Table of Contents

Chapter 1. Summary

1.1 General Description

The 45W USB PD 3.0 Adaptor Evaluation Board EV3 is composed of three main parts, AP3108LS PWM controller offers with high voltage soft startup circuit, a high voltage LDO makes the Vcc working range more wider, with a X-cap discharge function and a frequency fold back functional for improving Eff. The APR348 is a Synchronous Rectification Controller, as well as AP43771 is a USB PD3.0 protocol decoder that is based on monitoring CC1 & CC2 signals and interprets the desired voltage and current requested from secondary side, and then feeds back the information to primary side AP3108LS controller for getting well regulated voltage and current as well as related protection functions.

1.2 Key Features

1.2.1 System Key Features

- SSR Topology Implementation with an Opto-coupler for Accurate Step Voltage Controlling
- USB PD 3.0 Compliance
- Meet DOE 6 and CoC Tier 2 Efficiency Requirements
- <30mW No-Load Standby Power

1.2.2 AP3108LS Key Features

- Current Mode PWM Controller
- Frequency Shift function changes frequency per line loading
- Frequency fold back for high average efficiency
- Integration of High-Voltage Start-Up Circuit to enable low standby power
- Integration of 120V LDO, X-Cap discharge for minimal system BOM components
- Constant load output current during output short circuit
- Rich Protection Functions: , Precise Secondary Side OVP, UVP, OLP, BNO, FOCP, SSCP, External Programmable OTP

1.2.3 APR348 Key Features

- Synchronous Rectification operating at DCM, CCM and QR mode for Flyback topology
- Eliminate Resonant Ringing Interference
- Only Two External Components Used

1.2.4 AP43771 Key Features

- Supports USB PD3.0 PPS Type-C and QC4/QC4+
- Drives N-Channel MOSFET for Load Switch
- Built-in VBUS Discharger Pin
- 3V-20V operation voltage without external regulator
- On-chip OVP,UVP,OCP and SCP
- Supports OTP through integrated ADC circuit
- USB PD3.0 PPS Compliance (TID : 1100023)

1.3 Applications

- USB PD 3.0 Wall Adaptor
- USB PD 3.0 Car Charger
- Power Bank

1.4 Main Power Specifications (CV & CC Mode)

Parameter	Value
Input Voltage	90Vac to 264Vac
Input standby power	< 30mW
Main Output Vo / Io	**Fixed PDO:** 5V/4A, 9V/4A, 15V/3A, 20V/2.25A **PPS1:** 3.3V~11V@4A **PPS2:** 3.3V~16V@3A
Efficiency	>90%
Total Output Power	45W
Protections	OVP, UVP, OLP, BNO, FOCP, SSCP, OTP
XYZ Dimension	54 x 37.6 x 25mm
ROHS Compliance	Yes

1.5 Evaluation Board Picture

Figure 1: Top View

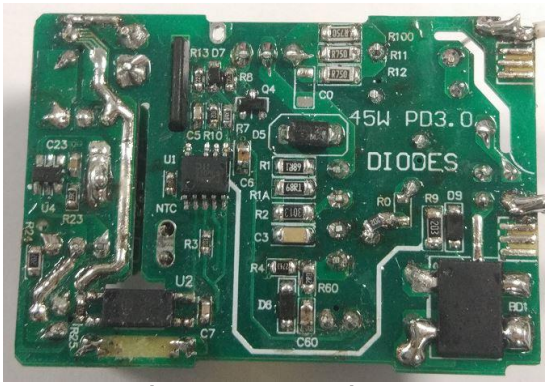


Figure 2: Bottom View

Chapter 2. Power Supply Specification

2.1 Specification and Test Results

Parameter	Value	Test Summary
Input Voltage	90V_{AC} to 264V_{AC}	
Input Voltage Frequency	47Hz to 64Hz	
Input Current	<1.0$A_{AC(RMS)}$	
Standby Power	<30mW; no-load	**PASS,** 25mW@230VAC/50Hz
5V/4A Average Efficiency	DoE VI Eff >83.08% Tier2 Eff>83.68%	**PASS,** 89.49% @115VAC/60Hz, 89.02% @230VAC/50Hz
5V/0.4A Efficiency (10% Load)	Tier2 Eff>74.24%	**PASS,** 86.92% @115VAC/60Hz, 85.45% @230VAC/50Hz
9V/4A average Efficiency	DoE VI Eff >87.40% Tier2 Eff>88.30%	**PASS,** 90.51% @115VAC/60Hz, 90.92% @ 230VAC/50Hz
9V/0.4A Efficiency (10% Load)	Tier2 Eff>78.30%	**PASS,** 88.76% @115VAC/60Hz, 86.44% @230VAC /50Hz
15V/3A Average Efficiency	DoE VI Eff >87.73% Tier2 Eff>88.85%	**PASS,** 91.15% @115VAC/60Hz, 91.81% @ 230VAC/50Hz
15V/0.3A Efficiency (10% Load)	Tier2 Eff>78.85%	**PASS,** 85.76% @115VAC/60Hz, 83.70% @230VAC /50Hz
20V/2.25A Average Efficiency	DoE VI Eff >87.73% Tier2 Eff>88.85%	**PASS,** 90.89% @115VAC/60Hz, 91.73% @ 230VAC/50Hz
20V/0.225A Efficiency (10% Load)	Tier2 Eff>78.85%	**PASS,** 81.88% @115VAC/60Hz, 80.29% @230VAC /50Hz
EMI Conduction & Radiation	>6dB Margin; according to FCC / EN55022 Class B	Pass, CE Margin >6dB Pass, RE Margin >6dB

2.2 Compliance

Parameter	Test conditions	Low to High	High to Low	standard	Test Summary
Output Voltage Transition time	5V/3A to 9V/3A	57ms	64ms	275mS <	Pass
Output Voltage Transition time	9V/3A to 15V3A	82ms	85ms	275ms <	Pass
Output Voltage Transition time	15V/2.25A to 20V/2.25A	70ms	66ms	275mS <	Pass
Output Voltage Transition time	5V/0A to 20V/0A (Worst Case)	193ms	199ms	275mS <	Pass
Output Connector	USB Type C	-	-	-	
Temperature	20V / 2.25A @90Vac and 264Vac		-	-	<90℃
Dimensions (W /D/ H)	L54mm x 37.6mm x 25mm	-	-	-	
Safety	IEC/EN/UL 60950 Standard	-	-	-	
EMI Conduction & Radiation	FCC/EN55022 Class B	-	-	-	Margin>6db

Chapter 3. Schematic

3.1 EV3 Board Schematic

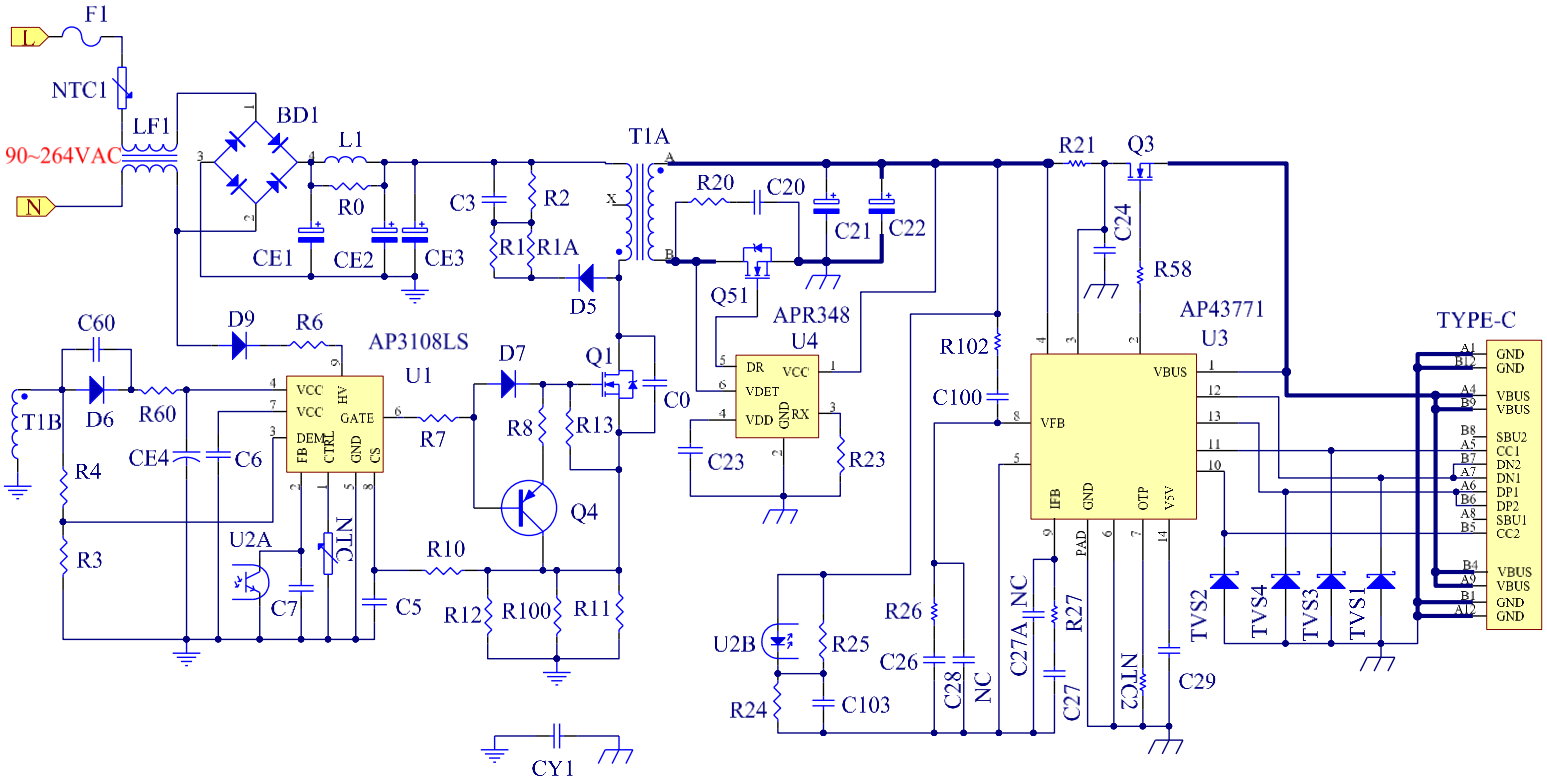


Figure 3: Evaluation Board Schematic

3.2 Bill of Material (BOM)

Designator	Comment	Manufactory	Footprint	Quantity
BD1	TT410-13	DIODES	TT	1
Q3	DMN3008SFGQ-7	DIODES	DFN3*3	1
Q4	MMBT3906-7-F	DIODES	SOT-23	1
Q51	DMT10H010LPS-13	DIODES	PowerDI5060-8	1
TVS1, TVS2, TVS3, TVS4	DESD5V0S1BA-7	DIODES	SOD323	4
D5	S2MA-13-F	DIODES	SMA	1
D6, D9	S1MWF-7-F	DIODES	SOD-123	2
D7	1N4148WS-7-F	DIODES	SOD-323	1
U1	AP3108LGSTR-G1	DIODES	SSOP-9	1
U3	AP43771FB-7	DIODES	DFN14	1
U4	APR348W6-7	DIODES	SOT23-6	1
Q1	UTC15NM65L	UTC	TO-220AB	1
U2	Photo coupler, TCLT1006	VISHAY		1
C0	NC			
C3	1nF/1KV	Yageo	C1206	1

C5	220pF/25V	Yageo	C0603	1
C6	6.8uF/35V	Yageo	C0805	1
C7	1.2nF/25V	Yageo	C0603	1
C20	1nF/200V	Yageo	C0805	1
C23	4.7uF/10V	Yageo	C0603	1
C24	100nF/50V	Yageo	C0402	1
C26	68nF/25V	Yageo	C0402	1
C27	2.7nF/25V	Yageo	C0402	1
C27A, C28	NC			
C29	10uf/6.3V	Yageo	C0603	1
C60	47pF/200V	Yageo	C0805	1
C100	1nF/50V	Yageo	C0402	1
C103	2.2nF/50V	Yageo	C0603	1
CE1, CE2, CE3	22UF/400V, E-Cap/105℃	AISHI	D10.3xH18.0mm	3
CE4	6.8uF/100V, E-Cap/105℃	AISHI	D5.0xH12.0mm	1
CY1	470pF/300VAC, Y-Cap		CY-10.0	1
C21, C22	560UF/25V,Solid Cap/105℃	Solid Cap	D6.3xH15.0mm	2
T1	T-RM9 Transformer, Lp=400uH		RM9 core & bobbin	1
F1	T2A/250V,Class Fuse		FUSE1	1
J1	TYPE-C Connector		TYPEC-SMT2	1
L1	DM inductor, Lp>220uH/>0.5A		D5.0xH12.0mm	1
LF1	Common Chock, Lp>200uH/>0.8A		D10.0xT10.0mm	1
NTC1	8S2R5M, NTC Resistor			1
NTC	If not used, install one 100k resistor		R0603	1
NTC2	If not used, install one 20k resistor		R0402	1
R0	2K	Yageo	R0805	1
R1, R1A	68R	Yageo	R1206	2
R2	300K	Yageo	R1206	1
R3	20K	Yageo	R0603	1
R4	270K	Yageo	R0805	1
R9	20K	Yageo	R1206	1
R7	100R	Yageo	R0603	1
R8	15R	Yageo	R0603	1
R10	1K	Yageo	R0603	1
R11, R12, R100	0.75R	Yageo	R1206	3
R13	22K	Yageo	R0603	1
R20	27R	Yageo	R0805	1
R21	10mΩ/2W, ±1%	SART FUSE	R1206	1
R23	24K	Yageo	R0603	1
R24	1.5K	Yageo	R0805	1
R25	4.7K	Yageo	R0603	1

R26	10K	Yageo	R0402	1
R27,R58	0R	Yageo	R0402	2
R60	2.2R	Yageo	R0805	1
R102	1K	Yageo	R0402	1

3.3 Transformer Design Specification

RM9（Ae=75mm2）						
NO	NAME	TERMINAL NO.		WINDING		
		START	FINISH	WIRE	TURNS	Layers
1	**Np1**	1	5	Φ 0.14mm*8P **2UEW**	23.5 TS	2
2	**Na**	4	3（GND）	Φ 0.14mm*1P **2UEW**	15 TS	1
	Shield1	3	NC	Φ 0.14mm*2P **2UEW**	15 TS	
3	**Ns**	A	B	Φ 0.23 mm *15P **TIW-B**	5 TS	1
4	**Shield2**	3	NC	Φ 0.15mm*1P **2UEW**	26 TS	1
5	**Np2**	6	2	Φ 0.14mm*8P **2UEW**	11.5 TS	1

Primary Inductance	Pin 1-2,all other windings open, measured at 20kHz, 0.4VRMS	360μH±5%
Primary Leakage Inductance	Pin 1-2, all other windings shorted, measured at 20kHz, 0.4VRMS	20μH (Max.)
Notes	1, Core connect to Pin3 2, Core Material：PC95 3, Pin5 & Pin6 connected on PCB Board 4, Two layers of tape wrapped on each of winding.	

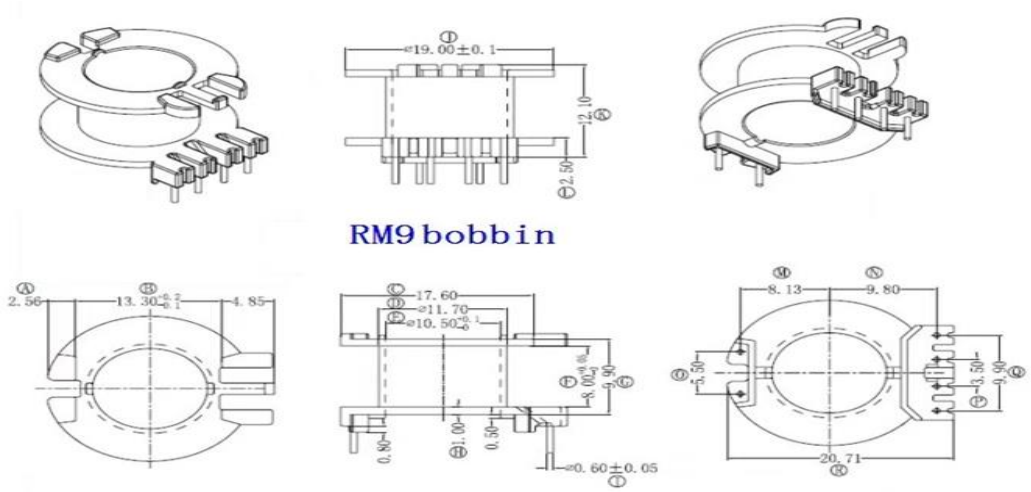


Figure 4: RM9 Bobbin

3.4 Schematics Description

3.4.1 AC Input Circuit & Differential Filter

There are four components in this section. The Fuse F1 protects against over-current conditions which occur when some of the main components fail. The NTC1 can effectively reduce inrush current. The LF1 is common choke filter for the common mode noise suppression filtering due to each coil with large impedance. The BD1 is an AC-DC rectifier, and converts alternating current & voltage into direct current & voltage.

3.4.2 AP3108LS PWM Controller

The AP3108LS PWM controller U1 and Opto-Coupler U2 as well as Q1 are the power converting core components. Connected to filtered output after bridge circuit, D9 & R6 resistor path will provide start-up voltage and current during starting up through HV (Pin 9). Subsequent VCC power will be provided by voltage feedback from the auxiliary winding through R60 and D6. This design is to accommodate the required wide voltage range to support various protocols (including USB PD Programmable Power Supply PPS), from 3.3V to 20V.

Based on feedback of secondary side (Pin CATH of AP43771 Decoder) to primary side (FB pin of AP3108LS) by through Opto-coupler U2, the AP3108LS will switch ON and Off Q1 to regulate the desired voltage and current on the secondary side.

3.4.3 APR348 Synchronous Rectification (SR) MOSFET Driver

The APR348 operates in CCM/DCM mode in this design and drives the Q51 MOSFET. As the power loss with the APR348-controlled MOSFET Q51 is less than Schottky Diodes, the total efficiency can be improved.

3.4.4 AP43771 PD3.0+ Decoder & Protection on /off P MOSFET and Interface to Power Devices

The few sets of important pins provide critical protocol decoding and regulation functions in AP43771:

1) **CC1 & CC2 (Pin 10, 11)**: CC1 & CC2 (Configuration Channel 1 & 2) are defined by the USB PD spec to provide the channel communication link between power source and sink devices.

2) **Constant Voltage (CV)**: The CV sensing resistors are integrated into MCU. There is a loop compensation circuit C26 & R26 between Pin8 & Pin5, the fast voltage response can be obtained by adjusting their value. The output voltages can be adjusted by firmware programming.

3) **Over current protection (OCP)**: The OCP is implemented by sensing via current sense resistor (R21, 10mΩ) and current sense amplifier, then comparing with internal programmable reference voltage to generate a signal on OCDRV pin (pin 5).

4) **OCDRV (Pin 5)**: It is the key interface that links secondary decoder (AP43771) to primary PWM regulation controller (AP3108LS), through the Cath pin to Opto-coupler U2A link that will feed all information based on all sensed CC1 & CC2 voltage status signals back to primary PWM controller for getting desired Vbus voltage & current.

5) **GATE Driver (Pin 2) to N-MOSFET Gate**: The pin is used to turn on/off Vbus load switch (Q3) to enable/disable voltage output to the Vbus. An extra N-MOSFET (Q3) is required to prevent reverse current from the attached battery source.

Chapter 4. The Evaluation Board (EVB) Connections

4.1 EVB PCB Layout

The thickness for both sides of PCB board trace copper is 2 oz.

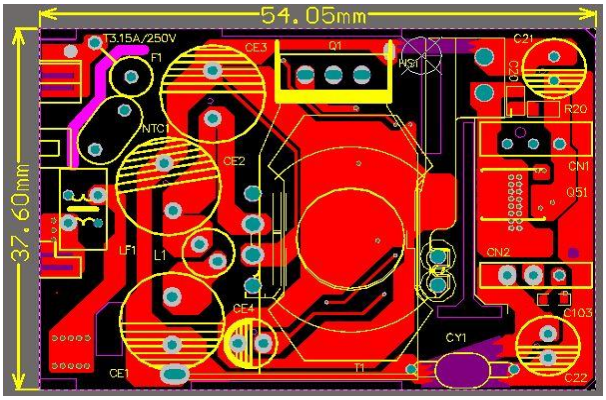


Figure 5: PCB Board Layout Top View

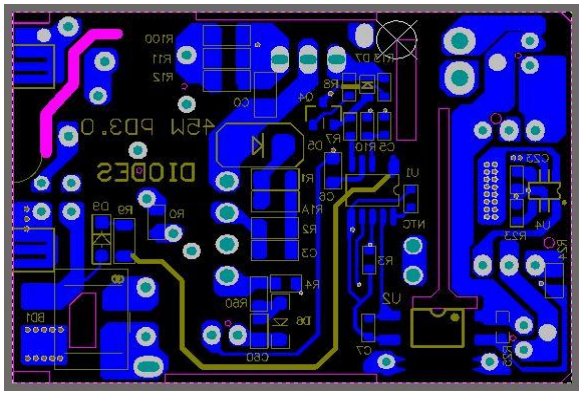


Figure 6: PCB Board Layout Bottom View

4.2 Quick Start Guide before Connection

1) Before starting the 45W EVB test, the end user needs to prepare the following tool, software and manuals.
   For details, please consult USBCEE sales through below link for further information.
   USBCEE PD3.0 Test Kit: USBCEE Power Adapter Tester. https://www.usbcee.com/product-details/4

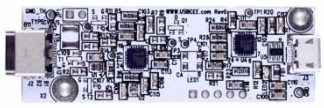
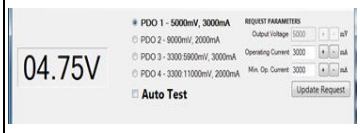
USBCEE PAT Tester	GUI Display	USB-A to Micro-B Cable	Type-C Cable
			

Figure 6: Items: Test Kit / Test Cables

2) Prepare a certified three-foot Type-C cable and a Standard-A to Micro-B Cable.
3) Connect the input AC L & N wires to AC power supply output “L and N“ wires.
4) Ensure that the AC source is switched OFF or disconnected before the connection steps.
5) A Type-C cable for the connection between EVB’s and Cypress’s Type-C receptacles.
6) Use 2 banana jack cables, one port of the cables are connected to E-load + & - terminals while the other port of the cables are connected to EVB’s VBUS & GND pads.

7) A Standard-A to Micro-B cable to be connected to the Cypress test kit's Micro-B receptacle & PC Standard-A receptacle respectively.

4.3 System Setup

4.3.1 Connection with E-Load

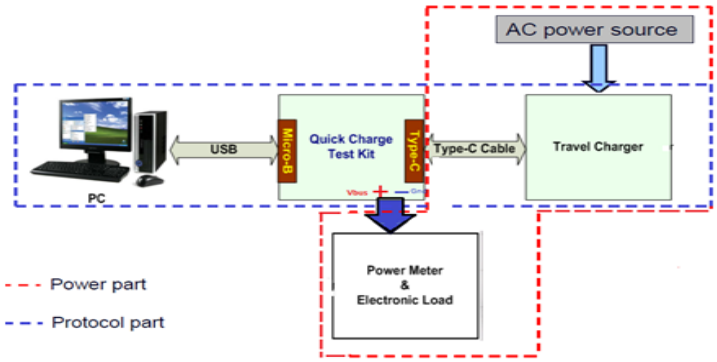


Figure 7: Diagram of Connections in the Sample Board

4.3.2 USBCEE PAT Tester

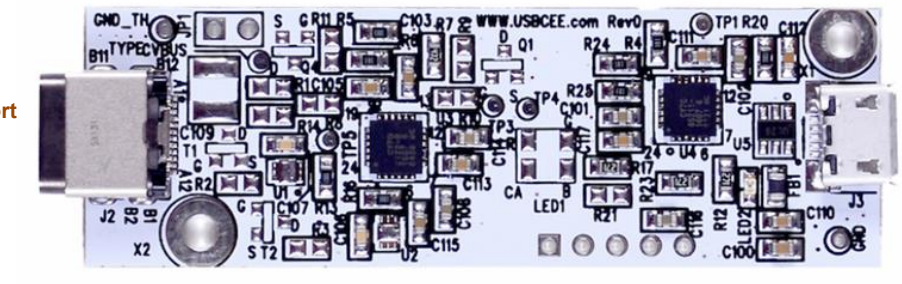


Figure 8: The Test Kit Input & Output and E-load Connections

4.3.3 Input & Output Wires Connection

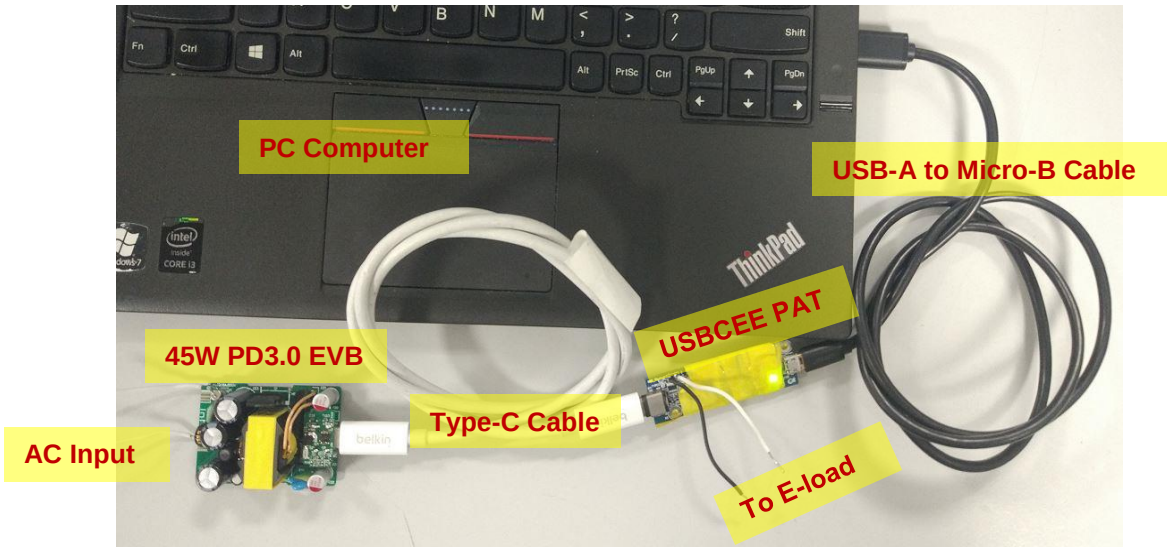


Figure 9: Wire Connection of 45W PD3.0 EVB to Test Kit and PC Computer

Chapter 5. Testing the Evaluation Board

5.1 Input & Output Characteristics

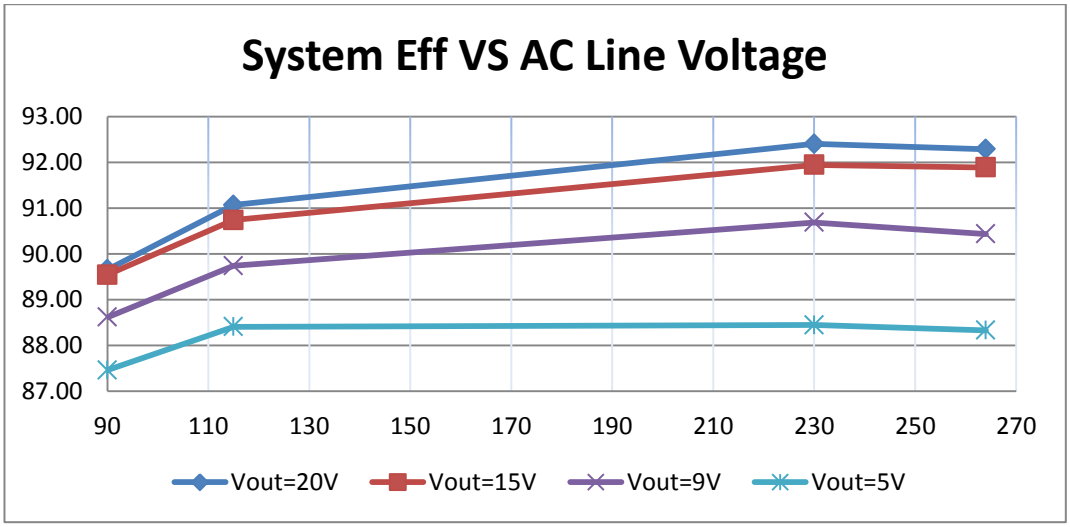
5.1.1 Input Standby Power

Output Voltage	Input Voltage	Standby Power (mW)
5V @ No Load	115Vac 60HZ	19
	230Vac 50HZ	25

Note: Standard Power test condition: The output terminal of power board don't connected any load

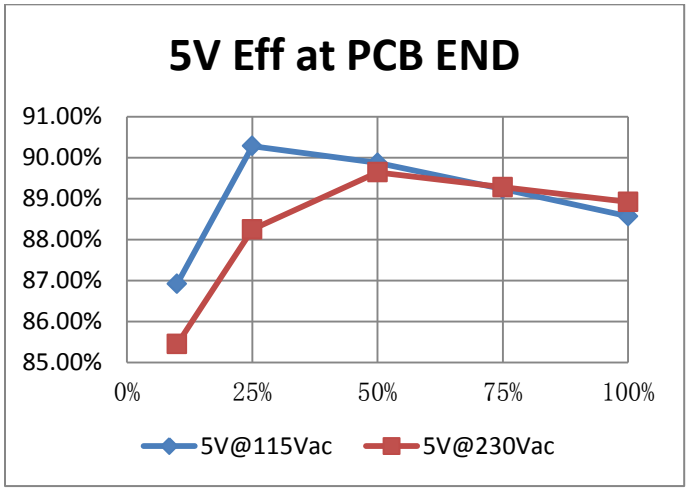
5.1.2 Input Power Efficiency at Different AC Line Input Voltage and its chart curve

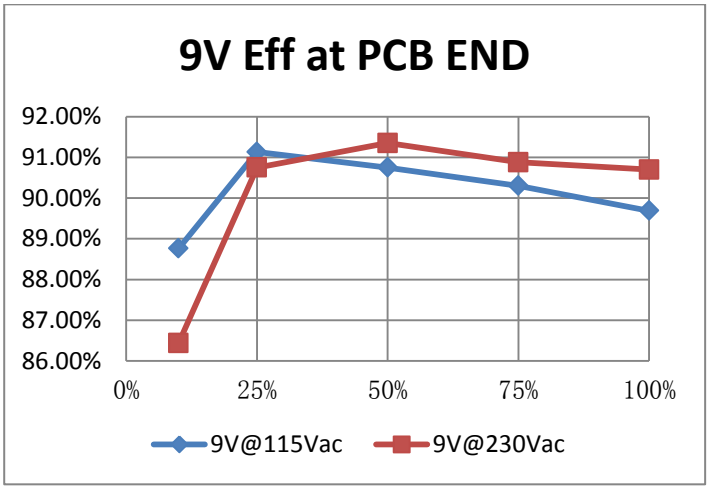
Vin (Vac)	Freq (HZ)	Vin (V)	Iin (A)	PF	Pin (W)	Vout (V)	Iout (A)	Pout (W)	Pd (W)	Eff (%)
90	47	90.01	0.928	0.59	49.83	19.874	2.248	44.68	5.153	89.66
115	60	115.1	0.79	0.54	49.06	19.874	2.248	44.68	4.383	91.07
230	50	230.34	0.5	0.42	48.35	19.874	2.248	44.68	3.673	92.40
264	63	264.22	0.47	0.39	48.41	19.874	2.248	44.68	3.733	92.29
90	47	89.99	0.94	0.59	50.21	14.947	3.008	44.96	5.249	89.55
115	60	115.1	0.79	0.54	49.55	14.947	3.008	44.96	4.589	90.74
230	50	230.35	0.5	0.42	48.9	14.947	3.008	44.96	3.939	91.94
264	63	264.33	0.392	0.39	48.93	14.947	3.008	44.96	3.969	91.89
90	47	90.04	0.76	0.59	40.78	9.03	4.002	36.14	4.642	88.62
115	60	115.14	0.657	0.53	40.27	9.03	4.002	36.14	4.132	89.74
230	50	230.37	0.424	0.39	39.85	9.03	4.002	36.14	3.712	90.69
264	63	264.33	0.384	0.38	39.96	9.03	4.002	36.14	3.822	90.44
90	47	90.08	0.463	0.55	23.3	5.092	4.002	20.38	2.922	87.46
115	60	115.17	0.409	0.48	23.05	5.092	4.002	20.38	2.672	88.41
230	50	230.4	0.255	0.39	23.04	5.092	4.002	20.38	2.662	88.45
264	63	264.33	0.229	0.38	23.07	5.092	4.002	20.38	2.692	88.33

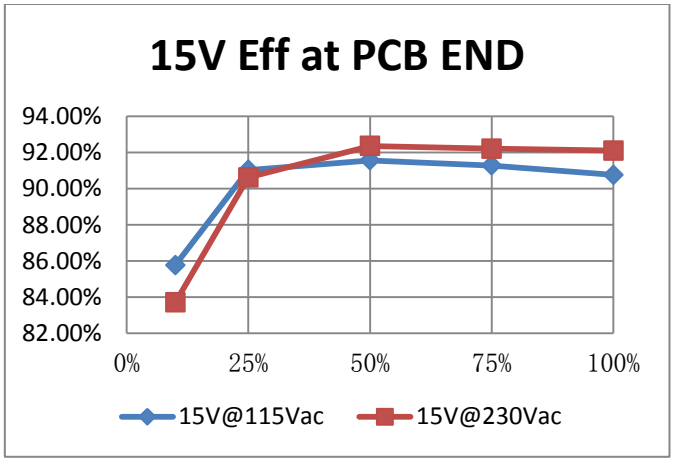


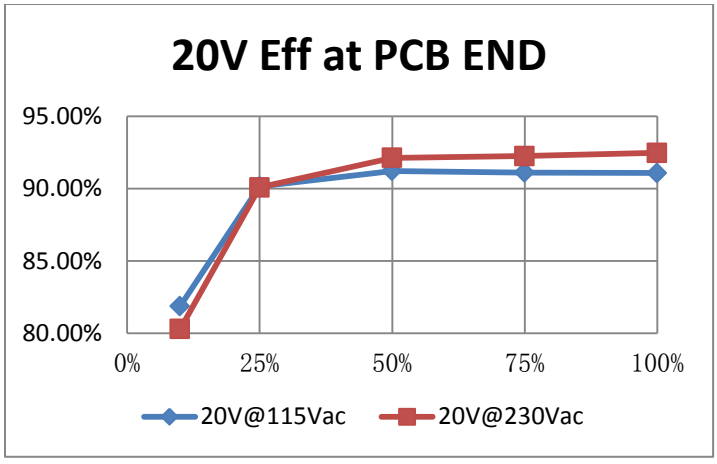
5.1.3 Average Efficiency at Different Loading (@ PCB end) and its chart curve

Vin	Vo	10% Load	25% Load	50% Load	75% Load	100% Load	**Average Efficiency**	Energy Star Level VI	COC_Tier2
115V/60Hz	5V-4A	86.92%	90.28%	89.87%	89.23%	88.57%	**89.49%**	>83.08%	>83.68%
	9V-4A	88.76%	91.13%	90.75%	90.30%	89.69%	**90.51%**	>87.40%	>88.30%
	15V-3A	85.76%	91.03%	91.56%	91.27%	90.75%	**91.15%**	>87.73%	>88.85%
	20V-2.25A	81.88%	90.15%	91.22%	91.11%	91.07%	**90.89%**	>87.73%	>88.85%
230V/50HZ	5V-4A	85.45%	88.25%	89.64%	89.28%	88.92%	**89.02%**	>83.08%	>83.68%
	9V-4A	86.44%	90.75%	91.35%	90.88%	90.70%	**90.92%**	>87.40%	>88.30%
	15V-3A	83.70%	90.61%	92.35%	92.20%	92.10%	**91.81%**	>87.73%	>88.85%
	20V-2.25A	80.29%	90.08%	92.12%	92.24%	92.47%	**91.73%**	>87.73%	>88.85%









5.2 Key Performance Waveforms

5.2.1 45W PD3.0 System Start-up Time

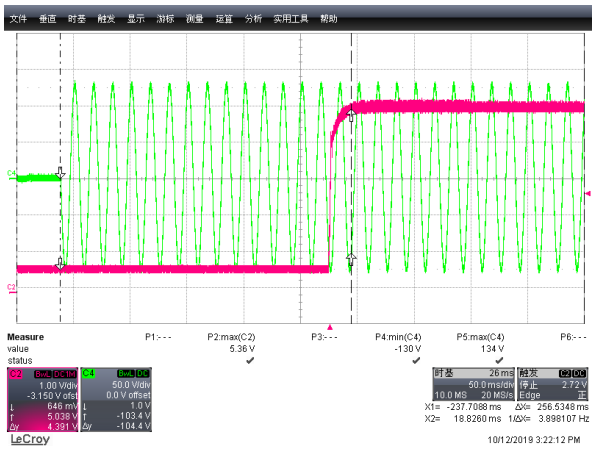


Figure 10: 45W PD 3.0 turn on time 0.256s 5V/4A at 90Vac

5.2.2 Q1 /Q2 Main Switching Voltage MOSFET Stress on at 20V/ 2.25A Loading @264Vac

Primary side MOSFET - Q1

Figure 11: Q1 Vds Voltage stress

Secondary side SR MOSFET- Q2

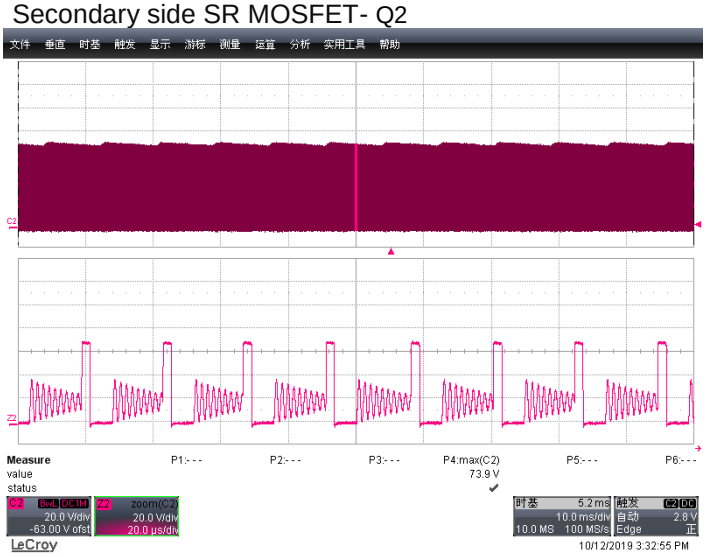


Figure12: Q2 Vds Voltage stress

Vout	Vds	Vds_Max_Spec	Ratio of voltage stress		Vout	Vds	Vds_Max_Spec	Ration of voltage stress
20V	620V	650V	95%		20V	73.9V	100V	74%

5.2.3 System Output Ripple & Noise with @ PCB End

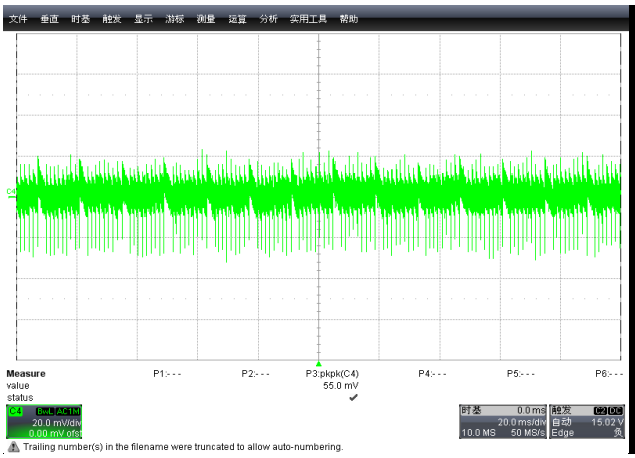


Figure 13: The Ripple at 90Vac/60Hz ΔV=55mV 5V/0A

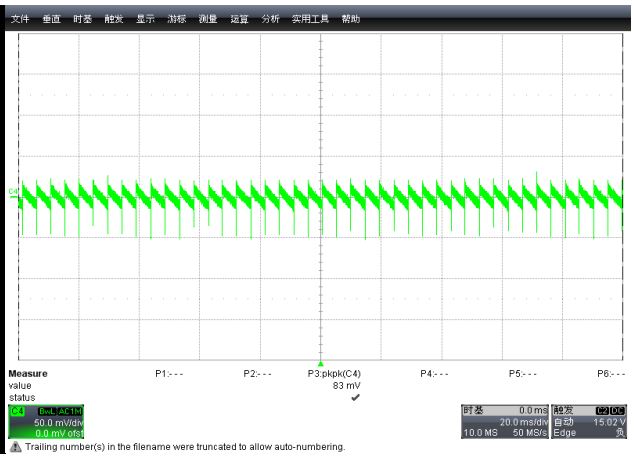


Figure 14: The Ripple at 264Vac/50Hz ΔV=83mv 5V/0A

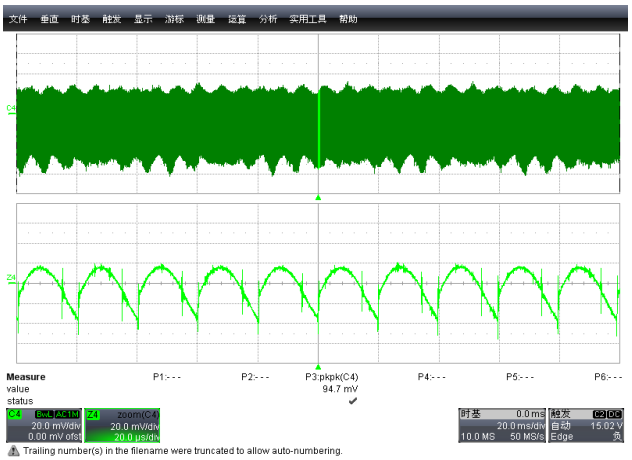


Figure 15: 90Vac/60Hz 5V/4A ΔV=95mV

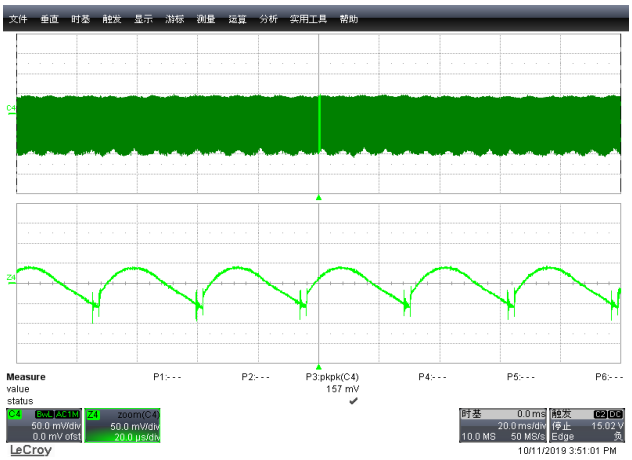


Figure 16: 264Vac/50Hz 5V/4A ΔV=157mv

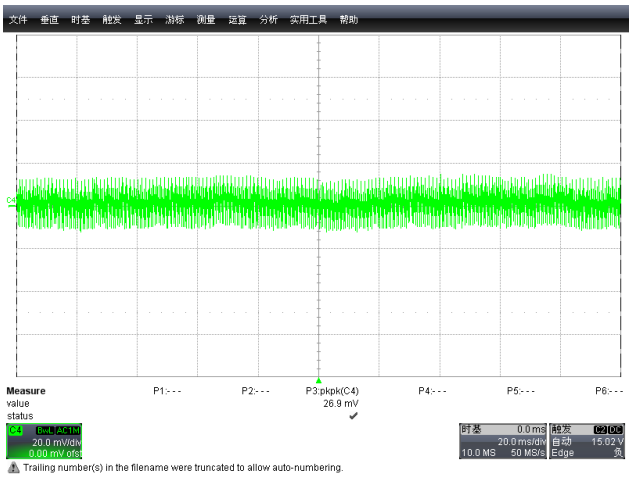


Figure 17: 90Vac/60Hz 9V/0A ΔV=27mV

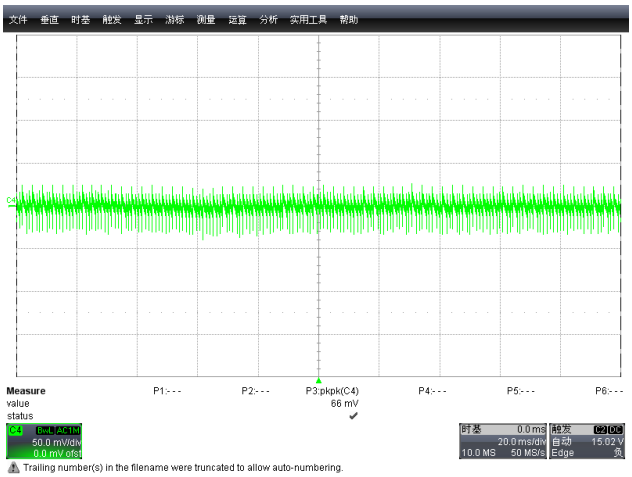


Figure 18: 264Vac/50Hz 9V/0A ΔV=66mv

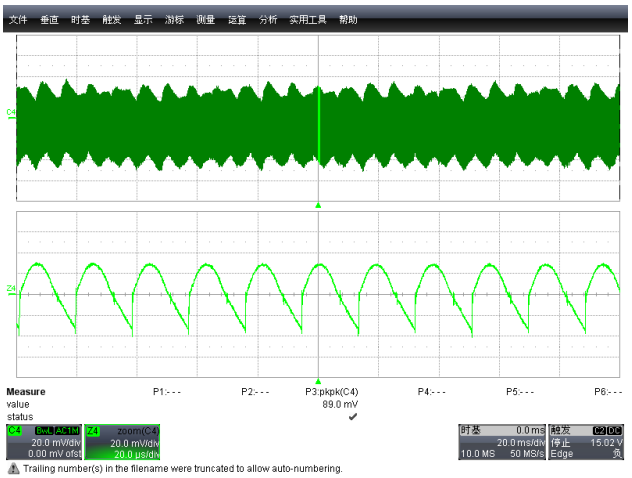


Figure 19: 90Vac/60Hz 9V/4A ΔV=89mV

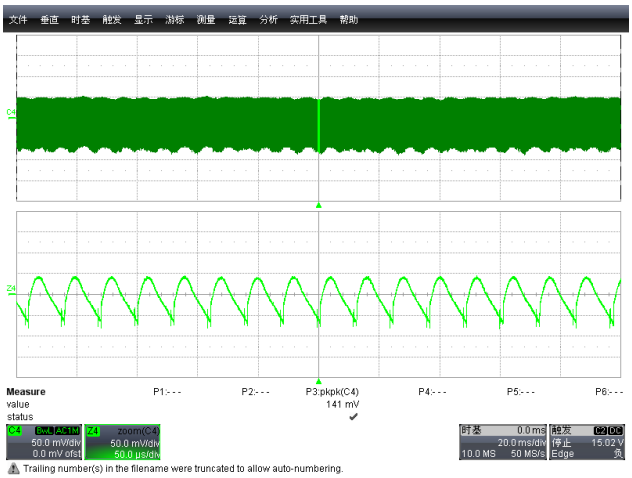


Figure 20: 264Vac / 60Hz 9V/4A ΔV=141mV

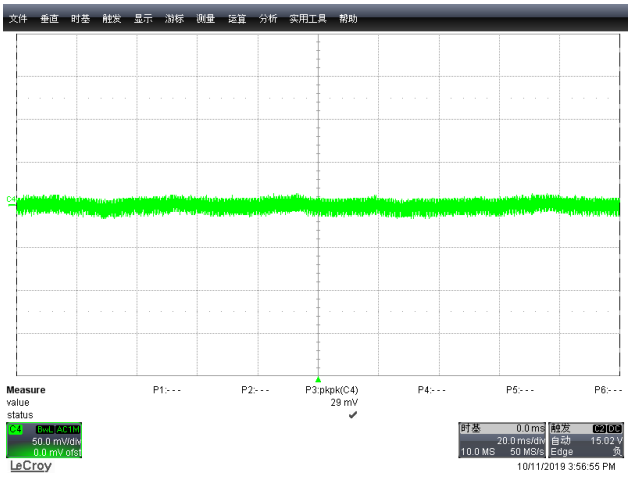


Figure 21: 90Vac/60Hz 15V/0A ΔV=29mV

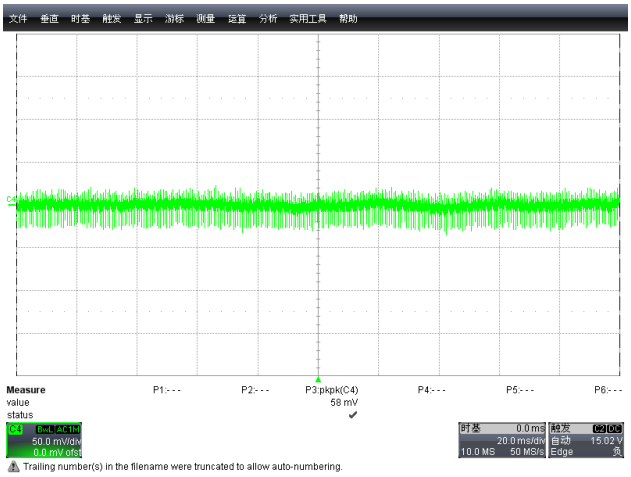


Figure 22: 264Vac / 60Hz 15V/0A ΔV=58mV

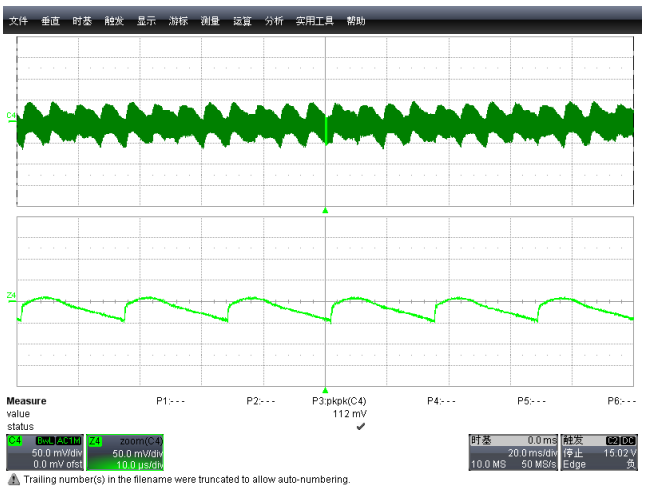


Figure 23: 90Vac/60Hz 15V/3A ΔV=112mV

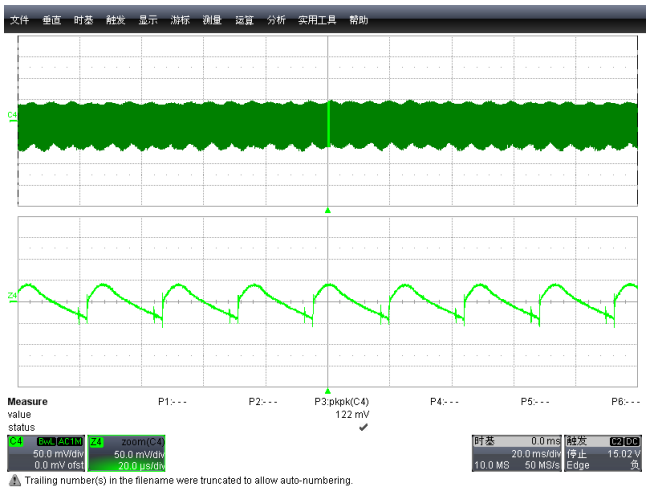


Figure 24: 264Vac / 60Hz 15V/3A ΔV=122mV

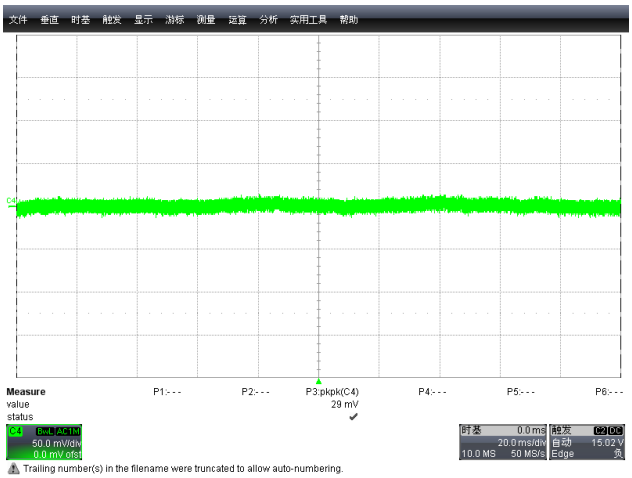


Figure 25: 90Vac/60Hz 20V/0A ΔV=29mV

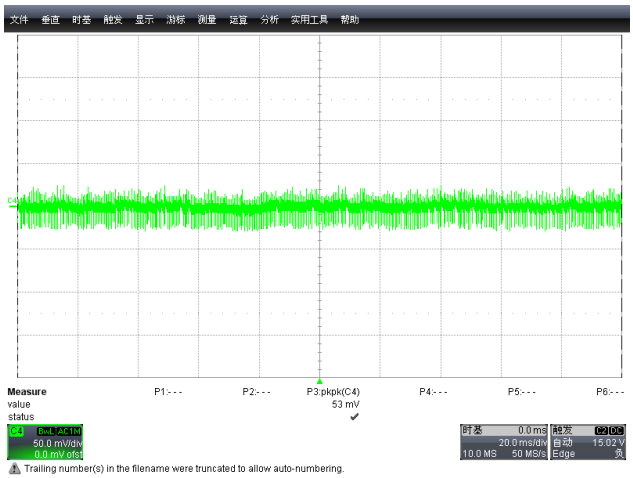


Figure 26: 264Vac / 60Hz 20V/0A ΔV=53mV

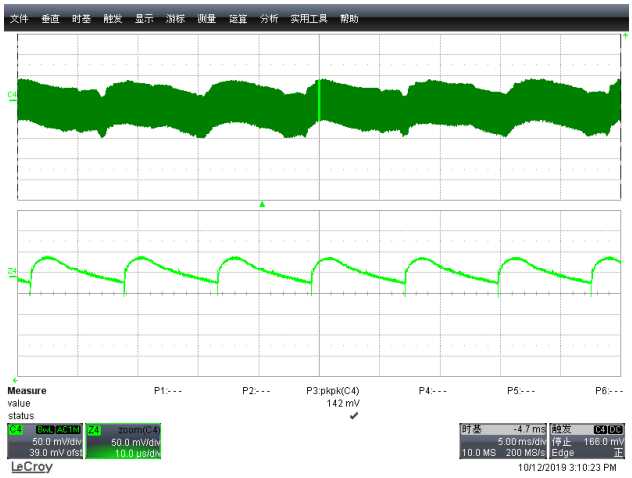


Figure 27: 90Vac/60Hz 20V/2.25A ΔV=142mV

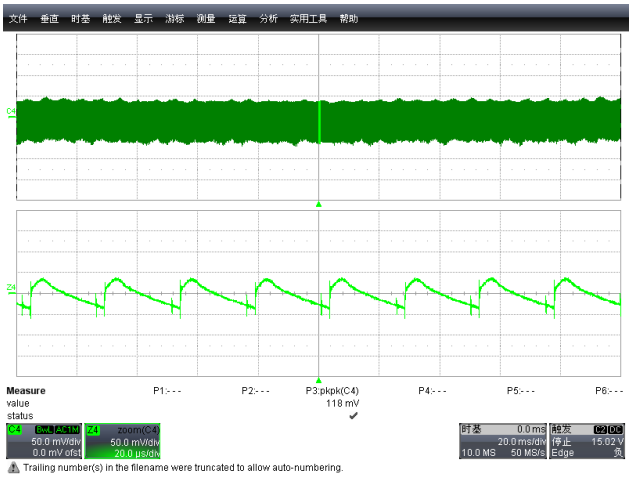


Figure28: 264Vac / 60Hz 20V/2.25A ΔV=118mV

5.2.4 Dynamic load ----10% Load – 90% Load, Tr=10mS , 100mA/uS(PCB End)

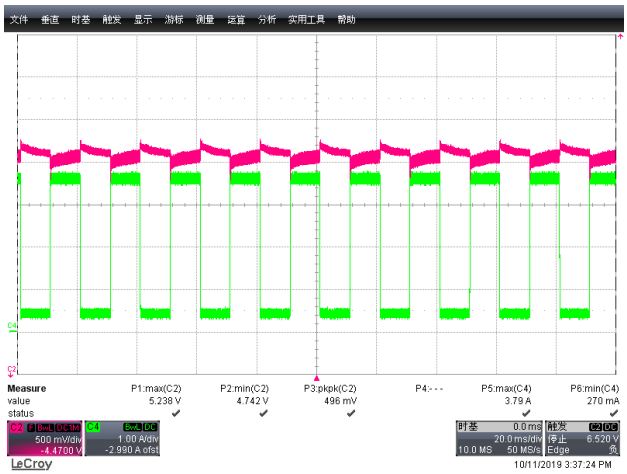


Figure 29: VIN=90VAC, 5V @ 0.4 ~ 3.6A

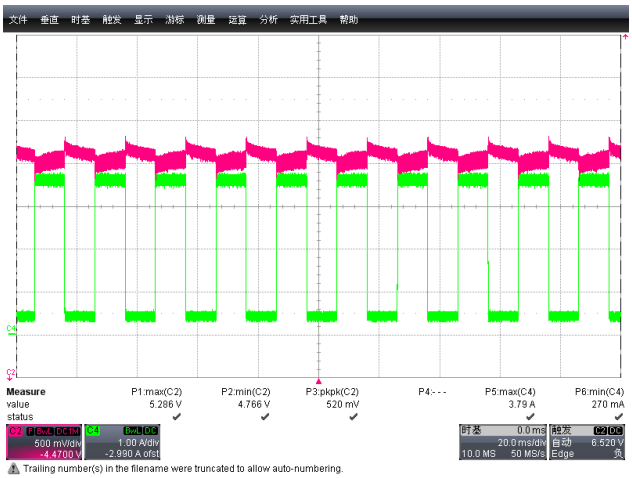


Figure 30: VIN=264VA, 5V @ 0.4 ~ 3.6A

	Vo_Undershoot(V)	Vo_Overshoot(V)
Vin=90VAC	4.74	5.23
Vin=264VAC	4.77	5.286

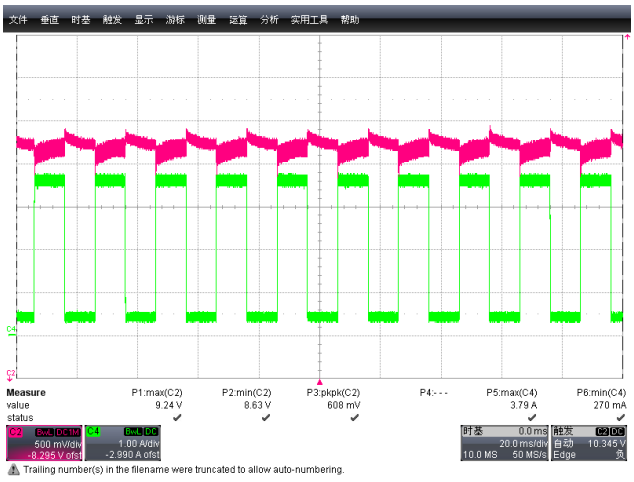


Figure 31: VIN=90VAC, 9V @ 0.4 ~ 3.6A

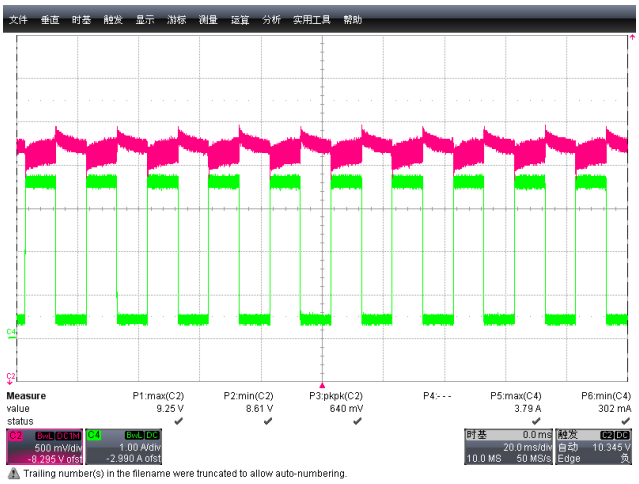


Figure 32: VIN=264VAC, 9V @ 0.4 ~ 3.6A

	Vo_Undershoot(V)	Vo_Overshoot(V)
Vin=90VAC	8.63	9.24
Vin=264VAC	8.63	9.25

Figure 33: VIN=90VAC, 15V @ 0.3 ~ 2.7A

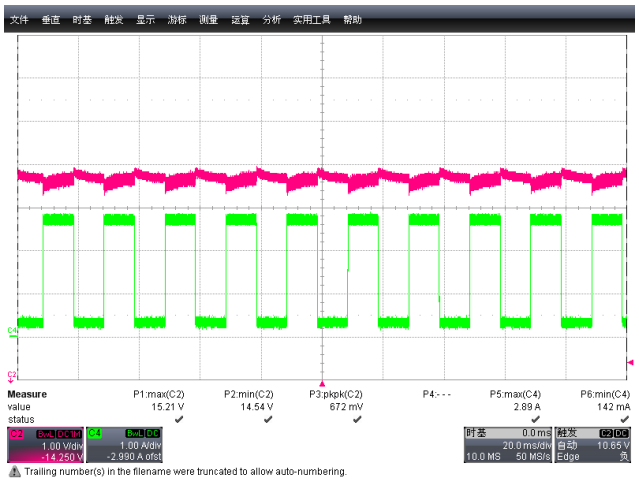


Figure 34: VIN=264VAC, 15V @ 0.3 ~ 2.7A

	Vo_ Undershoot(V)	Vo_ Overshoot(V)
Vin=90VAC	14.57	15.15
Vin=264VAC	14.54	15.21

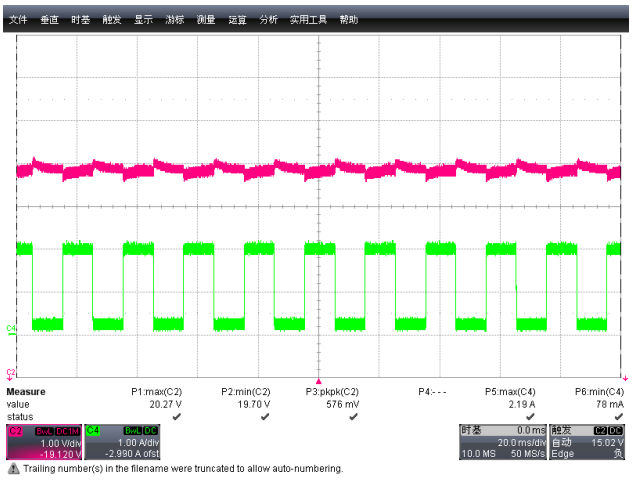


Figure 35: VIN=90VAC, 20V @ 0.22 ~ 2A

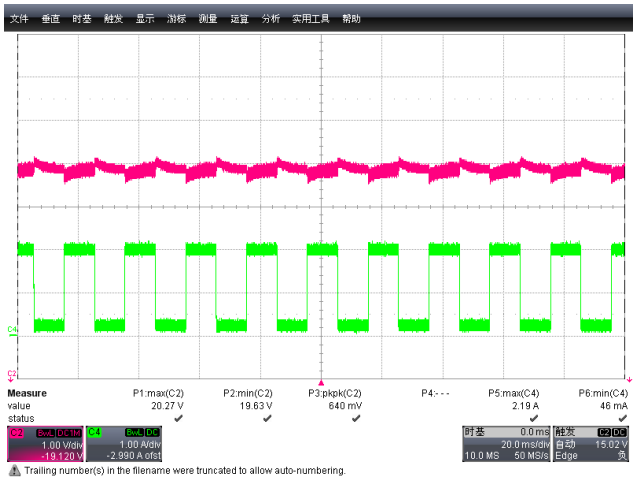


Figure 36: VIN=264VAC, 20V @ 0.22 ~ 2A

	Vo_ Undershoot(V)	Vo_ Overshoot(V)
Vin=90VAC	19.70	20.27
Vin=264VAC	19.63	20.27

5.2.5 Output Voltage Transition Time

5.2.5.1 From Step up & Step down

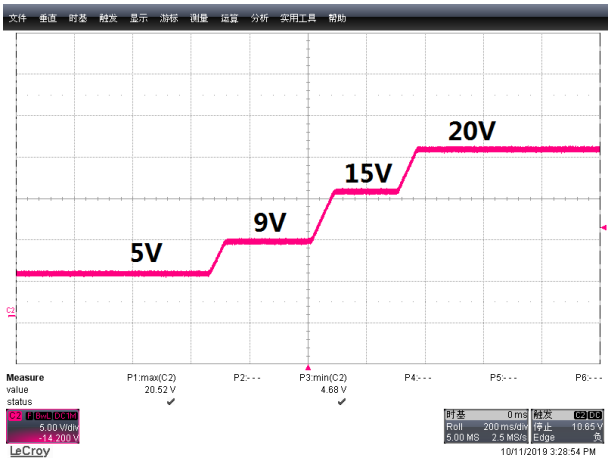


Figure 37: 5V-9V-15V-20V Transition Step Up Time

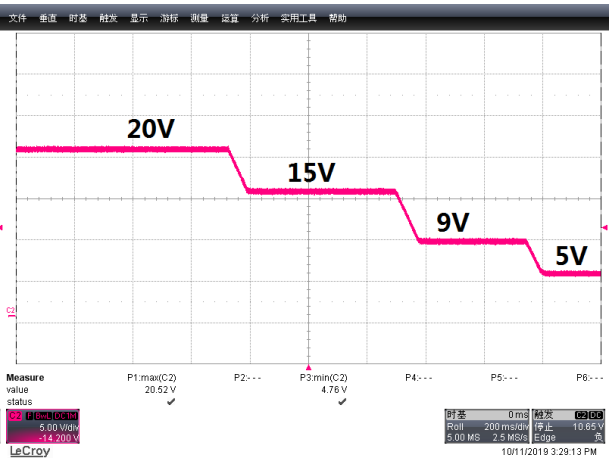


Figure 38: 20V-15V-9V-5V Transition Steo down Time

5.2.5.2 Transition time from Low to high

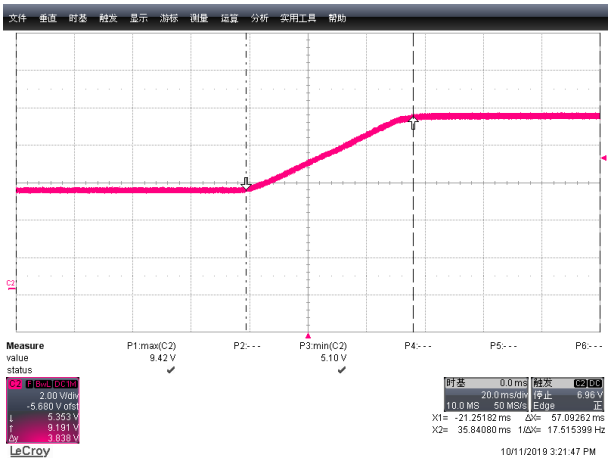


Figure 39: 5V→9V Transition upl Time: 57ms

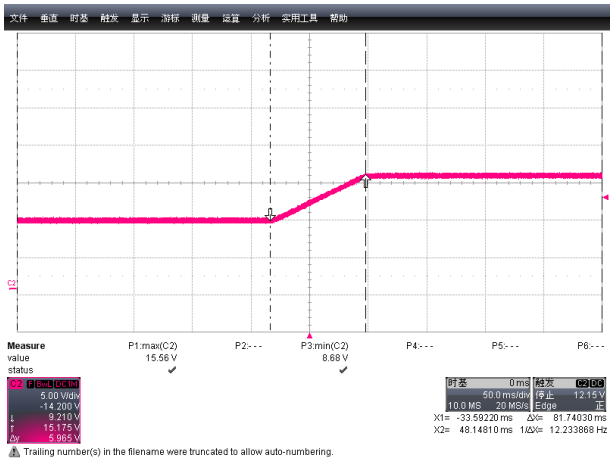


Figure 40: 9V→15V Fall Time: 82ms

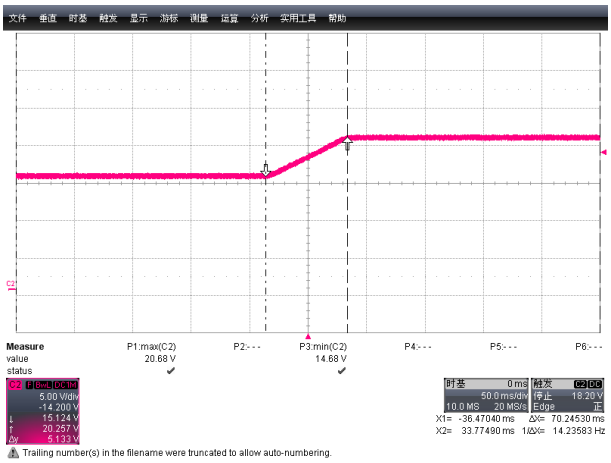


Figure 41: 15V→20V Fall Time: 70ms

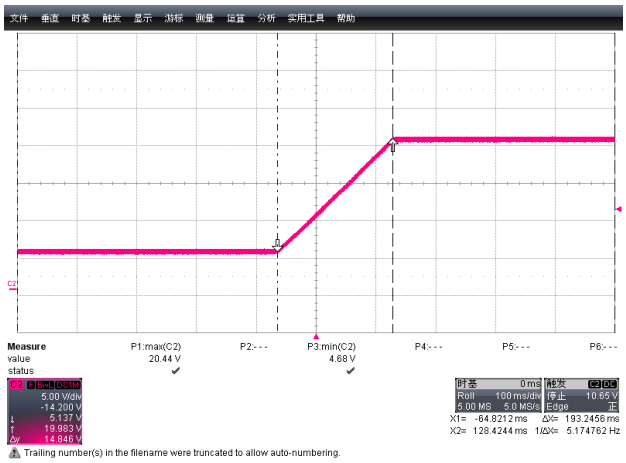


Figure 42: 5V→20V Fall Time: 192ms

5.2.5.3 Output Voltage Transition Time from High to Low

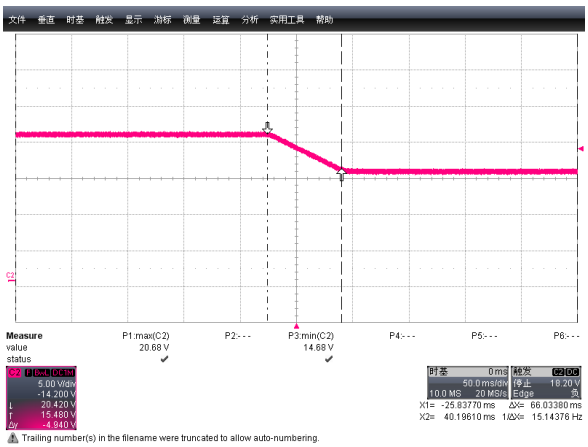


Figure 43: 20V→15V Fall Time: 66ms

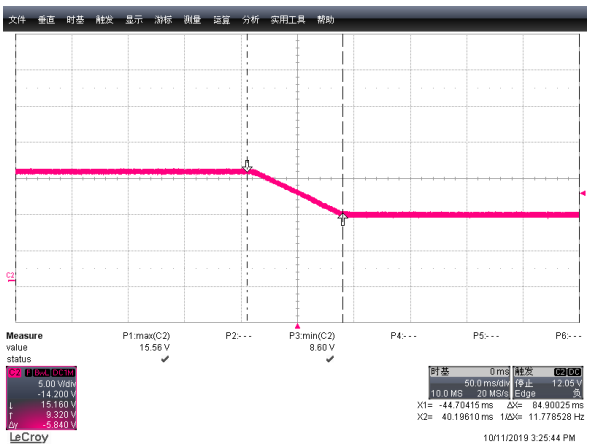


Figure 44: 15V→9V Fall Time: 95ms

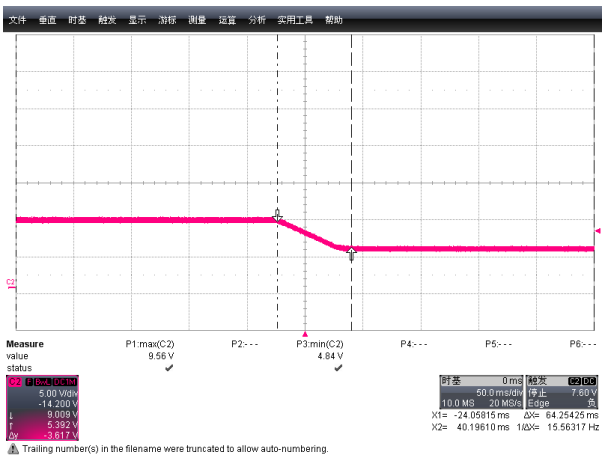


Figure 45: 9V→5V Fall Time: 64ms

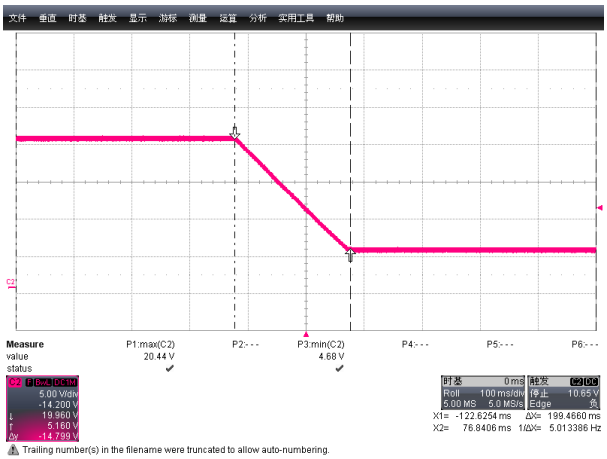


Figure 46: 20V→5V Fall Time: 199ms

5.2.7 Thermal Testing

5.2.7.1 Test Condition: AC input=90Vac, Load 20V-2.25A ,Open Frame

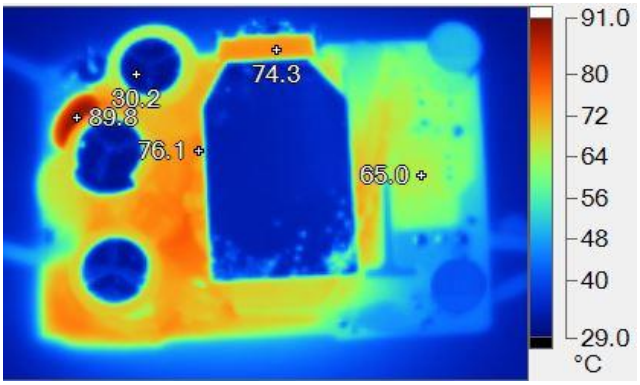


Figure 47: Components Side

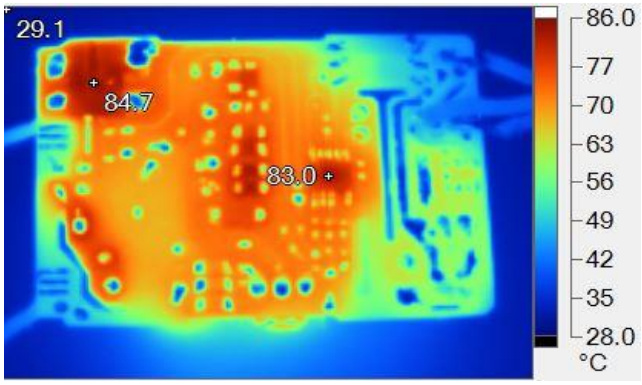


Figure 48: surface mount side

Test Items	Temperature	Unit
Ambient Temp	30.1	℃
AP3108LS	83	℃
Q1	74.3	℃
T1	76.1	℃
Q2	65	℃
BD1	84.7	℃
NTC1	89.8	℃

5.2.7.2 Test Condition: Vin=264Vac Vo=20V Io=2.25A Open Frame

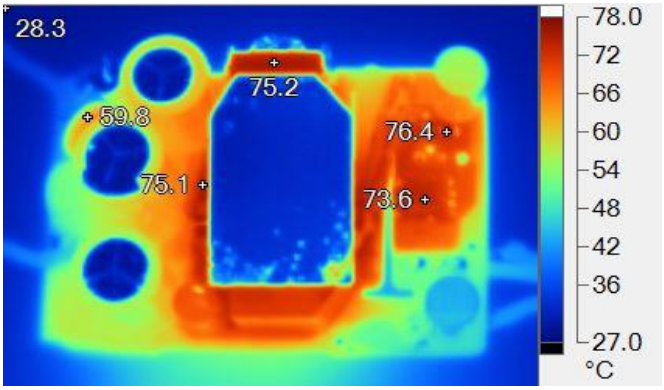


Figure 49: Components Side

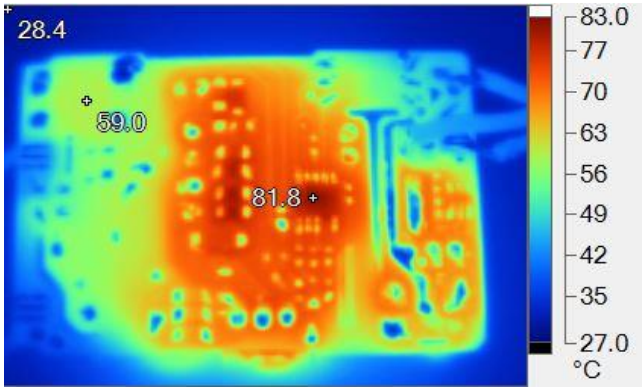


Figure 50: Surface mount side

Test Items	Temperature	Unit
Ambient Temp	28.4	℃
AP3108LS	81.8	℃
Q1	75.2	℃
T1	75.1	℃
Q2	73.6	℃

BD1	59	℃
NTC1	59.8	℃

5.3. EMI testing results

5.3.1 EMI (CE) Testing results—115Vac @ 20V/2.25A- (L) & (N)

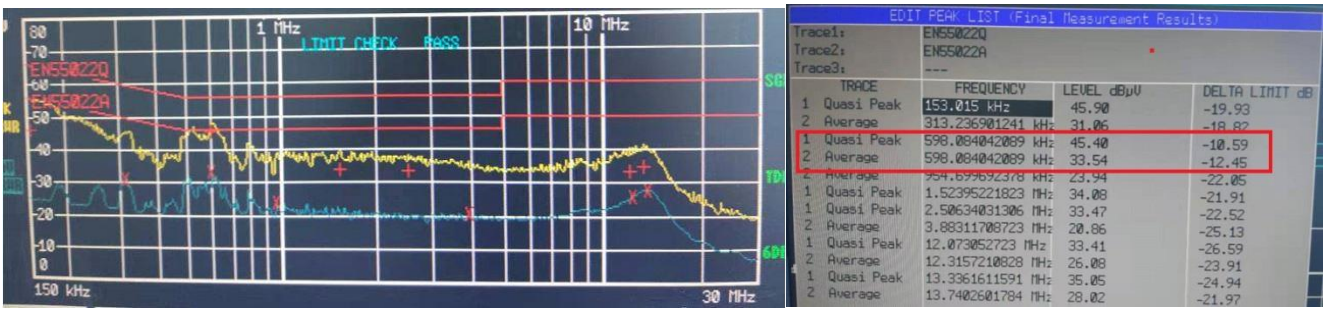


Figure 51: 115Vac/60Hz 20V/3.25A (L)

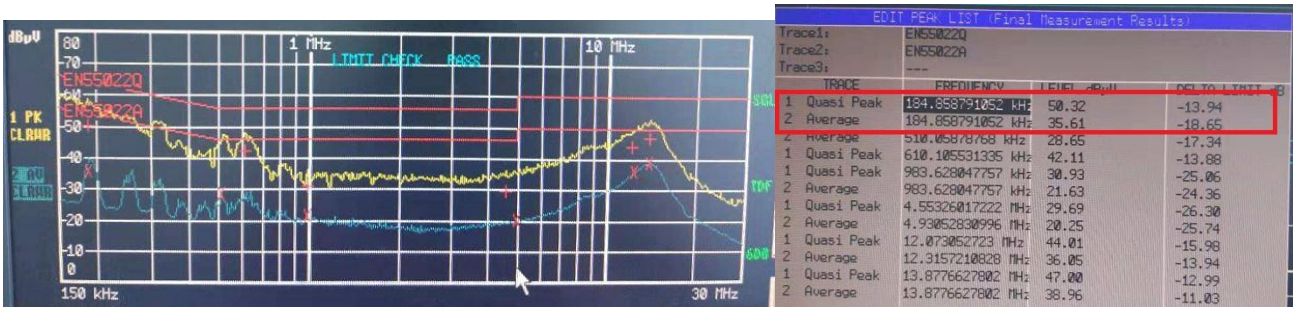


Figure 52: 115Vac/60Hz 20V/3.25A (N)

5.3.2 EMI (CE) Testing results—230Vac @ 20V/2.25A- (L) & (N)

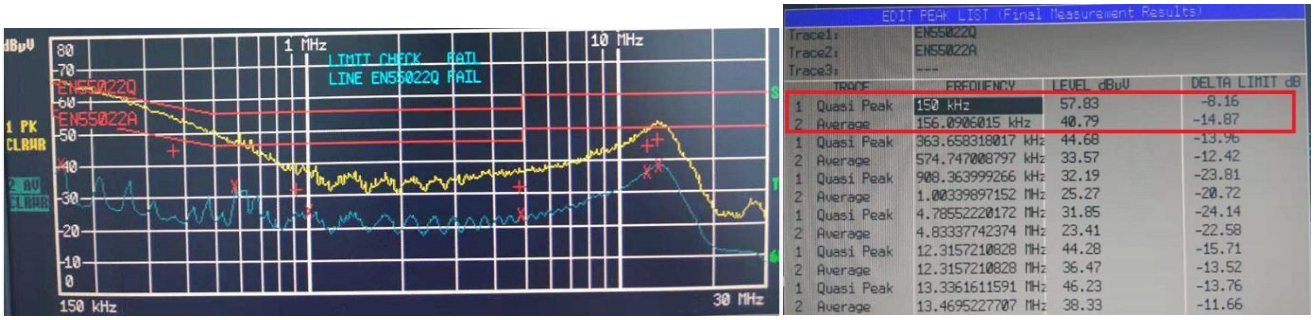


Figure 53: 230Vac/50Hz 20V/3.25A (L)

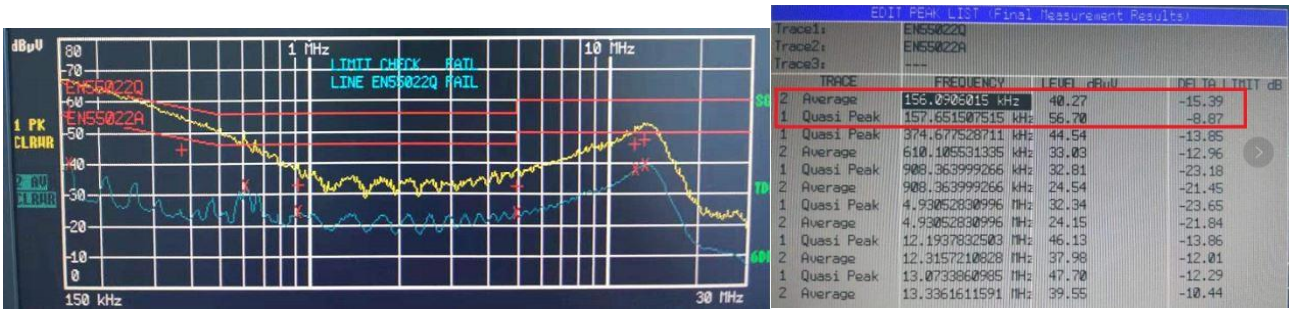
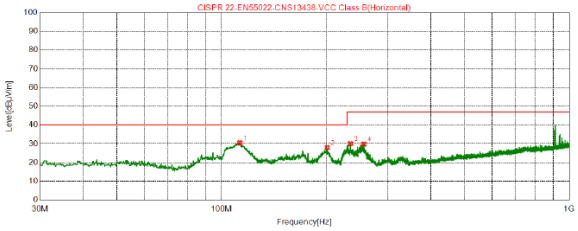


Figure 54: 230Vac/50Hz 20V/3.25A (N)

5.3.3 EMI (RE) Testing results—115Vac @ 20V/2.25A

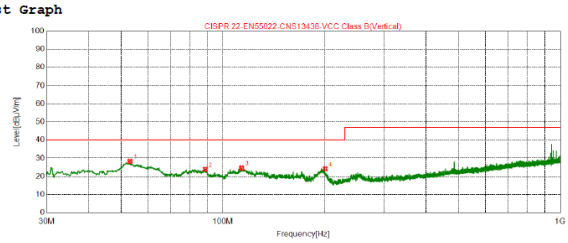
Test Graph



QP Detector

NO.	Freq. [MHz]	Reading [dBµV/m]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	112.8	42.50	-11.98	30.52	40.00	9.48	200	179	Horizontal
2	201.3	40.28	-12.30	27.98	40.00	12.02	100	172	Horizontal
3	234.8	41.04	-10.95	30.09	47.00	16.91	100	90	Horizontal
4	256.9	40.01	-10.19	29.82	47.00	17.18	100	288	Horizontal

Test Graph

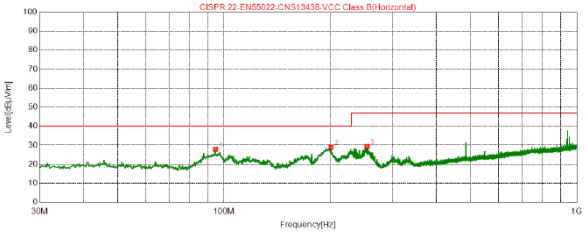


QP Detector

NO.	Freq. [MHz]	Reading [dBµV/m]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	53.08	38.29	-9.97	28.32	40.00	11.68	100	255	Vertical
2	88.78	38.34	-14.42	23.92	40.00	16.08	100	264	Vertical
3	113.8	36.51	-11.95	24.56	40.00	15.44	100	296	Vertical
4	201.1	36.52	-12.31	24.21	40.00	15.79	100	154	Vertical

5.3.4 EMI (RE) Testing results—230Vac @ 20V/2.25A

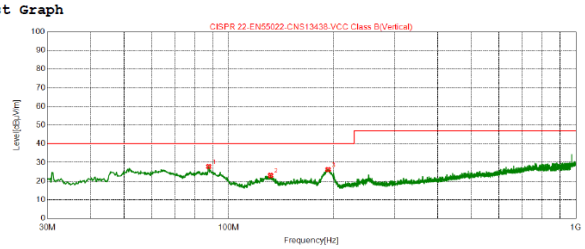
Test Graph



QP Detector

NO.	Freq. [MHz]	Reading [dBµV/m]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	94.60	41.92	-14.03	27.89	40.00	12.11	200	17	Horizontal
2	201.1	41.28	-12.31	28.97	40.00	11.03	100	161	Horizontal
3	254.4	39.64	-10.28	29.36	47.00	17.64	100	302	Horizontal

Test Graph



QP Detector

NO.	Freq. [MHz]	Reading [dBµV/m]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	87.61	42.15	-14.33	27.82	40.00	12.18	200	188	Vertical
2	132.0	33.67	-10.63	23.04	40.00	16.96	100	0	Vertical
3	193.3	38.29	-12.07	26.22	40.00	13.78	100	132	Vertical

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