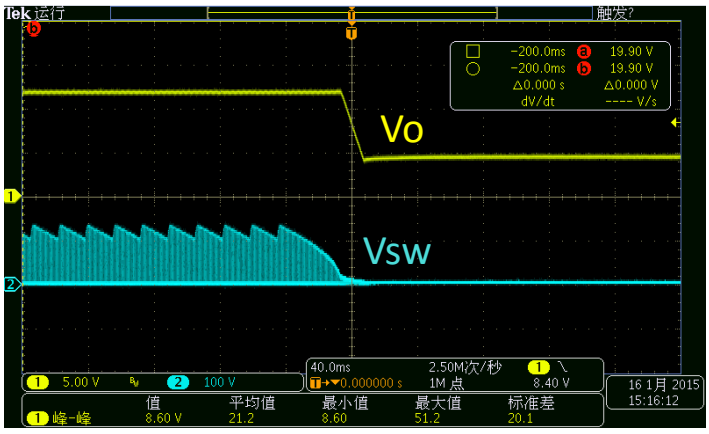


115Vac and no load

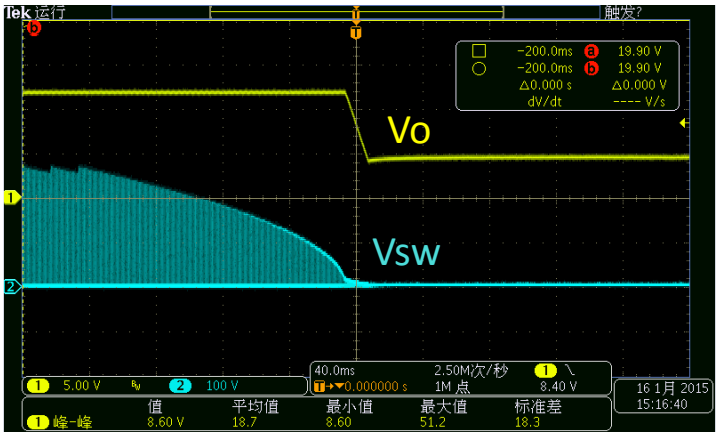


115Vac and 0.35A CC load

Power Off

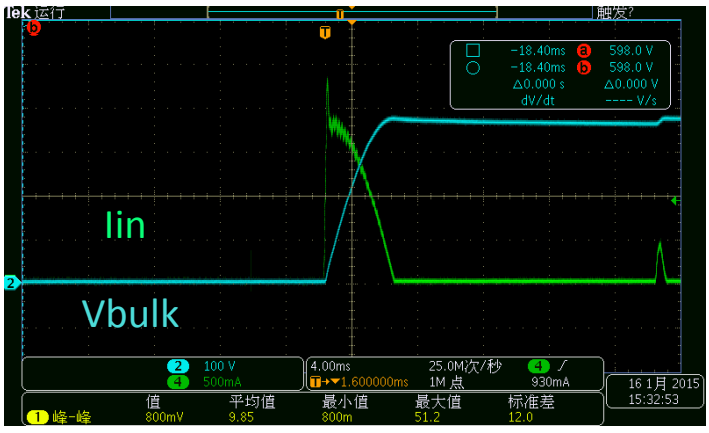


115Vac and 0.35A CC load



230Vac and 0.35A CC load

Inrush



264Vac and 0.35A CC load

BOM

Item	Qty	Referer	Type	Part Name	MFR	Value	Package	Description
1	3	C4 C8-9	Ceramic	std	std	0.15uF,50V	805	Capacitor, Ceramic, SMD,10%
2	1	C7	Ceramic	std	std	0.33uF,50V	805	Capacitor, Ceramic, SMD,10%
3	1	C1	Ceramic	C3216X7T2W104	TDK	NA	1206	Capacitor, Ceramic, NA
4	1	J1	connector	std	std	1x3pin,2.54m	2.54mm	std 1x3pin connector,2.54mm
5	1	D4	Switching diode	MMSD4148T1G	ON	0.2A,100V	SOD-123	Switching Diode, 0.2A/100V
6	1	DNR1	Varistor	820573011	Wurth Electronic	10D471K	leaded type	Varistor, 10D471K
7	1	D1	General rectifier	MRA4007T3G	ON	1A, 1000V	SMA	General Rectifier,1A/1000V
8	2	D2-3	Ultrafast rectifier	MURA160T3G	ON	1A, 600V	SMA	Ultrafast Rectifier,1A/600V
9	1	FR	Fuse Resistor	std	std	4.7ohm,1W	Radiallead	Fuse Resistor,4.7ohm,1W,5%
10	1	U2	Regulator	MC7805CTG	ON	5V	TO-220	Positive voltage regulator
11	1	U1	Buck converter	NCP1063AP060G	ON		DIP7	Buck Converter
12	1	L1	Radial leaded wire wound inductor	7447462102	Wueth Electronic	1mH	TH type	fixed inductor
13	1	L2	Radial leaded wire wound inductor	744772471	Wueth Electronic	470uH	TH type	fixed inductor
14	1	JR1	Resistor	std	std	0	1206	Resistor, Chip, 1/4W, 1%
15	1	R1	Resistor	std	std	15K	805	Resistor, Chip, 1/5W, 1%
16	1	R2	Resistor	std	std	15k	805	Resistor, Chip, 1/5W, 1%
17	1	R4	Resistor	std	std	20K	805	Resistor, Chip, 1/5W, 1%
18	1	R3	Resistor	std	std	56K	805	Resistor, Chip, 1/5W, 1%
19	1	C5	Electrolytic capacitor	Electrolytic capacitor	TEAPO	10uF,25V	5mm(die.)x1	size, 5mmx11mm
20	1	C6	Electrolytic capacitor	Electrolytic capacitor	SAMXON	470uF,16V	8mm(die.)x1	Low impedance
21	2	C2-3	Electrolytic capacitor	Electrolytic capacitor	Rubycon/TEA	6.8uF,400V	8mm(die.)x1	size, 8mmx11.5mm

References

ON Semiconductor datasheet for NCP1063 monolithic switcher.

ON Semiconductor Design Notes DN05012, DN05017, DN05018, DN05028, DN05029

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