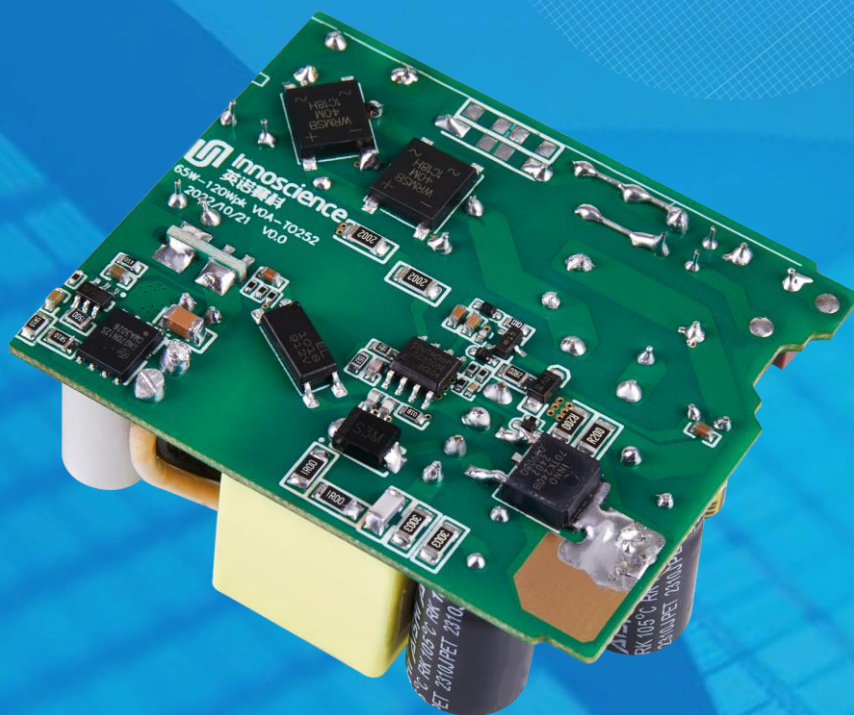


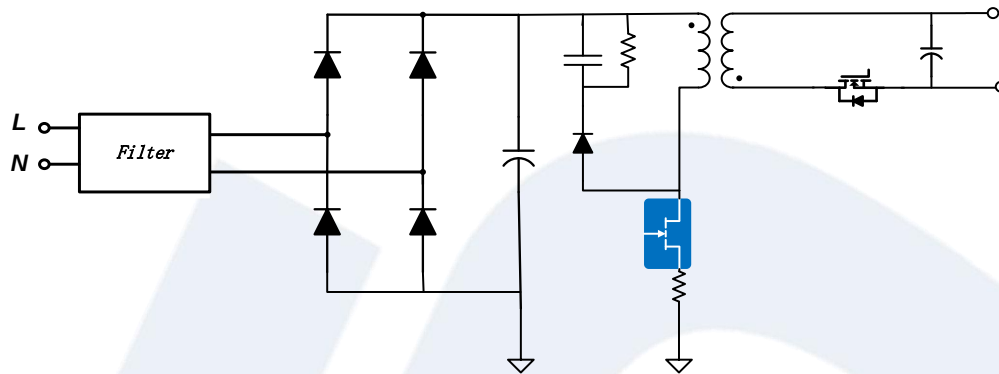
INNDA120B2

Demo Manual
65W (Peak 120W) QR Charger



65W (Peak 120W) QR Charger

- The Introduction

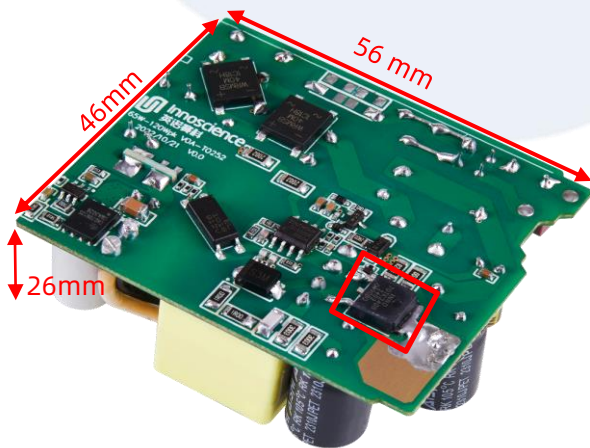


INNDAD120B2 is mainly used in the field of chargers. The input voltage is 90Vac-264Vac, the output is 20V/6A, and the maximum output power of 120W can be maintained for 3 minutes when the input voltage is 230V. The peak efficiency is 94.14%, the full load efficiency is 94.1% @ 230Vac, and the power density is 29.4W/in³. The primary side adopts QR control IC, and the secondary side adopts synchronous rectification.

- Highlighted Products

- INN700TK240B

- Photo

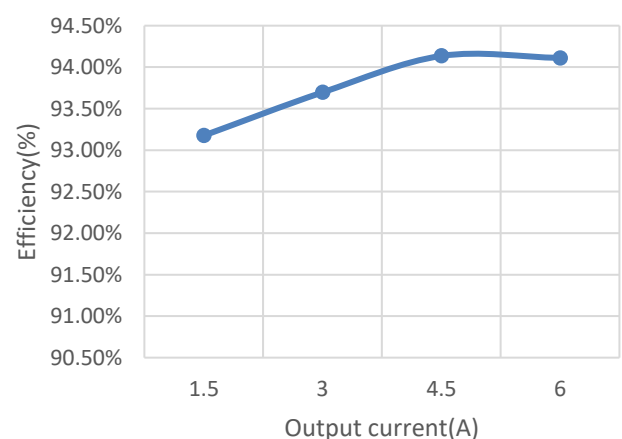


- Target Applications

- Charger

- Test

Overall efficiency Curve



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1. Overview

1.1. Description

INNDAD120B2 is mainly used in the field of chargers. The input voltage is 90Vac-264Vac, the output is 20V/6A, and the maximum output power of 120W can be maintained for 3 minutes when the input voltage is 230V. The peak efficiency is 94.14%, the full load efficiency is 94.1% @ 230Vac, and the power density is 29.4W/in³. The primary side adopts QR control IC, and the secondary side adopts synchronous rectification.

1.2. Features and Advantages

- Main features and Advantages
 - High efficiency: 94.14%(@230Vac),
 - PCBA size: 56*46*26mm
- Protection Function
 - Over current protection
 - Brown in/out with auto-recovery
 - Output over voltage protection
 - Output short protection
 - Over power protection (OPP)

1.3. Applications

- charger

2. Parameters

Table 1 Electrical Characteristic (Ta=25°C)

Symbol	Parameters	Test Conditions	Min	Nom	Max	Units
System Spec						
V_{in}	Input voltage		90	230	264	Vac
F_{ac}	Input frequency			50		Hz
$F_{sw,QR}$		$V_{in}=230Vac$, Full load		63		kHz
V_{out}	Output Voltage	$0A \leq I_o \leq 6A$		20		V
P_{out}	Output power	@ 230Vac 3min			120	W
Demo Performance						
$P_{standby}$	Standby power	230Vac			0.5	W
V_{ripple}	Output voltage ripple	Full load			1000	mV
Eff_{pk}	Peak efficiency	$V_{in}=230Vac$			94.14	%
Eff	Full load efficiency	$V_{in}=230Vac$		94.1		%

3. Demo Solutions

3.1. Block Diagram

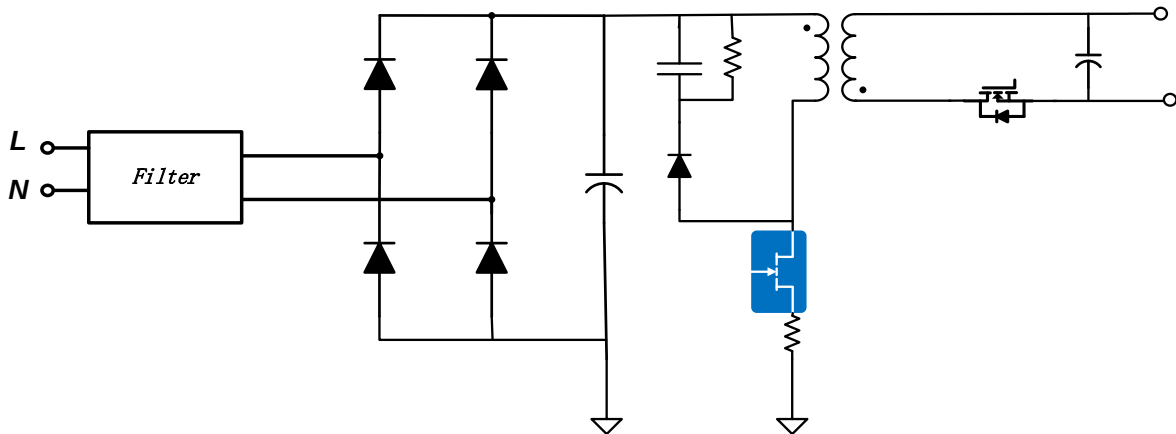


Figure 1 INNDAD120B2 System Block Diagram

3.2. INN700TK240B

INN700TK240B is a 700V silicon-based gallium nitride enhanced power transistor packaged in a TO-252 package. Compared to Si-MOSFET devices with the same conduction resistance, INN700TK240B has advantages such as lower Q_g and C_{oss} , zero reverse recovery charges, etc., which can reduce the switching and driving losses of the system.

Table 2 INN700TK240B Key performance parameters($T_j=25^\circ\text{C}$)

Parameter	Value	Unit
$V_{ds,max}$	700	V
$R_{ds(on),max}@V_{gs}=6V$	240	m Ω
$Q_{g,typ}@V_{ds}=400V$	2	nC
$I_{d,pulse}$	18	A
$Q_{oss}@V_{ds}=400V$	21	nC
$Q_{rr}@V_{ds}=400V$	0	nC

4. Hardware Implementation

4.1. Photos

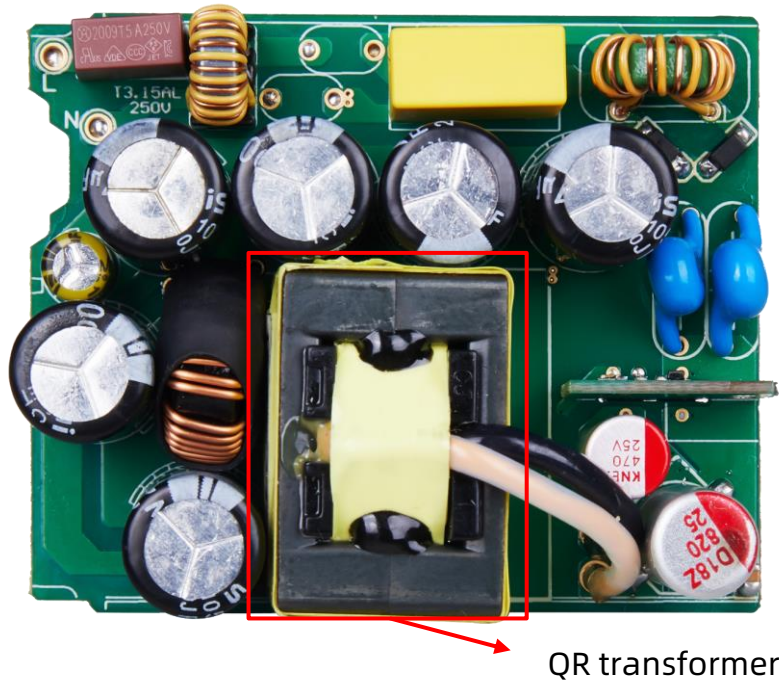


Figure 2 Top view of INNDAD120B2

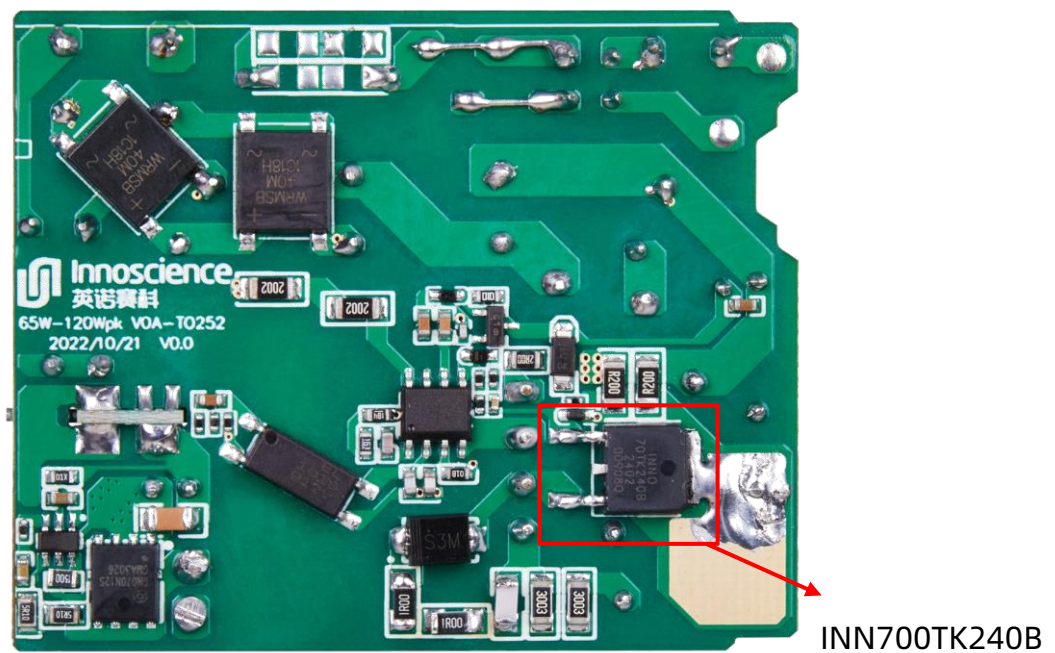
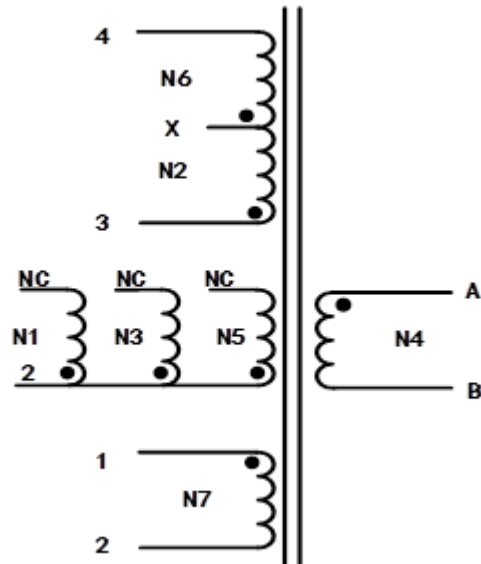


Figure 3 Bottom view of INNDAD120B2

4.2. Design Considerations

4.2.1. QR Transformer

Electrical diagram



Construction diagram

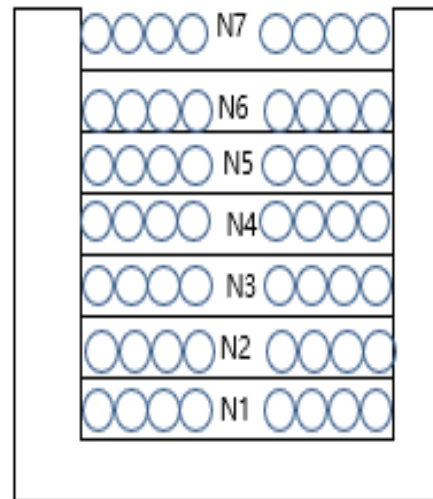


Table 3 Magnetic Core

No.	Name	Core Size/Material	Vendor
1	Core	ATQ25/16	
2	Bobbin	Bobbin: ATQ2516	
3	Material	PC95	A-CORE/TDG/

Table 4 Parameter

No.	Winding	Turns	position	wire diameter	Test Case
1	N1	16	2—NC	0.12*3 2UEW-H	/
2	N2	12	3—X	0.1*20 2UEW-H	/
3	N3	12	2—NC	0.12*3 2UEW-H	/
4	N4	4	A—B	0.1*150 TEX-E	/
5	N5	10	2—NC	0.12*3 2UEW-H	/
6	N6	12	X—4	0.1*20 2UEW-H	/
7	N7	4	1—2	0.12*2 2UEW-H	
Others	/	1	4- copper foil	6*0.05	
NP	/	/			L3-4 =200uH± 5%1V/100KHz
Short 1-2 A-B					L3-4_max=5uH 1V/100KHz

4.2.2. Layout

- Single switch

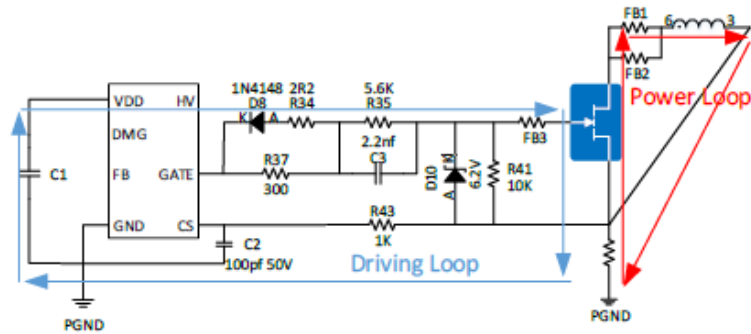


Figure 4 Single Switch Layout Recommendation (a)

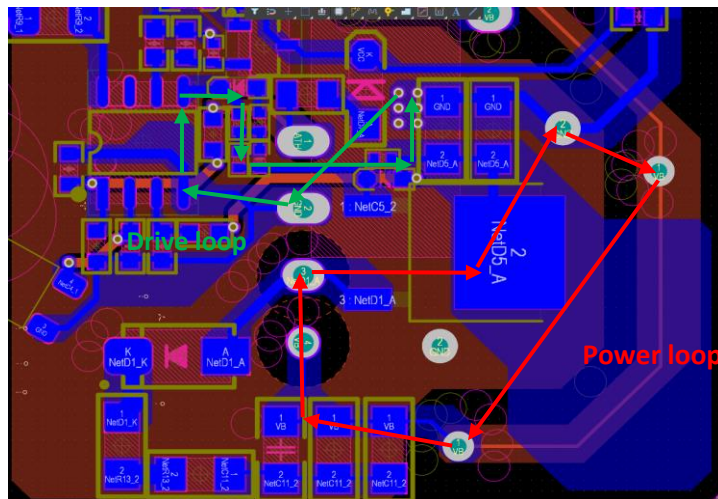


Figure 4 Single Switch Layout Recommendation (b)

As shown in Figure 4, set CBYPASS close to the IC and place the driver loop close to InnoGaN; CBUS, Transformer, InnoGaN circuits loop should be minimized.

5. Testing & Results

5.1. Test Setup

Input Power Meter: Tektronix PA1000

Output load: ITECH IT8712C

Oscilloscope: Tektronix MSO44 200MHz

Input AC Power Source: eec 6700

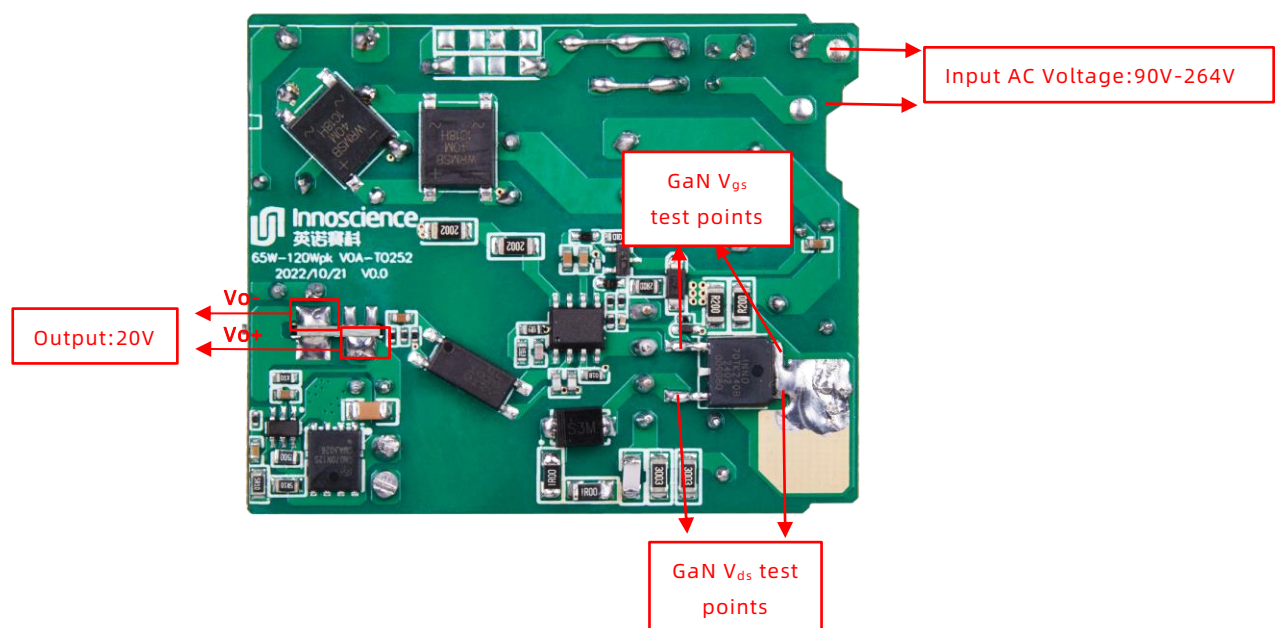


Figure 5 Test points

5.2. Test results

5.2.1. Efficiency

Table 5 Overall efficiency

V_{in} (V)	100%load η (%)	75%load η (%)	50%load η (%)	25%load η (%)	Average η (%)
90Vac	91	92.44	93.07	93.09	92.4
110Vac	92.42	93.44	93.56	93.38	93.2
230Vac	94.11	94.14	93.7	93.18	93.78
264Vac	93.59	93.63	93.27	92.45	93.24

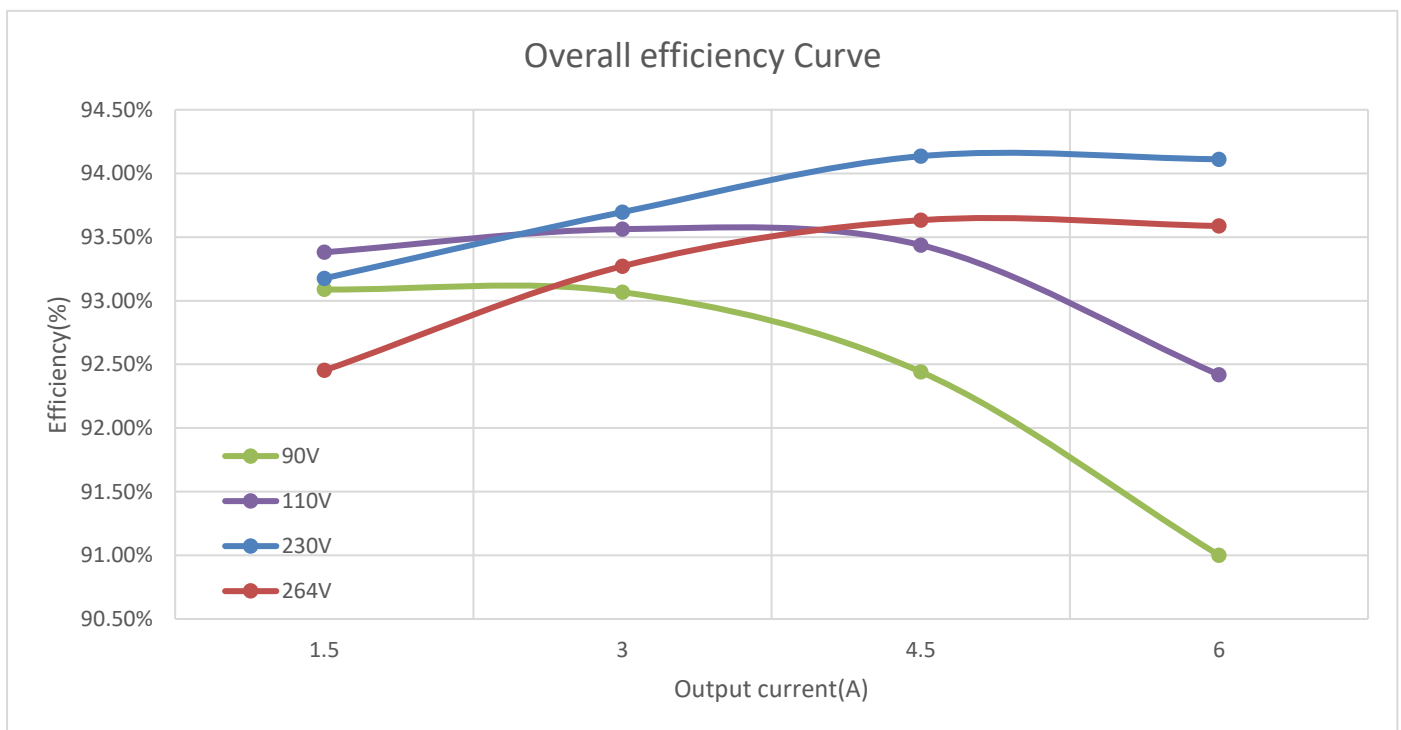
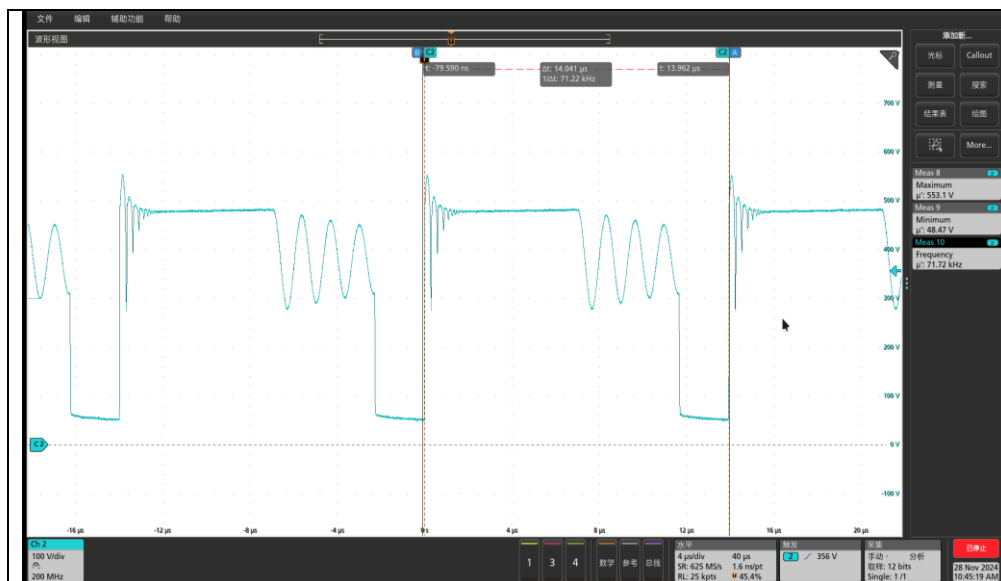


Figure 6 Overall efficiency curve

5.2.2. Switching Waveforms



Test conditions

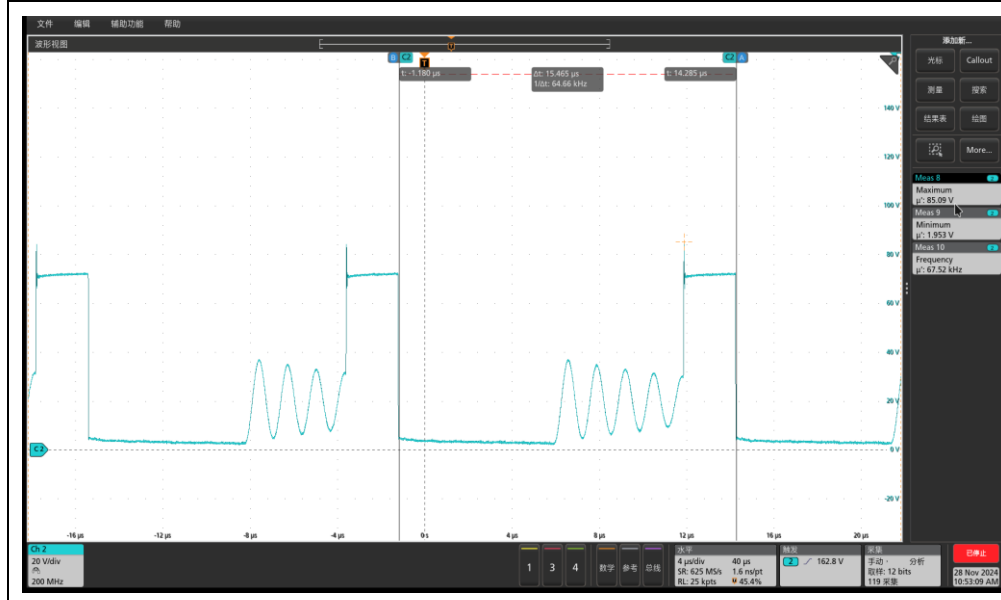
$V_{in}=264V_{ac}/50Hz$

$V_{out}=20V$

Full load

Result

$V_{ds_max}=553.1V$



Test conditions

$V_{in}=264V_{ac}/50Hz$

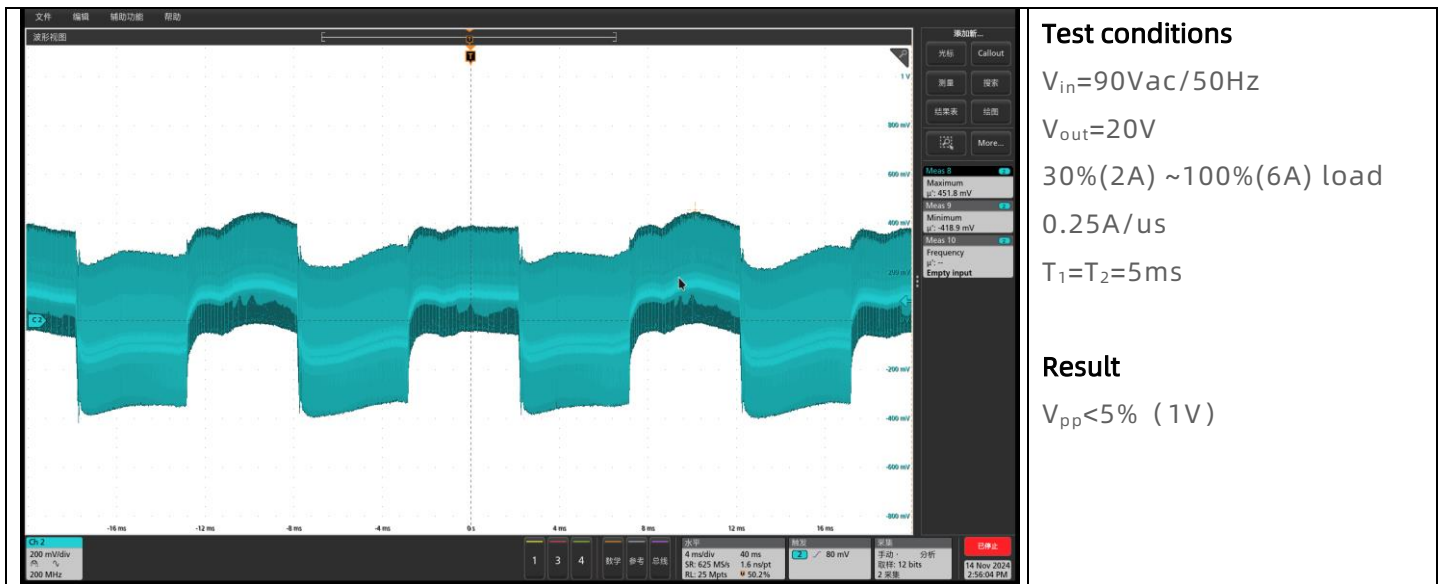
$V_{out}=20V$

Light load to Full load

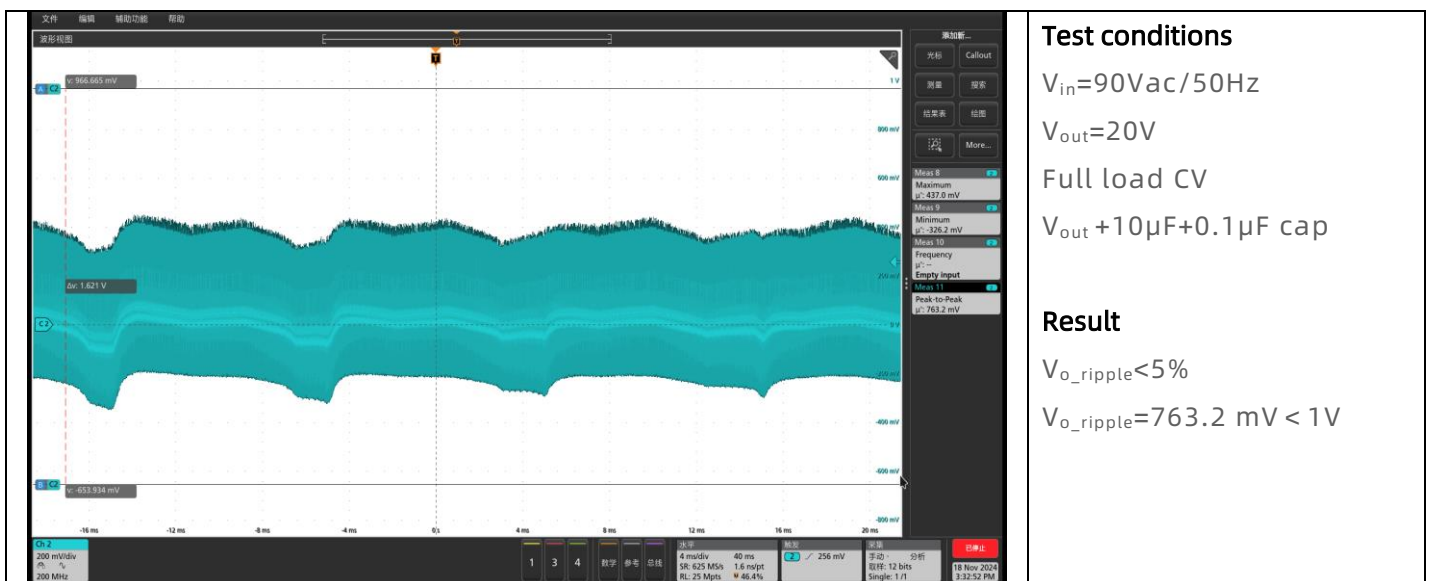
Result

$V_{ds_max_SR}=85.09V$

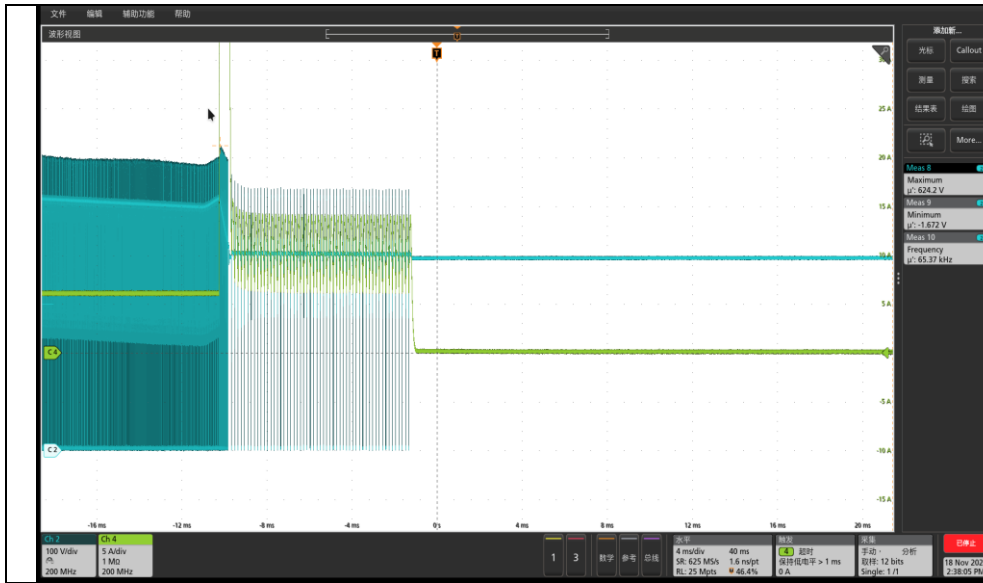
5.2.3. Dynamic Performance



5.2.4. Output Ripple waveform



5.2.5. Short



Test conditions

$V_{in}=275V_{ac}/50Hz$

$V_{out}=20V$

Full load-short

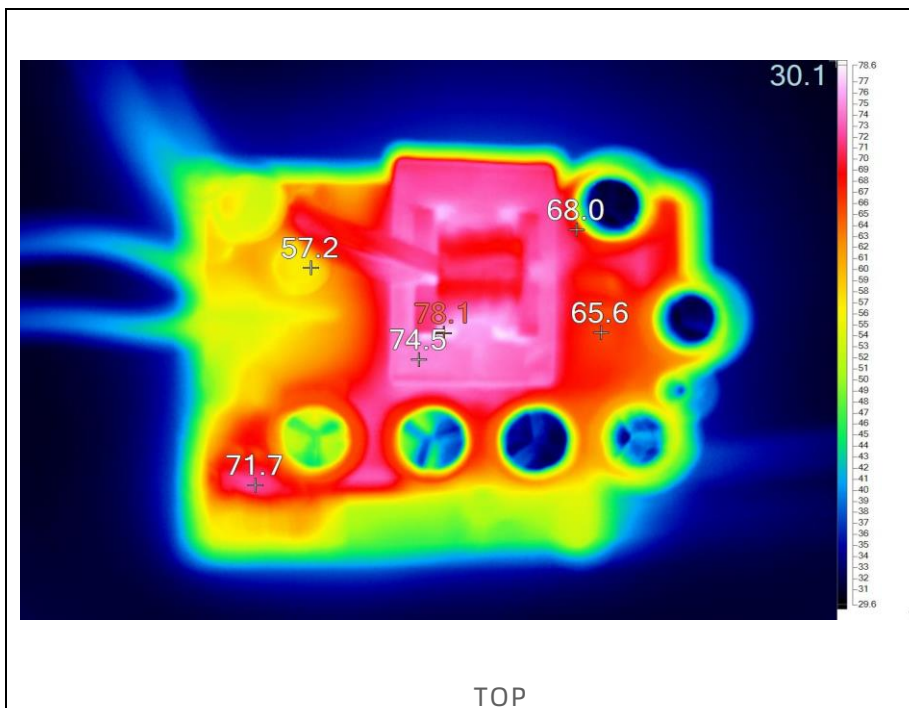
CH2: $V_{ds_max_QR}$

CH4: I_{out}

Result

$V_{ds_max_QR}=624.2V$

5.2.6. Thermal



Test conditions

$V_{in}=90V_{ac}/50Hz$

$V_{out}=20V$

50% load 3A

Ambient temp 30.1°C

Run for 0.5h

Result

Transformer: Winding: 78.1°C

Core: 74.5°C

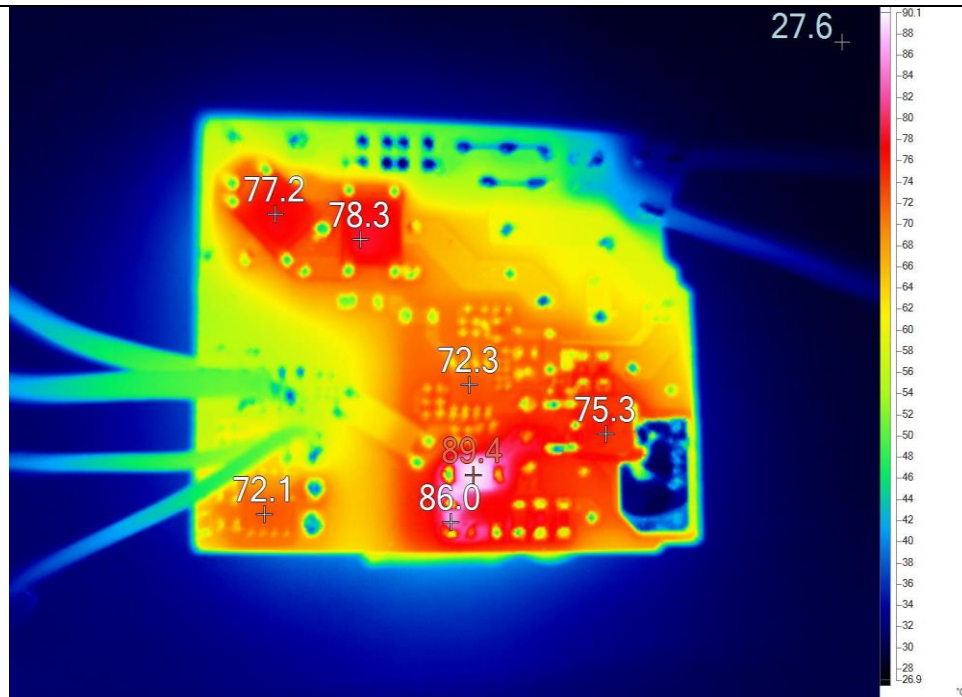
V_{bus} capacitor: 68°C

V_{out} capacitor: 57.2°C

Common mode choke: 71.7°C

Differential mode in

ductance : 65.6°C



Bottom

Test conditions $V_{in}=90\text{Vac}/50\text{Hz}$ $V_{out}=20\text{V}$

50% load 3A

Ambient temp 27.6°C

Run for 0.5h

Result

GaN: 75.3°C

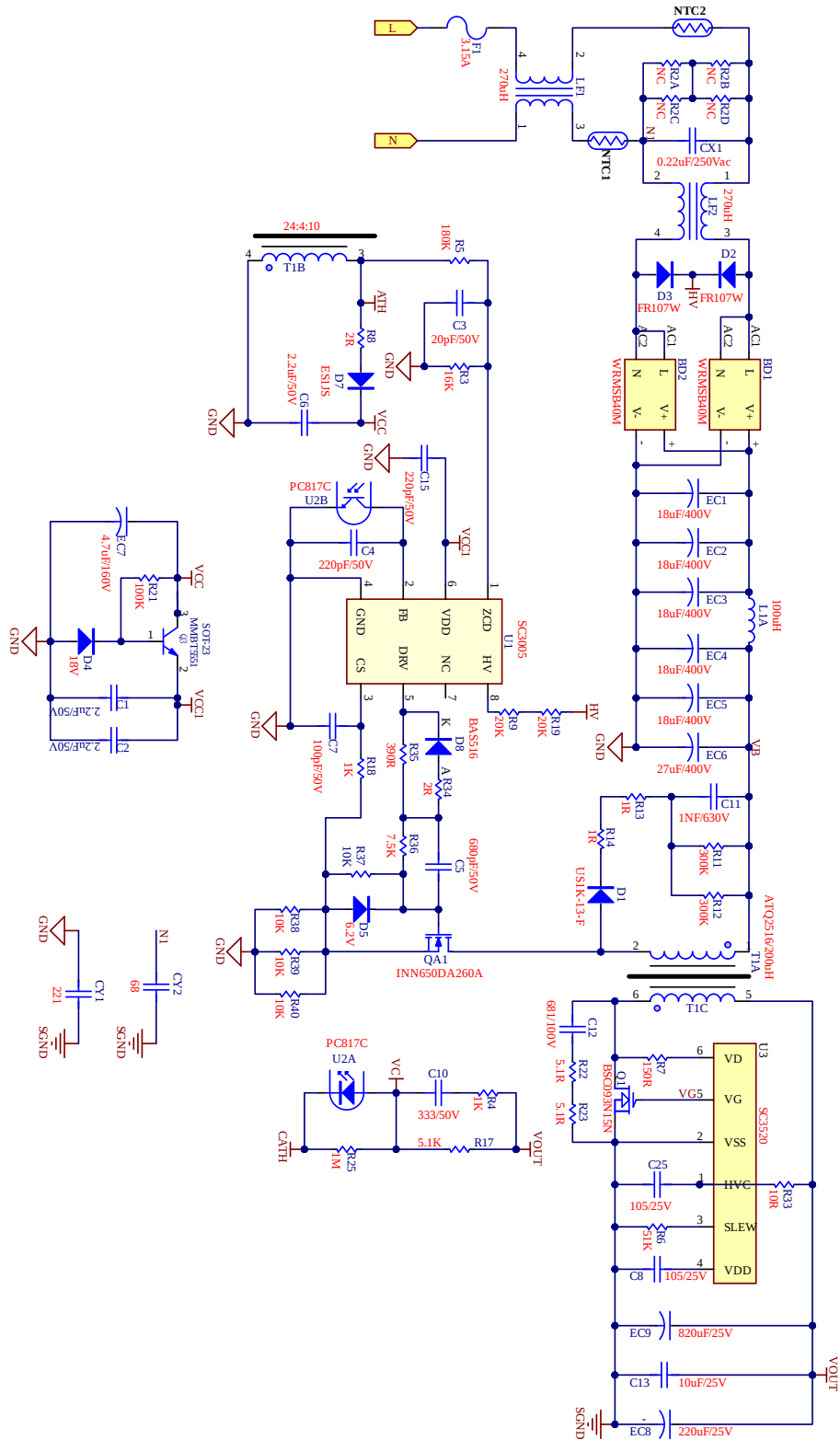
Snubber Diode: 89.4°C

SR MOS: 72.1°C

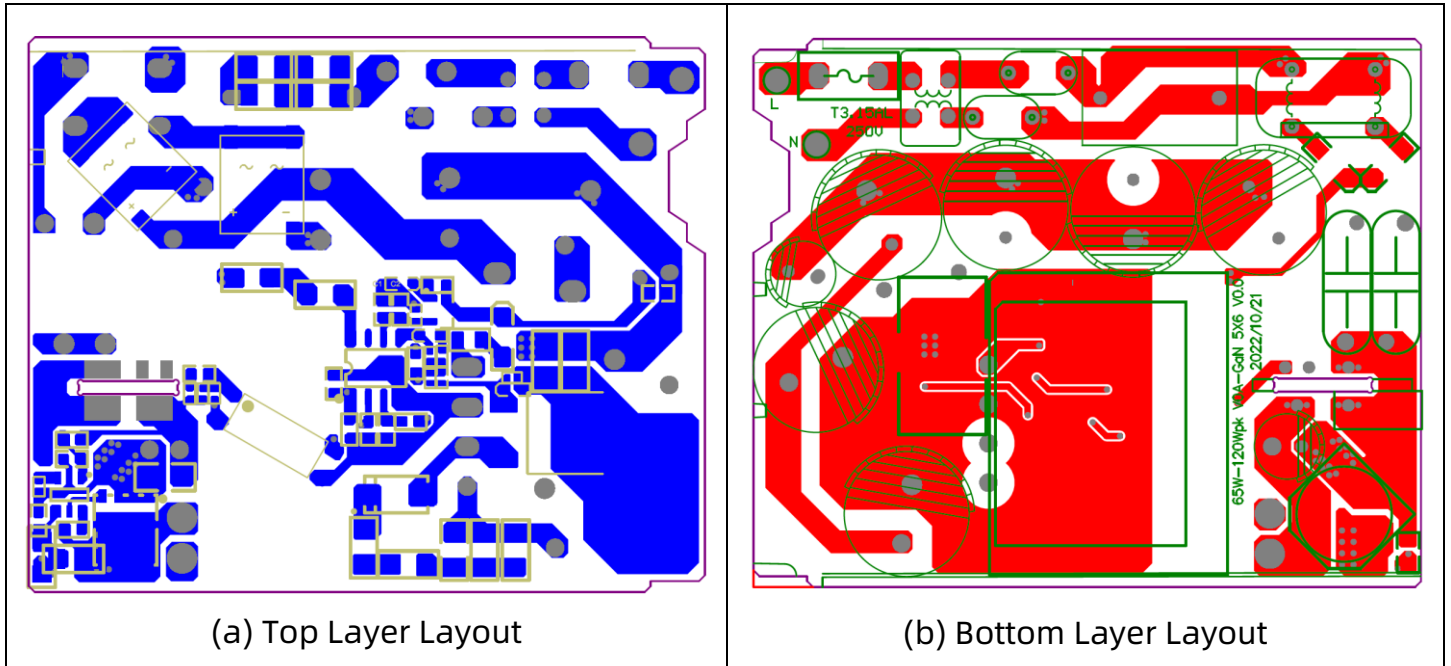
Bridge rectifiers: 78.3°C

Appendix

Appendix A. Schematics



Appendix B. PCB Layouts



Appendix C. BOM

Part Number	Manufacture	Description	Dsignator	Footprint	Quantity
WRMSB40M	/	Rectifier Bridge 1KV/4A	BD1, BD2	RMSB40	1
2.2uF/50V	YAGEO	Capacitor X7R 10%	C1, C2, C6	C0603R	1
20pF/50V	YAGEO	Capacitor X7R 10%	C3	C0603R	1
220pF/50V	YAGEO	Capacitor X7R 10%	C4	C0603R	2
680pF/50V	YAGEO	Capacitor X7R 10%	C5	C0402	1
100pF/50V	YAGEO	Capacitor X7R 10%	C7	C0603R	1
1uF/25V	YAGEO	Capacitor X7R 10%	C8, C25	C0603R	1
33nF/50V	YAGEO	Capacitor X7R, 10%	C10	C0603R	3
1nF/630V	YAGEO	Capacitor X7R, 10%	C11	C1206R	2
680pF/100V	YAGEO	Capacitor X7R, 10%	C12	C0805R	1
10uF/25V	YAGEO	Capacitor X7R, 10%	C13	C1206R	2
220pF/50V	YAGEO	Capacitor X7R, 10%	C15	C0402	2
0.15uF/250Vac	KNSCHA	X2 154K MPX/MKP 275VAC305VAC	CX1	X- 12.7*8*1 4	1
220pF	ZNRC	Capacitor P=10mm,220PF,Y1	CY1	CY-12X4- P10	1
68pF	ZNRC	Capacitor P=10mm,68PF,Y1	CY2	CY-12X4- P10	2
US1K-13-F	/	fast recovery Diode 800V 1A	D1	SMA	2
FR107W	/	fast recovery Diode 1000V 1A	D2, D3	SOD-123	1
18V	/	18V Zener diode	D4	SOD-523	1
6.2V	/	6.2V Zener diode	D5	SOD-523	3
ES1JS	/	fast recovery Diode 600V 0.5A	D7	SOD-123	1
BAS516	/	Switching diode 100V 0.25A	D8	SOD-523	3

27uF/400V	AISHI	Aluminum electrolytic capacitor 27uF 400V	EC1, EC2, EC3, EC4, EC5, EC6	EC10-P5.0MM	1
10uF/160V	YMIN	Aluminum electrolytic capacitor 10uF 100V	EC7	EC5-P2.5MM	1
220uF/25V	/	Aluminum electrolytic capacitor 220uF 25V	EC8	CT 8*7-V	1
820uF/25V	/	Aluminum electrolytic capacitor 820uF 25V	EC9	EC5-P2.5MM	1
3.15A	/	FUSE P=5mm	F1	FUSE4X8	1
100uH	/	Differential mode choke	L1	LMR135	1
270uH	/	common mode choke	LF1	LF-L6*3*3	1
270uH	/	common mode choke	LF2	LF-SQ1012	1
JP		NTC	NTC1, NTC2	NTC-7-PIN5-K	2
HGN070N125	HUNTECK	SR NMOSFET	Q1	PDFN-8-5060	1
MMBT5551	/	NPN General Purpose Amplifier Vceo=160V Ic=600mA	Q3	SOT23-3L	1
INNO700TK240B	INNOGaN	GaN 700V 240mR	QA1	PDFN5x6-MOS	1
NC	/	/	R2A, R2B, R2C, R2D	R1206	4
16K	YAGEO	Resistor 1%	R3	R0603	1
1K	YAGEO	Resistor 1%	R4	R0402	1
180K	YAGEO	Resistor 1%	R5	R0603	1

51K	YAGEO	Resistor 1%	R6	R0402	1
150R	YAGEO	Resistor 1%	R7	R0603	1
2R	YAGEO	Resistor 1%	R8	R0805	1
20K	YAGEO	Resistor 1%	R9, R19	R1206	1
300K	YAGEO	Resistor 1%	R11, R12	R1206	1
1R	YAGEO	Resistor 1%	R13, R14	R1206	2
5.1K	YAGEO	Resistor 1%	R17	R0402	1
1K	YAGEO	Resistor 1%	R18	R0603	2
100K	YAGEO	Resistor 1%	R21	R0603	2
5.1R	YAGEO	Resistor 1%	R22, R23	R1206	4
1M	YAGEO	Resistor 1%	R25	R0402	1
10R	YAGEO	Resistor 1%	R33	R0603	5
2R	YAGEO	Resistor 1%	R34	R0402	4
390R	YAGEO	Resistor 1%	R35	R0402	1
7.5K	YAGEO	Resistor 1%	R36	R0402	3
10K	YAGEO	Resistor 1%	R37	R0402	2
0.2R	YAGEO	Resistor 1%	R39, R40	R1206	1
ATQ2516/200uH	/	Transformer	T1	ATQ-2502 H	1
SC3005	SouthChip	QR IC	U1	SOP8_L	2
EL1018	Everlight	Optocoupler	U2	817-SMD-02	2
MP6908	MPS	SR IC	U3	SOT23-6L	2

Revision History

Date	Versions	Description	Check
2025. 1.20	1.0	First edition	AE Team



Note:

There is a dangerous voltage on the demo board, and exposure to high voltage may lead to safety problems such as injury or death.

Proper operating and safety procedures must be adhered to and used only for laboratory evaluation demonstrations and not directly to end-user equipment.



Reminder:

This product contains parts that are susceptible to electrostatic discharge (ESD). When using this product, be sure to follow antistatic procedures.



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