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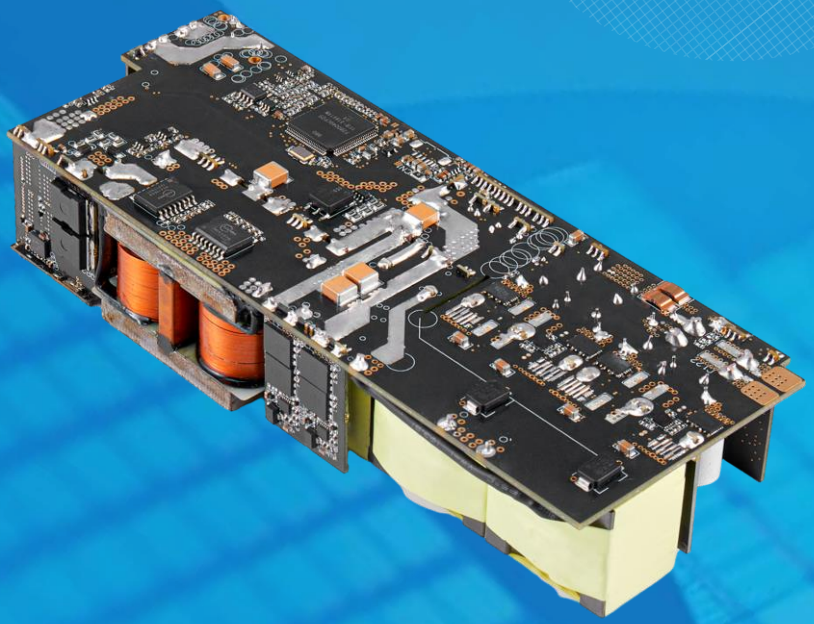
POWER THE FUTURE

INNDAD4K2A1

Demo Manual

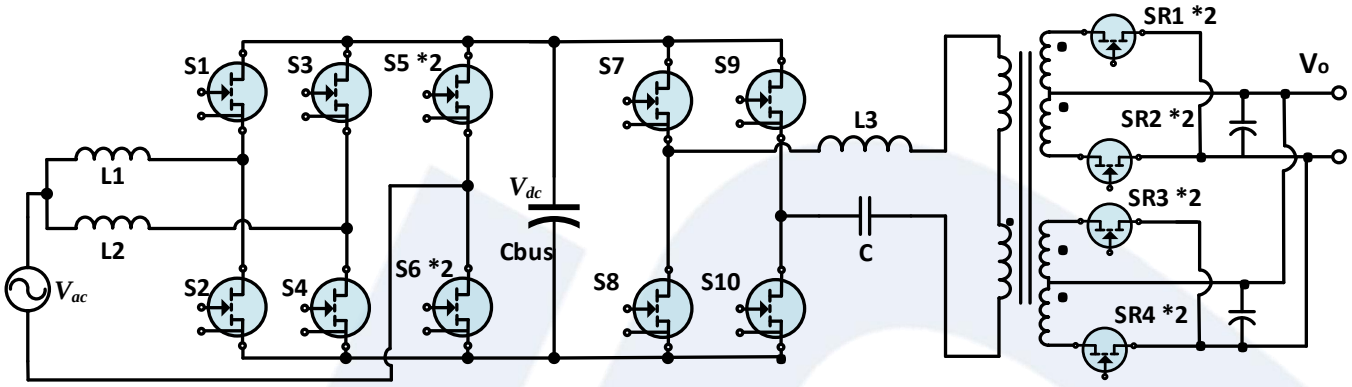
4.2KW PSU



4.2KW PSU DEMO

High Density Totem Pole PFC + LLC

Input voltage 180Vac-264Vac, output 48V/87A, peak efficiency up to 97%@V_{in}=230Vac.



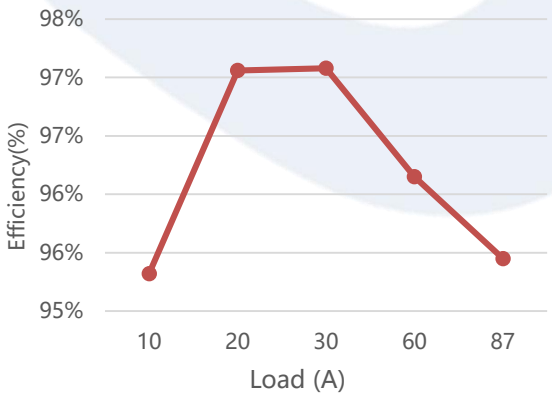
Highlighted Products

- S1~S4: INN650TA050AH
- S5~S9: INN650TA030CS
- SR1~SR4: INN150EQ032A

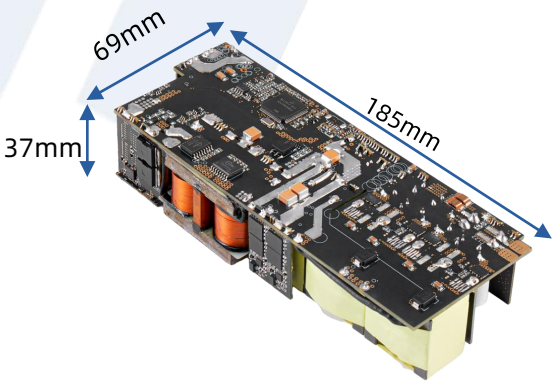
Target Applications

- Datacenter
- Telecom
- LED Lighting

Test Results



Photo



List of Content

1. Overview

1.1. Description

The INNDAD4K2A1 comprises a front-end AC-DC bridgeless two phase interleaved totem pole PFC followed by a back-end DC-DC isolated full bridge LLC converter. The measured peak efficiency of the complete PSU at 230 Vac is 97%, exclude fan. The PCBA size are 185mm x 69mm x 37mm, which yields a power density in the range of 130 W/inch^3.

1.2. Features

■ Main features and Advantages

- High efficiency: 97% @ 230Vac V_{in}
- High power density: 130W/inch^3
- size: 185mm x 69mm x 37mm(PCBA)

■ Protection Function

- Input over current protection
- Output short-circuit protection
- Output over voltage protection

1.3. Applications

- **Datacenter**
- **Telecom**
- **LED Lighting**

2. Parameters

Table 1 Electrical characteristics (Ta=25℃)

Symbol	Parameter	Conditions	Min	Nom	Max	Units
System Specifications						
V_{IN}	Input voltage		180	230	264	Vac
f_{AC}	Input frequency		47	50	53	Hz
PFC f_{SW}	Switching frequency			60		kHz
LLC f_{SW}	Switching frequency			175		kHz
V_{OUT}	Output voltage			48		V
P_{OUT}	Output power				4200	W
Demo Performance						
Eff,pk	Peak efficiency	Measured @V_{IN}=230Vac, Output=48V/30A		97		%

3. Demo Solutions

3.1. Topology

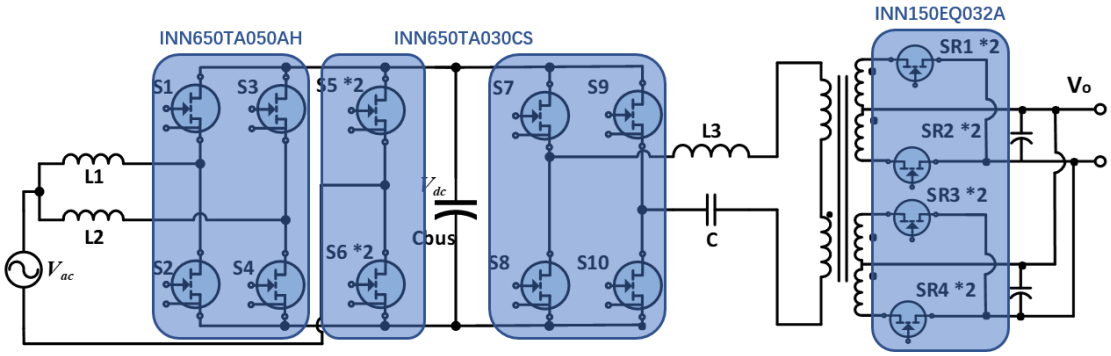


Figure 1 CCM TTP_PFC + LLC topology

The 4.2KW 48V PSU comprises a front-end AC-DC bridgeless totem pole PFC followed by a back-end DC-DC isolated full bridge LLC converter.

3.2. Value of InnoGaN

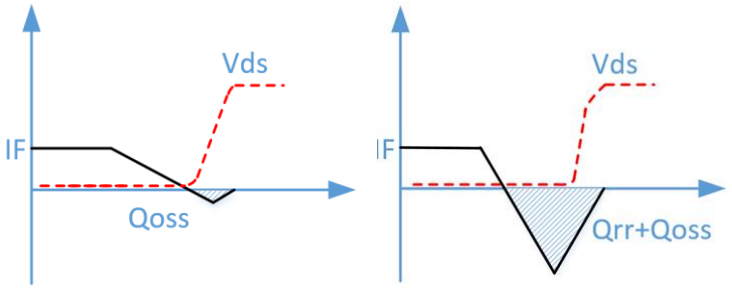
InnoGaN offer improved performance over silicon mosfet due to several key characteristics:

■ Gate Charge Q_g

Comparing InnoGaN to silicon mosfet with the same R_{on}, GaN has about seven times lower Q_g than silicon mosfet. Lower Q_g means faster turn on and turn off speed, resulting in lower switching loss and driver loss.

■ Reverse Recovery Charge Q_{rr}

Si mosfet have intrinsic body diode structures with a large reverse recovery charge. The poor reverse recovery performance in hard-switching half-bridge configuration makes it difficult for si mosfet to work in CCM totem pole PFC. InnoGaN have no Q_{rr} because there are no minority carriers in the channel to recover, which makes it an ideal fit for CCM totem pole PFC.



(a) si mosfet (b) InnoGaN

Figure 2 turn off transition

■ Time Related C_{oss} $C_{oss(tr)}$

$C_{oss(tr)}$ is used to represent the equivalent fixed capacitance value under the same charging time condition when V_{ds} rises from 0 to 400V. As shown in Figure 3, as Vds is increased from 0 to about 35 V, C_{oss} of si mosfet changes rapidly at a steep slope. Comparing InnoGaN to si mos with the same R_{on}, C_{oss} curve of InnoGaN is more linear. $C_{oss(tr)}$ of InnoGaN is seven times lower than that of si mos;

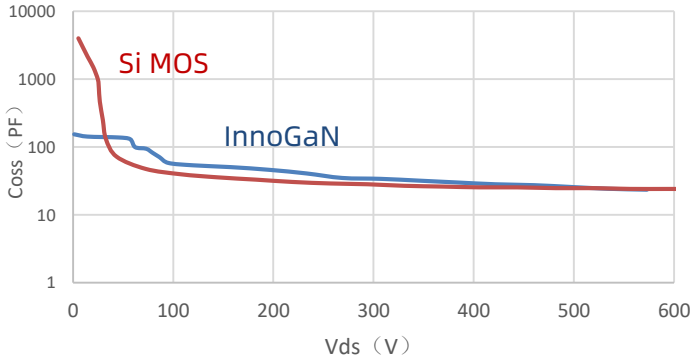


Figure 3 C_{oss} Comparison

■ R_{on} temperature coefficient

The temperature coefficient of R_{on} for InnoGaN is lower than for si mosfet. Over the range from 25°C to 150°C, the typical temperature coefficient of R_{on} for InnoGaN is 2.1, compared to 2.4 for si mosfet. This is a benefit in power system, reducing conduction loss and achieving higher efficiency.

3.3. Highlighted Products

3.3.1. InnoGaN Device INN650TA030CS

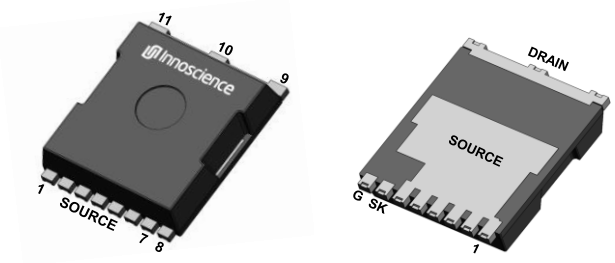


Figure 4 InnoGaN device INN650TA030CS

INN650TA030CS is designed with TOLL package, with independent KS pin, reduce the influence of parasitic parameters of the device power loop on the drive loop, improve the switching speed.

Table 2 INN0TA030CS Electrical characteristics (T_j = 25℃)

Parameter	Value	Unit
$V_{ds,max}$	650	V
$R_{ds(on),max}$@V_G=6V	35	mΩ
$Q_{g,typ}$@V_{ds}=400V	14	nC
$I_{d,pulse}$	127	A
Q_{oss}@V_{ds}=400V	155	nC
Q_{rr}@V_{ds}=400V	0	nC

3.3.2. InnoGaN Device INN650TA050AH

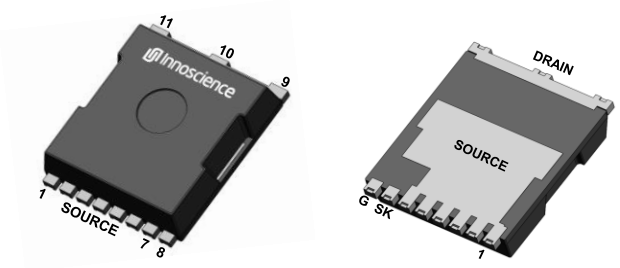


Figure 5 InnoGaN device INN650TA050AH

INN650TA050AH is designed with TOLL package, with independent KS pin, reduce the influence of parasitic parameters of the device power loop on the drive loop, improve the switching speed.

Table 3 INN0TA030CS Electrical characteristics (T_j = 25℃)

Parameter	Value	Unit
$V_{ds,max}$	650	V
$R_{ds(on),max}$@V_G=6V	50	mΩ
$Q_{g,typ}$@V_{ds}=400V	12.5	nC
$I_{d,pulse}$	84	A
Q_{oss}@V_{ds}=400V	150	nC
Q_{rr}@V_{ds}=400V	0	nC

3.3.3. InnoGaN Device INN150EQ032A

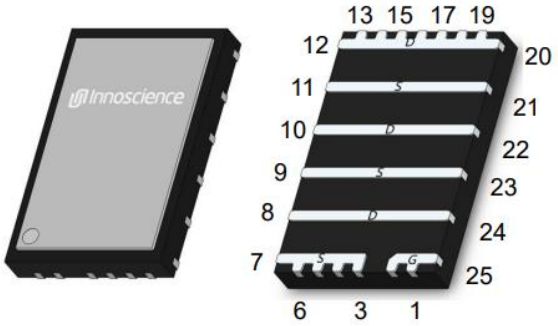


Figure 6 InnoGaN device INN150EQ032A

INN150EQ032A is a GaN-on-Silicon enhancement mode high-electron-mobility-transistor (HEMT) device designed with En-FCQFN package, with very low gate charge and ultra-low on resistance.

Table 4 INN150EQ032A Electrical characteristics (T_j = 25℃)

Parameter	Value	Unit
$V_{ds,max}$	150	V
$R_{ds(on),max}$@V_G=6V	3.9	mΩ
$Q_{g,typ}$@V_{ds}=400V	20	nC
$I_{d,pulse}$	260	A
Q_{oss}@V_{ds}=400V	130	nC
Q_{rr}@V_{ds}=400V	0	nC

4. Hardware Implementation

4.1. Photos

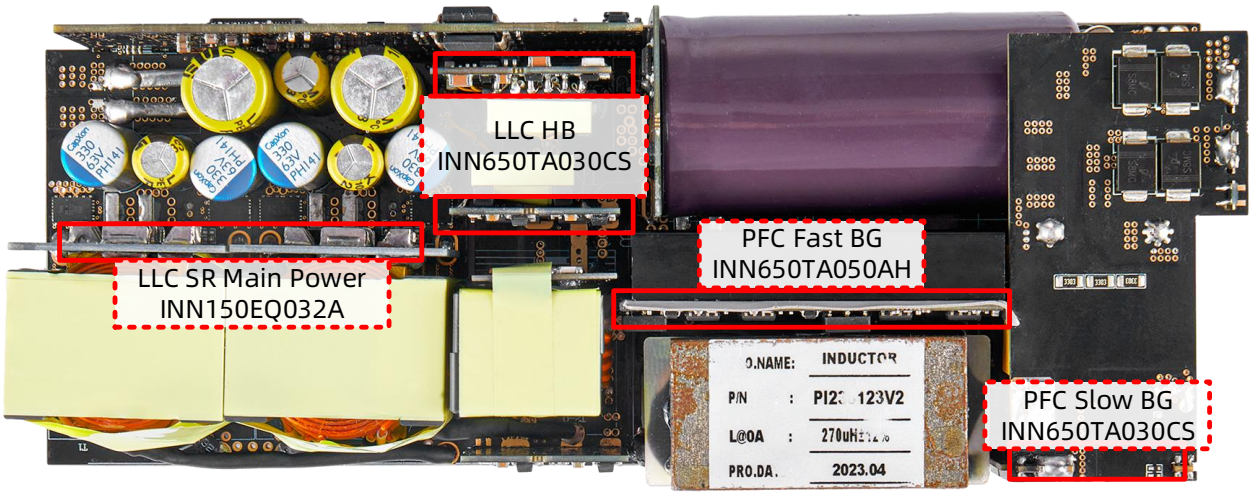


Figure 7 INNDAD4K2A1 top view

4.2. Design Considerations

4.2.1. PFC CHOKE

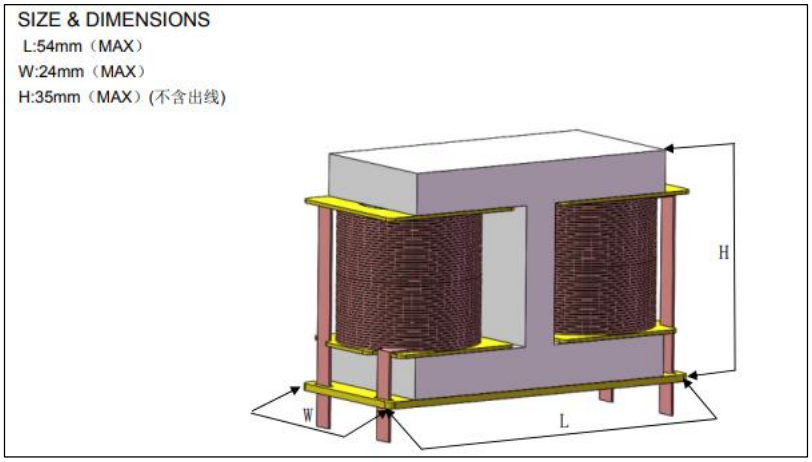


Figure 8 PFC Choke

Table 5 Choke parameters

No.	Measuring Parameter	Measuring PIN	Customer Specification	Test Condition
1	Inductance (μH)	1-2, 3-4	270μH±10%	16kHz/1V
2	DC Resistance	1-2, 3-4	57mΩ (Max)	-
3	Dielectric Strength	COIL-CORE	100MΩ-	DC 500V
4	Insulation Grade	CLASS-H	-	

5	Weight	-	0.18kg (Max)	-

4.2.2. LLC TRANSFORMER

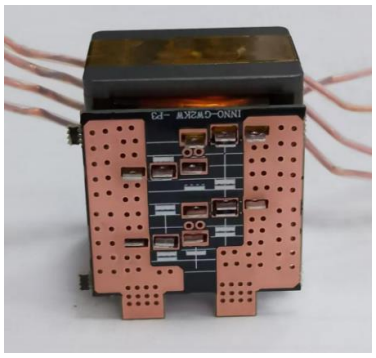


Figure 9 LLC Transformer

Table 6 Transformer parameters

No.	Measuring Parameter	Measuring PIN	Customer Specification	Test Condition	Test Instrument
1	Inductance (μH)	1-2	70μH±5%	200kHz/0.3V	3260B
2	DC Resistance	1-2	-	25℃	7122
		3-4	-		
		4-5	-		
3	Withstand voltage strength	Primary-Secondary	3000Vac/1mA/60S	-	7122
		Primary-Core	3000Vac/1mA/60S		
		Secondary-Core	500Vac/1mA/60S		
4	Turns Ratio	NP1:NS1:NS2	16:4:4	-	-

5. Testing & Results

5.1. Test Setup

INNDAD4K2A1 is designed mainly for evaluation of InnoGaN performance on PSU and provide reference solution for power stage. Demo board adopts digital control solution.

5.2. Test Results

5.2.1. Efficiency curve

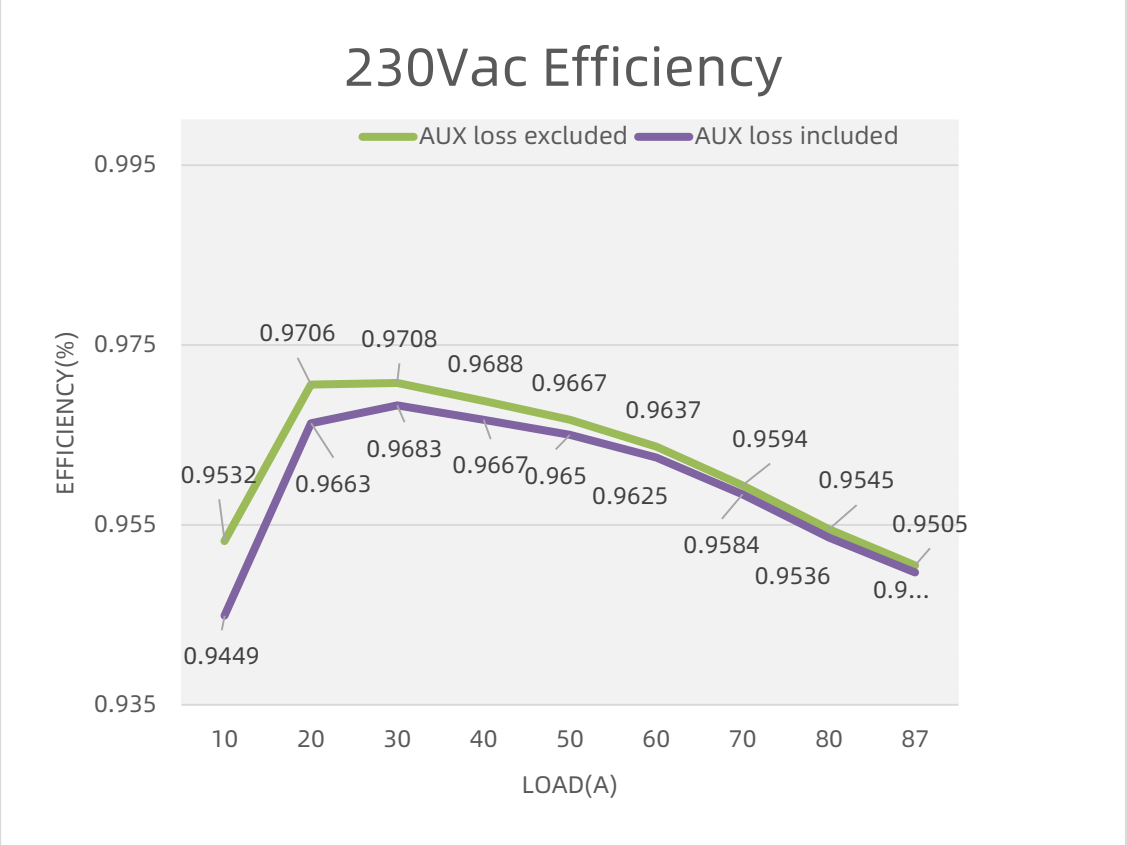
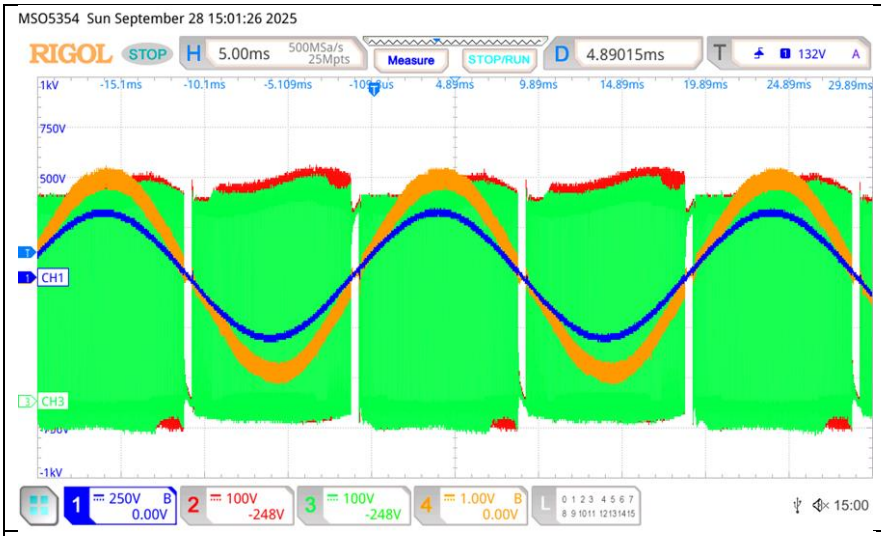


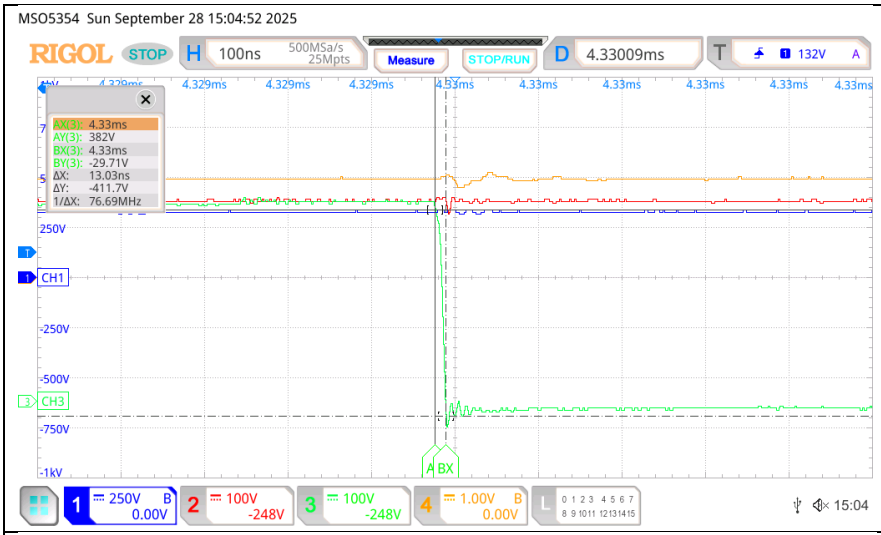
Figure 10 V_{in}=230V_{ac} Efficiency curve

5.2.2. Switching Waveforms

- PFC

3kW Steady-state waveform

	**Test Condition** V_{in}=230V_{ac} V_{out}=48V_{dc} I_{out}=60A f_{pfc}=60kHz f_{llc}=175kHz
	**Test Condition** V_{in}=230V_{ac} V_{out}=48V_{dc} I_{out}=60A f_{pfc}=60kHz f_{llc}=175kHz **Test Results** V_{ds} rising time:19.09ns
	**Test Condition** V_{in}=230V_{ac} V_{out}=48V_{dc} I_{out}=60A f_{pfc}=60kHz f_{llc}=175kHz **Test Results** V_{ds} falling time:13.03ns



Test Condition

V_{in}=230V_{ac}

V_{out}=48V_{dc}

I_{out}=60A

f_{pfc}=60kHz

f_{llc}=175kHz

Test Results

V_{ds} falling time:13.03ns

Test Condition

V_{in}=230V_{ac}

V_{out}=48V_{dc}

I_{out}=60A

f_{pfc}=60kHz

f_{llc}=175kHz

Test Results

V_{ds} rising time:21.88ns

Test Condition

V_{in}=230V_{ac}

V_{out}=48V_{dc}

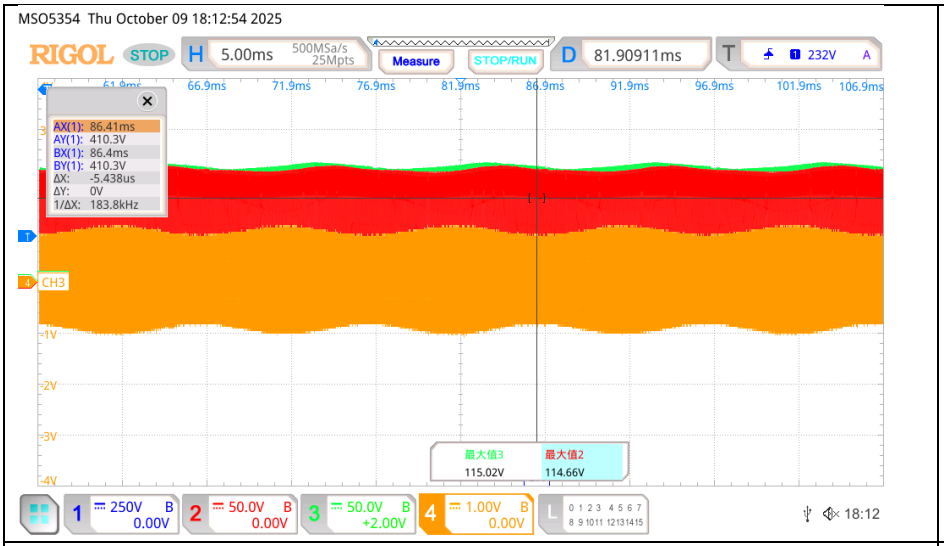
I_{out}=60A

f_{pfc}=60kHz

f_{llc}=175kHz

- LLC

3kW Steady-state waveform



Test Condition

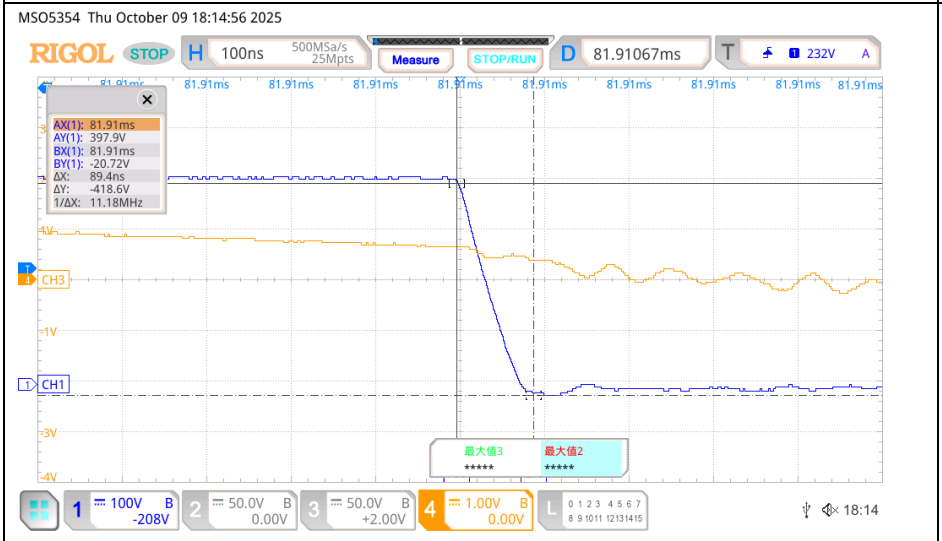
V_{in}=230V_{ac}

V_{out}=48V_{dc}

I_{out}=60A

f_{pfc}=60kHz

f_{llc}=175kHz



Test Condition

V_{in}=230V_{ac}

V_{out}=48V_{dc}

I_{out}=60A

f_{pfc}=60kHz

f_{llc}=175kHz

Test Results

V_{ds} falling time:89.4ns

Test Condition

V_{in}=230V_{ac}

V_{out}=48V_{dc}

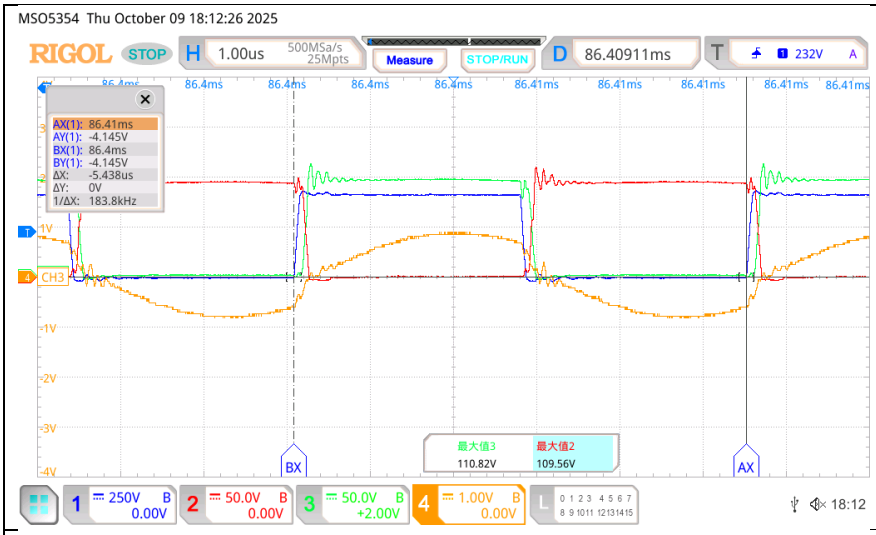
I_{out}=60A

f_{pfc}=60kHz

f_{llc}=175kHz

Test Results

V_{ds} rising time:96.85ns



Test Condition

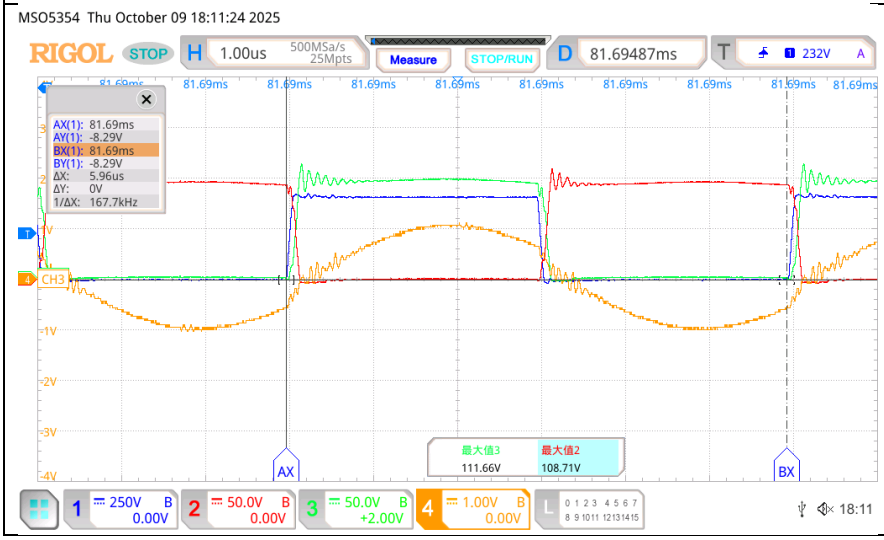
V_{in}=230V_{ac}

V_{out}=48V_{dc}

I_{out}=60A

f_{pfc}=60kHz

f_{llc}=184kHz



Test Condition

V_{in}=230V_{ac}

V_{out}=48V_{dc}

I_{out}=60A

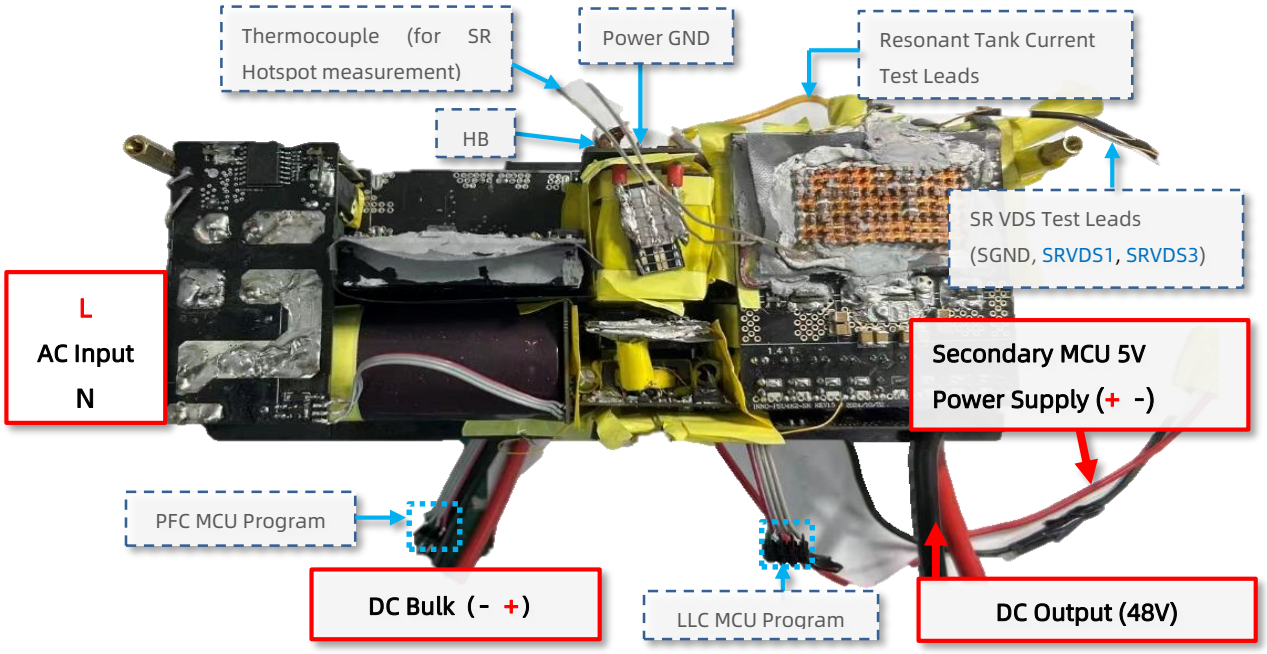
f_{pfc}=60kHz

f_{llc}=167kHz

Appendix

Appendix A. Testing Guidance

1、 Test point location and wiring diagram



Appendix Figure 1 Test point location and wiring diagram

2、 Power on sequence

1) Check the PCB layout and connect all test equipment (input source, electronic load, secondary MCU 5V auxiliary supply, oscilloscope), ensuring the cooling fan is powered on.
2) Preset the electronic load to 6.7A, but keep it in the OFF state.
3) For DC input test: First, connect the DC voltage source to the **DC Bulk** input terminals and set it to 390V.
4) For AC input test: First, connect the AC power source to the **AC Input** terminals and set it to 230V.
5) Turn on the input power (DC 390V or AC 230V).
6) Then, turn on the 5V auxiliary power supply connected to the **Secondary MCU 5V**.
7) After confirming the output voltage is stable at 48V, turn on the

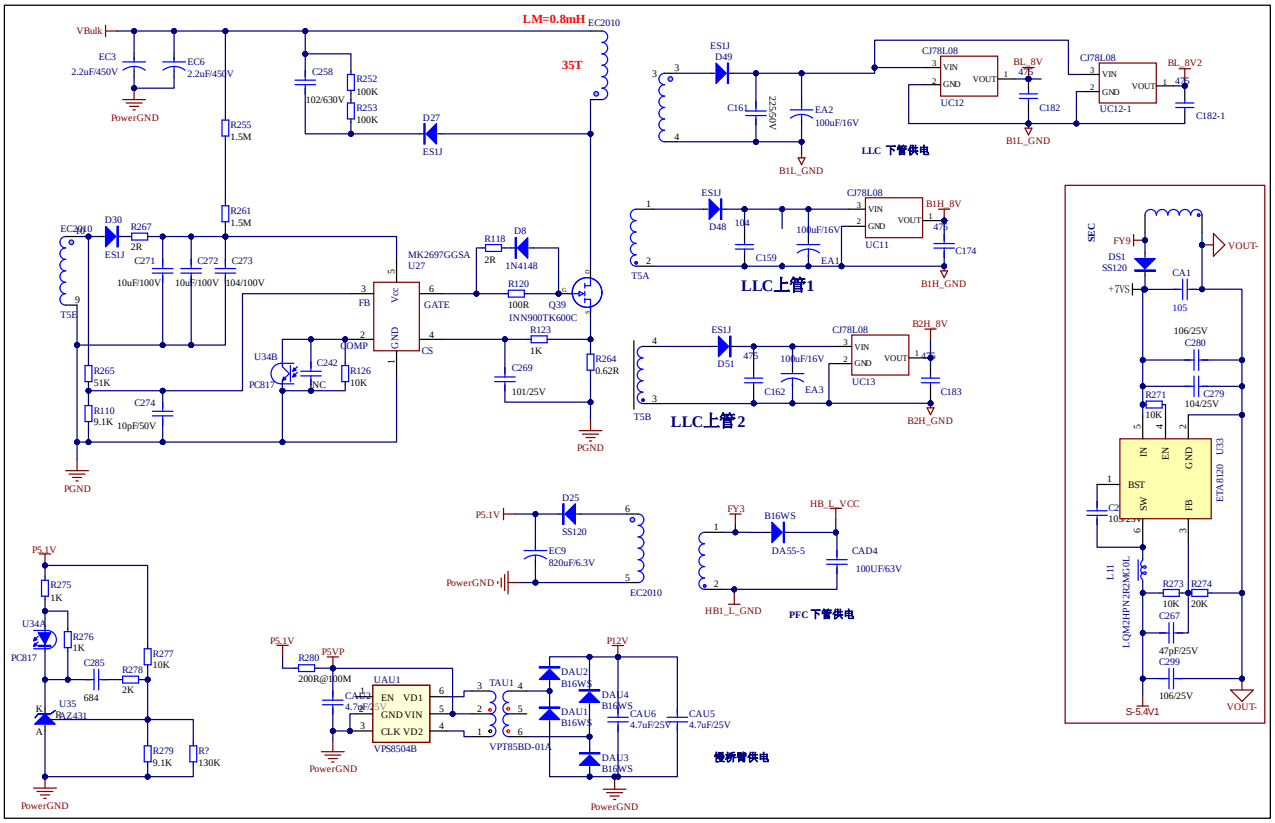
electronic load.

8) Slowly increase the load current from 6.5A in 0.1A increments. Pay attention to heat dissipation and ensure the fan has sufficient static pressure.

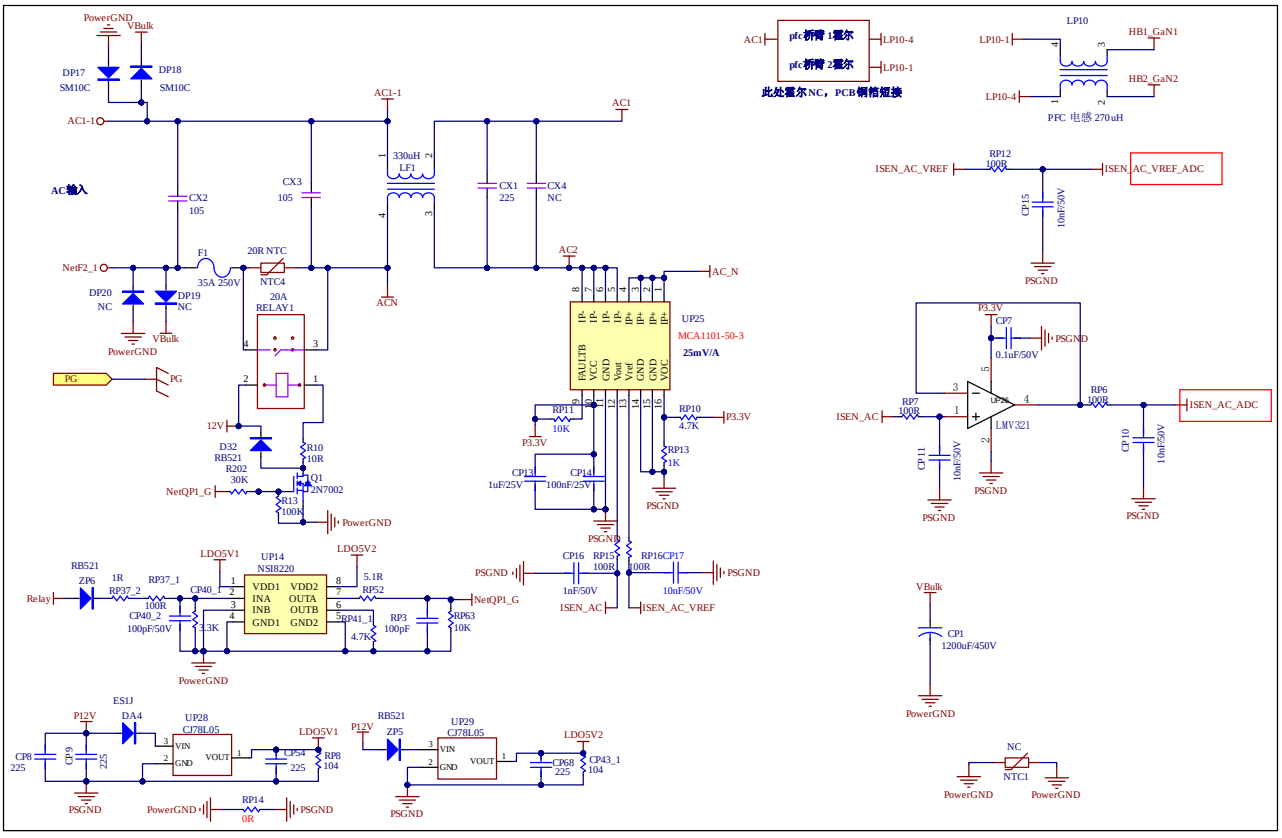
3、 Power off sequence

1) First, slowly reduce the load (to 21A for DC input, to 20A for AC input).
2) Then, turn off the input power (DC source or AC source).
3) (For AC input test only) Before reapplying power, you must wait for the VBULK voltage to drop below 15V.

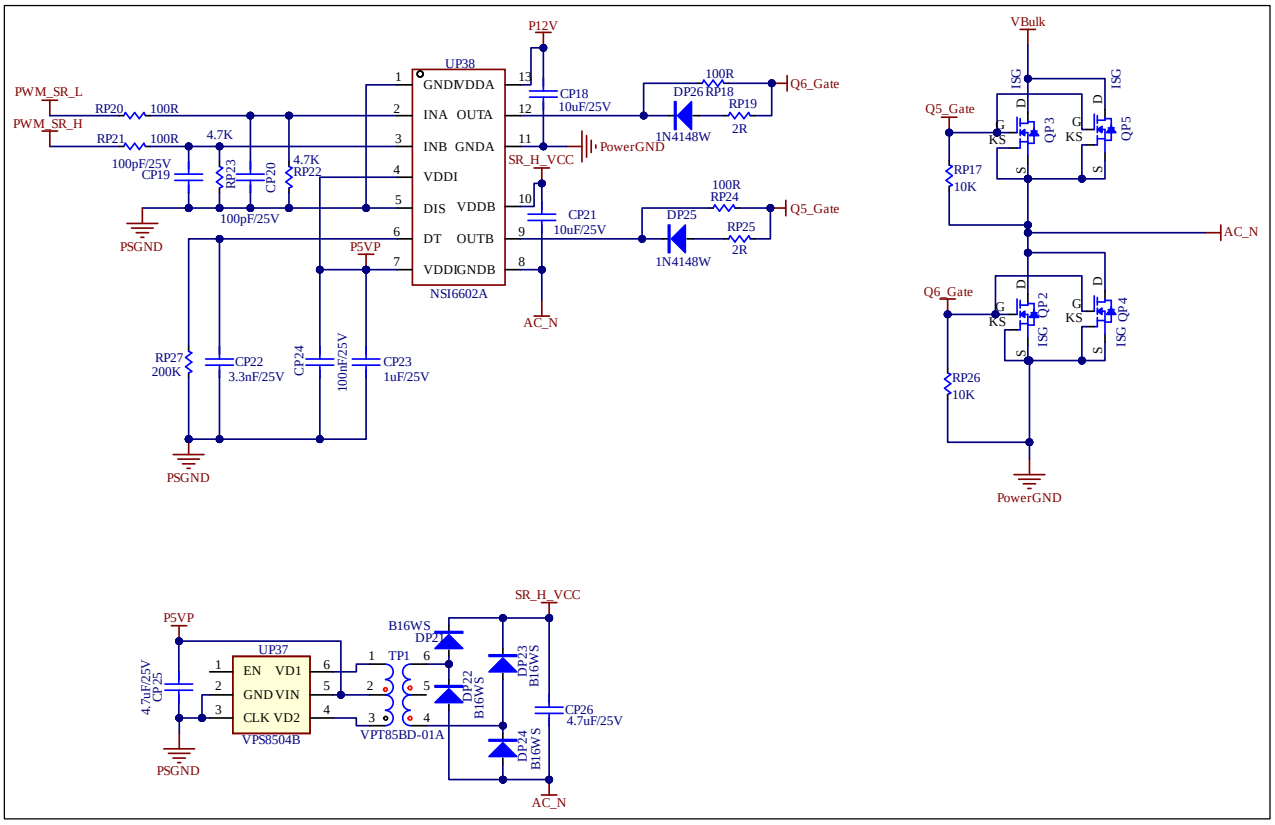
Appendix B. SCH



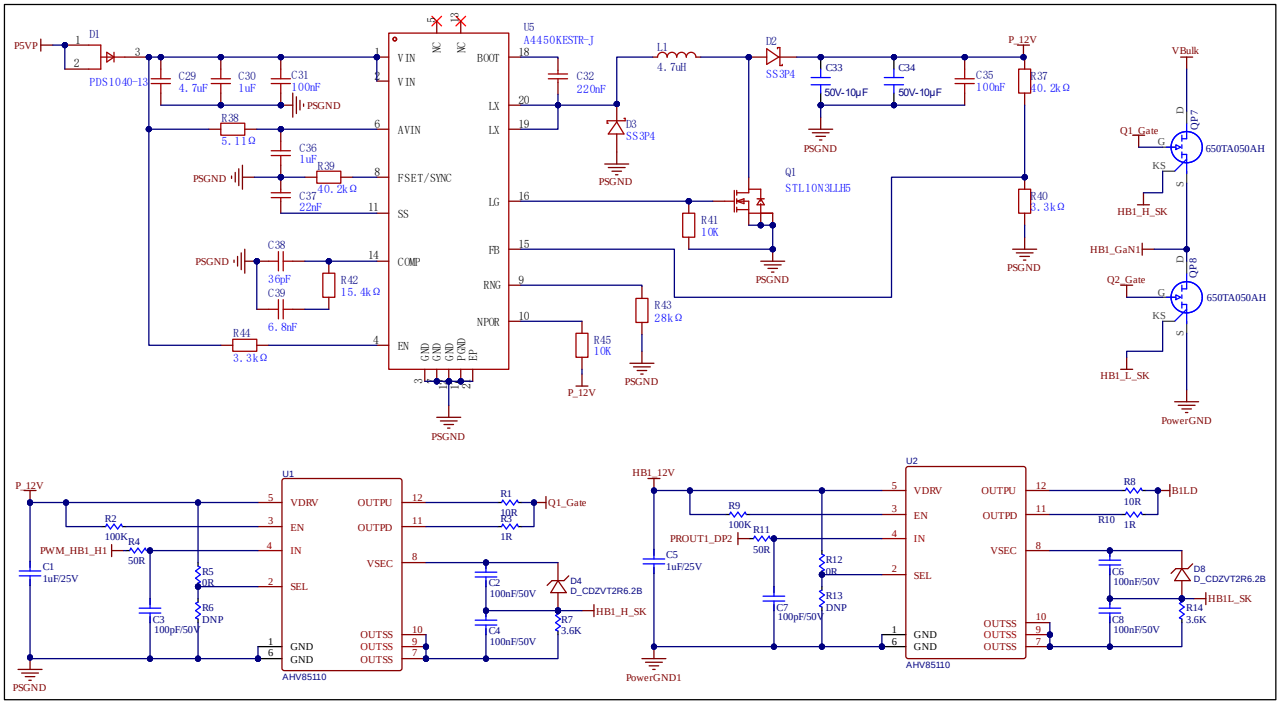
Appendix Figure 2 AUX power schematics



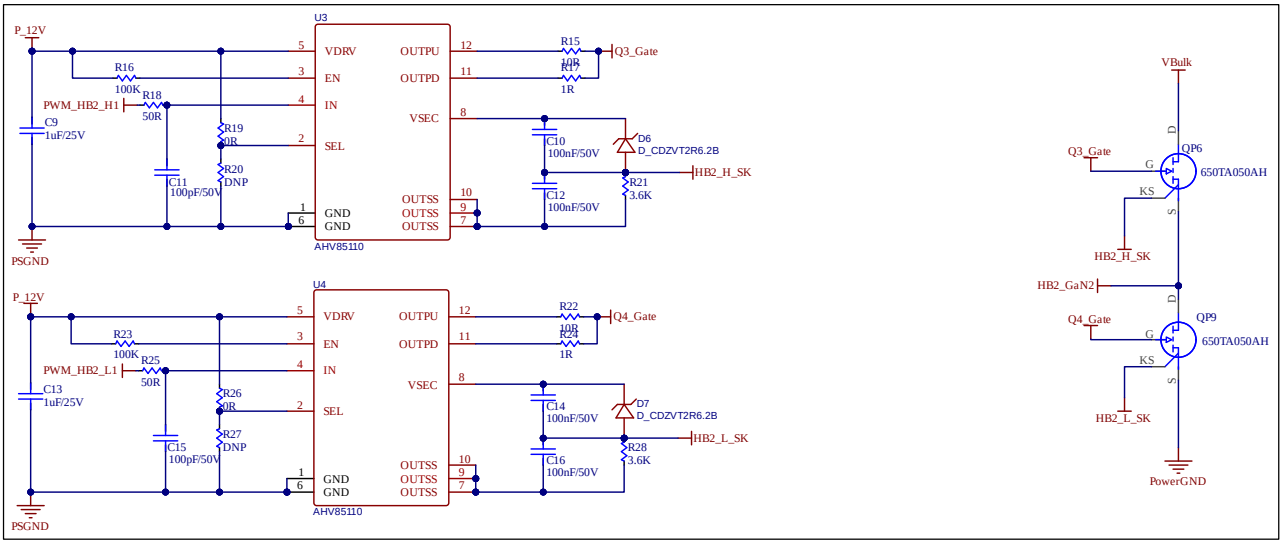
Appendix Figure 3 PFC main EMC schematic



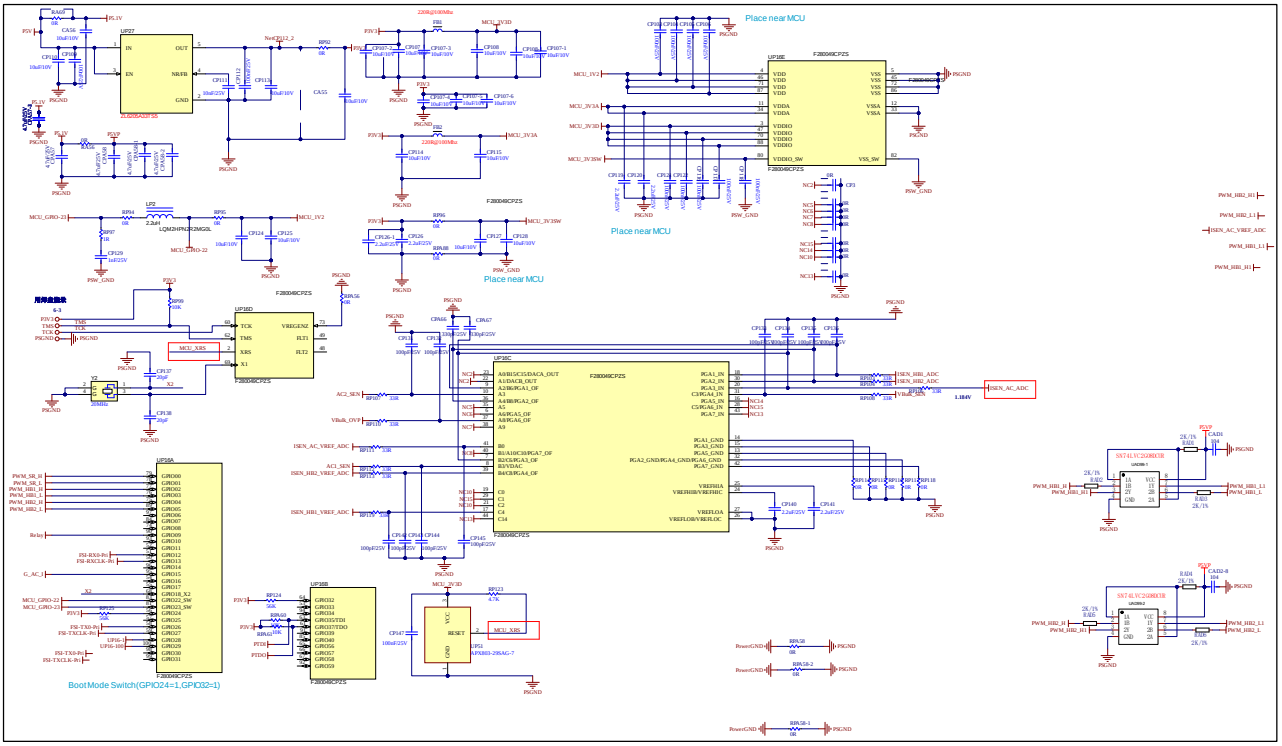
Appendix Figure 4 PFC slow bridge EMC schematic



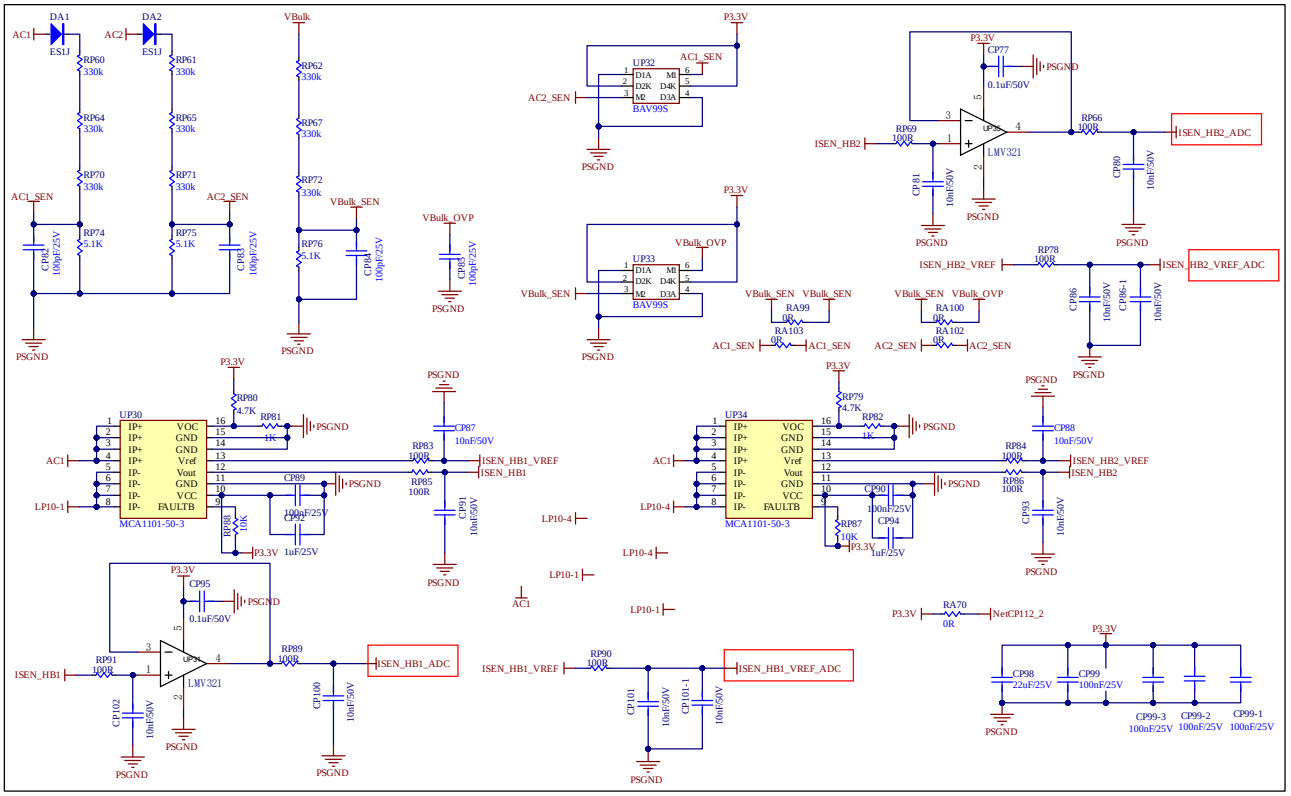
Appendix Figure 5 PFC half-bridge1 schematic



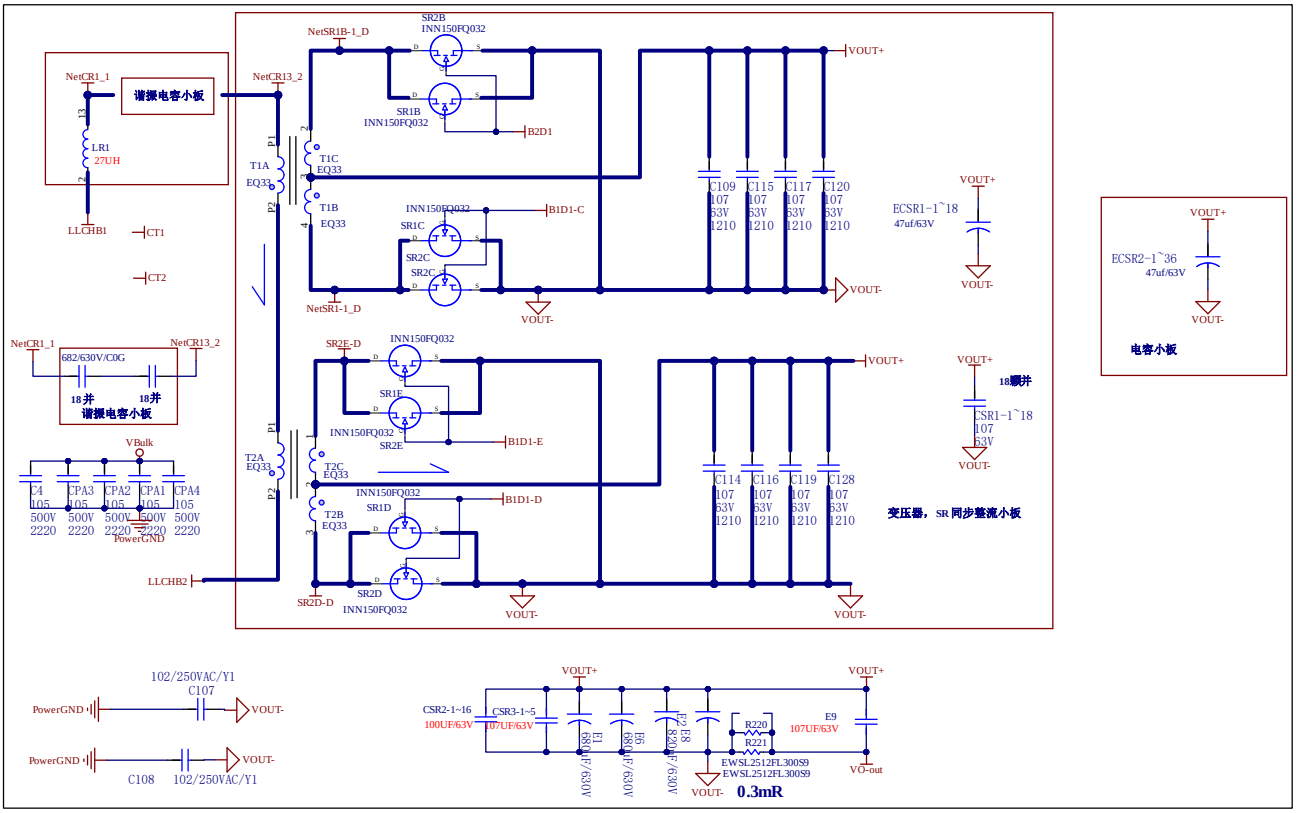
Appendix Figure 6 PFC half-bridge2 schematic



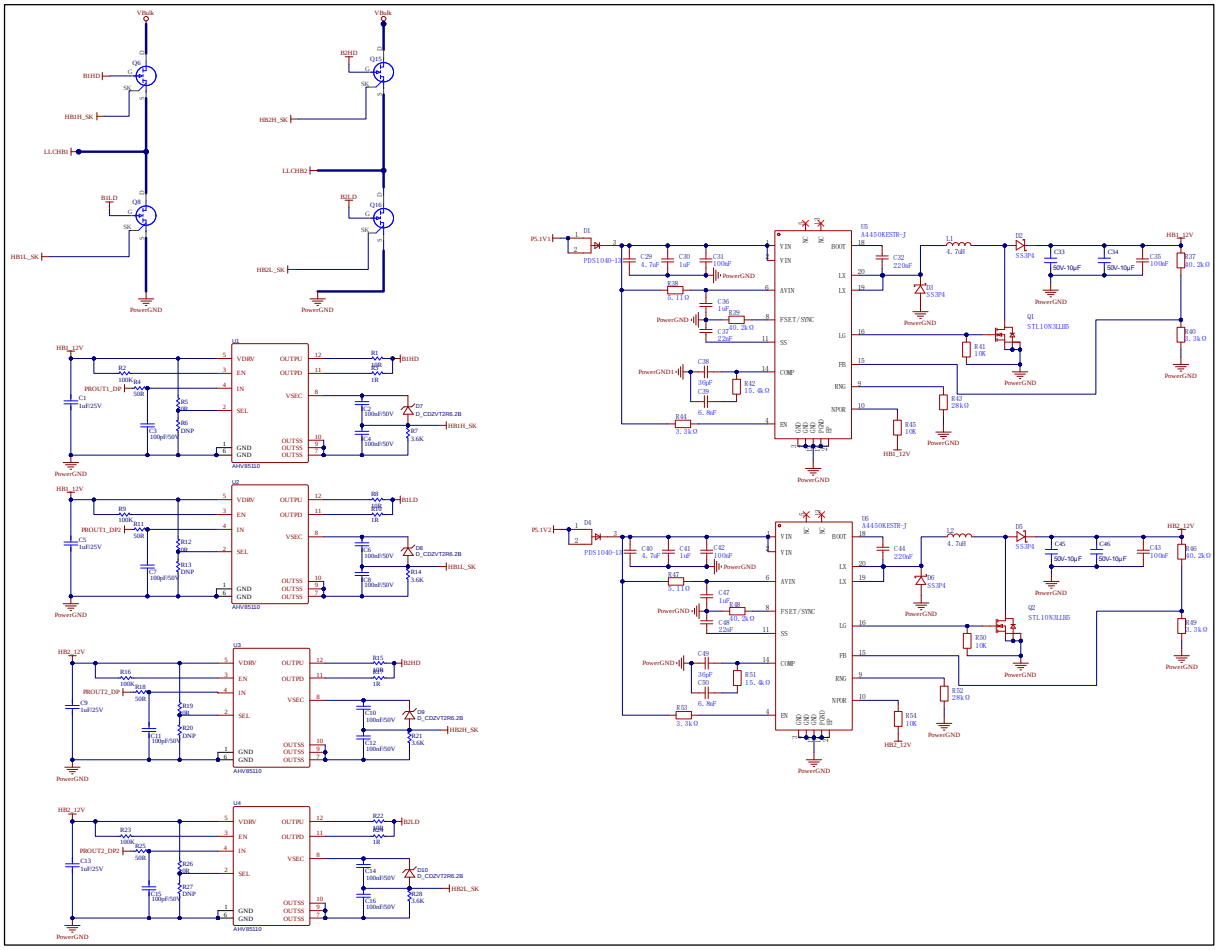
Appendix Figure 7 PFC MCU con schematic



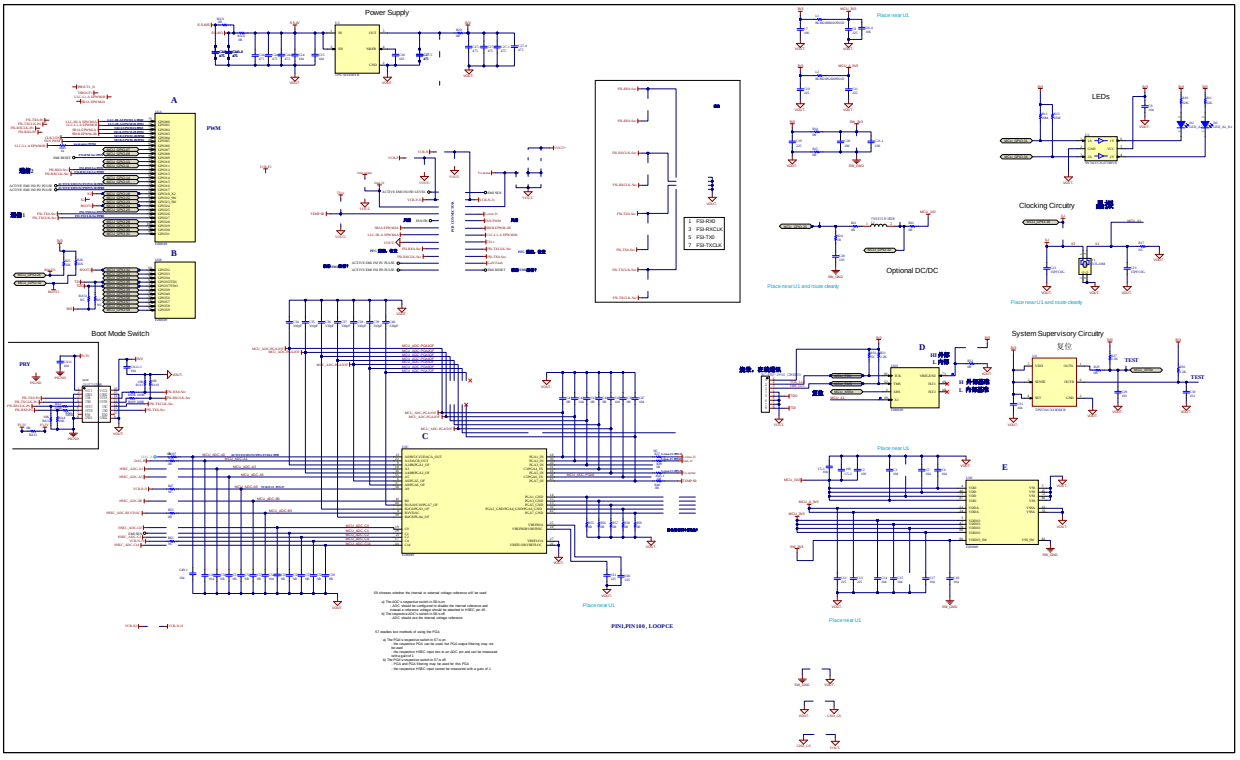
Appendix Figure 8 PFC sense schematic



Appendix Figure 9 LLC main power schematic



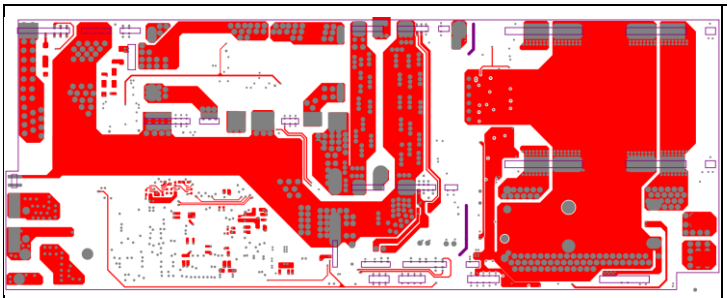
Appendix Figure 10 LLC half-bridge schematic



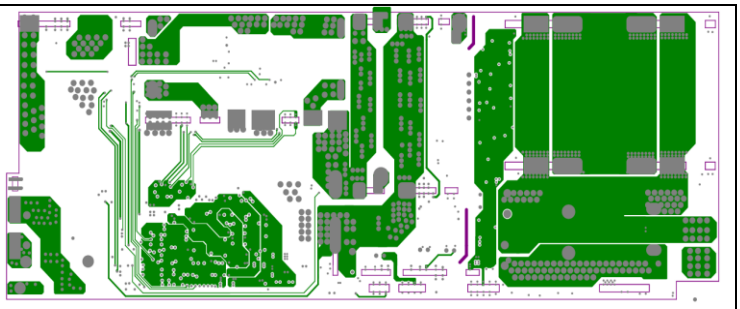
Appendix Figure 11 LLC MCU schematic

Appendix C. PCB Layout

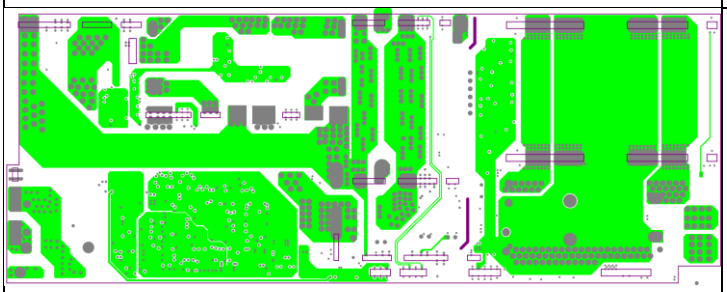
Main PCB board



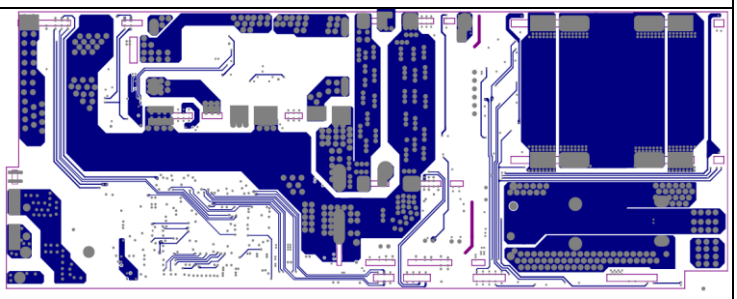
(a) Top Layer



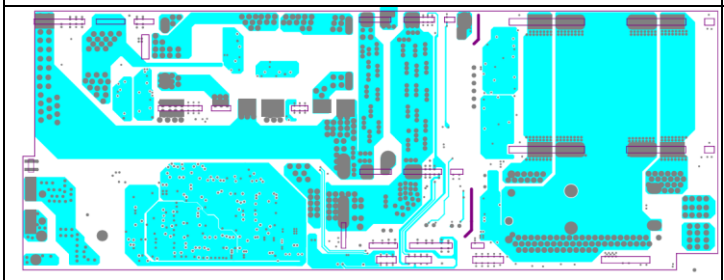
(b) Mid Layer 1



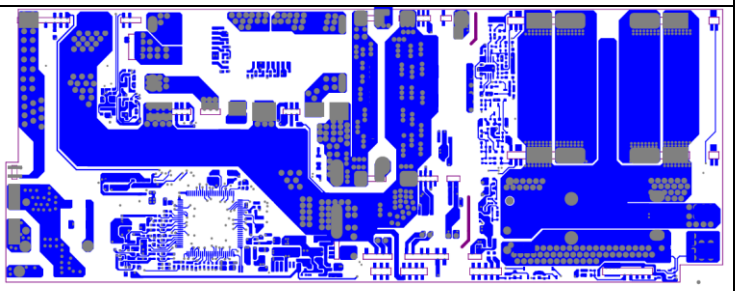
(c) Mid Layer 2



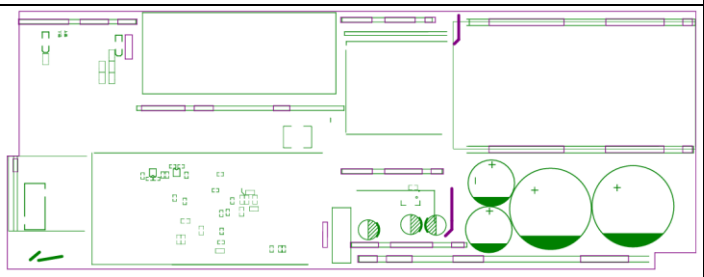
(d) Mid layer3



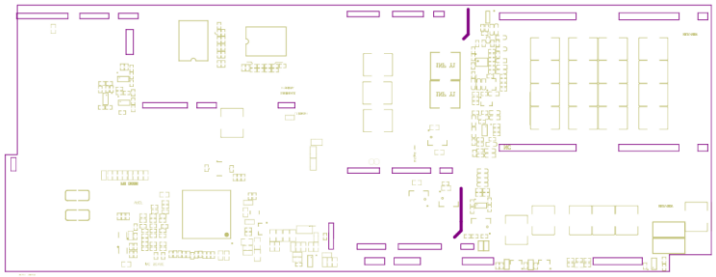
(e) Mid Laye4



(f) Bottom Layer

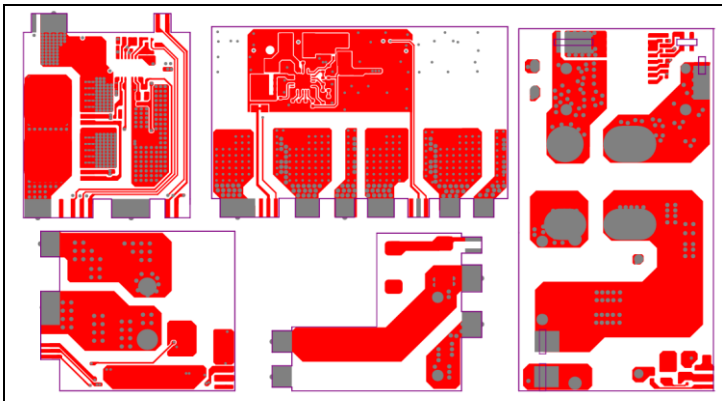


(g)Top Overlayer

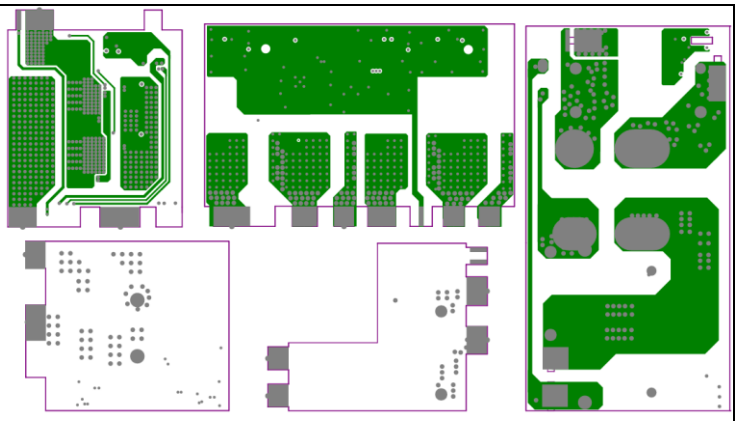


(h) Bottom Overlayer

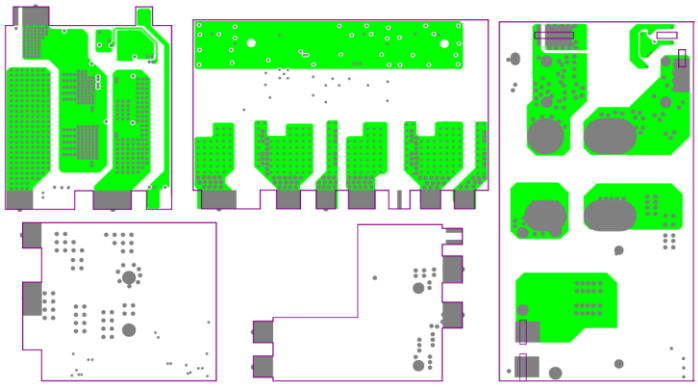
PFC board



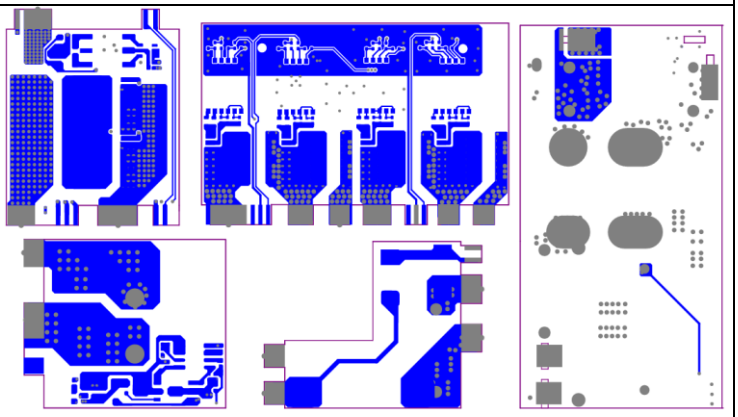
(a) Top Layer



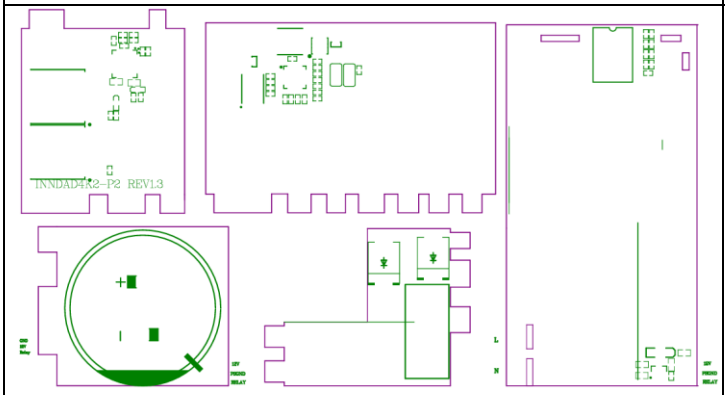
(b) Mid Layer 1



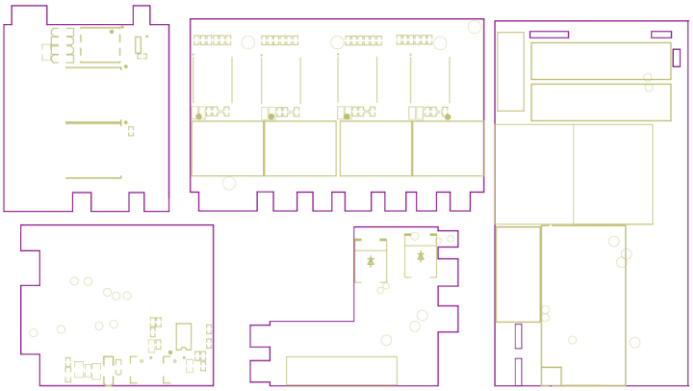
(c) Mid Layer 2



(d) Bottom Layer

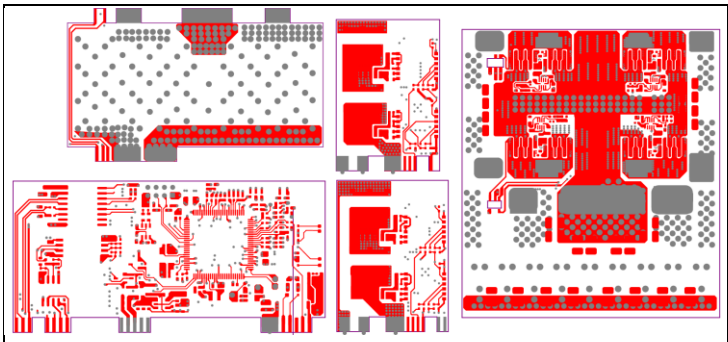


(g)Top Overlayer

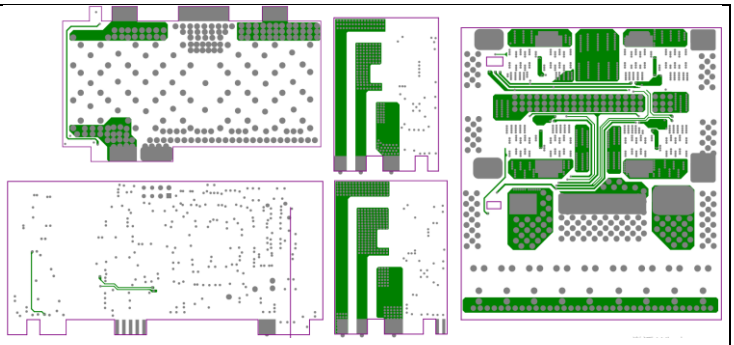


(h) Bottom Overlayer

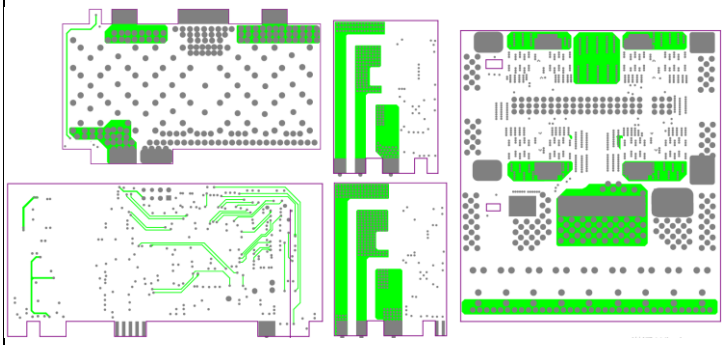
LLC board



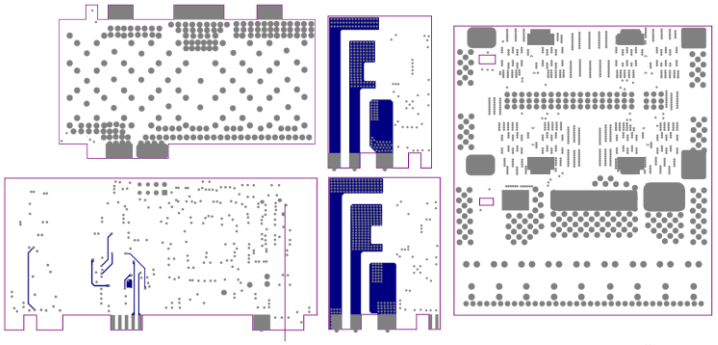
(a) Top Layer



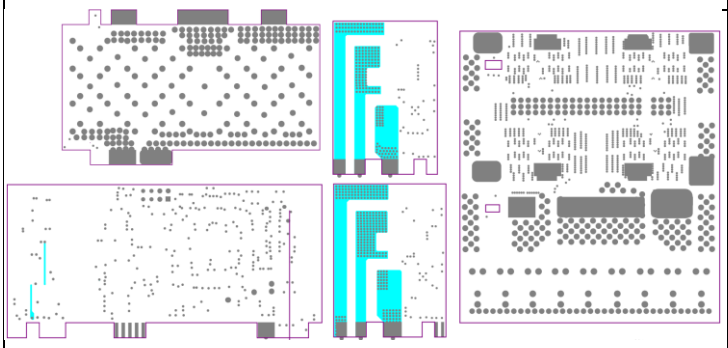
(b) Mid Layer 1



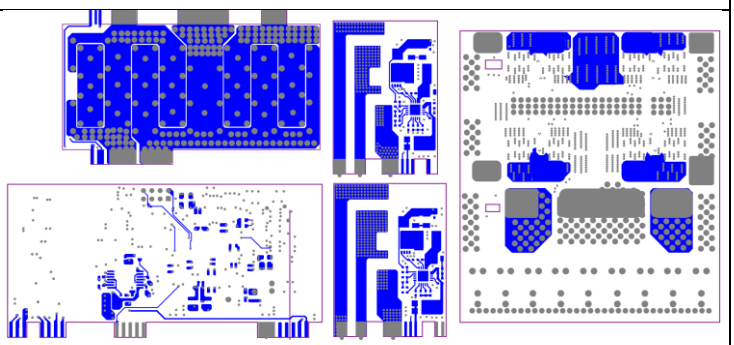
(c) Mid Layer 2



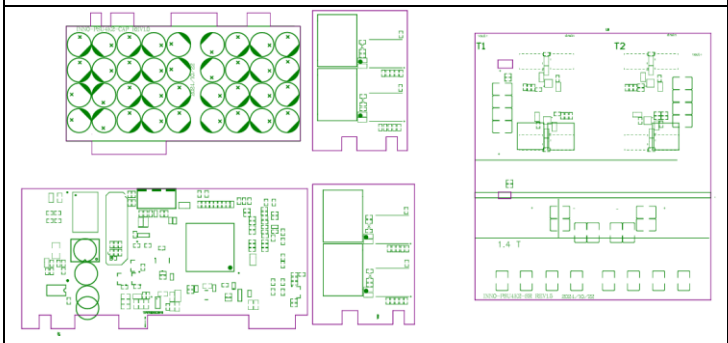
(d) Mid layer3



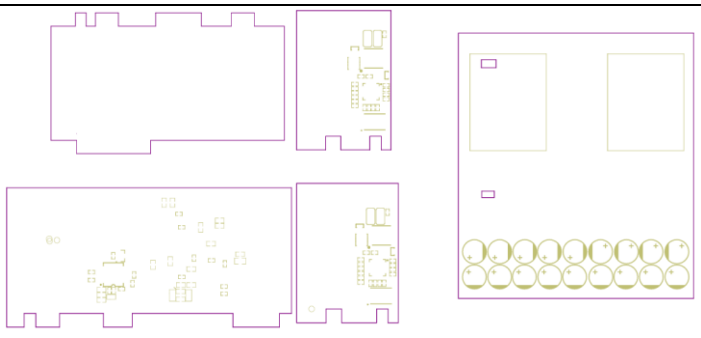
(e) Mid Laye4



(f) Bottom Layer

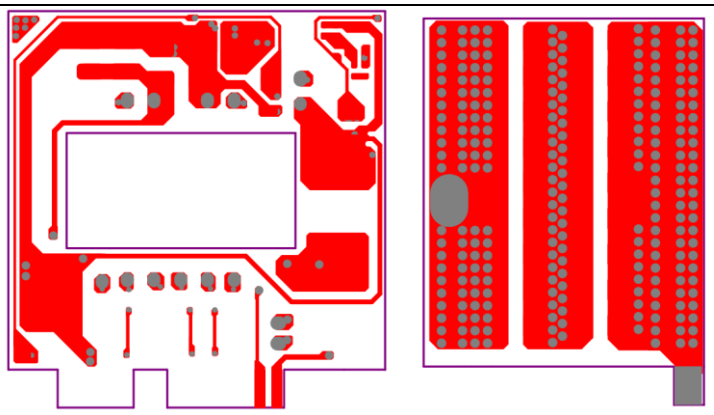


(g)Top Overlayer

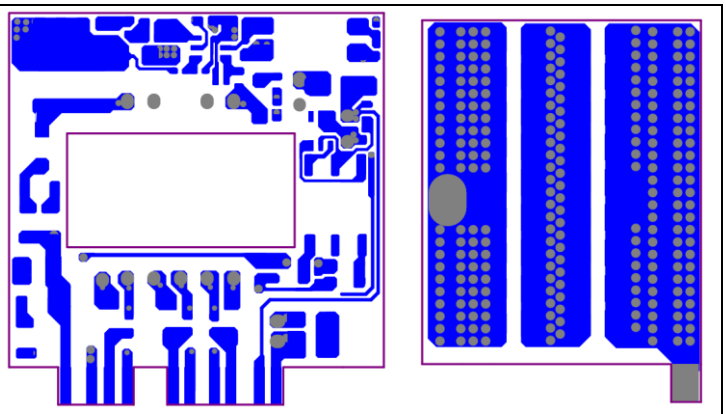


(h) Bottom Overlayer

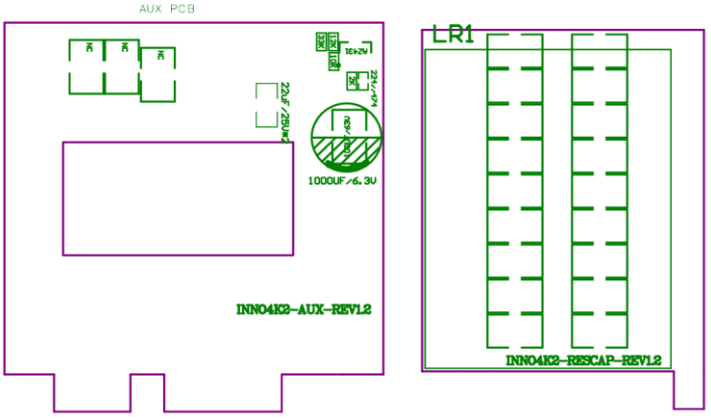
Auxiliary, capacitor board



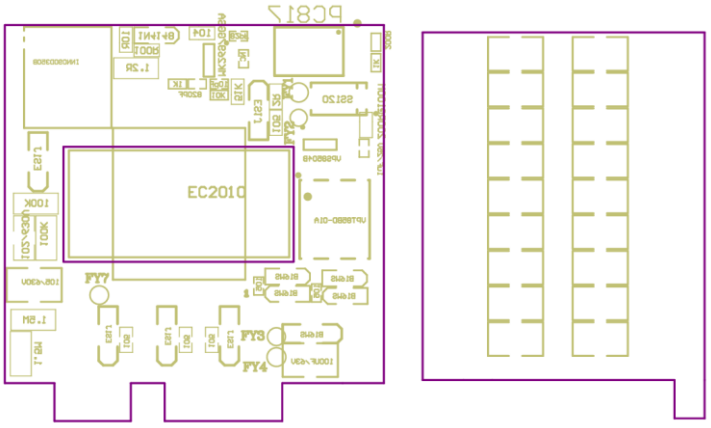
(a) Top Layer



(b) Bottom Layer



(g)Top Overlayer



(h) Bottom Overlayer

Appendix D. BOM

Comment	Manufacture	Description	Designator	Footprint	Quantity
ECAP	Rubycon	100uF 16V	EA1, EA2, EA3	EC5×11×2.0	3
Relay	Hongfa	HF161F 20A	RELAY1	RELAY-TH_HF161F-24-HT	1
Safety CAP(X2)	Kemet	1uF ±10% 310VAC	CX1	Radial-8.5×18-P15	1
Safety CAP(X2)	Kemet	1uF ±10% 310VAC	CX2, CX3	Radial-8.5×18-P15	2
Fuse	Littelfuse	Time-delay 20A 250V	F1	FUSE-5×20	1
NTC	Murata	20R	NTC4	NTC-C1451	2
CMC	TDK	-	LF1	(TBD)	1
NTC	-	(NC-Confirm)	NTC1	(TBD)	1
MOV	Littelfuse	-	RV1	RES-TH_L12.5-W5.5-P7.50	1
IND	TDK	270uH PFC	LP10	(TBD)	1
ECAP	Rubycon	1200uF 450V	CP1	C30×30	1
DIP CAP	Chemi-Con	680uF 63V	E2, E8	C12.5×20	2
DIP CAP	Chemi-Con	1000uF 63V LOW ESR	E1, E6	C22×20	2
ECAP	Rubycon	47uF 63V	ECSR1-1~18, ECSR2-1~36	(TBD)	54
IND	TDK	Resonant EQ3325	LR1	LR	1
XFMR	Bourns	LLC EQ3330	T1, T2	(TBD)	2
ECAP	Rubycon	1000uF 6.3V	EC9	EC6.3×11.2×2.5	1
ECAP	Rubycon	2.2uF 450V	EC3	1210	1
SMD CAP	Murata	100uF 63V	EC4, EC5	1210	2
SMD CAP	Murata	1uF 630V X7R 10%	EC6, EC7, EC8	1210	3
SMD CAP	Murata	10uF	C2, C7, C8, C20, C21, CA56, CP110, CP113	0603	8
SMD CAP	Murata	100nF	C3, C5, C15, C17, CA11	0603	5
SMD CAP	Murata	1uF 630V	C4, CPA2, CPA3, CPA4	2220	4
SMD CAP	Murata	100nF	C5, C6, C9, C14, C18, C24, C25, C31, C47, C49, C54, CAD1, CAD2, CB29, CM5, CP43	0402	17
SMD CAP	Murata	10uF	C5-2	0402	1
SMD CAP	Murata	2.2uF	C8	0402	1
SMD CAP	Murata	2.2uF	C10	0805	1
SMD CAP	Murata	2.2uF	C11, C12, C13, C19, C60, C61	0603	6
SMD CAP	Murata	15pF C0G	C22, C23	0402	2
SMD CAP	Murata	1uF	C22, C23, C24, C25, CAU5, CAU6	0402	6
SMD CAP	Murata	4.7uF ±10% 25V	C24-1, C24-2,	0603	21

			C24-3, C27, C27-1, C27-2, C27-3, C27-4, C27-5, C162-1, C174, C182, C182-1, C183, C243-4, C243-5, C243-6, C243-7, C243-9, C243-10, CPA57		
SMD CAP	Murata	10nF ±10% 25V	C26, C28, C29, C30, CP11	0402	5
RES	Yageo	0Ω	C32, C41, C43, C44, C50, C51, C52, C53, C55, C56, C57, C58, C59, CP6, CP28, CP31, CP35, CP79, CP148, CP149, CP152	0402	21
SMD CAP	Murata	330pF	C34, C35, C36, C37, C38, C39, C40, CPA66	0402	8
SMD CAP	Murata	330pF	C34, C35, C36, C37, C38, C39, C40, CPA66	0402	8
SMD CAP	-	(NC-Confirm)	C42, C45, CAD2, CAD7, CAD8, CAD15, CAD16, CAD17, CAD18, CAD19, CAD21, CAD24, CAD25, CAD99, CAD100, CAD101, CM1, CM5-5, CM5-6, CM16, CM108, CM110, CM110-1, CP3, CP77, CP80, CP81, CP86, CP86-1, CP87, CP88, CP89, CP90, CP91, CP92, CP93, CP94, CP95, CP100, CP101, CP101-1, CP102	0402	42
Safety CAP(Y1)	Kemet	1nF Y1	C107, C108	SMDY1	2
SMD CAP	Murata	100uF 63V X5R	C109, C114, C115, C116, C117, C119, C120, C128	1210	8
SMD CAP	Murata	1uF	C159, C161, C162,	0603	8

			CN40, CP54, CP68, CP109, CP112		
SMD CAP	Murata	1uF 25V	C198-2, C214, CAU2, CP13, CP23	0402	5
SMD CAP	Murata	100pF 50V	C217-1, C218	0402	2
SMD CAP	Murata	1uF 25V	C222, CAD6, CAD10	0402	3
RES	-	(NC-Confirm)	C242, R10, R11, R17, R31-1, R37, R47, R63, RA50, RA51, RAD16, RAD19, RAD20, RAD22, RAD23, RAD25, RAD26, RAD27, RAD28, RAD29, RAD30, RAD32, RAD33, RAD34, RAD35, RAD36, RAD41, RAD42, RAD43, RAD44, RAD45, RAD46, RM9, RM11, RM12-3, RM103, RM111, RM112, RM114, RS12, RS14-1	0402	42
SMD CAP	Kemet	1nF 630V X7R	C258	1206	1
SMD CAP	Murata	820pF	C269	0402	1
SMD CAP	Murata	22uF 25V	C271	1206	1
SMD CAP	Murata	1uF	C272	0603	1
SMD CAP	Murata	100nF	C273	0603	1
SMD CAP	Murata	10pF	C274	0402	1
SMD CAP	Murata	220nF/470nF	C285	0402	1
SMD CAP	Murata	10uF 25V	CA30	0603	1
SMD CAP	Murata	10uF 10V	CA55, CP108, CP114, CP115, CP124, CP127, CP128	0603	8
RES	Yageo	3kΩ	CAD9	0402	1
SMD CAP	Murata	100pF 50V	CAD11, CAD12	0402	2
SMD CAP	Murata	1uF 25V	CAD13	1206	1
SMD CAP	Murata	10pF	CAD14, CAD22, CAD23	0402	3
SMD CAP	Murata	1uF	CAD20	0402	1
SMD CAP	Murata	2.2nF	CM17	0402	1
SMD CAP	-	(NC-Confirm)	CM18-1	0603	1
SMD CAP	Murata	470pF	CM18, CP82, CP83	0402	3
Connector	TE Connectivity	HC-PHD-2×4A	CN2	H-8PIN	1

SMD CAP	Murata	100nF 50V	CP7	0402	1
SMD CAP	Murata	10uF	CP8	0805	1
SMD CAP	Murata	100nF	CP9	0603	1
SMD CAP	Murata	10nF 50V	CP10, CP15	0402	2
SMD CAP	Murata	100nF 25V	CP14, CP24, CP99-1, CP99-2, CP99-3, CP103, CP104, CP105, CP116, CP117, CP118, CP121, CP122, CP147	0402	14
SMD CAP	Murata	10nF 50V	CP16, CP17	0402	2
SMD CAP	Murata	4.7uF 25V	CP18, CP21, CPA57-1, CPA57-2, CPA57-3, CPA57-4, CPA58, CPA58-1, CPA58-2	0603	9
SMD CAP	Murata	100pF 25V	CP19, CP20, CP132, CP133, CP134, CP135, CP136, CP142, CP143, CP145	0402	10
SMD CAP	Murata	3.3nF 25V	CP22	0402	1
SMD CAP	Murata	4.7uF 25V	CP25	0402	1
SMD CAP	Murata	4.7uF 25V	CP26	0805	1
RES	Yageo	4.7kΩ	CP40_1	0402	1
SMD CAP	Murata	100pF	CP40_2	0402	1
SMD CAP	Murata	100pF	CP84, CP85	0402	2
SMD CAP	Murata	22uF 25V	CP98	0603	1
SMD CAP	Murata	100nF 25V	CP99, CP106	0603	2
SMD CAP	Murata	10uF 10V X7R	CP107, CP107-1, CP107-2, CP107-3, CP107-4, CP107-5, CP107-6	0805	7
SMD CAP	Murata	10nF 25V X7R	CP111	0402	1
SMD CAP	Murata	2.2uF 25V	CP119, CP120, CP126, CP126-1, CP140, CP141	0603	6
SMD CAP	Murata	10uF 10V X7R	CP125	0402	1
SMD CAP	Murata	1nF 25V X7R	CP129	0402	1
SMD CAP	Murata	22pF NP0	CP131, CP144	0402	2
SMD CAP	Murata	20pF NP0	CP137, CP138	0402	2
SMD CAP	Murata	NP0	CPA1	2220	1
SMD CAP	Murata	330pF 25V NP0	CPA67	0402	1
SMD CAP	Murata	6.8nF 630V C0G	CR1-1~18, CR2-1~18	1210	36
SMD CAP	Murata	1nF	CS1, CS12, CS13, CS14	0402	4

SMD CAP	Murata	100nF	CS2, CS22, CS23, CS24	0402	4
SMD CAP	Murata	100uF 63V X5R	CSR1-1~18	1210	16
SMD CAP	Murata	100uF 63V X5R	CSR2-1~16, CSR3-1~5, E9	2220	22
Safety CAP	-	(NC-Confirm)	CX4	CAP-TH_L26.5-W7.0-P22.50	1
Safety CAP(Y)	-	(NC-Confirm)	CY1, CY2	1808	2
RES	-	(NC-Confirm)	D2, D3, RA56	0603	3
Diode	ON Semiconductor	1N4148 75V 150mA	D8	SOD-323	1
Diode	ON Semiconductor	SS120 200V 1A Schottky	D25	SMA	1
Diode	ON Semiconductor	ES1J 600V 1A Ultra Fast	D27, D30, D48, D49, D51, DA1, DA2, DA3, DA4	SOD-123	9
Diode	ON Semiconductor	B16WS Schottky	DAU1, DAU2, DAU3, DAU4, DP21, DP22, DP23, DP24	SOD-323	8
Diode	ON Semiconductor	B16WS Schottky	DAU7	SOD-123	1
Diode	ROHM	RB521 Schottky	DM1	SOD-523	1
Diode	-	(NC-Confirm) RB521 Schottky	DM2, DM3, DM4, DM5, DM6, DM7, DM8, DM9, DM10, DM15, DM16, DM17, DM18, DM30, DM31, DM32, DM33, DM34, DM35, DM55	SOD-523	22
Diode	ON Semiconductor	SM10C	DP17, DP18	SMC	2
Diode	-	(NC-Confirm)	DP19, DP20	SMC	2
Diode	ON Semiconductor	1N4148W	DP25, DP26	SOD-523	2
Bead	Murata	220R@100MHz	FB1, FB2	0603	2
RES	Yageo	1kΩ	FR2	0603	1
RES	Yageo	10Ω	FR3_1, FR3_2	0603	2
RES	Yageo	100kΩ	FR5	0402	1
RES	Yageo	0Ω	JC111	0805	1
Bead	muRata	BLM21BB201SN1D	L1	0805	2
Bead	muRata	BLM21PG600SN1D	L2	0805	1
IND	YJYCOIN	YNR4018-2R2M 2.2uH	L3	L3	1
CMC		(TBD)	LF1	L-COMMON	1
IND	muRata	LQM2HPN2R2MG0L 2.2uH	LP2	L3	1
MOSFET	CJ	2N7002	Q1	SOT-23	1
GaN	INNOSCIENCE	INNO90D350B	Q39	DFN8×8	1
MOSFET	Infineon	IRF5802TRPBF	QAD8	SOT23-6L	1
GaN	INNOSCIENCE	INN650TA030CS	QP2, QP3, QP4, QP5	PG-HOSF-8	4

MOSFET	BORN	2N7002 Sync Rectifier 1.2mR 60V	QSA1, QSA2, QSA3, QSA4 QSA7, QSA8, QSA9, QSA10, UP51	SOT-23-3	4
SMD RES	Yageo	10MΩ	R12, R13	0402	2
SMD RES	Yageo	0Ω	R14, R15, R20	0805	3
SMD RES	Yageo	0Ω	R21, R22, R29, R32, R38, R39, R43, R46, R53, R55, R56, R57, R58, R59, R107, RS3, RS33, RS34	0402	18
SMD RES	Yageo	1Ω	R24	0402	1
SMD RES	Yageo	56kΩ	R25, R26	0402	2
SMD RES	Yageo	2.2kΩ	R27, R30, R31	0402	3
SMD RES	Yageo	10kΩ	R48, R110, R111, R277, RA3, RA4, RS2, RS7, RS22, RS23, RS24, RS72, RS73, RS74	0402	15
SMD RES	Yageo	2kΩ 1%	R49, R52, R54, R55, R65, R77, R83, R86, R88, RAD1, RAD2, RAD3, RAD4, RAD5, RAD6	0402	16
SMD RES	Yageo	100Ω	R108, R109, R269, RA1, RA2, RAD10, RAD11, RM14, RS1, RS12, RS13, RS14	0402	12
SMD RES	Yageo	10Ω	R118	0603	1
SMD RES	Yageo	100Ω	R120, R268	0603	2
SMD RES	Yageo	1kΩ	R123, R276, RM1	0402	3
SMD CAP	Murata	82pF	R126	0402	1
SMD RES	Yageo	1Ω 1% 2512	R220, R221	2512	2
SMD RES	Yageo	100kΩ 1%	R252, R253	1206	2
SMD RES	Yageo	1.5MΩ 1%	R255, R261	1206	2
SMD RES	Yageo	1.2Ω 1%	R264	1206	1
SMD RES	Yageo	3.3kΩ	R264, R265, RAD12, RAD13	0402	4
SMD RES	Yageo	51kΩ 1%	R265	0603	1
SMD RES	Yageo	2Ω 1%	R267	0603	1
SMD RES	Yageo	200Ω	R275	0402	1
SMD RES	Yageo	2kΩ	R278, RAD21, RAD24, RAD37, RAD38, RAD59	0402	6
SMD RES	Yageo	12kΩ	R279	0402	1

SMD RES	Yageo	200Ω@100MHz 1%	R280	0603	1
SMD RES	Yageo	33kΩ	R281	0402	1
SMD RES	Yageo	0Ω 1%	RA69, RA70, RA100, RAJ1, RAJ2, RAJ3, RAJ5, RP92, RP94, RP95, RP96, RPA58, RPA88, RS4, RS6, RS8, RS43, RS44, RS62, RS63, RS64, RS82, RS83, RS84	0603	24
SMD RES	Yageo	0Ω 1%	RA99, RP107, RP112, RP114, RP115, RP116, RP117, RP118, RPA56	0402	9
SMD RES	Yageo	30kΩ 0.1%	RA102, RA103	0402	2
SMD RES	Yageo	390Ω	RAD14	0402	1
SMD RES	Yageo	360Ω	RAD15	0402	1
SMD RES	Yageo	3kΩ	RAD17	0402	1
SMD RES	Yageo	24kΩ	RAD18	0402	1
SMD RES	Yageo	68kΩ	RAD31	0402	1
SMD RES	Yageo	10kΩ	RAD39, RAD40	0603	2
SMD RES	Yageo	0Ω	RAD49, RAD50	0603	2
SMD RES	-	(NC-Confirm)	RAD99, RAD100, RP66, RP69, RP78, RP79, RP80, RP81, RP82, RP83, RP84, RP85, RP86, RP87, RP88, RP89, RP90, RP91	0402	18
SMD RES	Yageo	91kΩ	RM12	0402	1
SMD RES	Yageo	3.6kΩ	RM12-1	0402	1
SMD RES	Yageo	5.1kΩ	RM13, RM15	0402	2
SMD RES	Yageo	680kΩ	RM15-1	0402	1
SMD RES	Yageo	5.1Ω	RP2	0402	1
SMD CAP	Murata	100pF	RP3	0402	1
SMD RES	Yageo	100Ω	RP6, RP7, RP12, RP15, RP16, RP37	0402	6
SMD RES	Yageo	100kΩ	RP8	0402	1
SMD RES	Yageo	4.7kΩ	RP10, RP22, RP23, RP41, RP123	0402	5
SMD RES	Yageo	10kΩ	RP11, RP17, RP26, RP63, RP99, RPA60, RPA61	0402	7
SMD RES	Yageo	1kΩ	RP13	0402	1
SMD RES	Yageo	0Ω 1%	RP14	1206	1
SMD RES	Yageo	39Ω	RP18, RP24	0402	2

SMD RES	Yageo	1Ω 1%	RP19, RP25, RP37, RP97	0402	4
SMD RES	Yageo	200kΩ	RP27	0402	1
SMD RES	Yageo	330kΩ 0.1%	RP60, RP61, RP64, RP65	0805	4
SMD RES	Yageo	330kΩ 1%	RP62, RP67, RP72	0805	3
SMD RES	Yageo	300kΩ 0.1%	RP70, RP71	0805	2
SMD RES	Yageo	5.1kΩ 0.1%	RP74, RP75	0402	2
SMD RES	Yageo	5.1kΩ 1%	RP76	0402	1
SMD RES	Yageo	33Ω 1%	RP103, RP104, RP106, RP108, RP110, RP111, RP113, RP119	0402	8
SMD RES	Yageo	56kΩ 1%	RP124, RP125	0402	2
SMD RES	-	(NC-Confirm)	RPA58-2	0402	1
SMD RES	Yageo	1Ω 1%	RS5, RS42, RS52, RS53, RS54	0603	5
GaN	INNOSCIENCE	INN150EQ032A	SR1C, SR1D, SR1E, SR2A, SR2B, SR2C, SR2D, SR2E	DFN8×8	8
Transformer	VPSC	VPT85BD-01A	TAU1, TP1	XFMR-SMD_L7.5-W6.7	2
IC	TI	TPS73033DBVR LDO 400mA	U3, UP27	SOT23-5	2
IC	TI	TPS3702CX33DDCR Voltage Monitor	U4	SOT23-6	1
IC	TI	SN74HC08D AND Gate	U5	SSOP-14	1
IC	TI	F280049 DSP	U6	LQFP-100	1
IC	DIODES	AZ431 Shunt Regulator	U13	SOT23-3	1
IC	Microchip	MK2697GGSA	U27	SOT23-6	1
IC	Novosense	NSI8220WO-DSWVR Isolator	U28	SOP-8	1
IC	Sharp/Everlight	PC817 Optocoupler	U34	SMD-4	1
IC	TI	ISO7742DWR Digital Isolator	UA10	SOIC-16	1
IC	Novosense	NSI8220WO-DSWVR Isolator	UAD7	SOW8	1
IC	AMS	AMS1117-3.3V LDO	UAD11	SOT89	1
IC	TI	TLV3602DGKR Comparator	UAD12	SSOP-8	1
IC	-	(NC-Confirm)	UAD55, UP31, UP35	SOT23-5	3
IC	TI	SN74LVC2G08DCUR AND Gate	UAD99-1, UAD99-2	VSSOP-8	2
IC	VPSC	VPS8504B PMIC	UAU1, UP37	SOT23-6	2
IC	CJ	CJ78L08 LDO	UC11, UC12, UC13	SOT89	4
IC	TI	INA180A4IDBV Current Sense Amp	UM3	SOT23-5	1
IC	-	(NC-Confirm) Shunt	UM17	SOT23-3	1

		Regulator			
IC	TI	F280049CPZS Microcontroller	UP16	LQFP-100	1
IC	Novosense	NSI8220 Isolator	UP17_1	SOP-8	1
IC	Mornsun	MCA1101-50-3 Current Sensor	UP25	SOIC-16	1
IC	TI	LMV321 Op Amp	UP26	SOT23-5	1
IC	CJ	CJ78L05 LDO	UP28, UP29	SOT89	2
IC	-	(NC-Confirm) Current Sensor	UP30, UP34	SOIC-16	2
IC	NXP	(NC-Confirm) BAV99S Dual Diode	UP32, UP33	SOT-363	2
IC	Novosense	NSI6602A Isolator	UP38	LGA-13	1
IC	TPM	TPM2015	US1, US12, US13, US14	TPM2025	4
Crystal	ECS	ECS-20M 20MHz	Y1	SMD-2P	1
Crystal	TXC	20MHz 25ppm	Y2	SMD-2P	1
Diode	ROHM	RB521 Schottky	ZP5, ZP6	SOD-523	2

Comment	Manufacture	Description	Designator	Footprint	Quantity
SMD CAP	Murata	1uF 25V	C1, C5, C9, C13	0402	8
SMD CAP	Murata	100nF 50V	C2, C4, C6, C8, C10, C12, C14, C16	0402	16
SMD CAP	Murata	100pF 50V	C3, C7, C11, C15	0402	8
SMD CAP	Murata	4.7uF	C29, C40	0402	3
SMD CAP	Murata	1uF	C30, C36, C41, C47	0402	6
SMD CAP	Murata	100nF	C31, C35, C42, C43	0402	6
SMD CAP	Murata	220nF	C32, C44	0402	3
SMD CAP	Murata	10uF 50V X5R	C33, C34, C45, C46	1206	6
SMD CAP	Murata	22nF	C37, C48	0402	3
SMD CAP	Murata	36pF	C38, C49	0402	3
SMD CAP	Murata	6.8nF	C39, C50	0402	3
Diode	ON Semiconductor	PDS1040-13	D1, D4	POWERDI-5	3
Diode	ON Semiconductor	SS3P4	D2, D3, D5, D6	DO-220AA	6
Diode	ON Semiconductor	D_CDZVT2R6.2B 6.2V 400mW Zener	D4, D5, D6, D7, D8, D9, D10	SOD-923	8
IND	TDK	4.7uH	L1, L2	IND-SMD_L5.0-W5.0	3
MOSFET	STMicroelectronics	STL10N3LLH5	Q1, Q2	PDFN3333-8	3
GaN	INNOSCIENCE	INN650TA030CS	Q6, Q8, Q15, Q16	TOLL	4
GaN	INNOSCIENCE	INN650TA050AH	QP6, QP7, QP8, QP9	TOLL	4
SMD RES	Yageo	10Ω	R1, R8, R15, R22	0603	8
SMD RES	Yageo	100kΩ	R2, R9, R16, R23	0402	8
SMD RES	Yageo	1Ω	R3, R10, R17, R24	0603	8
SMD RES	Yageo	50Ω	R4, R11, R18, R25	0402	8
SMD RES	Yageo	0Ω	R5, R12, R19, R26	0402	8
SMD RES	-	DNP	R6, R13, R20, R27	0402	8
SMD RES	Yageo	3.6kΩ	R7, R14, R21, R28	0402	8

SMD RES	Yageo	40.2kΩ	R37, R39, R46, R48	0402	6
SMD RES	Yageo	3.3kΩ	R40, R44, R49, R53	0402	6
SMD RES	Yageo	10kΩ	R41, R45, R50, R54	0402	6
SMD RES	Yageo	15.4kΩ	R42, R51	0402	3
SMD RES	Yageo	28kΩ	R43, R52	0402	3
IC	Texas Instruments	AHV85110	U1, U2, U3, U4, U7, U8, U9, U10	SMD_AHV85111	8
IC	Texas Instruments	A4450KESTR-J	U5, U6	QFN-20	3

Revision History

Date	Version	Description	Check
2025/11/12	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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