RRW22111-153+IW610-08+RRW30110-190 FOR 65W PD3.2 ZSP DESIGN EBC10296

GENERAL DESIGN SPECIFICATION:

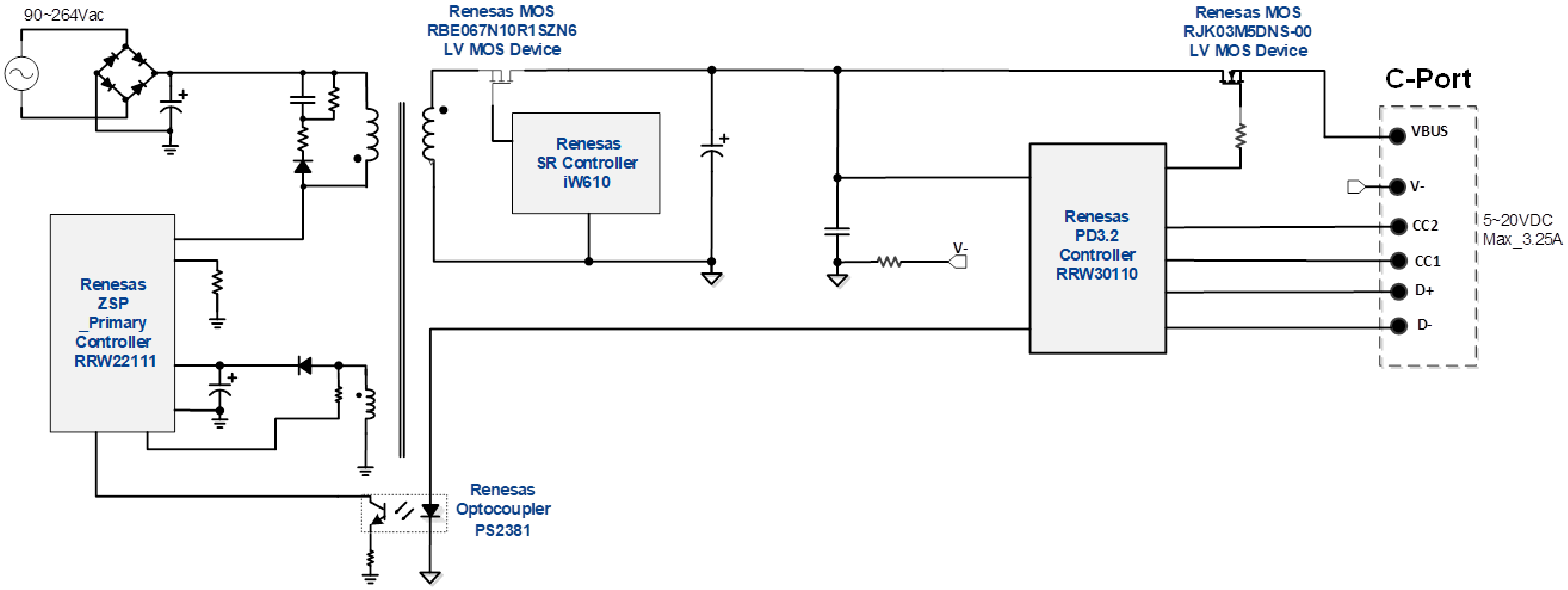
1. AC INPUT RANGE: 90-264V_{AC}
2. DC OUTPUT: 5-20V/3.25A WITH E-MARK CABLE
3. MEET BOTH "COC_V5_TIER2" AND "DOE VII" EFFICIENCY REQUIREMENT
4. STANDBY POWER <5mW
5. SUPPORT PD3.2
6. INTEGRATED GaNFET APPLICATION

NOTE: This reference design document is intended as a design idea to show potential capability of this integrated circuit device. Evaluation boards may not be available.

August 2025; Rev. 1.1

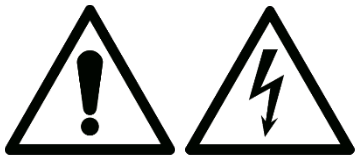
RENESAS CONFIDENTIAL

BLOCK DIAGRAM OF EBC10296



WARNING

DISCLAIMER FOR HIGH VOLTAGE (MAINS POWERED) EVALUATION BOARDS



Warning
This evaluation board is powered by AC mains voltage. When powered, this evaluation board generates non-insulated high voltages which may produce electrical shock, burn, and/or fire hazards, resulting in risk of property damage, personal injury, and/or death.

When the evaluation board is powered, never touch the board or its electrical circuits since they may be operating at high voltages that can cause an electrical shock hazard.

TO BE USED FOR EVALUATION PURPOSES ONLY
This board is intended for evaluation purposes only and not intended for commercial use in an end product. Any other use is strictly prohibited by Renesas Electronics Corporation and its Subsidiaries (“Renesas”).

WORK AREA AND PERSONAL SAFETY
This board should be used in a test area/laboratory specifically designed and designated for working with, and evaluating high-voltage electrical devices. Only trained and qualified professional personnel with experience, knowledge and training in the use of high-voltage electrical circuits should use this evaluation board. Trained personnel must use required personal protective equipment and required laboratory equipment when working with the evaluation board.

The professional personnel operating this evaluation board and the test area/laboratory in which it is operated must be qualified according to the local regulations, guidelines and labor laws applicable to working with non-isolated mains voltages and high voltage circuits.

An isolated housing is highly recommended when using this evaluation board.

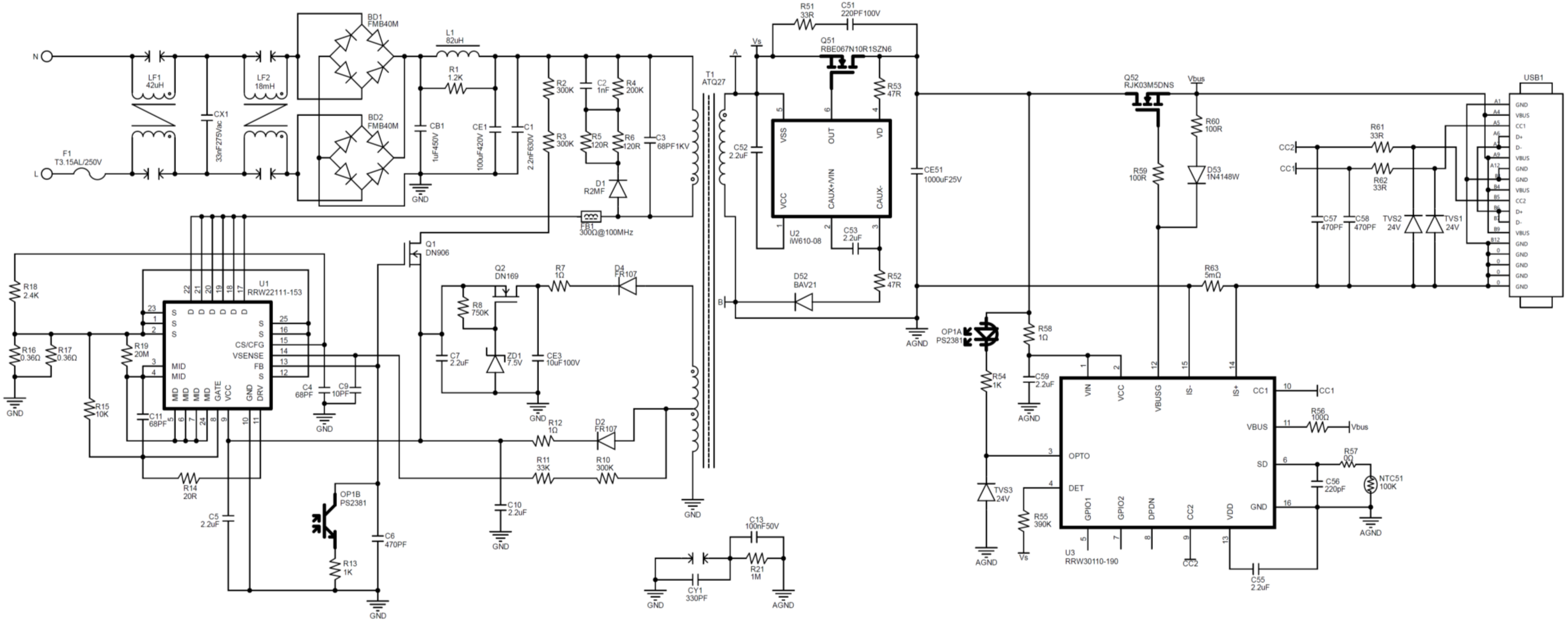
Use this evaluation board at your own risk.

NOT AGENCY APPROVED
This evaluation board has not been agency tested or approved for safety, technical performance, and/or regulatory requirements, such as electromagnetic interference or other technical regulatory or safety requirements.

1. GENERAL SPECIFICATION

Description	Symbol	Min	Typ	Max	Units	Comment
Input Voltage	V_{IN}	90		264	V_{AC}	2 Wire
Frequency	f_{LINE}	47	50/60	63	Hz	
No-load Input Power (230V_{AC})				5	mW	
Output Voltage	V_{OUT_CV}	5		20	V	Measured at PCB-end
Output Current	I_{OUT}	0		3.25	A	Power limit (65W_Max)
Protocol		Meets PD3.2				
Ripple & Noise	V_{RIPPLE}			200	mV_{P_P}	Add 0.1uF Ceramic capacitor and 10uF E-cap at the end of cable and set oscilloscope at 20MHz bandwidth.
Over Current Protection	I_{OCP}			3.9	A	
Conducted EMI		Meets FCC Part 15B / EN55032B				Output is Connected to Ground
Safety		Designed to meet IEC60950, UL1950 Class II				
Ambient Temperature	T_{AMB}	0		25	° C	Free convection, sea level

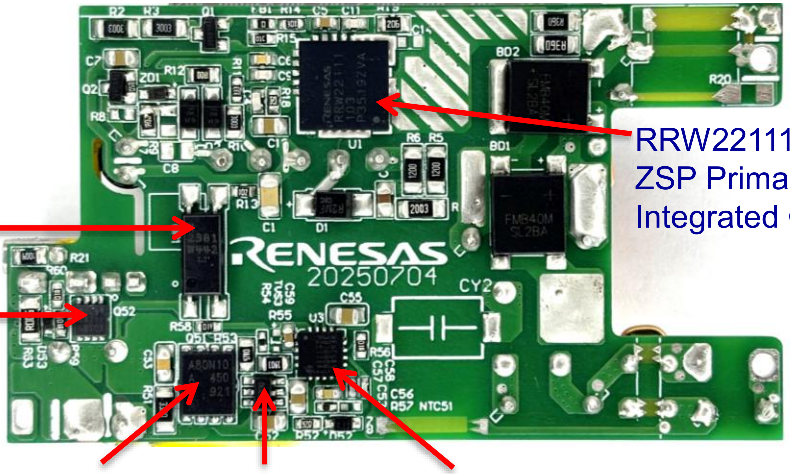
2. SCHEMATIC



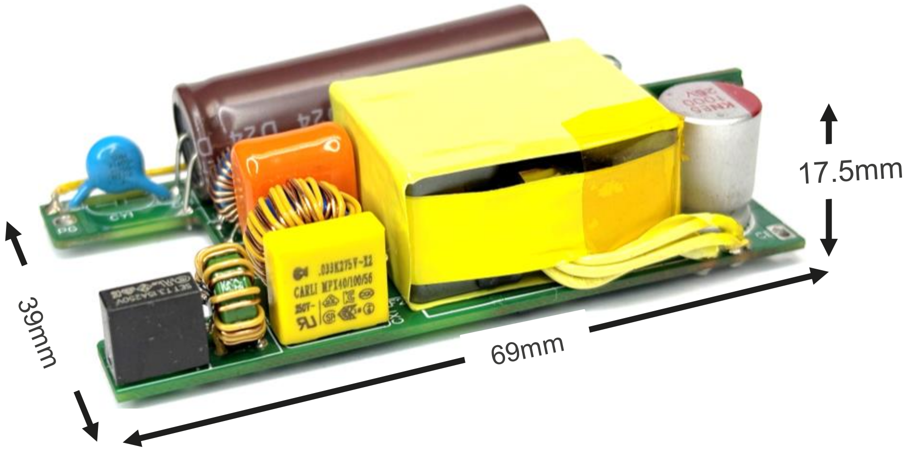
N
L
F1
T3.15AL/250V
LF1
42uH
LF2
18mH
CX1
33nF275Vac
BD1
FMB40M
BD2
FMB40M
L1
82uH
R1
1.2K
CB1
1uF450V
CE1
100uF420V
C1
2.2nF630V
R2
300K
R3
300K
C2
1nF
R4
200K
R5
120R
R6
120R
C3
68PF1KV
D1
R2MF
FB1
300Ω@100MHz
T1
ATQ27
Q1
DN906
Q2
DN169
R7
1Ω
D4
FR107
R8
750K
ZD1
7.5V
C7
2.2uF
CE3
10uF100V
U1
RRW22111-153
CS/CFG
VSENSE
FB
MID
GATE
VCC
GND
DRV
R18
2.4K
R16
0.36Ω
R17
0.36Ω
R19
20M
R15
10K
C11
68PF
R14
20R
C5
2.2uF
C4
68PF
C9
10PF
OP1B
PS2381
R13
1K
C6
470PF
R12
1Ω
D2
FR107
R11
33K
R10
300K
C10
2.2uF
C13
100nF50V
R21
1M
CY1
330PF
GND
AGND
R51
33R
C51
220PF100V
Q51
RBE067N10R1SZN6
R53
47R
C52
2.2uF
U2
iW610-08
VSS
OUT
VD
VCC
CAUX+/VIN
CAUX-
C53
2.2uF
R52
47R
D52
BAV21
CE51
1000uF25V
Vs
A
B
Q52
RJK03M5DNS
Vbus
R60
100R
R59
100R
D53
1N4148W
R63
5mΩ
OP1A
PS2381
R58
1Ω
R54
1K
C59
2.2uF
TVS3
24V
R55
390K
U3
RRW30110-190
VIN
VBUSG
IS-
IS+
CC1
VBUS
OPTO
SD
DET
GPIO1
GPIO2
DPDN
CC2
VDD
R56
100Ω
R57
0Ω
NTC51
100K
C56
220pF
C55
2.2uF
CC2
CC1
R61
33R
R62
33R
C57
470PF
C58
470PF
TVS2
24V
TVS1
24V
USB1

3. CIRCUIT BOARD PHOTOGRAPH

Bottom View

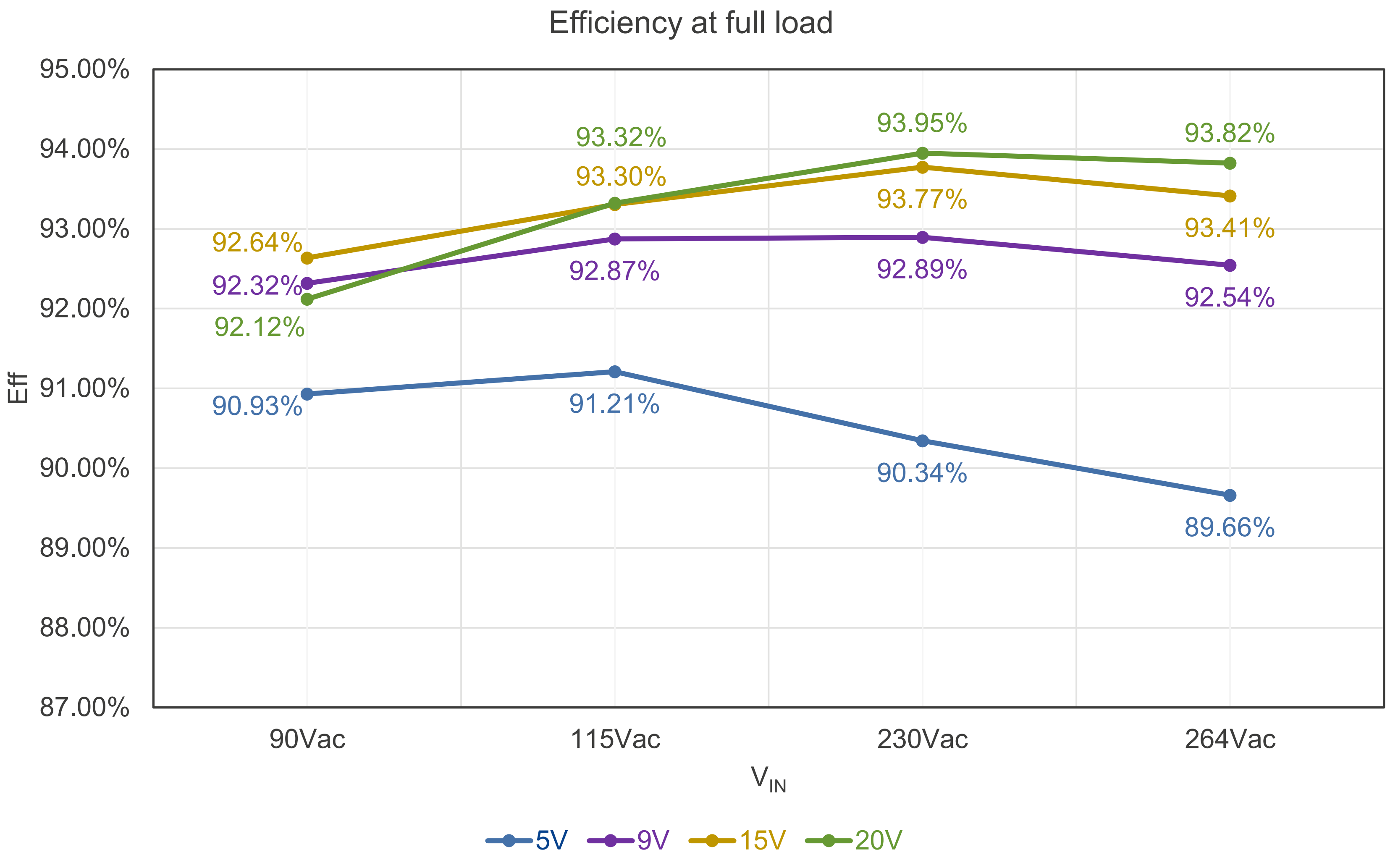


Top View



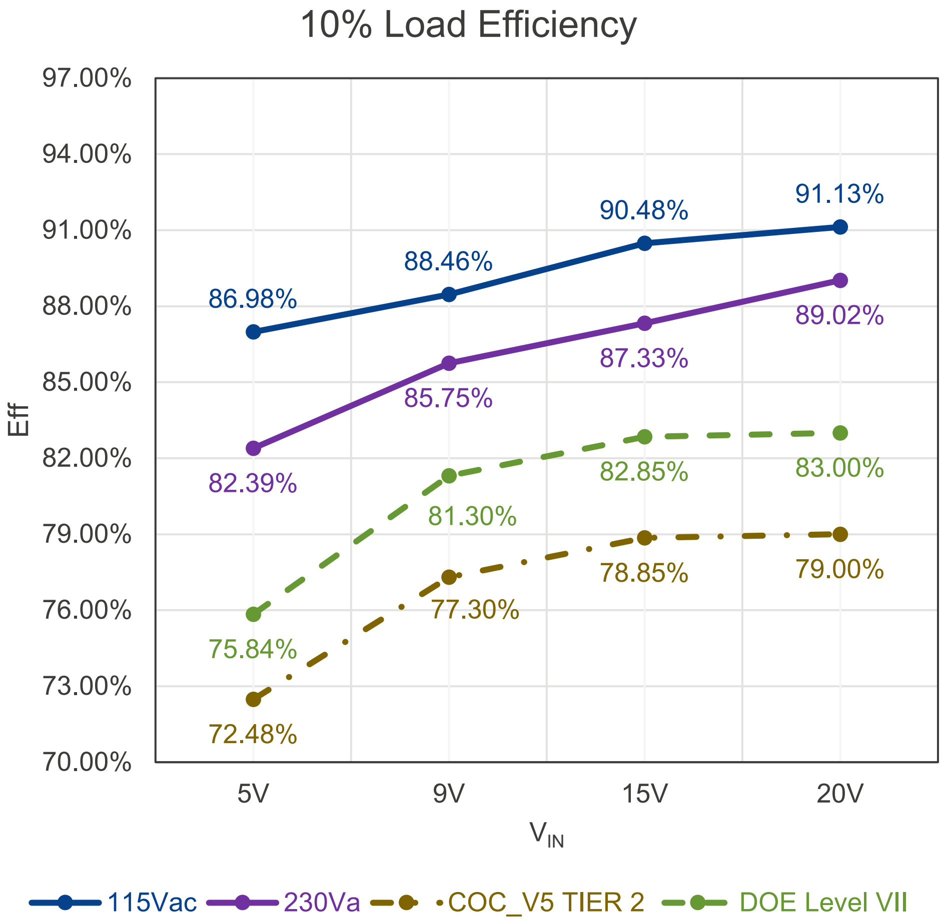
Ultra-Thin Design, Power Density: 1.38w/cm^3

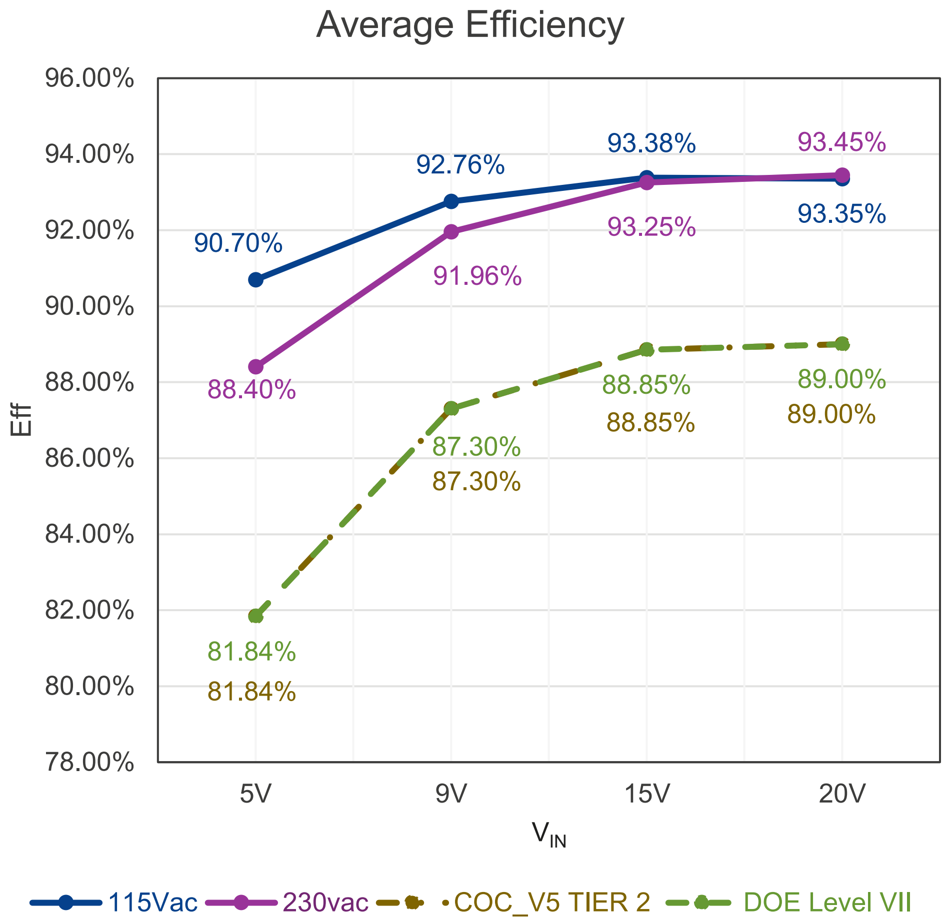
4. EFFICIENCY AT FULL LOAD



*Note: The output voltage is measured at PCB-end.

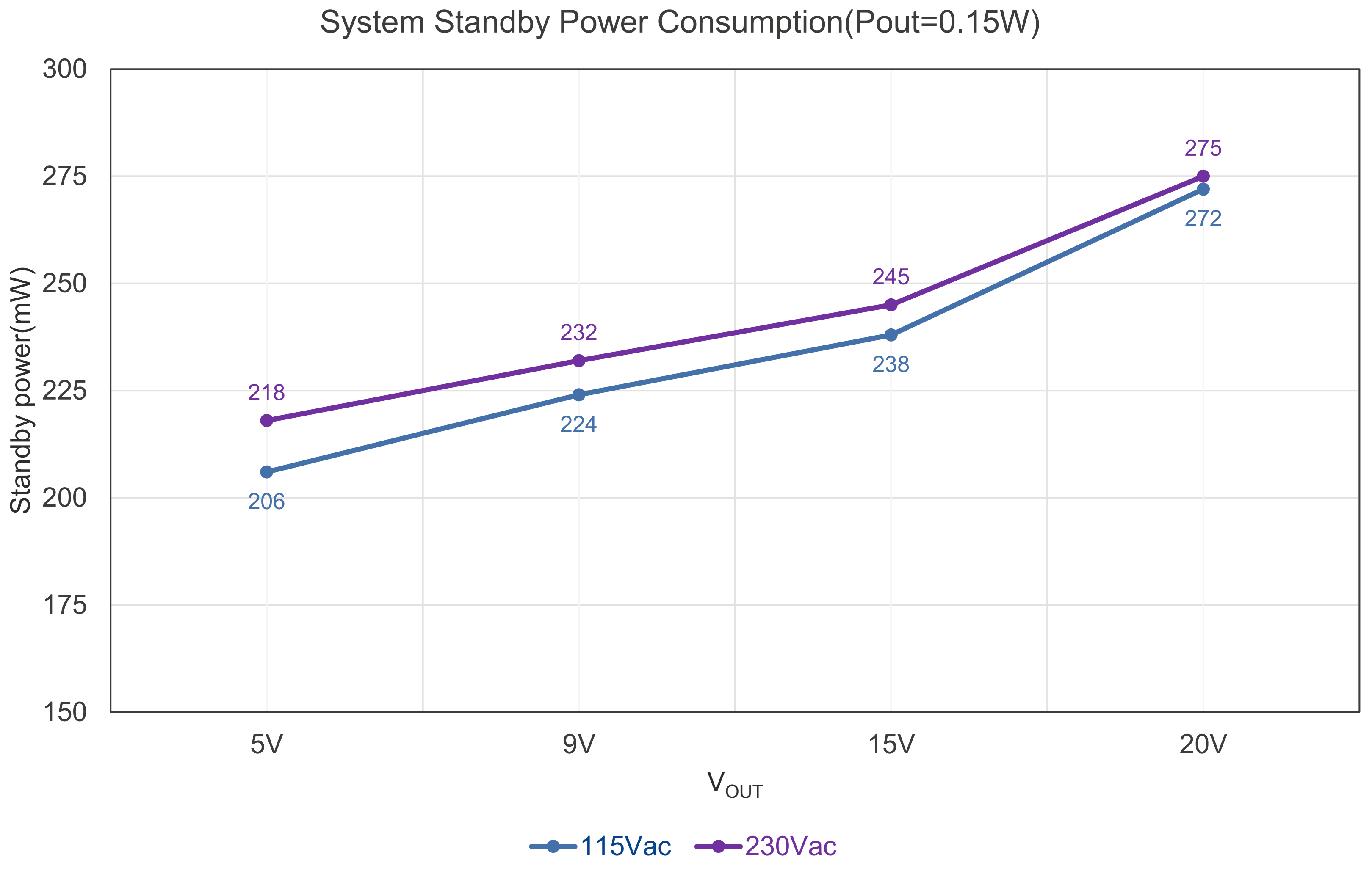
5. ACTIVE MODE EFFICIENCY





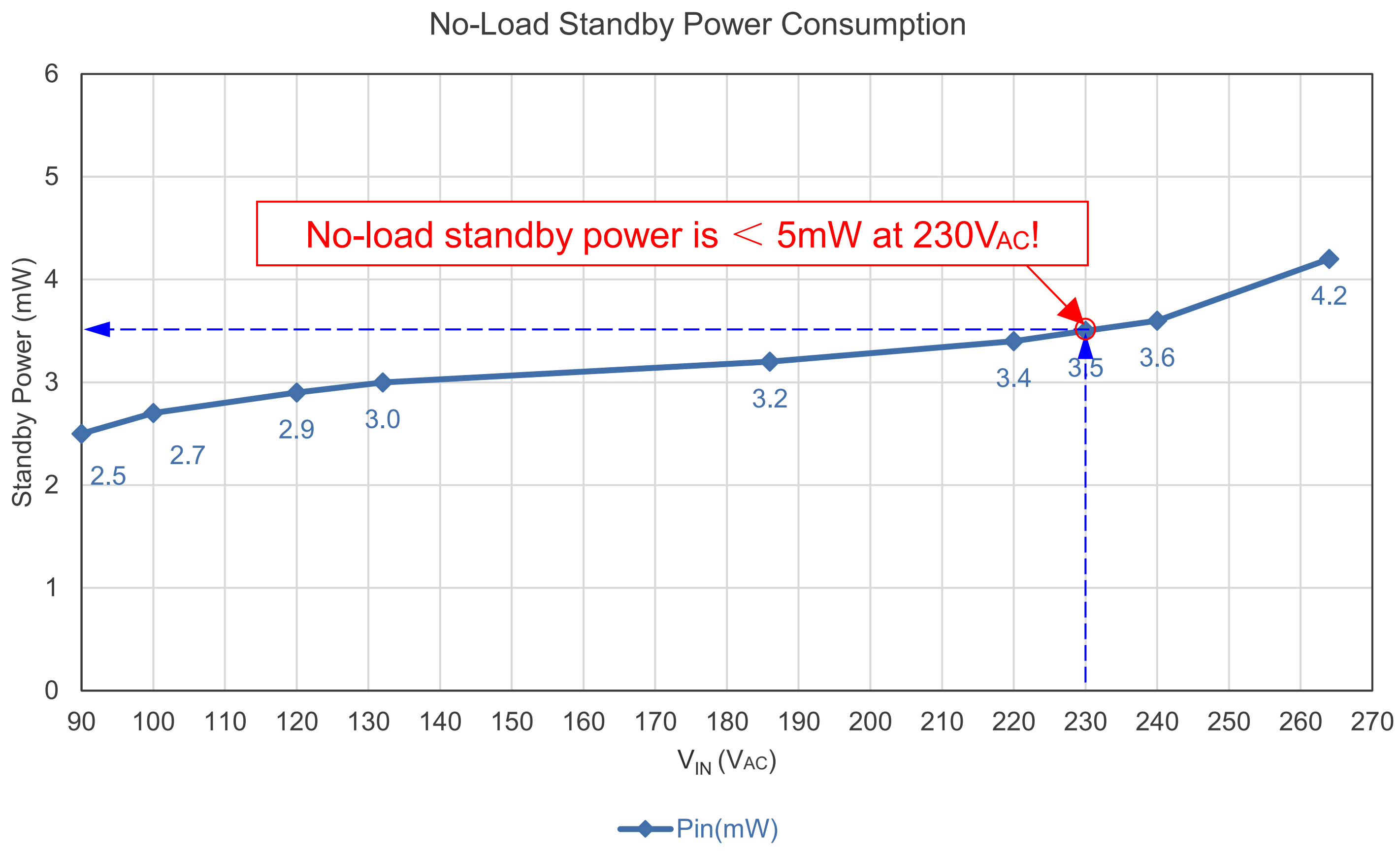
*Note: The output voltage is measured at PCB-end.

6. SYSTEM STANDBY POWER CONSUMPTION



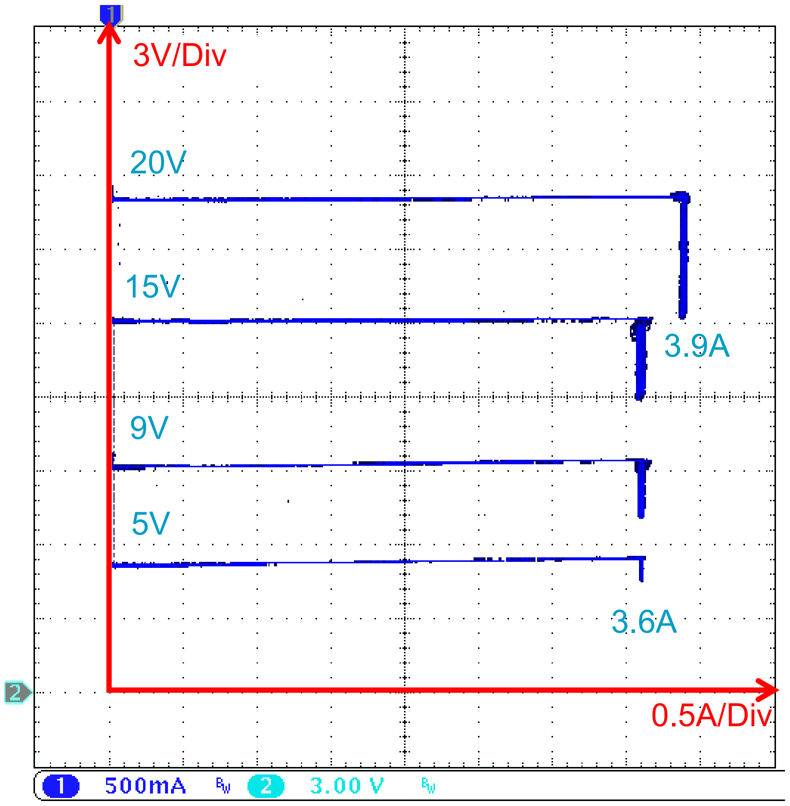
*Note: The output voltage is measured at Cable-end.

7. NO-LOAD STANDBY POWER

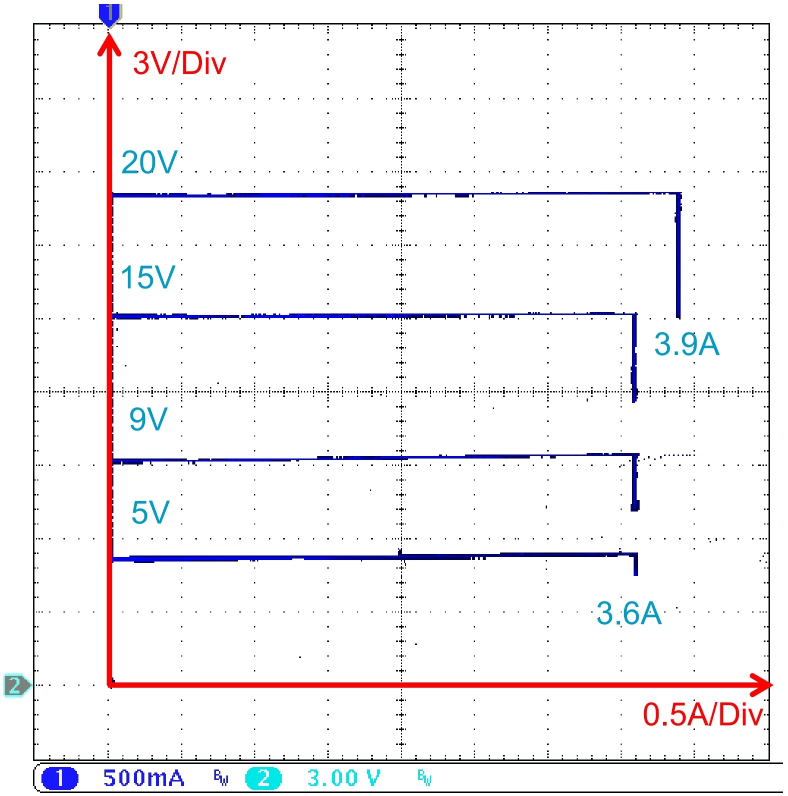


8. OUTPUT VI CHARACTERISTICS

V_{IN}=90V_{AC}/60Hz



V_{IN}=264V_{AC}/50Hz



*Note: The output voltage is monitored at PCB-end.

9. OUTPUT VOLTAGE RIPPLE

V_{IN}	I_{OUT} / V_{OUT}	0A	0.3A	0.75A	1.5A	2.25A	3A	3.25A
$115V_{AC}$	5V	84mV	104mV	70mV	110mV	124mV	118mV	N/A
	9V	94mV	102mV	76mV	96mV	100mV	110mV	N/A
	15V	90mV	64mV	82mV	90mV	104mV	122mV	N/A
	20V	80mV	72mV	78mV	88mV	114mV	132mV	152mV
$230V_{AC}$	5V	94mV	114mV	94mV	104mV	128mV	124mV	N/A
	9V	92mV	126mV	72mV	110mV	100mV	114mV	N/A
	15V	96mV	58mV	84mV	88mV	96mV	120mV	N/A
	20V	82mV	70mV	86mV	90mV	112mV	114mV	124mV

*Note:

1. Add 0.1uF Ceramic capacitor and 10uF E-cap at the end of cable(150mohm).
2. Set oscilloscope to 20MHz bandwidth.

10. DYNAMIC LOAD RESPONSE

Dynamic Load Condition			5V/9V/15V 0A-2.7A-0A and 20V 0A-2.93A-0A, Slew:2.5A/us				
			1Hz	10Hz	100Hz	1kHz	5kHz
5V (4.5V<Vo<5.5V)	$90V_{AC}$/ 60Hz	V_{O_MIN} (V)	4.60	4.60	4.60	4.80	4.64
		V_{O_MAX} (V)	5.38	5.38	5.36	5.40	5.28
	$264V_{AC}$/ 50Hz	V_{O_MIN} (V)	4.62	4.60	4.62	4.68	4.64
		V_{O_MAX} (V)	5.38	5.40	5.34	5.38	5.28
9V (8.1V<Vo<9.9V)	$90V_{AC}$/ 60Hz	V_{O_MIN} (V)	8.56	8.52	8.54	8.62	8.64
		V_{O_MAX} (V)	9.40	9.40	9.38	9.36	9.32
	$264V_{AC}$/ 50Hz	V_{O_MIN} (V)	8.54	8.54	8.56	8.70	8.64
		V_{O_MAX} (V)	9.38	9.42	9.36	9.34	9.32
15V (13.5V<Vo<16.5V)	$90V_{AC}$/ 60Hz	V_{O_MIN} (V)	14.6	14.6	14.5	14.5	14.6
		V_{O_MAX} (V)	15.4	15.4	15.4	15.4	15.4
	$264V_{AC}$/ 50Hz	V_{O_MIN} (V)	14.6	14.5	14.5	14.6	14.6
		V_{O_MAX} (V)	15.4	15.4	15.4	15.5	15.4
20V (18V<Vo<22V)	$90V_{AC}$/ 60Hz	V_{O_MIN} (V)	19.5	19.5	19.4	19.5	19.6
		V_{O_MAX} (V)	20.5	20.5	20.5	20.5	20.4
	$264V_{AC}$/ 50Hz	V_{O_MIN} (V)	19.5	19.5	19.4	19.5	19.6
		V_{O_MAX} (V)	20.4	20.5	20.5	20.5	20.4

Dynamic Load
esponse Waveforr

*Note

1. The output voltage is measured at Cable-end.
2. The cable impedance is 150mohm.
3. Refers to detail waveform as enclosed file.

11. PEAK LOAD RESPONSE

Output	Peak Power Condition: Frequency: 1Hz Slew-Rate: 2.5A/us	V_{OUT} Limits		$90V_{AC}$/ 60Hz		$264V_{AC}$/ 50Hz	
		V_{O_MIN} (V)	V_{O_MAX} (V)	V_{O_MIN} (V)	V_{O_MAX} (V)	V_{O_MIN} (V)	V_{O_MAX} (V)
5V	Load: 15W(999ms) – 22.5W(1ms)	4.50	5.50	4.54	5.14	4.52	5.14
9V	Load: 27W(999ms) – 40.5W(1ms)	8.10	9.90	8.52	9.12	8.54	9.14
15V	Load: 45W(999ms) – 68W(1ms)	13.5	16.5	14.4	15.0	14.4	15.0
20V	Load: 65W(999ms) – 95W(1ms)	18.0	22.0	18.8	20.1	19.3	20.1
20V	Load: 65W(999ms) – 95W(2ms)	18.0	22.0	18.5	20.1	19.2	20.1

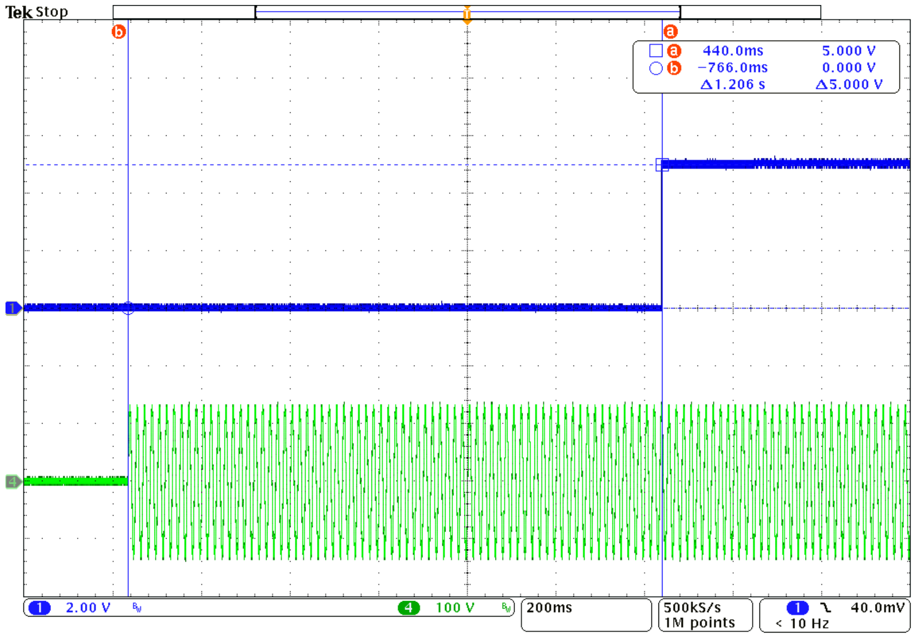
Peak Load
.esponse Waveforr

*Note
1. The output voltage is measured at Cable-end. The cable impedance is 150mohm.
2. Refers to detail waveform as enclosed file.

12. TURN-ON DELAY TIME

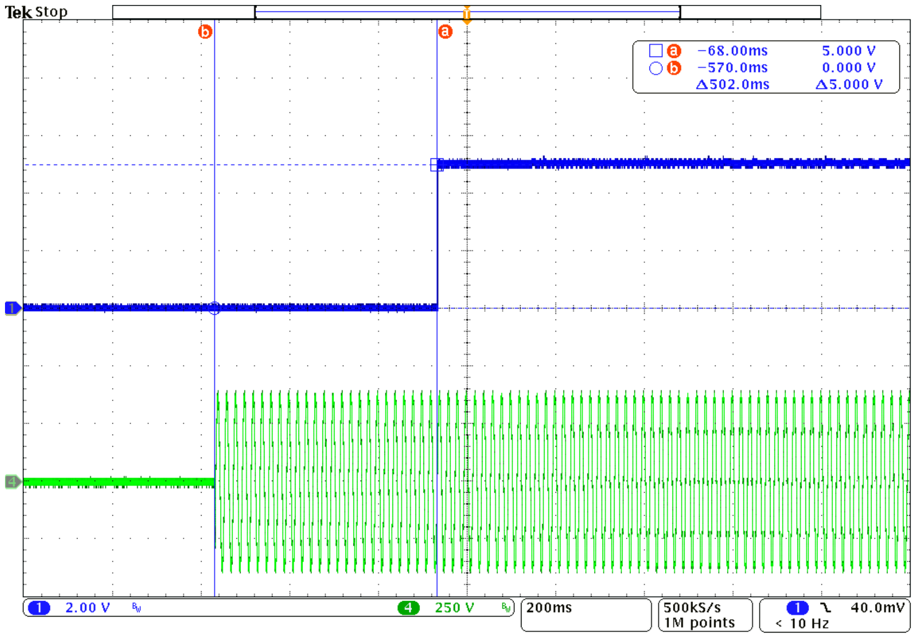
90VAC, No Load

T_{ST_DELAY}=1.206S



264VAC, No Load

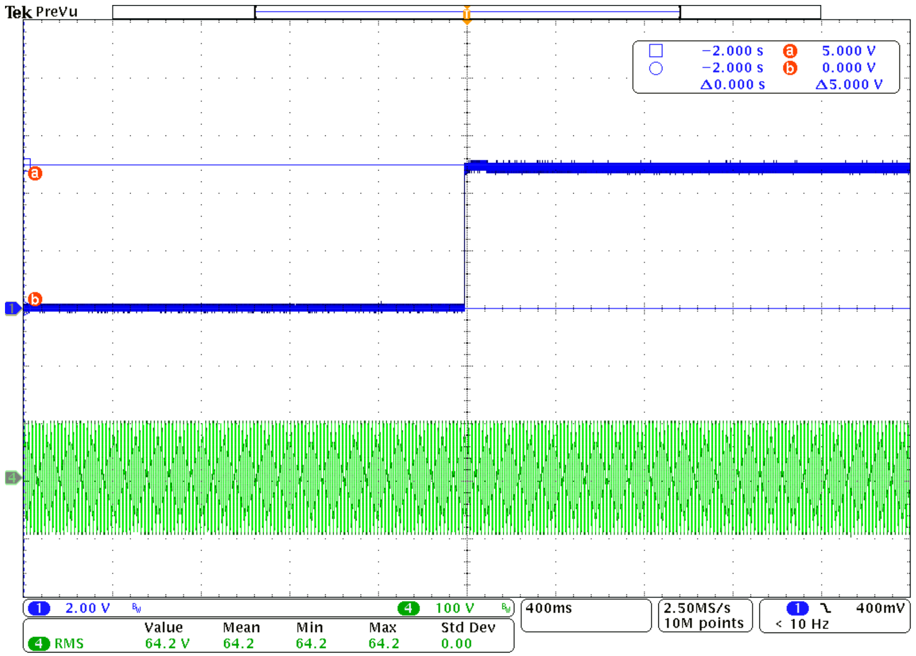
T_{ST_DELAY}=0.502S



13. AC BROWN IN/OUT VOLTAGE

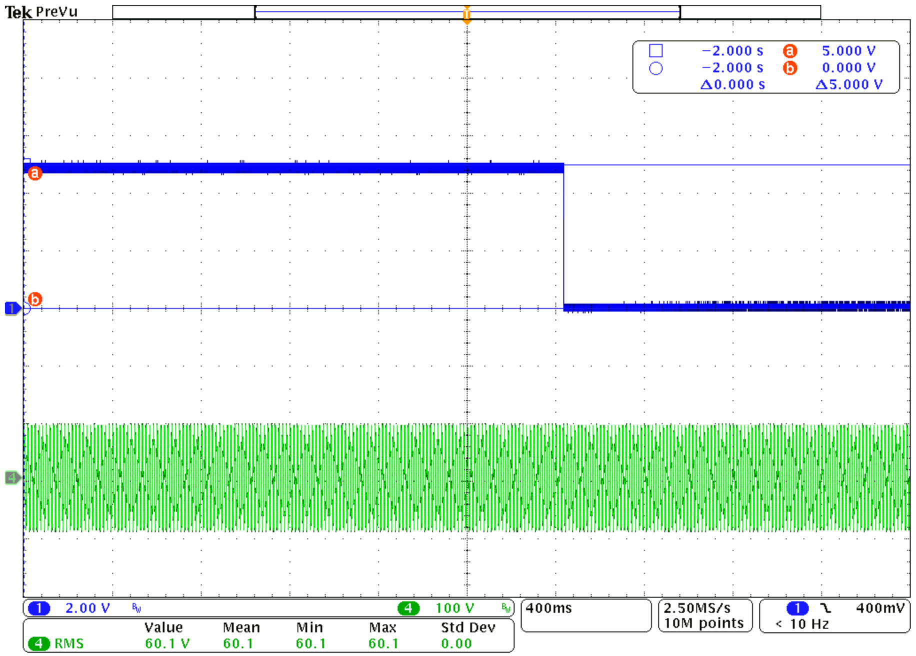
Full Load

$V_{IN\_STARTUP}$ =64.2VAC



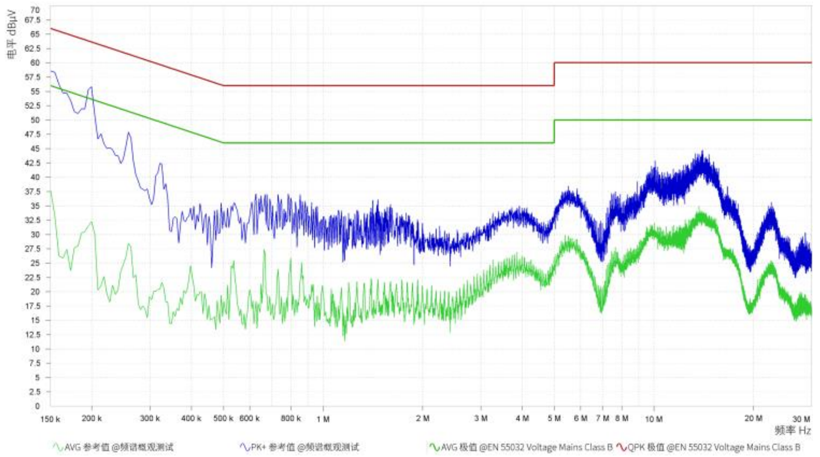
Full Load

$V_{IN\_BROWNOUT}$ =60.1VAC

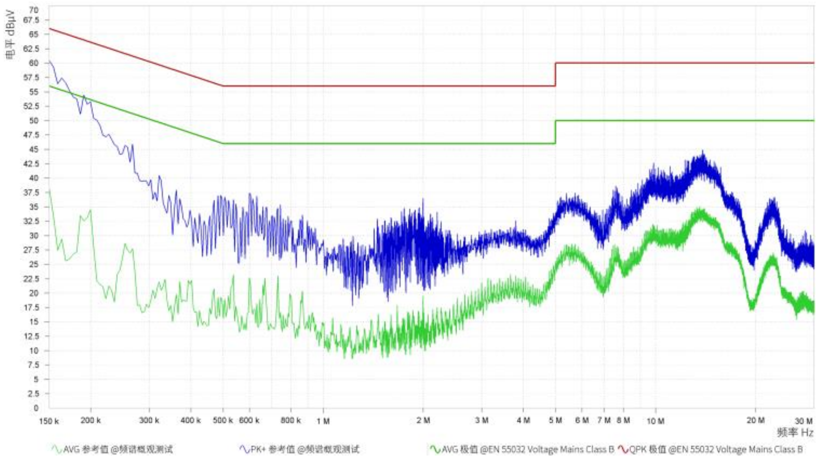


14. CONDUCTED EMI (@20V/3.25A)

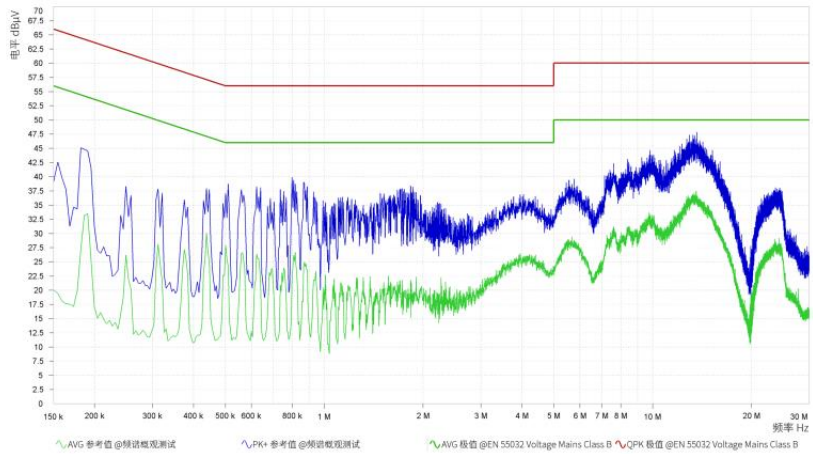
VIN=120VAC/60Hz, Live



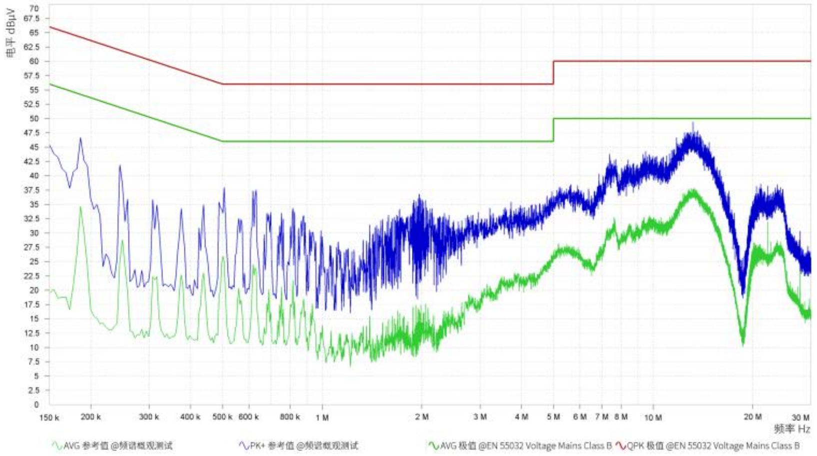
VIN=120VAC/60Hz, Neutral



VIN=230VAC/50Hz, Live



VIN=230VAC/50Hz, Neutral



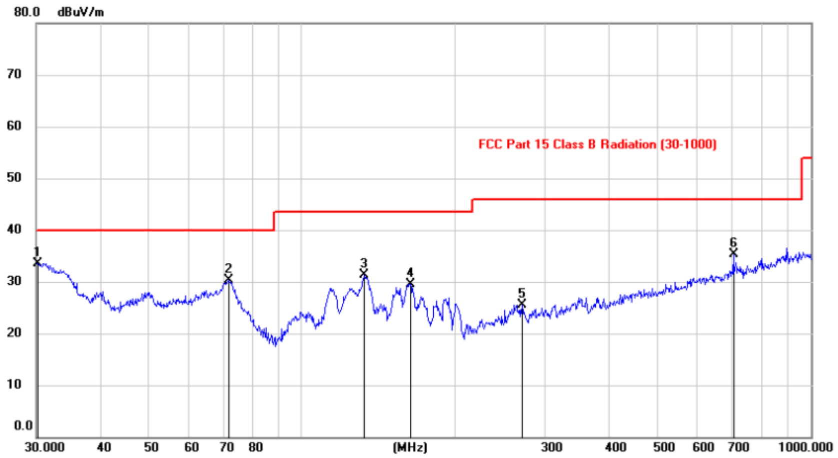
*Note: Output “-” is connected to Earth.

15.1 RADIATED EMI (@20V/3.25A)

V_{IN}=120V_{AC}/60Hz, Vertical

Radiated Emission Measurement

File :65W   Data :#25   Date: 2025/7/22   Time: 16:57:11

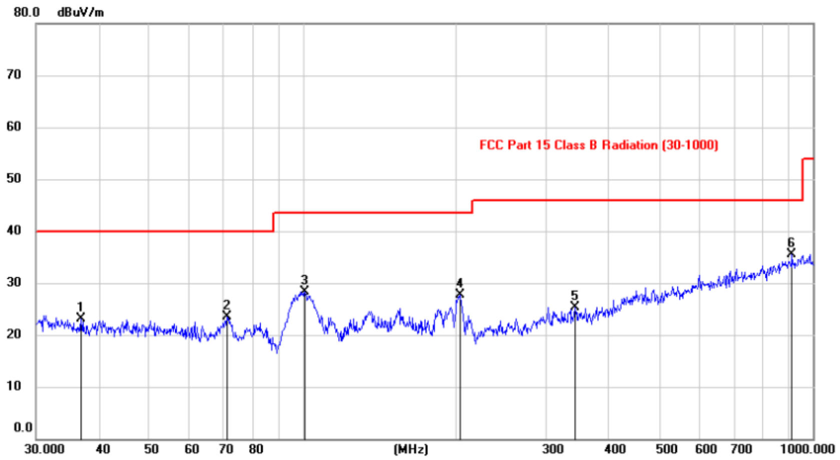


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	30.2606	20.04	13.54	33.58	40.00	-6.42	peak			
2		71.9917	19.28	11.11	30.39	40.00	-9.61	peak			
3		132.2824	17.62	13.75	31.37	43.50	-12.13	peak			
4		163.4873	14.84	14.71	29.55	43.50	-13.95	peak			
5		270.5961	12.17	13.31	25.48	46.00	-20.52	peak			
6		705.4619	13.41	21.81	35.22	46.00	-10.78	peak			

V_{IN}=120V_{AC}/60Hz, Horizontal

Radiated Emission Measurement

File :65W   Data :#24   Date: 2025/7/22   Time: 16:55:25

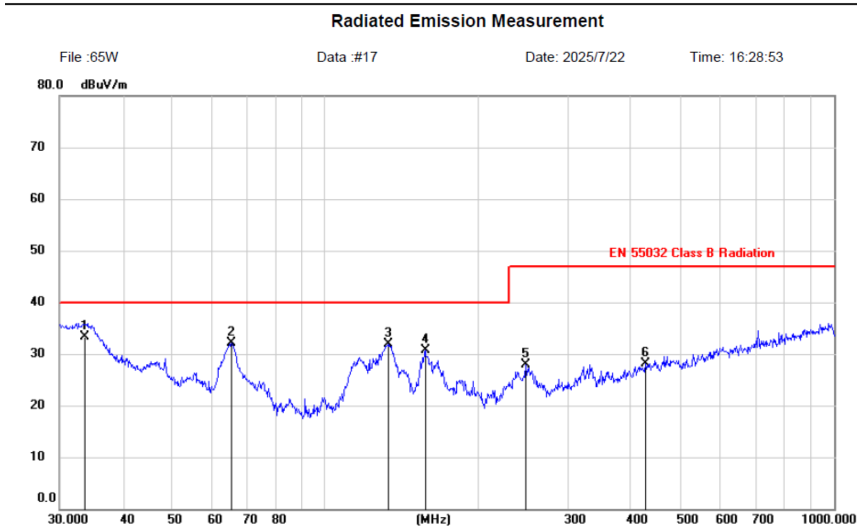


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		36.7963	9.14	14.03	23.17	40.00	-16.83	peak			
2		71.2134	12.34	11.11	23.45	40.00	-16.55	peak			
3		101.0048	17.36	10.95	28.31	43.50	-15.19	peak			
4		203.7846	16.67	10.96	27.63	43.50	-15.87	peak			
5		342.8192	10.15	15.12	25.27	46.00	-20.73	peak			
6	*	909.9857	11.26	24.17	35.43	46.00	-10.57	peak			

*Note: Output “-” is connected to Earth.

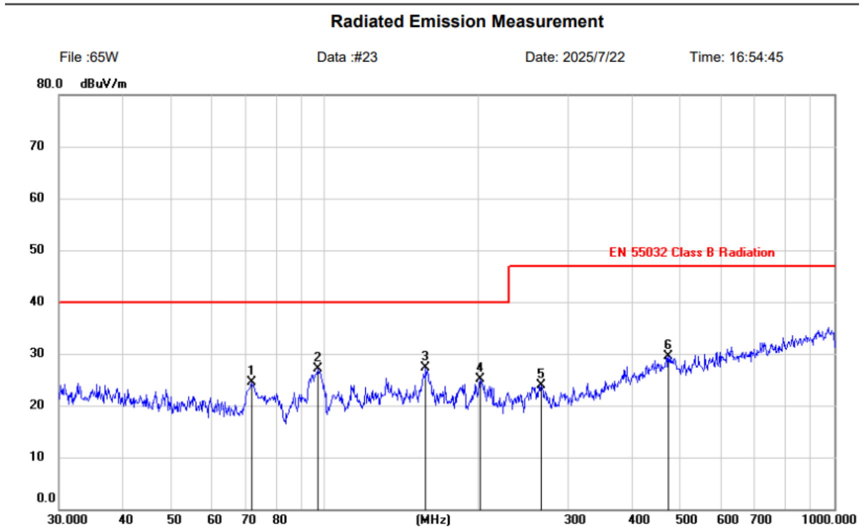
15.2 RADIATED EMI (@20V/3.25A)

V_{IN}=230V_{AC}/50Hz, Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	33.8042	19.69	13.69	33.38	40.00	-6.62	QP			
2		65.3661	19.96	12.14	32.10	40.00	-7.90	peak			
3		133.0733	18.17	13.81	31.98	40.00	-8.02	peak			
4		157.2094	15.56	15.05	30.61	40.00	-9.39	peak			
5		248.0295	15.12	12.73	27.85	47.00	-19.15	peak			
6		425.2268	11.22	16.91	28.13	47.00	-18.87	peak			

V_{IN}=230V_{AC}/50Hz, Horizontal



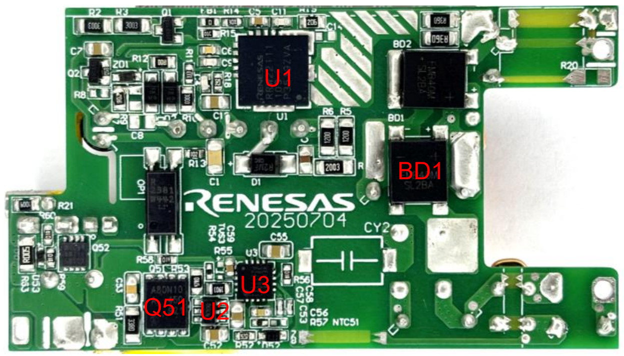
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		71.7062	13.32	11.11	24.43	40.00	-15.57	peak			
2		97.0921	16.42	10.68	27.10	40.00	-12.90	peak			
3	*	157.7247	12.26	15.04	27.30	40.00	-12.70	peak			
4		201.6521	14.11	10.93	25.04	40.00	-14.96	peak			
5		266.5466	10.66	13.18	23.84	47.00	-23.16	peak			
6		472.5625	11.72	17.81	29.53	47.00	-17.47	peak			

*Note: Output “-” is connected to Earth.

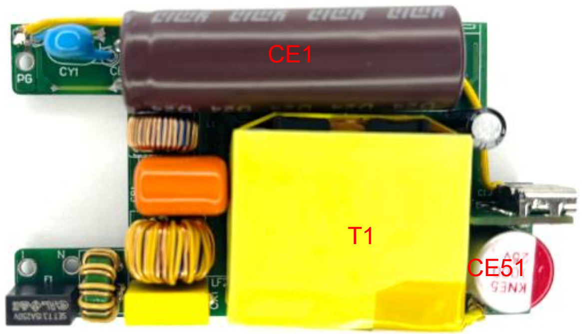
16. THERMAL FOR CRITICAL COMPONENT

Item	V_{IN}=90V_{AC}, V_{OUT}=20V I_{OUT}=3A		V_{IN}=264$_{AC}$, V_{OUT}=20V I_{OUT}=3A	
	Temp.(℃)	Rising Temp.(℃)	Temp.(℃)	Rising Temp.(℃)
BD1, FMB40M	98.8	73.8	77.0	52.0
CE1, 120uF420V	88.2	63.2	81.2	56.2
T1, ATQ27 Core	82.2	57.2	79.4	54.4
T1, ATQ27 Wire	88.3	63.3	85.6	60.6
CE51, 1000uF25V	81.7	56.7	80.5	55.5
U1, RRW22111-153 (150mΩ)	89.0	64.0	85.5	60.5
U2, iW610-08	88.7	63.7	87.2	62.2
U3, RRW30110-190	87.3	62.3	85.0	60.0
Q51, RBE067N10R1SZN6	93.1	68.1	91.7	66.7
Ambient (Chamber) Temp.(℃)	25			

Bottom View



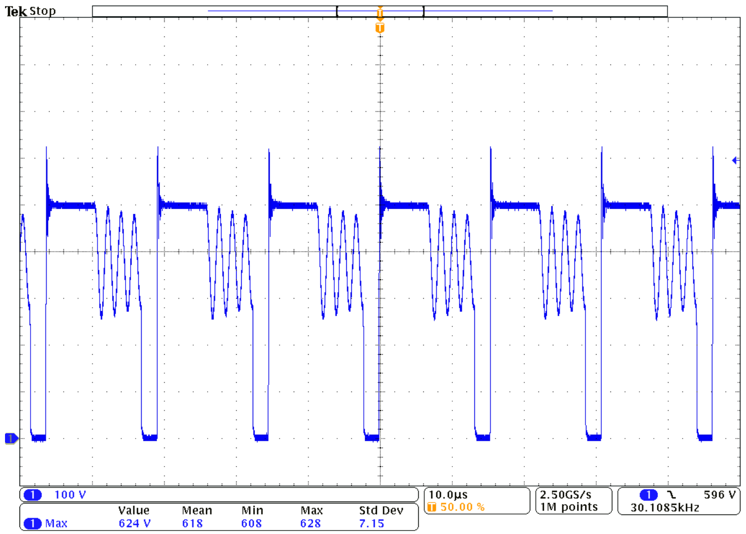
Top View



*Note:
1. Place UUT without plastic housing in a temperature chamber.

RENESAS

17. MAXIMUM DRAIN VOLTAGE OF GaN DEVICE



Test Condition (Full Load):

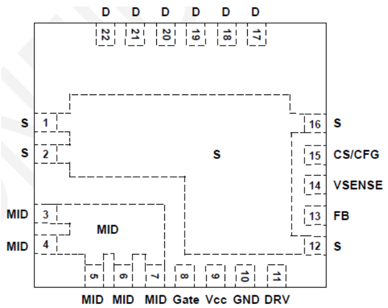
V_{IN}=264V_{AC}

Output=20V/3.25A

Result:

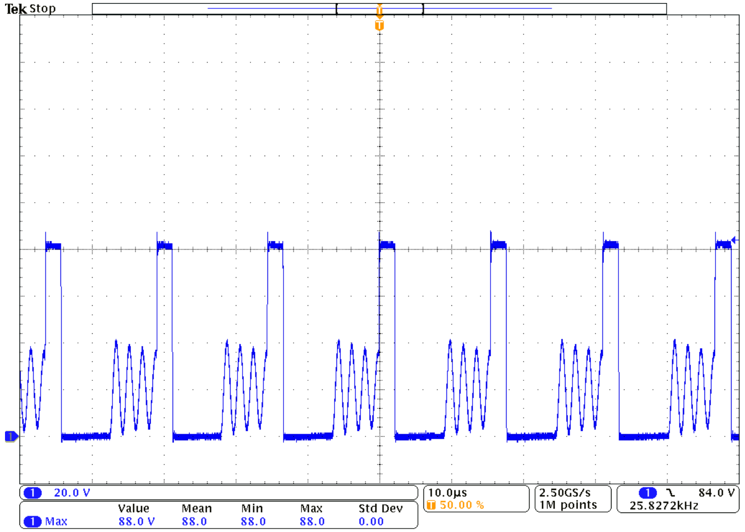
V_{DS_MAX}= **624V**

The below is Key Performance Parameters of Integrated GaNFET Device (RRW22111-153)



V_{DSS}	Drain to source voltage (T_J = -55°C to 150°C)			700	V	
$V_{DSS(TR)}$, non-repetitive	Transient drain to source voltage, non-repetitive (1)			800	V	
$V_{DSS(TR)}$, repetitive	Transient drain to source voltage, repetitive (2)			750	V	
V_{GSS}	Gate to source voltage			±12	V	

18. MAXIMUM DRAIN VOLTAGE OF SR MOSFET



Test Condition (Full Load):

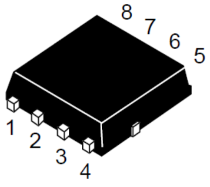
V_{IN}=264V_{AC}

Output=20V/3.25A

Result:

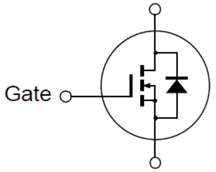
V_{DS_MAX}= **88.0V**

The below is Key Performance Parameters of SR MOSFET (RBE067N10R1SZN6)



1. Source
2. Source
3. Source
4. Gate
5. Drain
6. Drain
7. Drain
8. Drain

SO8-FL



Equivalent circuit

Electrical Characteristics

(T_a=25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Zero Gate Voltage Drain Current	I_{DSS}	—	—	10	µA	V_{DS} = 100 V, V_{GS} = 0 V
Gate Leakage Current	I_{GSS}	—	—	±1	µA	V_{GS} = ± 20 V, V_{DS} = 0 V
Gate to Source Threshold Voltage	$V_{GS(th)}$	2.0	—	4.0	V	V_{DS} = V_{GS}, I_D = 250 µA
Drain to Source On-state Resistance	$R_{DS(on)}$	—	5.8	6.7	mΩ	V_{GS} = 10 V, I_D = 40 [Notes5] A
Input Capacitance	C_{iss}	—	2800	—	pF	V_{DS} = 50 V
Output Capacitance	C_{oss}	—	690	—	pF	V_{GS} = 0 V
Reverse Transfer Capacitance	C_{rss}	—	26	—	pF	f = 100 kHz

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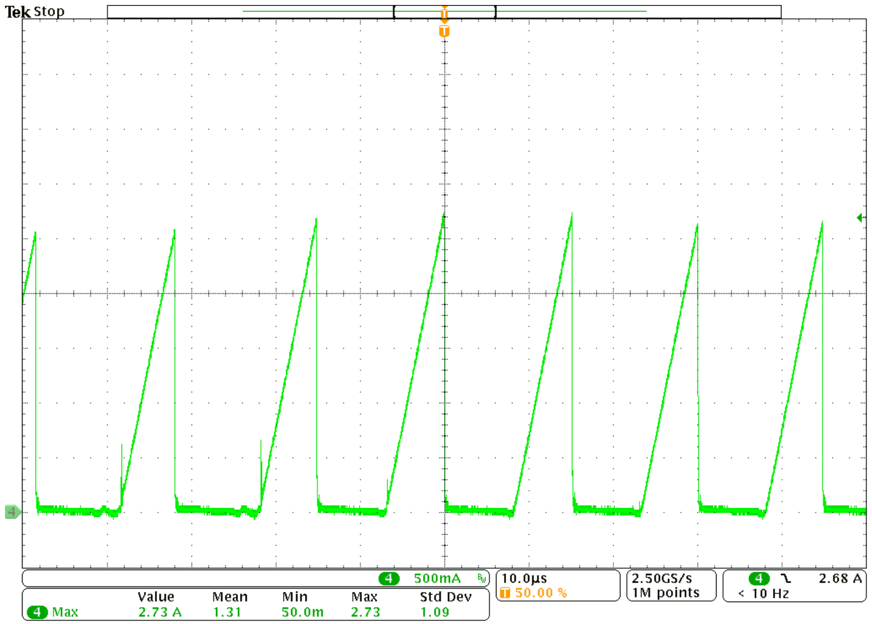
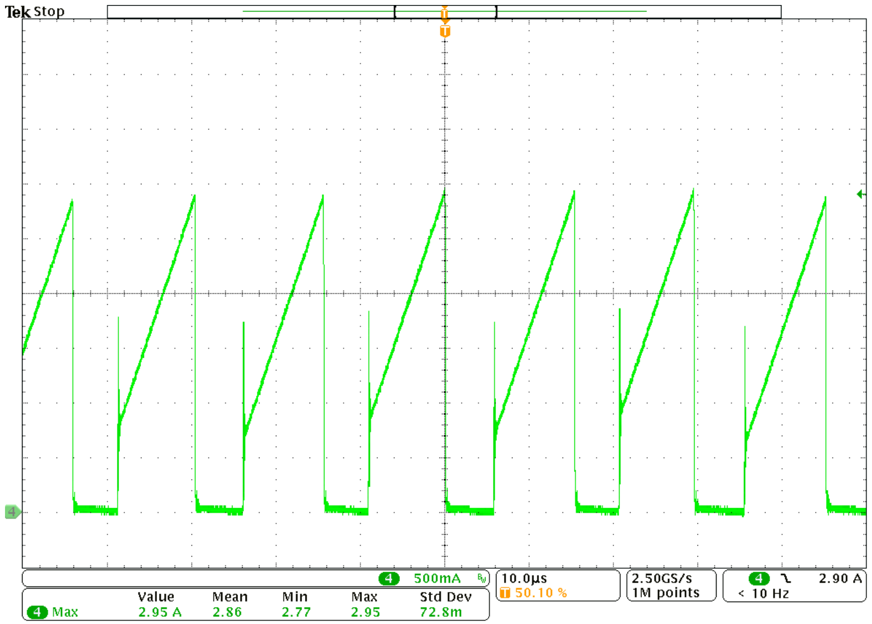
19. TRANSFORMER FLUX DENSITY

(N=24Ts, L=320uH, Ae=126.52mm^2)



I_P *is monitored at* $90VAC$ *and* $3.25A@20V$ $(full\ load)$

$$B_{MAX} = \frac{L_M \times I_{pk}}{N \times A_e} = \frac{0.32 \times 2730}{24 \times 126.52} = 0.288(Tesla)$$



I_P *is monitored at* $90VAC$ *and* $3.9A@20V$ (OCP)

$$B_{MAX} = \frac{L_M \times I_{pk}}{N \times A_e} = \frac{0.32 \times 2950}{24 \times 126.52} = 0.311(Tesla)$$

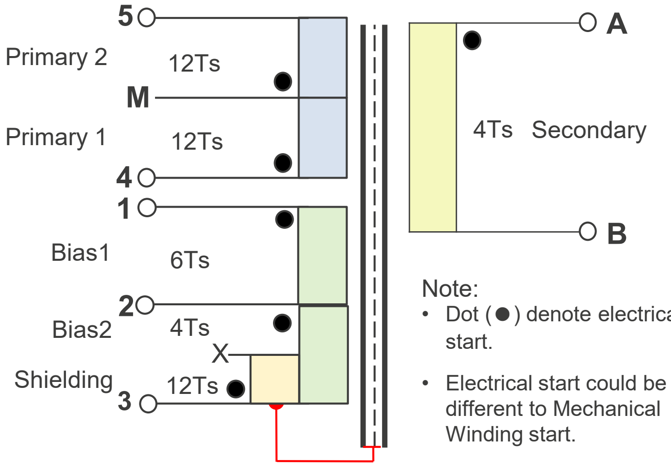
APPENDIX-1 BILL OF MATERIAL

Item	Qty.	Ref. designator	Description	Manufacturer	Part no.
1	1	U1	Zero Standby Power Flyback Integrated GaN controller, QFN8*8	Renesas	RRW22111-153
2	1	U2	Synchronous Rectifier controller, SOT23-6	Renesas	iW610-08
3	1	U3	Programmable USB PD Source Controller, QFN4*4	Renesas	RRW30110-190
4	1	OP1	Photocoupler	Renesas	PS2381-1Y-AX/W
5	1	F1	Fuse, size: 8mmX4mmX7mm	Littelfuse	40013150000
6	1	LF1	Common-mode inductor, TC8×4×3, 42uH	DELI ELECTRONICS	240305191
7	1	LF2	Common-mode inductor, TC9×6×5, 18mH	B&M Magnetism	QYT09060503827018ML
8	1	L1	Differential-mode inductor,TC8×4×3-50uH/min, Wire:0.4x35.5T	B&M Magnetism	TWL031125-50uH
9	1	FB1	Multilayer Chip Ferrite Bead	Baorenhong	BEAD1206S301A30T
10	2	BD1, BD2	Fast Recovery Bridge Rectifier	Samwin	FMB40M
11	1	Q1	N-Channel Depletion-Mode Power Mosfet	PolySemi	DN906
12	1	Q2	N-Channel Depletion-Mode Power Mosfet	PolySemi	DN169
13	1	Q51	N-Channel Power Mosfet	Renesas	RBE067N10R1SZN6
14	1	Q52	Silicon N-Channel Power Mosfet	Renesas	RJK03M5DNS
15	1	T1	Transformer, Vertical type	Renesas	ATQ2714
16	1	CE1	Electrolytic capacitor, 100uF420V,Φ12.5mmX40mm	YMM	100uF420V,Φ12.5mmX40mm
17	1	CE3	Electrolytic capacitor, 10uF100V, Φ5mmX11mm	YMM	10uF100V, Φ5mmX11mm
18	1	CE51	Solid Capacitor, 1000uF25V, Φ10mmX13mm	KNSCHA	KNE5 1000UF25V 149EC0026
19	1	CB1	CBB capacitor, 1uF450V, size:12mm*17.5mm*6.5mm	NISSEI	105J450
20	1	CX1	X2 capacitor, 0.033uF275V	CARLI	0.033K275V-X2
21	1	C1	Ceramic capacitor	SAMSUNG	2.2nF, 630V, X7R, SMD-1206
22	1	C2	Ceramic capacitor	SAMSUNG	1nF, 250V, X7R, SMD-0805
23	1	C3	Ceramic capacitor	SAMSUNG	68pF, 1000V, NPO, SMD-1206
24	2	C4,C11	Ceramic capacitor	SAMSUNG	68pF, 50V, NPO, SMD-0603
25	2	C5,C7	Ceramic capacitor	SAMSUNG	2.2uF, 25V, X7R, SMD-0603
26	1	C6	Ceramic capacitor	SAMSUNG	470pF, 50V, NPO, SMD-0603
27	1	C9	Ceramic capacitor	SAMSUNG	10pF, 50V, NPO, SMD-0603
28	1	C10	Ceramic capacitor	SAMSUNG	2.2uF, 25V, X7R, SMD-0805
29	1	C13	Ceramic capacitor	SAMSUNG	100nF, 50V, X7R, SMD-0805
30	1	C51	Ceramic capacitor	SAMSUNG	220pF, 250V, X7R, SMD-0805
31	3	C52,C53,C59	Ceramic capacitor	SAMSUNG	2.2uF, 25V, X7R, SMD-0603
32	1	C55	Ceramic capacitor	SAMSUNG	2.2uF, 50V, X7R, SMD-0805
33	1	C56	Ceramic capacitor	SAMSUNG	220pF, 50V, NPO, SMD-0603
34	2	C57,C58	Ceramic capacitor	SAMSUNG	470pF, 25V, X7R, SMD-0402
35	1	CY1	Y-Cap, DIP	SHM	Y1, 330pF

APPENDIX-2 BILL OF MATERIAL

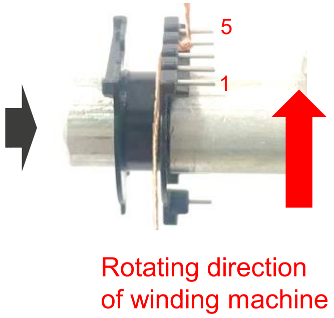
Item	Qty.	Ref. designator	Description	Manufacturer	Part no.
36	1	D1	Diode, SMAF	PINGWEI	R2MF
37	2	D2,D4	Diode, SOD-123	Diodes	FR107
38	1	D52	Diode, SOD-323	Onsemi	BAV21
39	1	D53	Diode, SOD-523	Onsemi	1N4148WT
40	2	TVS1,TVS2	TVS, 24V, SOD-523	Nexperia	PESD24VS1UB,115
41	1	TVS3	TVS, 24V, SOD-523	Nexperia	PESD24VS1UB,115
42	1	ZD1	Zener Diode, 7.5V, SMD-323	Nexperia	PDZ7.5B,115
43	1	R1	Resistor	YAGEO	1.2KΩ ±5%, SMD-0805
44	2	R2,R3	Resistor	YAGEO	300KΩ ±5%, SMD-1206
45	1	R4	Resistor	YAGEO	200KΩ ±5%, SMD-1206
46	2	R5,R6	Resistor	YAGEO	120Ω ±5%, SMD-1206
47	2	R7,R12	Resistor	YAGEO	1Ω ±5%, SMD-0805
48	1	R8	Resistor	YAGEO	750KΩ ±5%, SMD-0603
49	1	R10	Resistor	YAGEO	330KΩ ±1%, SMD-0805
50	1	R11	Resistor	YAGEO	33KΩ ±1%, SMD-0603
51	2	R13, R65	Resistor	YAGEO	1KΩ ±5%, SMD-0603
52	1	R14	Resistor	YAGEO	20Ω ±5%, SMD-0603
53	1	R15	Resistor	YAGEO	10KΩ ±5%, SMD-0603
54	2	R16,R17	Resistor	YAGEO	0.36Ω ±1%, SMD-1206
55	1	R18	Resistor	YAGEO	2.4KΩ ±5%, SMD-0603
56	1	R19	Resistor	YAGEO	20MΩ ±5%, SMD-0805
57	1	R21	Resistor	YAGEO	1MΩ ±5%, SMD-0805
58	1	R51	Resistor	YAGEO	33Ω ±5%, SMD-0805
59	1	R52	Resistor	YAGEO	47Ω ±5%, SMD-0603
60	1	R53	Resistor	YAGEO	47Ω ±5%, SMD-0805
61	1	R54	Resistor	YAGEO	1KΩ ±5%, SMD-0402
62	1	R55	Resistor	YAGEO	390KΩ ±5%, SMD-0805
63	3	R56,R59,R60	Resistor	YAGEO	100Ω ±5%, SMD-0603
64	1	R57	Resistor	YAGEO	0Ω ±5%, SMD-0402
65	1	R58	Resistor	YAGEO	1Ω ±5%, SMD-0603
66	1	R63	Resistor	SART	SMF12M1FR005T, 5mΩ, SMD-1206
67	2	R61,R62	Resistor	YAGEO	33Ω ±5%, SMD-0402
68	1	NTC51	Resistor	YAGEO	100KΩ ±1%, SMD-0402
69	1	USB1	Connector	ZDT	5A, Type-C USB,14Pin
70	1	PCB	PCB	Renesas	2layer side, 2oZ, FR-4

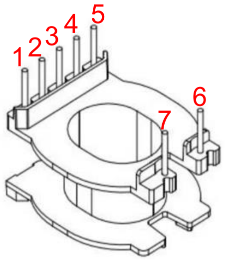
APPENDIX-3 TRANSFORMER (T1)

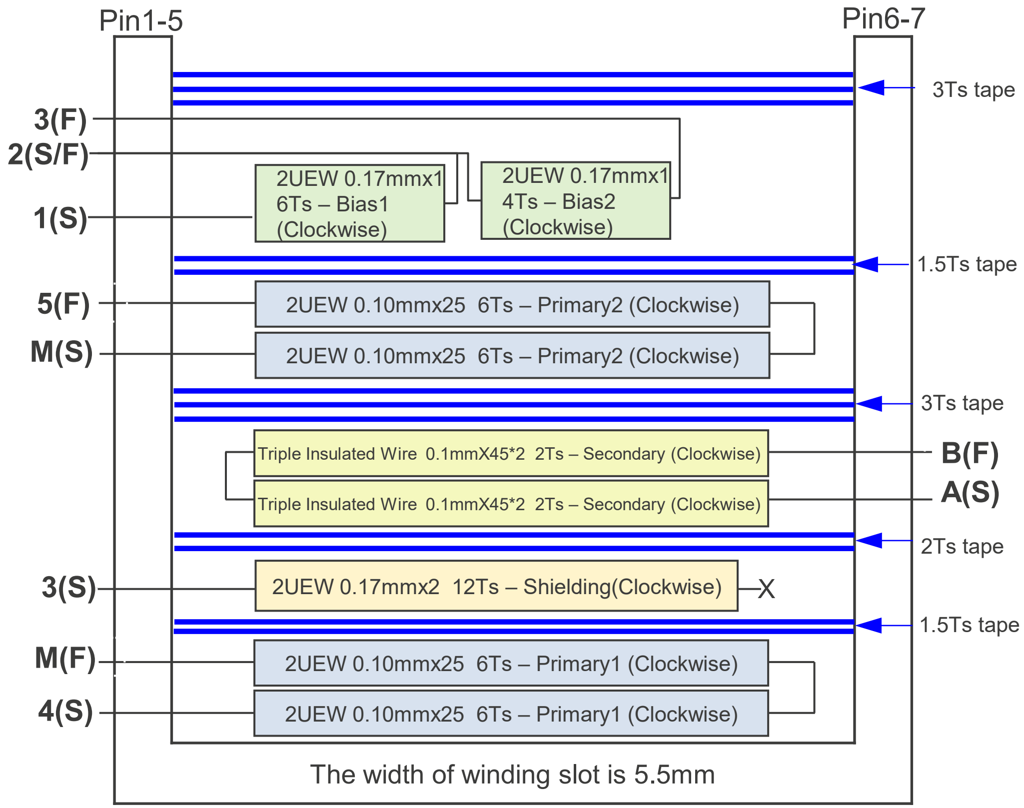


Note:
- Dot (●) denote electrical start.
- Electrical start could be different to Mechanical Winding start.

Winding Start pin-4& End M to "Clockwise" direction-looking from bottom side of the Bobbin







ELECTRICAL SPECIFICATIONS:

1. Primary Inductance (Lp) =320±5%uH @10KHz
2. Electrical Strength = 3KV, 50/60Hz,1Min (pins1~5 to pins A~B)

MATERIALS:

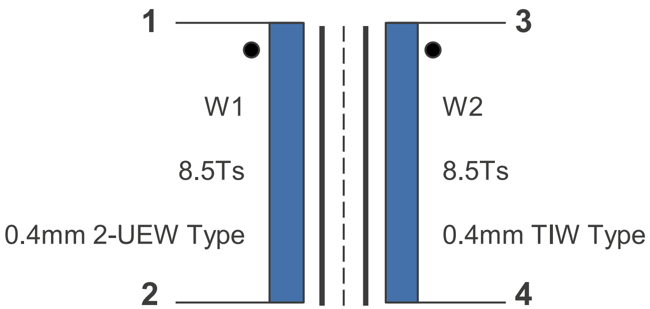
1. Core: ATQ2714(Ferrite Material DMR97 or equivalent)
2. Bobbin: ATQ2714
3. Magnet Wires (pri): Type 2-UEW
4. Magnet wires(sec): Triple Insulated Wire
5. Layer Insulation Tape: 3M1298 or equivalent.

FINISHED :

1. Vacuum varnish.
2. Core and winding around 1T copper and connect to Pin3.

APPENDIX-4 COMMON MODE INDUCTOR

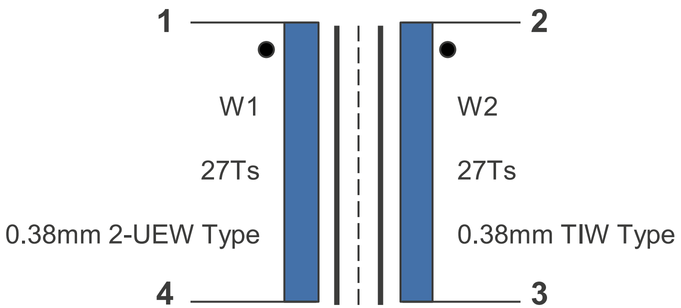
SCHEMATIC LF1:



ELECTRICAL SPECIFICATIONS:

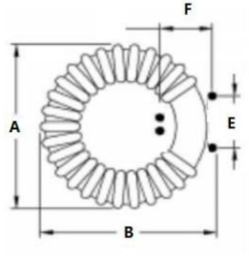
1. Primary Inductance (Lm) = 40uH@10KHz, 1V
2. Ferrite Material: Ni-Zn
3. CORE: T8X4X3mm
4. Electrical Strength = AC 1000V 3mA 3S

SCHEMATIC LF2:



ELECTRICAL SPECIFICATIONS:

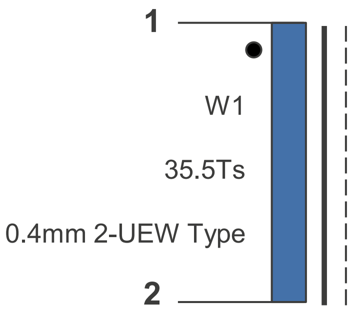
1. Primary Inductance (Lm) = 18mH MIN@1KHz, 0.25V
2. Ferrite Material: Nanocrystalline
3. CORE: T9*6*5
4. Electrical Strength = AC 1000V 3mA 3S



A	12.5	MAX
B	13.0	MAX
C	9.5	MAX
D	3.5	±0.5
E	7.2	±0.5
F	2.6	±0.5

APPENDIX-5 DIFFERENTIAL MODE INDUCTOR

SCHEMATIC L1:



ELECTRICAL SPECIFICATIONS:

1. Primary Inductance (Lm) >50uH@10KHz, 1V
2. Ferrite Material: Fe-Si
3. CORE: T8X4X3mm

REVISION HISTORY

Revision history

Document version	Date of release	Description of changes
V1.0	2025/07/31	Initial release
V1.1	2025/08/07	Updated PCB Layout Updated Schematic Updated Bill of materials

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