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Reference Design

RT7790GEQ & RT7208E

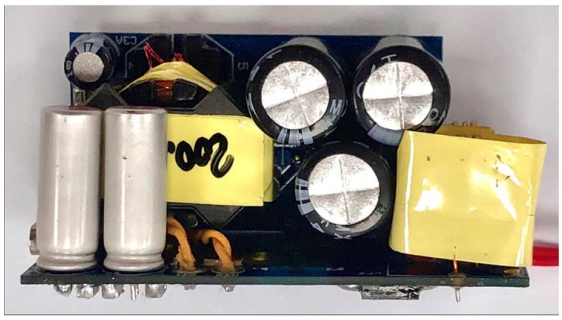
PCB : RT7790 & RT7208E_20V_65W_Cuboid

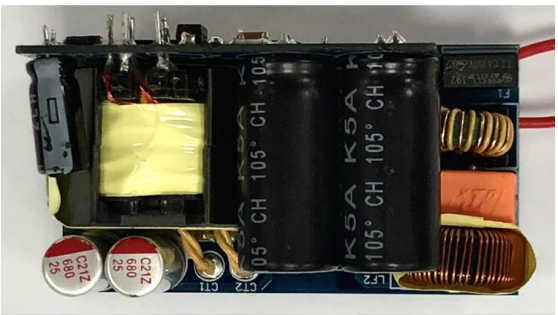
System Performance Test Report

Table of Contents

		Page
1.	Electrical Specification	2
2.	Schematics	3
3.	Bill of Material	4
4.	Transformer Specification	6
5.	Performance Evaluation	7

TOPOLOGY	INPUT RANGE	OUTPUT	MAX.POWER	APPLICATION
Flyback with SR	90Vac ~ 265Vac	5V/3A 9V/3A 15V/3A 20V/3.25A	65W	Adaptor Charger





(Dimension : L50.9mm×W27.4mm×H26mm)

1. Electrical Specification

AC Input Voltage ..... $90V_{rms}$~$265V_{rms}$

Line Frequency ..... 47Hz~63Hz

DC Output Voltage ..... 5V／9V／15V／20V

Nominal Output Current ..... 3A @ 5V／9V／15V／20V

Efficiency ..... ＞DOE 6 Standard @ 5V／9V／15V／20V

Power Consumption ..... ＜50mW @ 5V／0A

Hold-up Time ..... ＞5mS @ 20V／3A

Output Ripple & Noise ..... ＜200mV@ 5V／9V／15V／20V

Load Regulation ..... ±1%@ 5V／9V／15V／20V

Line Regulation ..... ±1%@ 5V／9V／15V／20V

Over Load Protection ..... Auto Recovery

Over Voltage Protection ..... Auto Recovery

Short Circuit Protection ..... Auto Recovery

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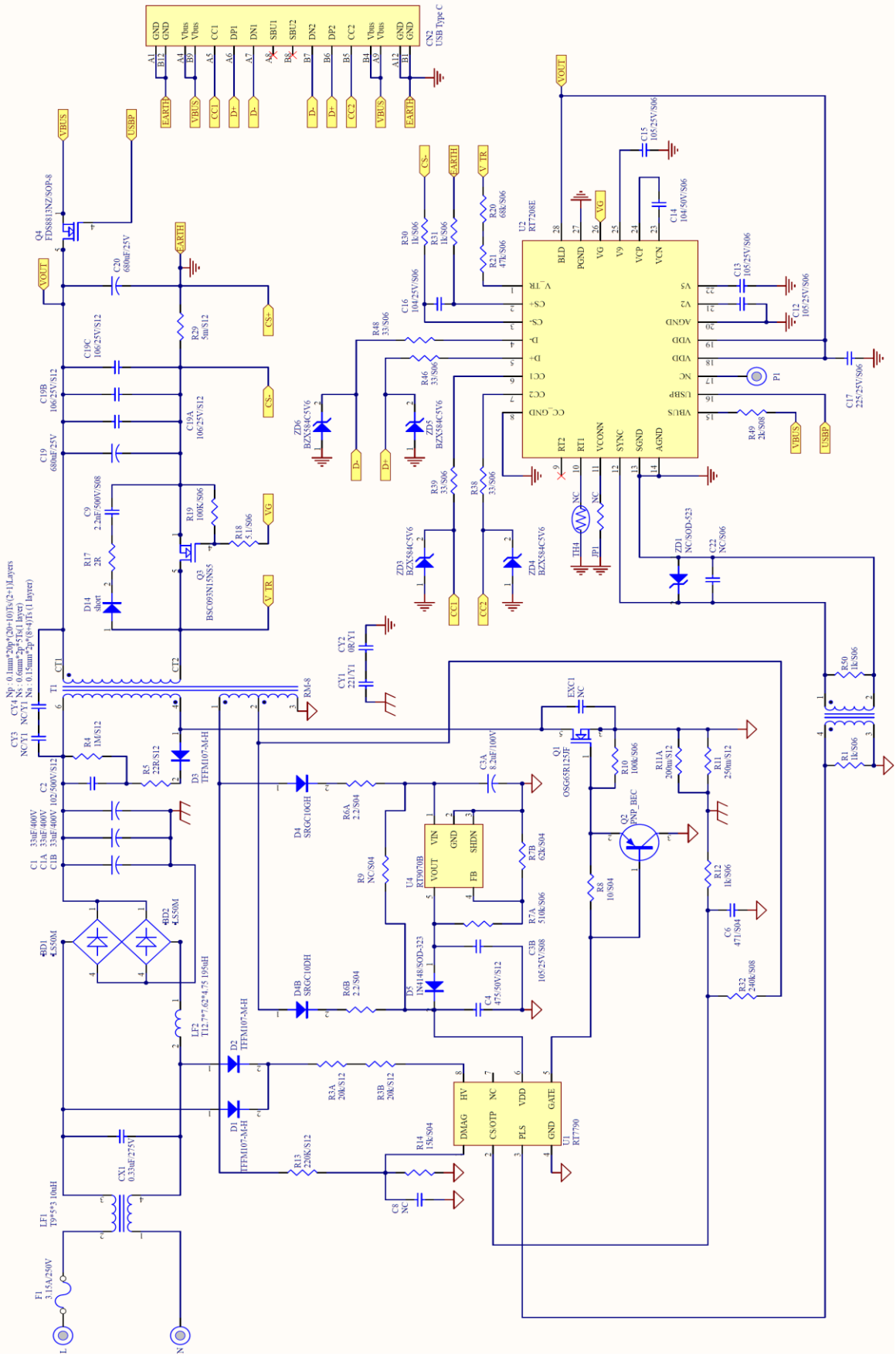
2. Schematics



3. Bill of Material

Designator	Comment	Footprint / Description	Vendor	Quantity
Capacitor				
C1, C1A, C1B	33uF/400V 10*20 SAMXON (KM)	DIP / EC_10	SAMXON	3
C12, C13, C15	105/25V/S06 X7R RoHS	SMD C0603	Murata	3
C14	104/50V/S06 X7R RoHS	SMD C0603	Murata	1
C16	104/25V/S06 X7R RoHS	SMD C0603	Murata	1
C17	225/25V/S06 X7R RoHS	SMD C0603	Murata	1
C19, C20	Polyer 680uF/25V 6.5*16	DIP / EC_6.3	AiSHi	2
C19A, C19B, C19C	106/25V/S12 X7R RoHS	SMD C1206	Murata	3
C2	102/500V/S12 X7R RoHS	SMD C1206	Murata	1
C3A	8.2uF/100V 5*10	DIP / EC_5_2	AiSHi	1
C3B	105/25V/S08 X7R RoHS	SMD C0805	Murata	1
C4	475/50V/S12 X7R RoHS	SMD C1206	Murata	1
C6	470P/25V/S04 X7R RoHS	SMD C0402	Murata	1
C9	2.2nF/500V/S08 X7R RoHS	SMD C0805	Murata	1
CX1	0.22uF/250V	DIP	UTX	1
CY1	221/Y1	SMD 1808	Murata	1
Resistor				
R10, R19	100k/S06 ±1% RoHS	SMD R0603	Ralec	2
R11	250m/S12 ±1% RoHS	SMD R1206	Ralec	1
R11A	200m/S12 ±1% RoHS	SMD R1206	Ralec	1
R13	220K/S08 ±1% RoHS	SMD R0805	Ralec	1
R14	15k/S04 ±1% RoHS	SMD R0402	Ralec	1
R17	2R/S12 ±1% RoHS	SMD R1206	Ralec	1
R18	5.1/S06 ±1% RoHS	SMD R0603	Ralec	1
R20	68k/S06 ±1% RoHS	SMD R0603	Ralec	1
R21	47k/S06 ±1% RoHS	SMD R0603	Ralec	1
R29	5m/S12 ±1% RoHS	SMD R1206	Ralec	1
R30, R31,R12	1k/S06 ±1% RoHS	SMD R0603	Ralec	3
R32	240K/S08 ±1% RoHS	SMD R0805	Ralec	1
R38, R39, R46, R48	33/S06 ±1% RoHS	SMD R0603	Ralec	4
R3A, R3B	20k/S12 ±1% RoHS	SMD R0402	Ralec	2
R4	1M/S12 ±1% RoHS	SMD R1206	Ralec	1
R49	2k/S08 ±1% RoHS	SMD R0805	Ralec	1
R5	22R /S12 ±1% RoHS	SMD R1206	Ralec	1

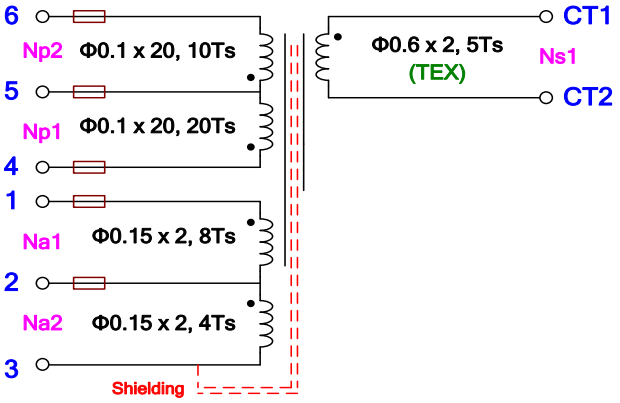
R6A, R6B	2.2/S04 ±1% RoHS	SMD R0402	Ralec	2
R7A	510k/S06 ±1% RoHS	SMD R0603	Ralec	1
R7B	62k/S04 ±1% RoHS	SMD R0402	Ralec	1
R8	10/S04 ±1% RoHS	SMD R0402	Ralec	1
R1,R50	1k/S06 ±1% RoHS	SMD R0603	Ralec	2
D14,CY1	0 ohm 1206 ±1% RoHS	SMD R1206	Ralec	2
Inductor				
T1	RM-8 200uH	RM-8 / Transfromer	康荃電子	1
T2	PLSTR 5T 16uH typ.	CBM4D19 / CHOKE	豐達 / 康荃	1
LF1	T10*6*5 75uH	L_11X7_P5 / CHOKE	康荃電子	1
LF2	T12.7*7.62*4.75 195uH	L_14.1X7 / CHOKE	康荃電子	1
Semiconductor				
U1	RT7790	SOP-8 / IC	RICHTEK	1
U2	RT7208E	QFN-4X5-28L / IC	RICHTEK	1
U4	RT9070B	SOT-23-5 / IC	RICHTEK	1
ZD3, ZD4, ZD5, ZD6	BZX584C5V6	SOD-523 / ZENER	VISHAY	4
Q1	OSG65R125JF	PDFN8X8 / N-MOS	東微	1
Q2	PNP_MMBT3906	SOT-23 / PNP	Formosa	1
Q3	BSC093N15NS5	SOP-8 / PNP	Infineon	1
Q4	FDS8813NZ/SOP-8	SOP-8 / PNP	On semiconductor	1
D1, D2	TFFM107-M-H	SOD-123 / DIODE	Formosa	2
D3	FFM107A-H	SMA / DIODE	德威科技	1
D4	SRGC10GH	SOD-80 / DIODE	千騰科技	1
D4B	SRGC10DH	SOD-80 / DIODE	千騰科技	1
BD1, BD2	LS 50M	BD-TMBF / DIODE	金碗國際	2
D5	1N4148/SOD-323	SOD-323 / DIODE	Formosa	1
Others				
F1	3.15A/250V	FUSE	MST	1
CN2	USB Type C	USB-C TYPE_USCF-16XN-4BV63		1
	TC 3015 散熱膠	散熱膠	Sil-More(喬越)	15g

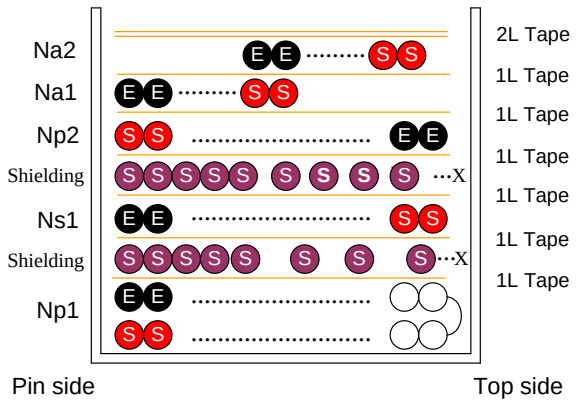
4. Transformer Specification

Core Size : RM-8 Material : PC95

Bobbin/PINs : Vertical / 6 Pins

Primary Inductor (±5%) : 200μH





Winding No.	Pin	Copper Wire & Foil	Winding Type	Tape Layer
Na2	2 → 3	Φ0.15 x 2 x 4 Ts	密繞(0.5Ts)	1
Na1	1 → 2	Φ0.15 x 2 x 8 Ts	密繞(0.5Ts)	1
Np2	5 → 6	Φ0.1 x 20 x 10 Ts (三層絕緣絲)	密繞 (1Ts)	1
Shielding	3 → NC	Φ0.18 x 3 x 9 Ts	5T 密繞 4T 疏繞 (1Ts)	1
Ns1	CT1 → CT2	Φ0.6 x 2 x 5 Ts (三層絕緣絲)	密繞 (1Ts)	1
Shielding	3 → NC	Φ0.18 x 3 x 8 Ts	5T 密繞 3T 疏繞 (1Ts)	1
Np1	4 → 5	Φ0.1 x 20 x 20 Ts (三層絕緣絲)	密繞 (2Ts)	2

Note:

1. Lm=200uH±7% (Pin 4 → Pin 6),PIN腳朝自己順時繞製.
2. 需要含浸(varnish).
3. 鐵芯接線連到Pin 3.
4. Ns1的CT1繞線由bobbin槽上方入線, CT1套白色熱縮套管,Ns1的CT2繞線由bobbin槽上方出線.
5. CT1線長20mm(含5mm裸錫部分), CT2線長20mm(含5mm裸錫部分).

5.	**Performance Evaluation**			7
	Test Environment Setup			8
5.1	**Input Characteristics**			9
5.1.1	Efficiency	■PASS	□FAIL	9
5.1.2	Input Power under No Load	■PASS	□FAIL	13
5.1.3	Start-up Time	■PASS	□FAIL	13
5.1.4	Brown-in and Brown-out	■PASS	□FAIL	14
5.1.5	Hold-up Time	■PASS	□FAIL	15
5.2	**Output Characteristics**			16
5.2.1	Line Regulation and Load Regulation	■PASS	□FAIL	16
5.2.2	Output Ripple & Noise	■PASS	□FAIL	17
5.2.3	Output Voltage Rising Time	■PASS	□FAIL	19
5.2.4	Output Voltage Falling Time	■PASS	□FAIL	22
5.2.5	Cable Detached	■PASS	□FAIL	25
5.2.6	Load Transient	■PASS	□FAIL	28
5.2.7	Line Transient	■PASS	□FAIL	30
5.3	**Protections**			34
5.3.1	Constant Current	■PASS	□FAIL	34
5.3.2	Output Short	■PASS	□FAIL	36
5.3.3	Photo-Coupler Short (V_{OUT} OVP)	■PASS	□FAIL	40
5.4	**Key Component Waveforms**			44
5.4.1	Voltage Stress on Primary Side MOSFET	■PASS	□FAIL	44
5.4.2	Voltage Stress on SR MOSFET	■PASS	□FAIL	45
5.5	**Others**			46
5.5.1	Thermal	■PASS	□FAIL	46
5.5.2	ESD	■PASS	□FAIL	50
5.5.3	Surge	■PASS	□FAIL	50
5.5.4	Conducted EMI	■PASS	□FAIL	50
5.5.5	Radiated EMI	■PASS	□FAIL	51

4. Performance Evaluation

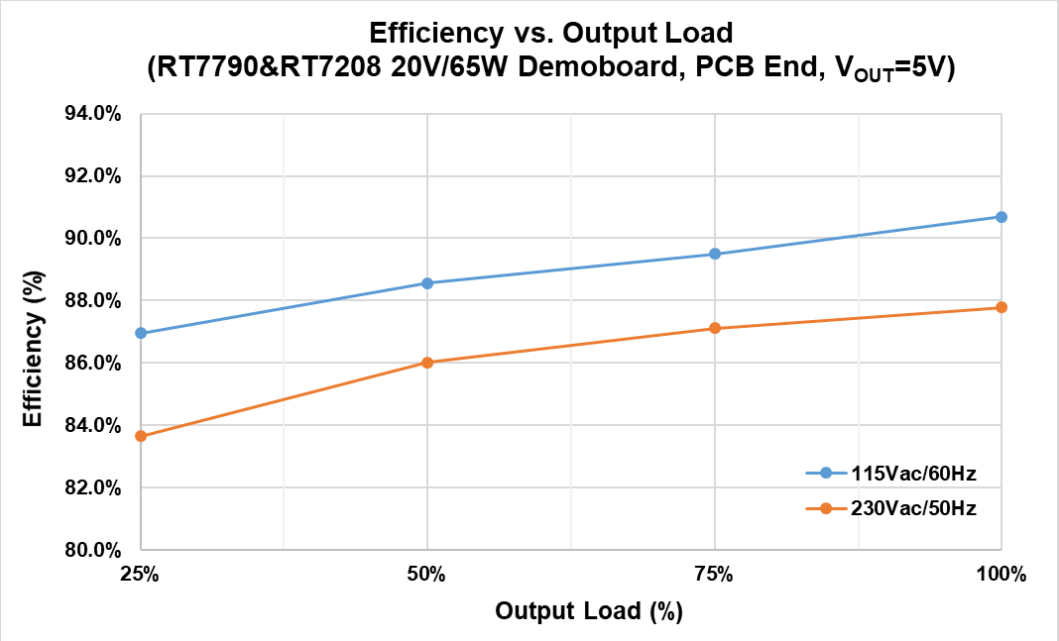
Test Equipment:

Instrument	Manufacturer	Type/Serial No.
AC Source	EXTECH	6800
Power Meter	YOKOGAWA	WT210
Oscilloscope	LeCroy	44MXi-A
Electronic Load	Chroma	63030
Multi-Meter	Fluke	287
Differential Probe	LeCroy	ADP305
Current Amplifier	LeCroy	CP030
Thermal Imager	Fluke	Ti32

5.1 Input Characteristics

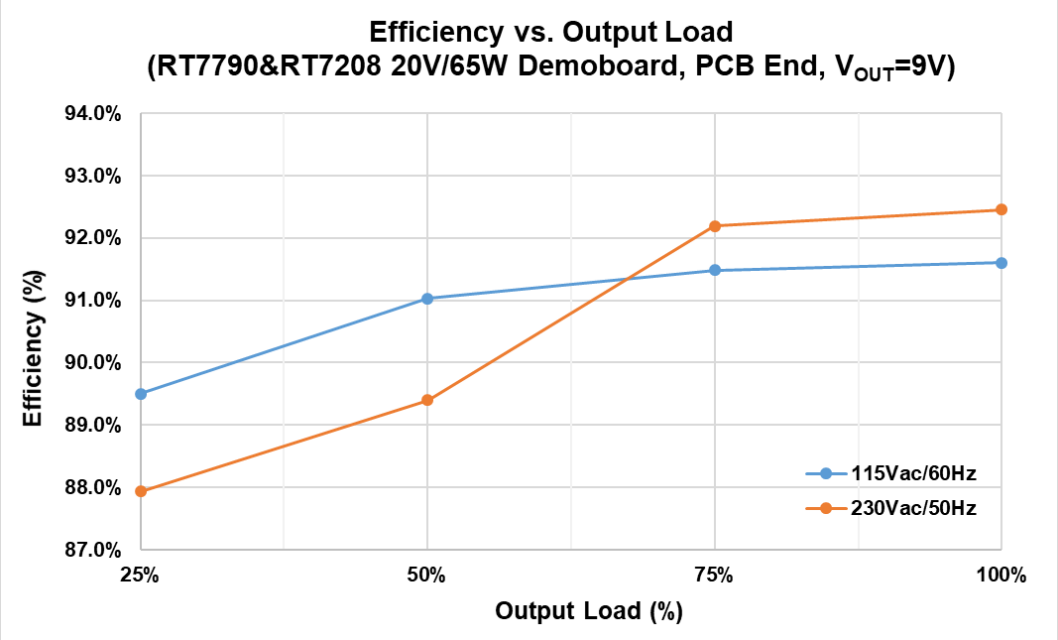
5.1.1 Efficiency

Output Voltage	Output Loading	Input Voltage	
		115Vac/60Hz	230Vac/50Hz
		η (%)	η (%)
5V	10%	82.2	79.6
	Specification	CoC Tire-2 (V_{OUT}<6V, P_{OUT}=15W) : >72.48%	
	Test Result	Pass	Pass
	25%	86.9	83.6
	50%	88.6	86.0
	75%	89.5	87.1
	100%	90.7	87.8
	Average η (%)	88.92	86.14
	Specification	DOE 6 (V_{OUT}<6V, P_{OUT}=15W) : >81.39% CoC Tire-2 (V_{OUT}<6V, P_{OUT}=15W) : >81.84%	
	Test Result	Pass	Pass



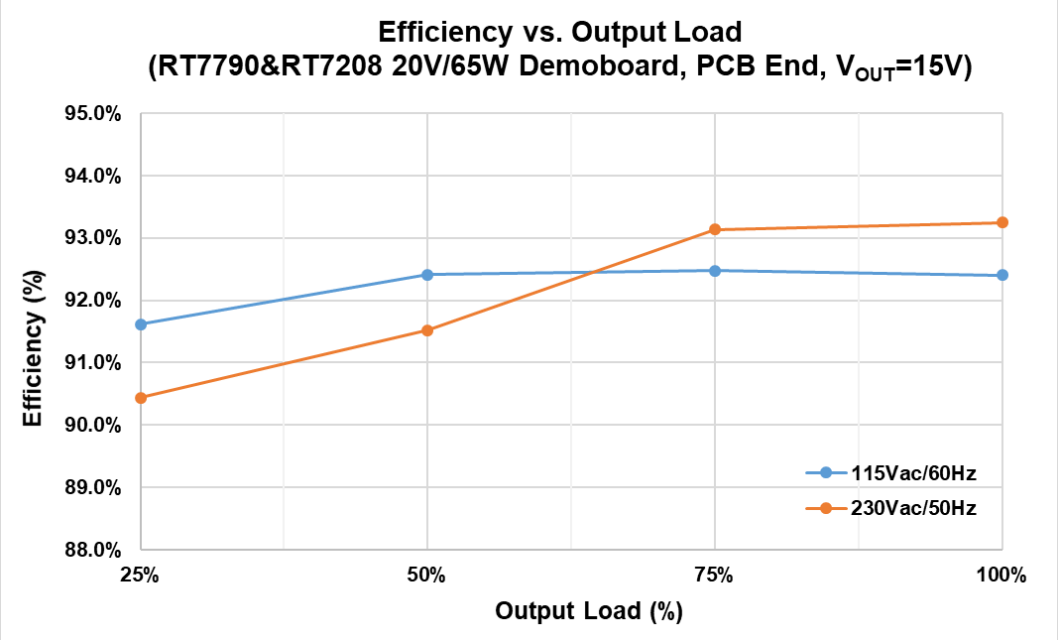
Test Condition	1.Burn-in 10 minutes 2.PCB End

Output Voltage	Output Loading	Input Voltage	
		115Vac/60Hz	230Vac/50Hz
		η (%)	η (%)
9V	10%	85.8	83.9
	Specification	CoC Tire-2 (V_{OUT}>6V, P_{OUT}=27W) : >77.30%	
	Test Result	Pass	Pass
	25%	89.5	87.9
	50%	91.0	89.4
	75%	91.5	92.2
	100%	91.6	92.5
	Average η (%)	90.90	90.49
	Specification	DOE 6 (V_{OUT}>6V, P_{OUT}=27W) : >86.62% CoC Tire-2 (V_{OUT}>6V, P_{OUT}=27W) : >87.30%	
	Test Result	Pass	Pass



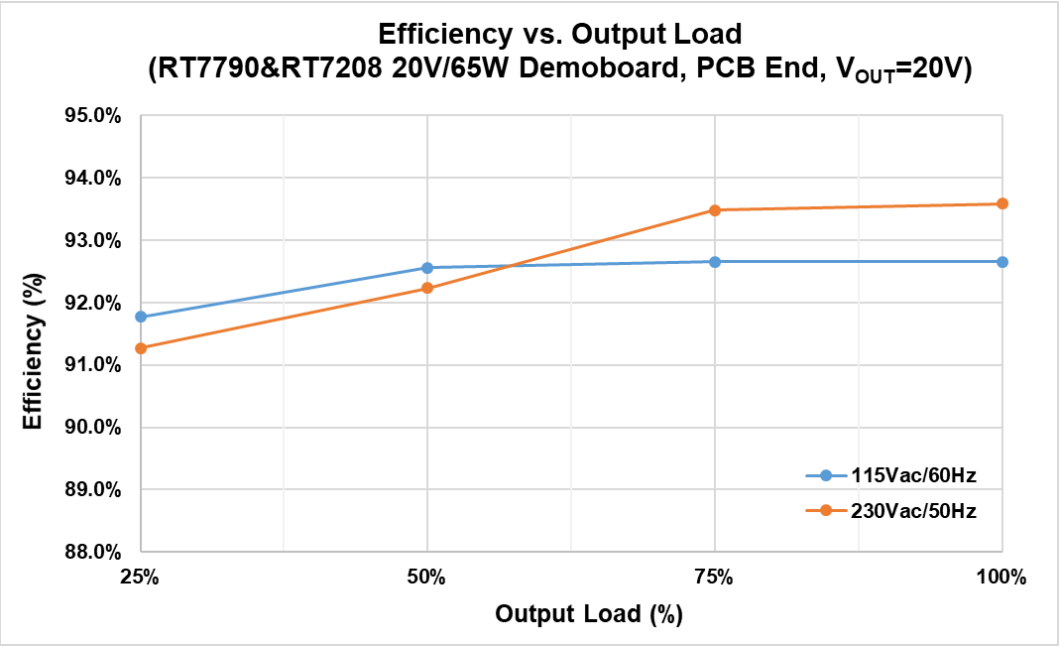
Test Condition	1.Burn-in 10 minutes 2.PCB End

Output Voltage	Output Loading	Input Voltage	
		115Vac/60Hz	230Vac/50Hz
		η (%)	η (%)
15V	10%	88.3	87.9
	Specification	CoC Tire-2 (V_{OUT}>6V, P_{OUT}=45W) : >78.85%	
	Test Result	Pass	Pass
	25%	91.6	90.4
	50%	92.4	91.5
	75%	92.5	93.1
	100%	92.4	93.2
	Average η (%)	92.23	92.08
	Specification	DOE 6 (V_{OUT}>6V, P_{OUT}=45W) : >87.73% CoC Tire-2 (V_{OUT}>6V, P_{OUT}=45W) : >88.85%	
	Test Result	Pass	Pass



Test Condition	1.Burn-in 10 minutes 2.PCB End

Output Voltage	Output Loading	Input Voltage	
		115Vac/60Hz	230Vac/50Hz
		η (%)	η (%)
20V	10%	88.7	88.0
	Specification	CoC Tire-2 (V_{OUT}>6V, P_{OUT}=60W) : >79.00%	
	Test Result	Pass	Pass
	25%	91.8	91.3
	50%	92.6	92.2
	75%	92.7	93.5
	100%	92.7	93.6
	Average η (%)	92.41	92.64
	Specification	DOE 6 (V_{OUT}>6V, P_{OUT}=60W) : >88.00% CoC Tire-2 (V_{OUT}>6V, P_{OUT}=60W) : >89.00%	
	Test Result	Pass	Pass



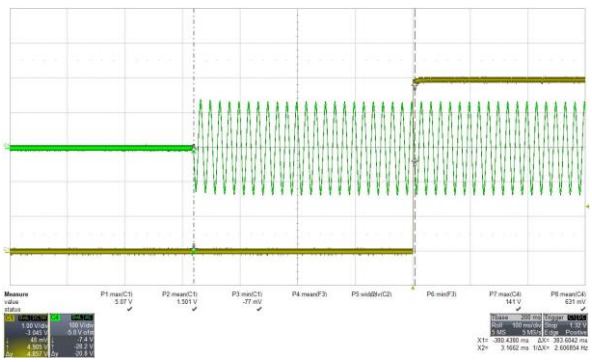
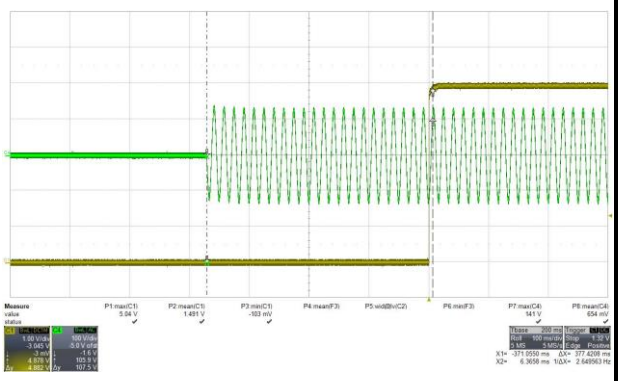
Test Condition	1.Burn-in 10 minutes 2.PCB End

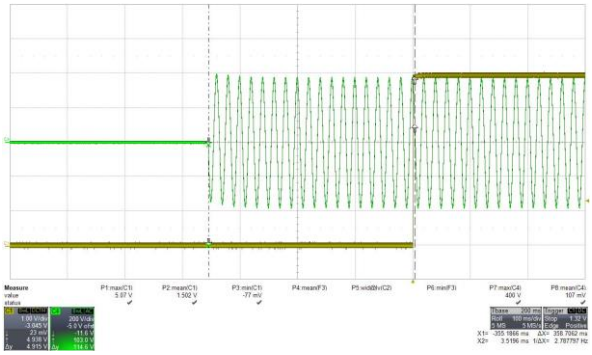
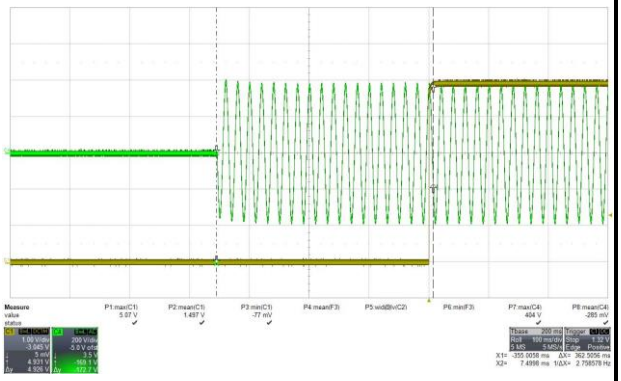
5.1.2 Input Power under No Load

Output Voltage	Output Power	Input Power (mW)			
		90Vac	115Vac	230Vac	265Vac
5V	0W	23.04	28.94	32.46	34.28
Specification		＜50mW			
Test Result		Pass		Pass	
Test Condition	1.Burn-in 10 minutes 2.Cable Detached				

5.1.3 Start-up Time

Input Voltage	Output Voltage	Output Current	Start-up Time	Test Result
90Vac/60Hz	5V	0A	383ms	Pass
		3A	377ms	Pass
265Vac/50Hz		0A	358ms	Pass
		3A	362ms	Pass

90Vac/60Hz ; 5V ; 0A	90Vac/60Hz ; 5V ; 3A
	
CH1:V_{BUS} CH4:V_{AC}	

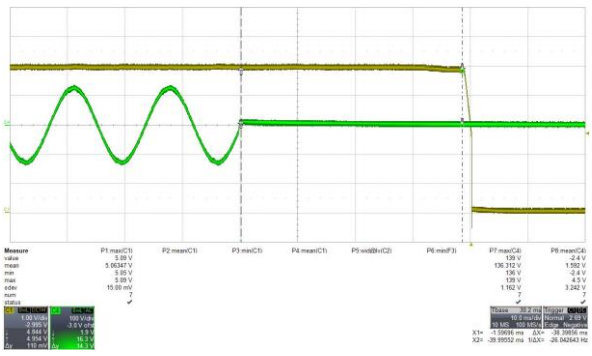
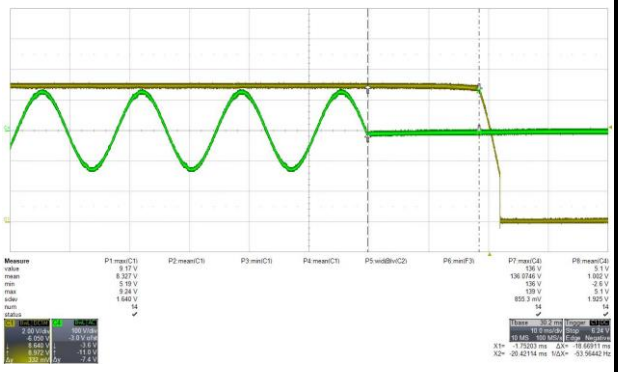
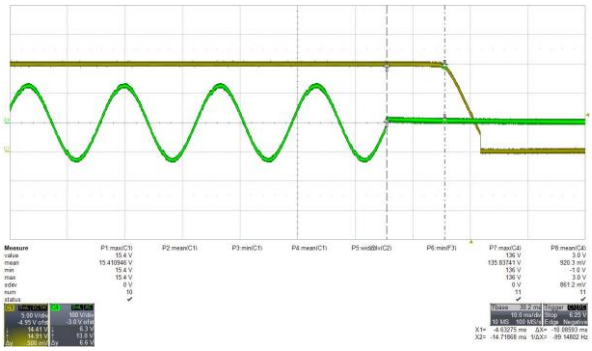
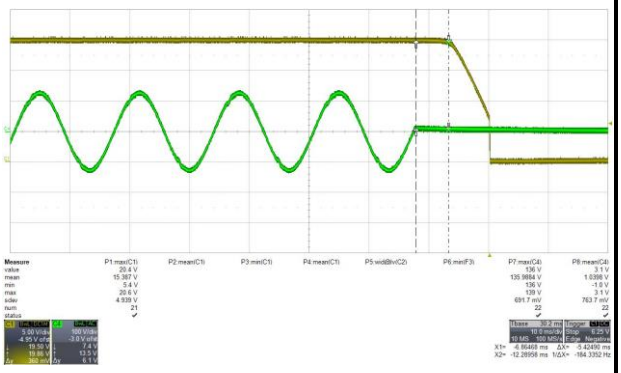
265Vac/50Hz ; 5V ; 0A	265Vac/50Hz ; 5V ; 3A
	
CH1:V_{BUS} CH4:V_{AC}	

5.1.4 Brown-in and Brown-out

Brown-in			
Output Voltage	**Output Current**	**Brown-in Voltage**	**Test Result**
5V	0A	80.2Vac	Pass
	3A	80.9Vac	Pass
Brown-out			
Output Voltage	**Output Current**	**Brown-out Voltage**	**Test Result**
5V	0A	70.5Vac	Pass
	3A	70.9Vac	Pass
9V	0A	70.7Vac	Pass
	3A	71.2Vac	Pass
15V	0A	71.2Vac	Pass
	3A	71.8Vac	Pass
20V	0A	70.9Vac	Pass
	3.25A	71.8Vac	Pass

5.1.5 Hold-up Time

Input Voltage	Output Voltage	Output Current	Hold up time	Specification	Test Result
90Vac/60Hz @ 0 Degree	5V	3A	38.39	＞5ms	PASS
	9V		18.66		PASS
	15V		10.08		PASS
	20V	3.25A	5.42		PASS

Hold-up Time ; 5V ; 3A	Hold-up Time ; 9V ; 3A
	
Hold-up Time ; 15V ; 3A	**Hold-up Time ; 20V ; 3.25A**
	

CH1:V_{BUS} CH4:V_{BLD}

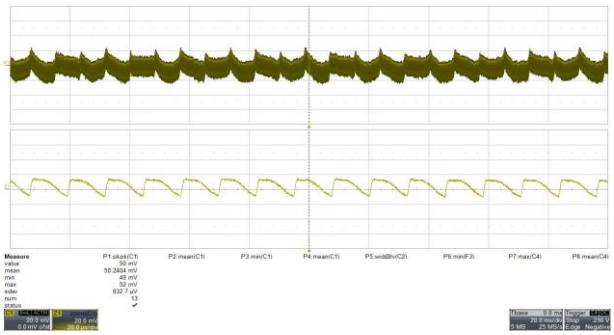
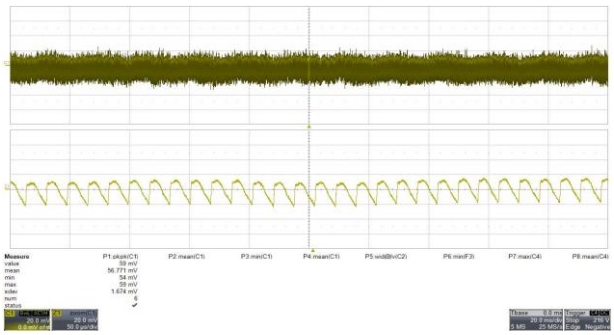
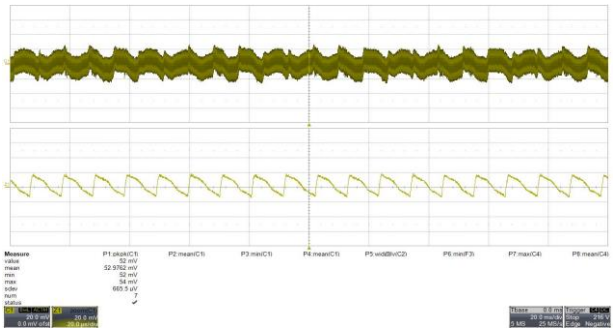
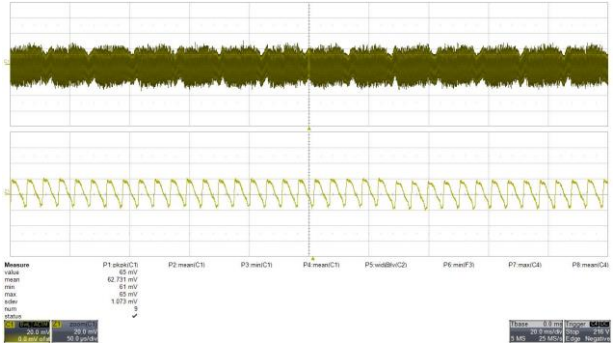
5.2 Output Characteristics

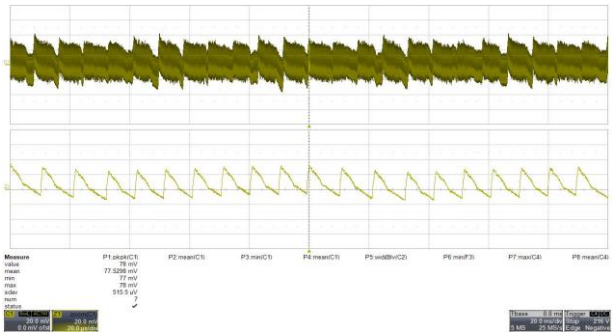
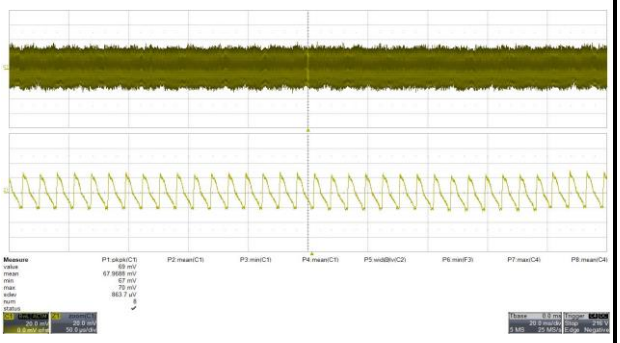
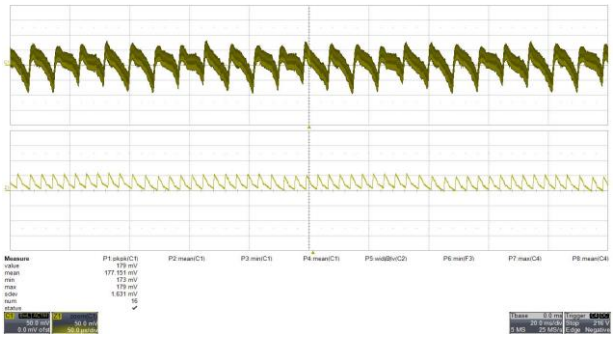
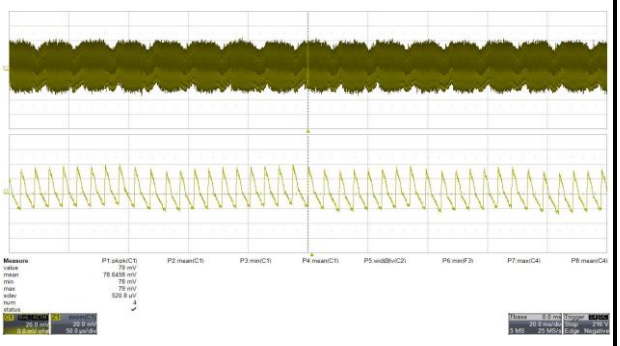
5.2.1 Line Regulation and Load Regulation

Intput Voltage	Output Voltage	Measured (V)			Load Regulation Specification	Test Result
		0%	50%	100%		
90Vac/60Hz	5V	4.991	4.986	4.972	V_{OUT} ± 1%	Pass
265Vac/50Hz		5.000	4.985	4.973		Pass
90Vac/60Hz	9V	9.010	9.000	8.987		Pass
265Vac/50Hz		9.012	9.000	8.984		Pass
90Vac/60Hz	15V	15.02	15.01	14.99		Pass
265Vac/50Hz		15.03	15.00	14.99		Pass
90Vac/60Hz	20V	20.01	19.99	19.97		Pass
265Vac/50Hz		20.01	20.00	19.98		Pass
Line Regulation Specification		V_{OUT} ± 1%				
Test Result		Pass	Pass	Pass		
Test Condition		PCB End				

5.2.2 Output Ripple & Noise

Input Voltage	Output Voltage	Output Current	Measured	Specification	Test Result
90Vac/60Hz	5V	3A	52mV	＜200mV	Pass
	9V		54mV		Pass
	15V		78mV		Pass
	20V	3.25A	179mV		Pass
265Vac/50Hz	5V	3A	59mV		Pass
	9V		65mV		Pass
	15V		70mV		Pass
	20V	3.25A	79mV		Pass

90Vac/60Hz ; 5V ; 3A	265Vac/50Hz ; 5V ; 3A
	
90Vac/60Hz ; 9V ; 3A	**265Vac/50Hz ; 9V ; 3A**
	

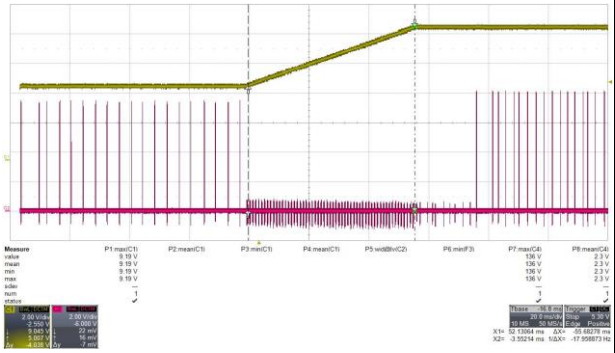
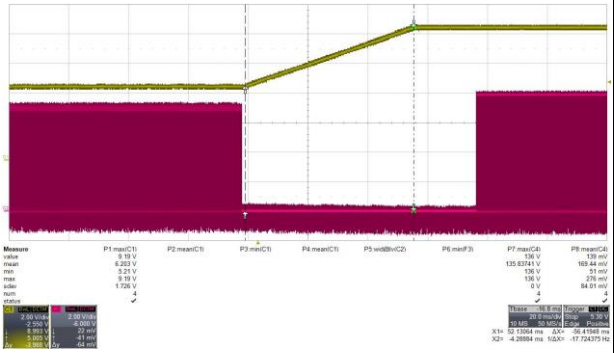
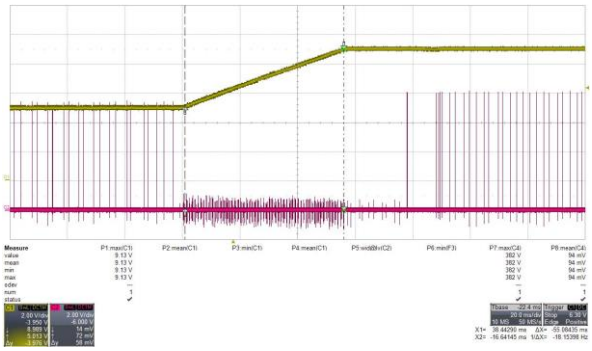
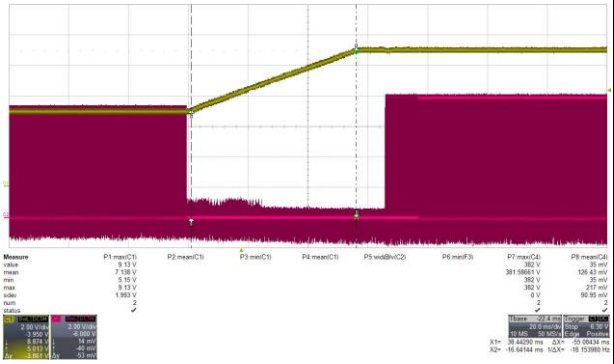
90Vac/60Hz ; 15V ; 3A	265Vac/50Hz ; 15V ; 3A
	
90Vac/60Hz ; 20V ; 3.25A	**265Vac/50Hz ; 20V ; 3.25A**
	

Note:

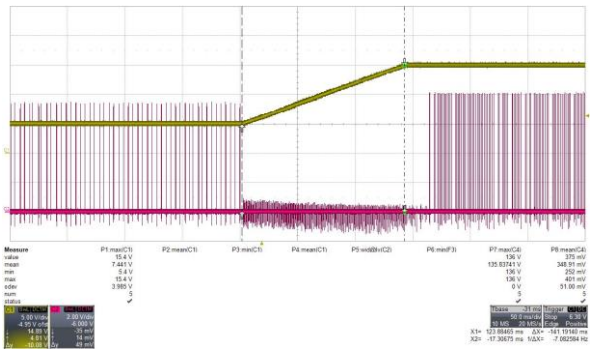
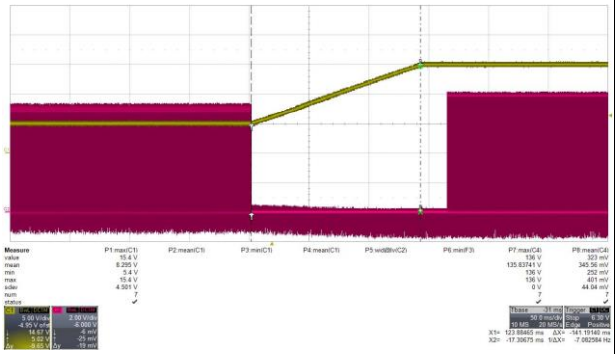
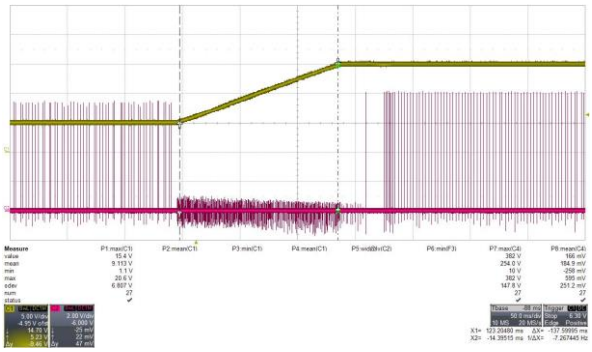
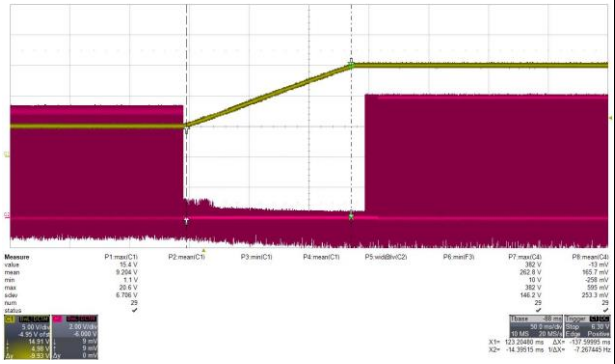
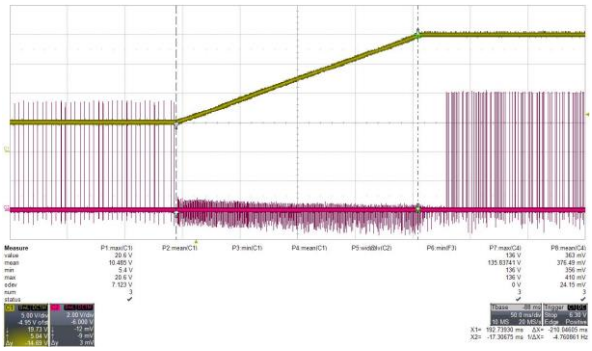
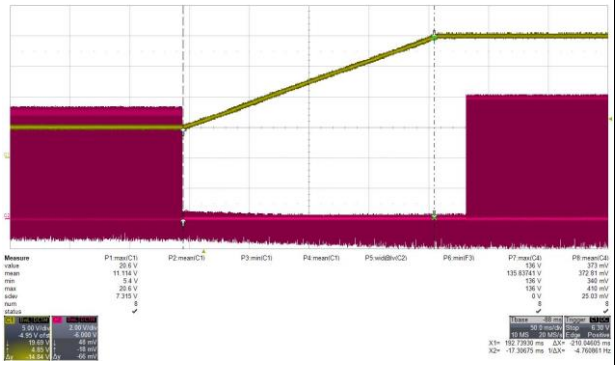
Measured by using a 12 inch twisted pair terminal with a 10μF aluminum electrolytic capacitor and a 0.1μF ceramic in parallel, measured at full load.

5.2.3 Output Voltage Rising Time

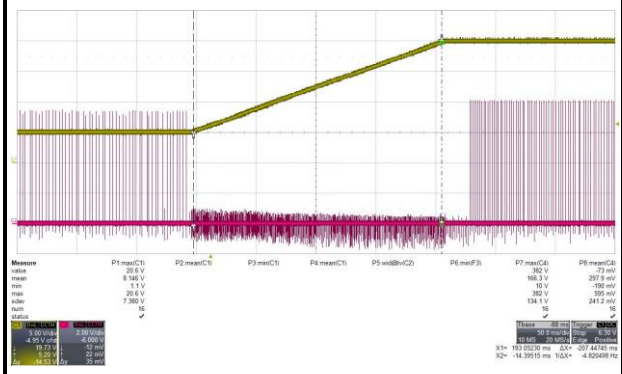
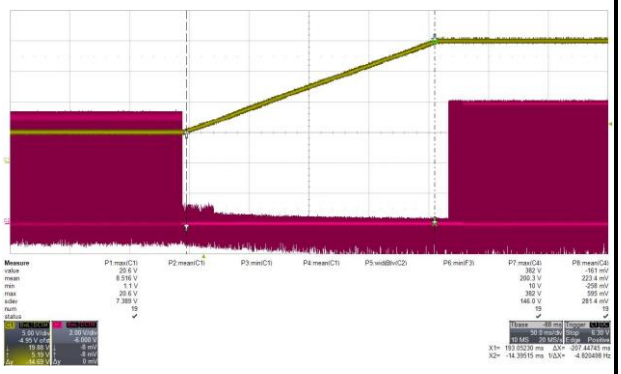
Input Voltage	Output Voltage	Rising Time (ms)		Specification	Test Result
		0A	3A		
90Vac/60Hz	5V⇨9V	55.7	56.4	＜275ms	Pass
	5V⇨15V	141.1	141.1		Pass
	5V⇨20V	210.0	210.1		Pass
265Vac/50Hz	5V⇨9V	55	55		Pass
	5V⇨15V	137.5	137.5		Pass
	5V⇨20V	207	207		Pass

90Vac/60Hz ; 5V⇨9V ; 0A	90Vac/60Hz ; 5V⇨9V ; 3A
	
265Vac/50Hz ; 5V⇨9V ; 0A	**265Vac/50Hz ; 5V⇨9V ; 3A**
	

CH1:V_{BUS} CH2:V_{GS_SR}

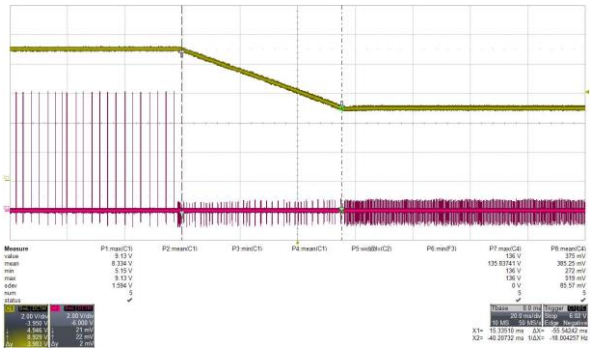
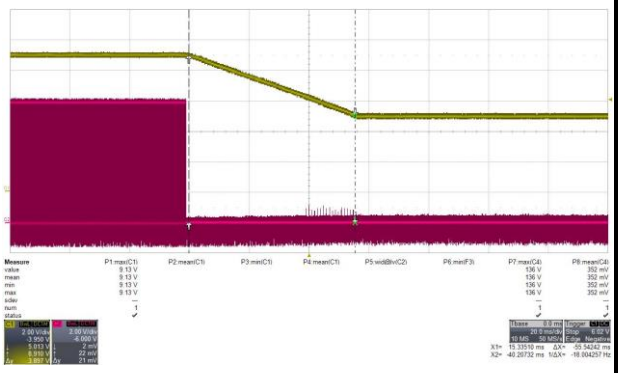
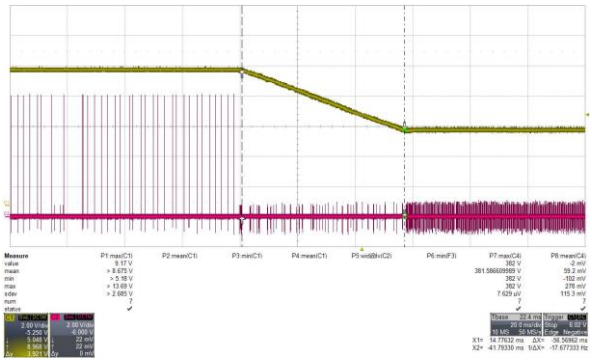
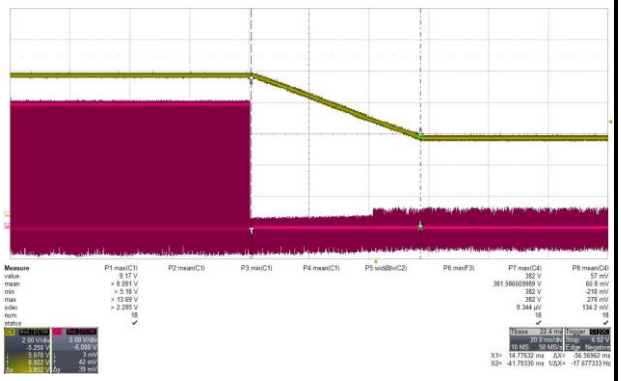
90Vac/60Hz ; 5V⇨15V ; 0A	90Vac/60Hz ; 5V⇨15V ; 3A
	
265Vac/50Hz ; 5V⇨15V ; 0A	**265Vac/50Hz ; 5V⇨15V ; 3A**
	
90Vac/60Hz ; 5V⇨20V ; 0A	**90Vac/60Hz ; 5V⇨20V ; 3A**
	

CH1:V_{BUS} CH2:V_{GS_SR}

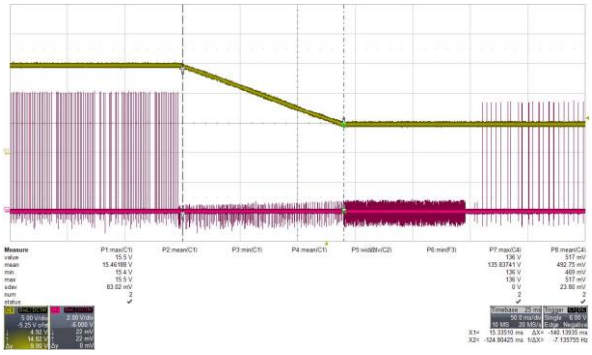
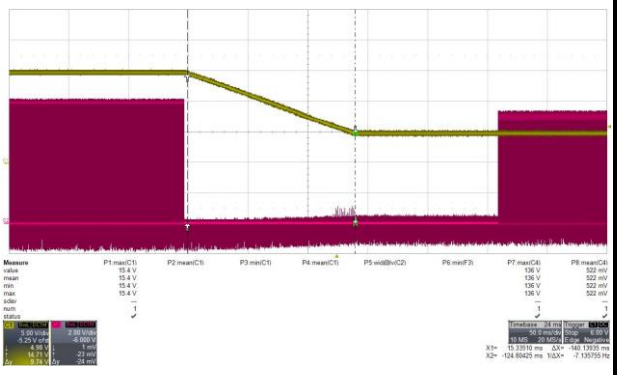
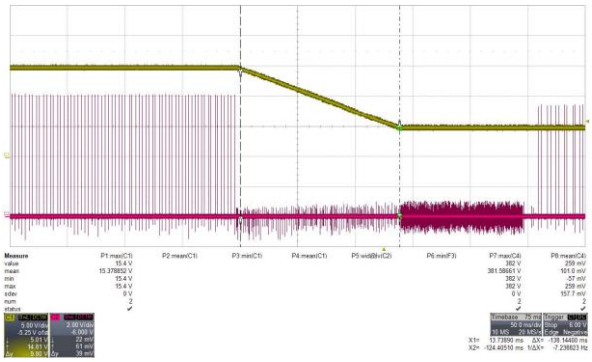
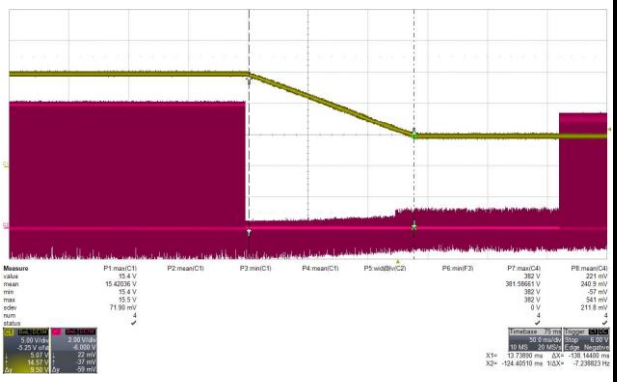
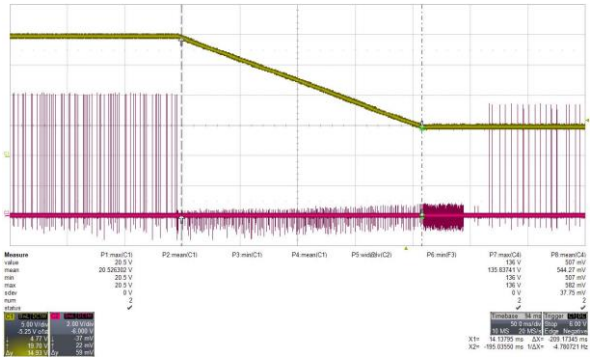
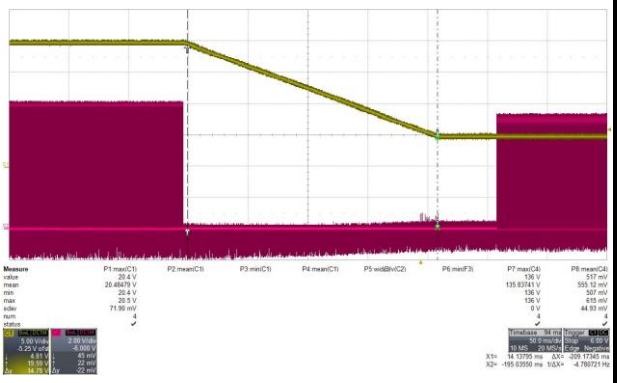
265Vac/50Hz ; 5V⇨20V ; 0A	265Vac/50Hz ; 5V⇨20V ; 3A
	
CH1:V_{BUS} CH2:V_{GS_SR}	

5.2.4 Output Voltage Falling Time

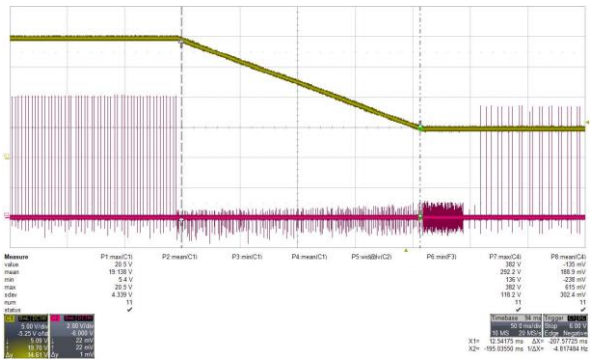
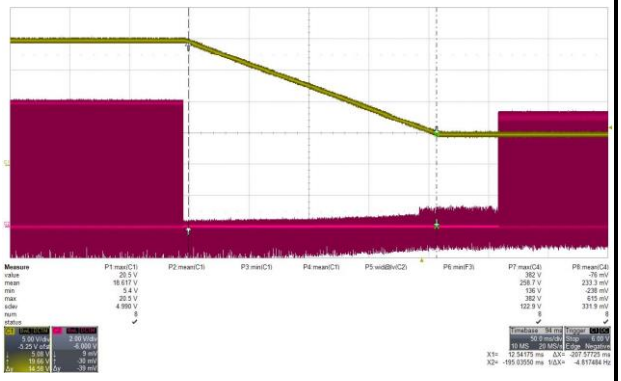
Input Voltage	Output Voltage	Falling Time (ms)		Specification	Test Result
		0A	3A		
90Vac/60Hz	9V⇨5V	55.5	55.5	＜275ms	Pass
	15V⇨5V	140.1	140.1		Pass
	20V⇨5V	209.1	209.1		Pass
265Vac/50Hz	9V⇨5V	55.5	55.5		Pass
	15V⇨5V	138.1	138.1		Pass
	20V⇨5V	207.5	207.5		Pass

90Vac/60Hz ; 9V⇨5V ; 0A	90Vac/60Hz ; 9V⇨5V ; 3A
	
265Vac/50Hz ; 9V⇨5V ; 0A	**265Vac/50Hz ; 9V⇨5V ; 3A**
	

CH1:V_{BUS} CH2:V_{GS_SR}

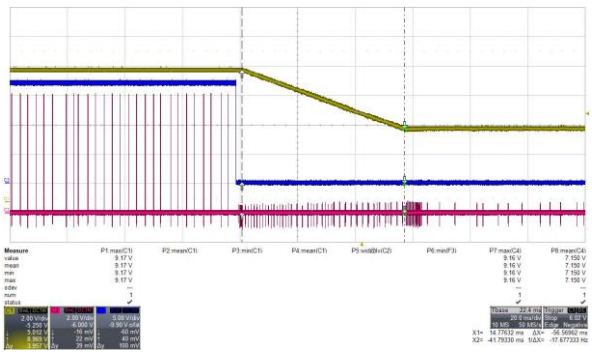
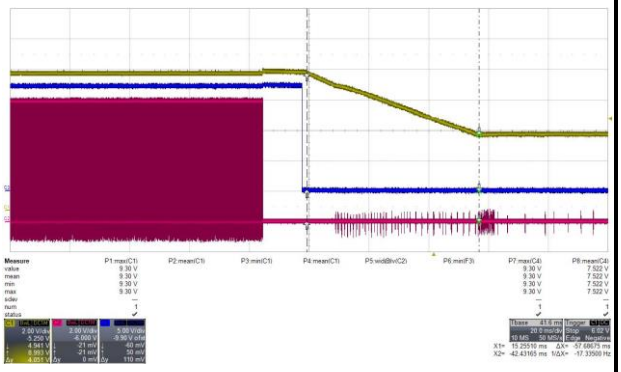
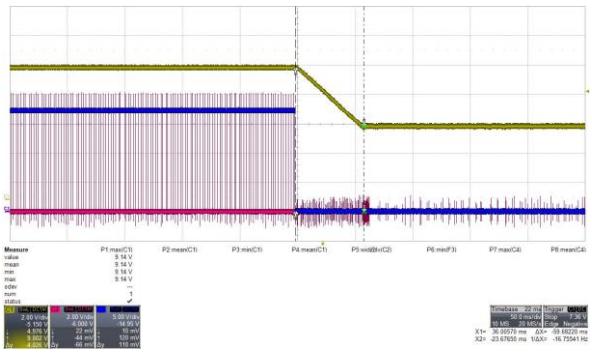
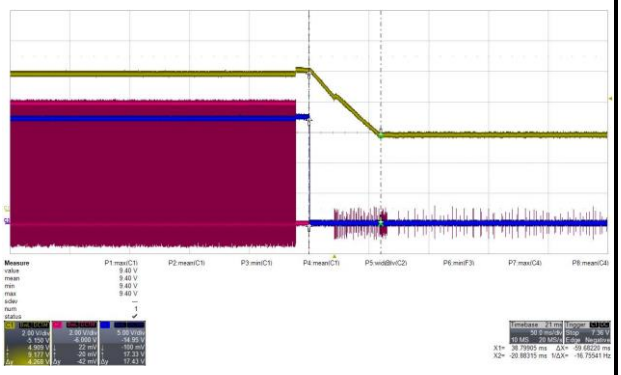
90Vac/60Hz ; 15V⇨5V ; 0A	90Vac/60Hz ; 15V⇨5V ; 3A
	
265Vac/50Hz ; 15V⇨5V ; 0A	**265Vac/50Hz ; 15V⇨5V ; 3A**
	
90Vac/60Hz ; 20V⇨5V ; 0A	**90Vac/60Hz ; 20V⇨5V ; 3A**
	

CH1:V_{BUS} CH2:V_{GS_SR}

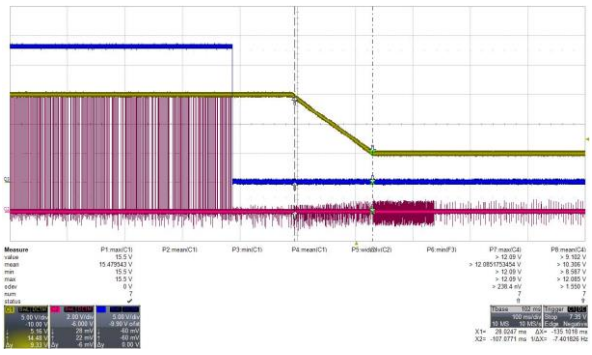
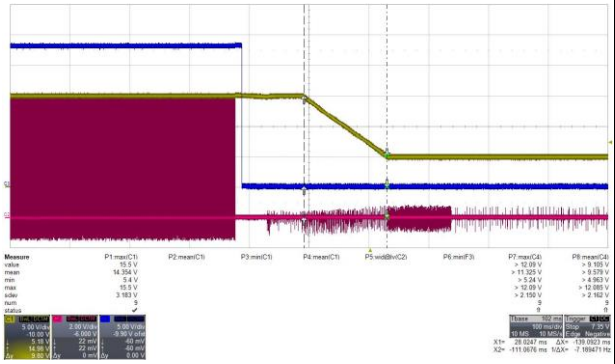
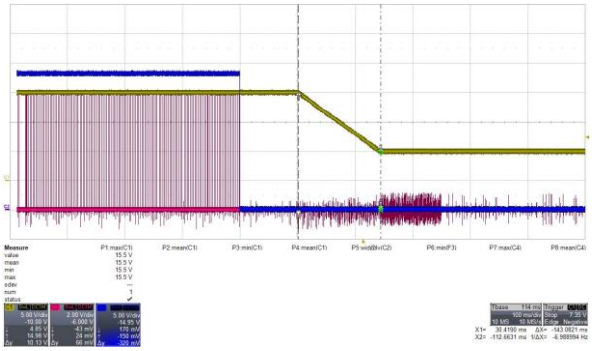
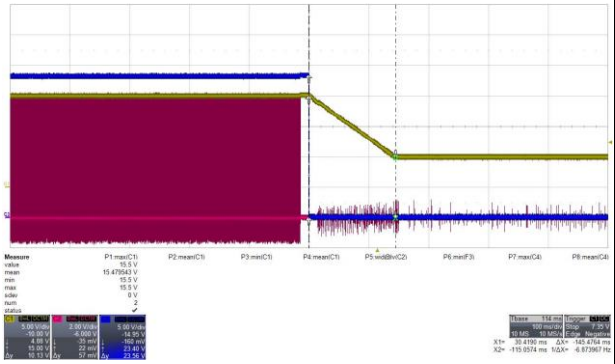
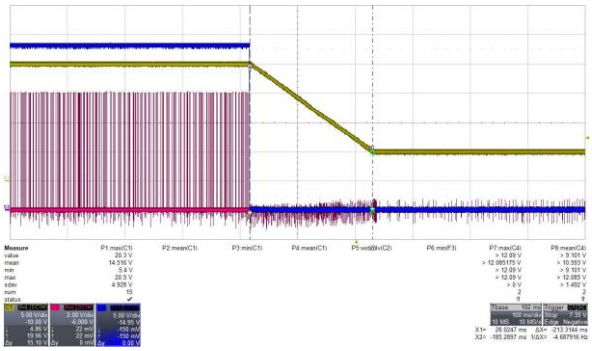
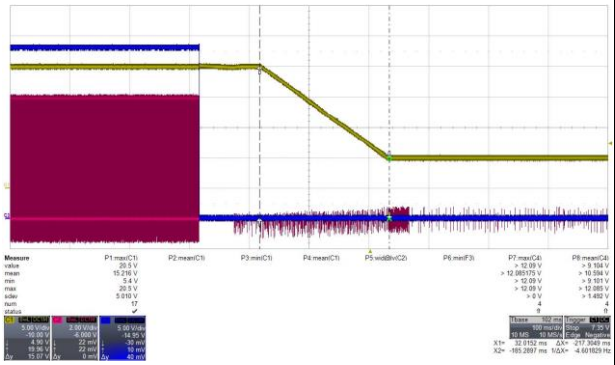
265Vac/50Hz ; 20V⇨5V ; 0A	265Vac/50Hz ; 20V⇨5V ; 3A
	
CH1:V_{BUS} CH2:V_{GS_SR}	

5.2.5 Cable Detached

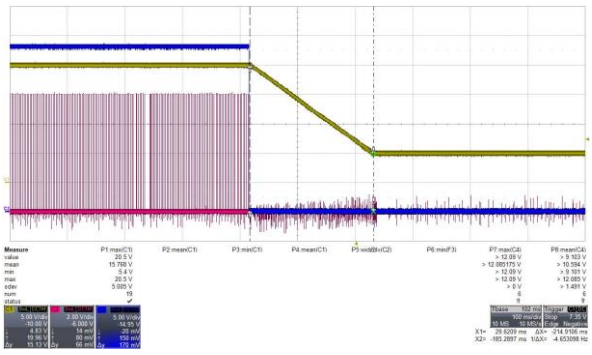
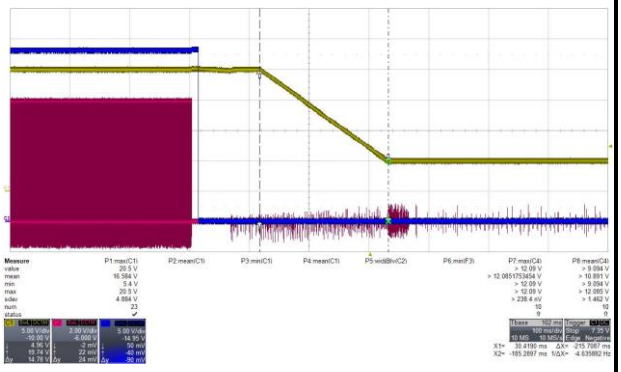
Input Voltage	Output Voltage	Falling Time (ms)		Test Result
		0A	3A	
90Vac/60Hz	9V⇨5V	56.56	57.67	Pass
	15V⇨5V	135.1	139	Pass
	20V⇨5V	213.3	217.3	Pass
265Vac/50Hz	9V⇨5V	59.68	59.68	Pass
	15V⇨5V	143	145.4	Pass
	20V⇨5V	214.9	215.7	Pass
Specification	Output Voltage Step Down to 5V			

90Vac/60Hz 9V ; 0A	90Vac/60Hz 9V ; 3A
	
265Vac/50Hz 9V ; 0A	**265Vac/50Hz 9V ; 3A**
	

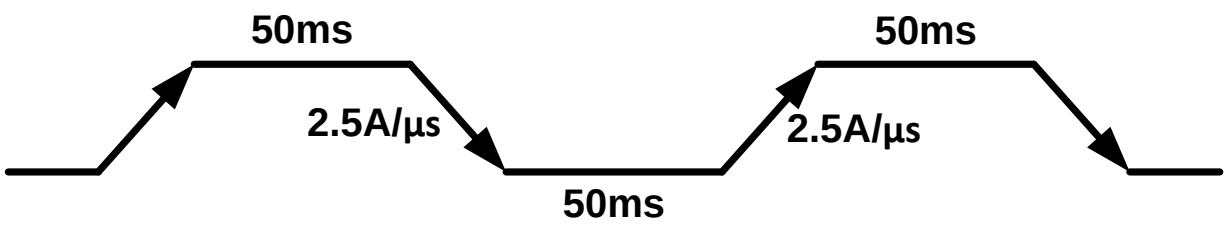
CH1:V_{OUT} CH2:V_{GS_SR} CH3:V_{USBP}

90Vac/60Hz 15V ; 0A	90Vac/60Hz 15V ; 3A
	
265Vac/50Hz 15V ; 0A	**265Vac/50Hz 15V ; 3A**
	
90Vac/50Hz 20V ; 0A	**90Vac/50Hz 20V ; 3A**
	

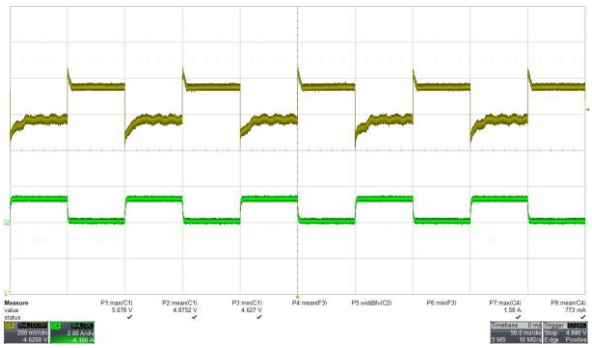
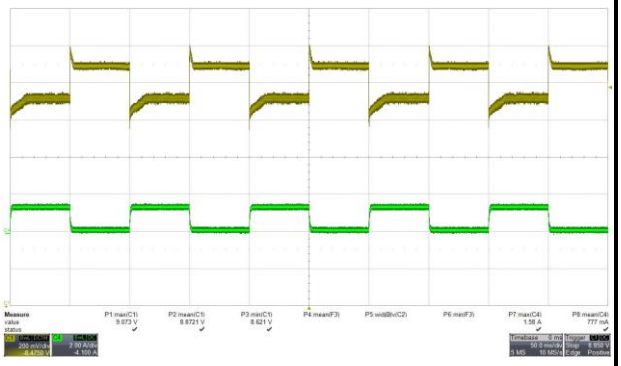
CH1:V_{OUT} CH2:V_{GS_SR} CH3:V_{USBP}

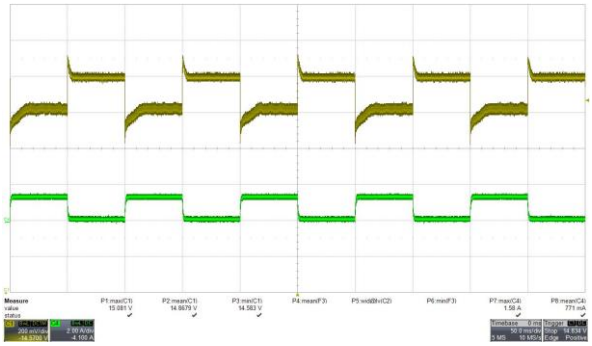
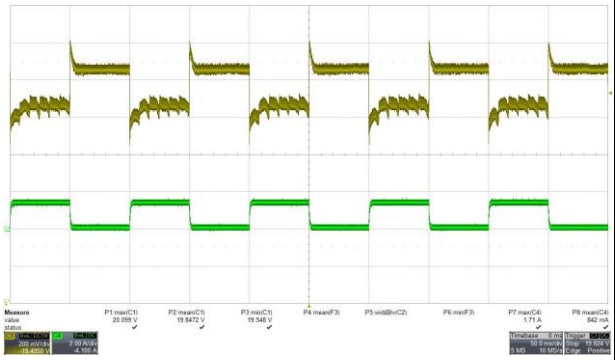
265Vac/50Hz 20V ; 0A	265Vac/50Hz 20V ; 3A
	
CH1:V_{OUT} CH2:V_{GS_SR} CH3:V_{USBP}	

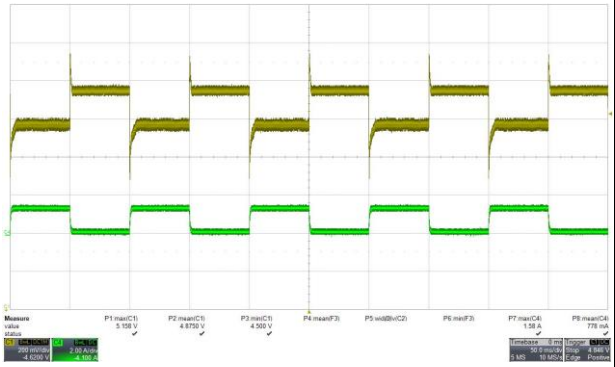
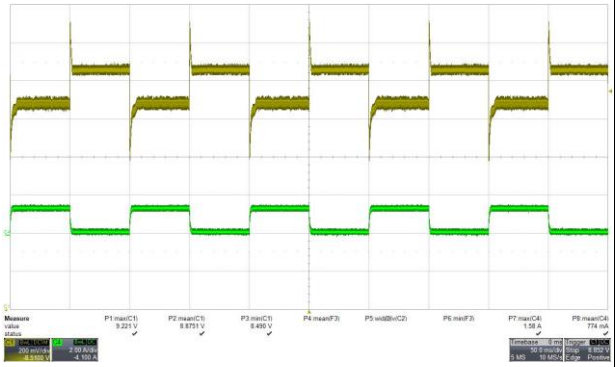
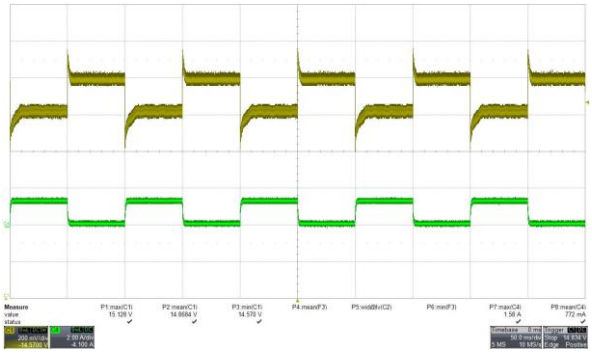
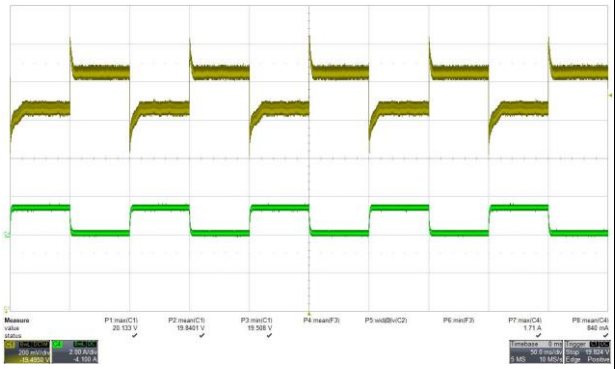
5.2.6 Load Transient



Input Voltage	Output Voltage	Measured V_{OUT} (V)		Specification	Test Result
		10%⇨90%	90%⇨10%		
90Vac/60Hz	5V	4.62	5.07	V_{OUT} ± 10%	Pass
	9V	8.62	9.07		Pass
	15V	14.58	15.08		Pass
	20V	19.54	20.09		Pass
265Vac/50Hz	5V	4.50	5.18		Pass
	9V	8.49	9.22		Pass
	15V	14.57	15.12		Pass
	20V	19.50	20.13		Pass

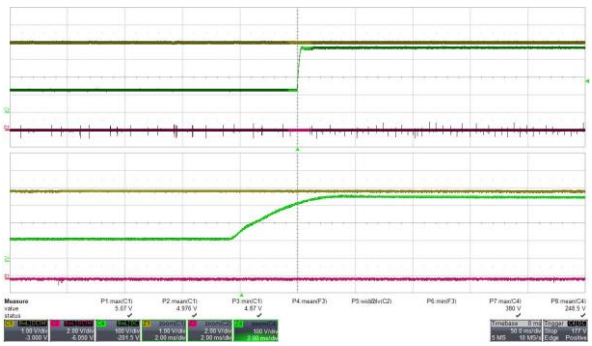
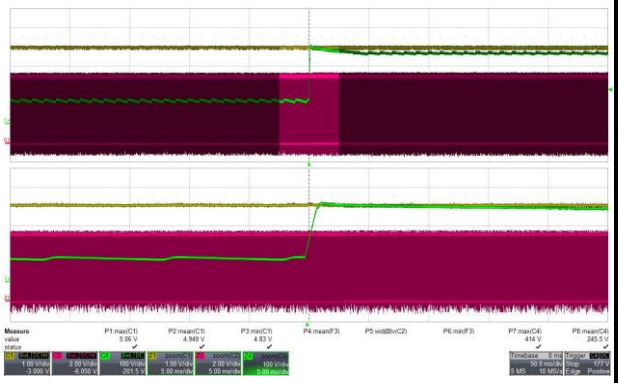
90Vac/60Hz ; 5V ; 10%⇔90%Load	90Vac/60Hz ; 9V ; 10%⇔90%Load
	
CH1:V_{BUS} CH4:I_{OUT}	

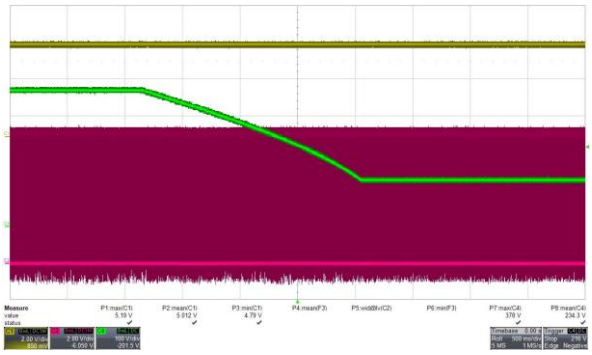
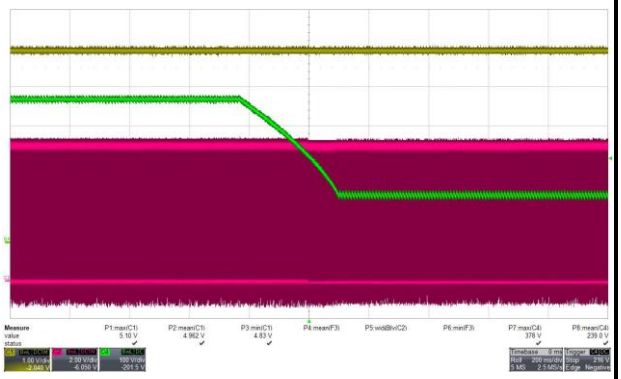
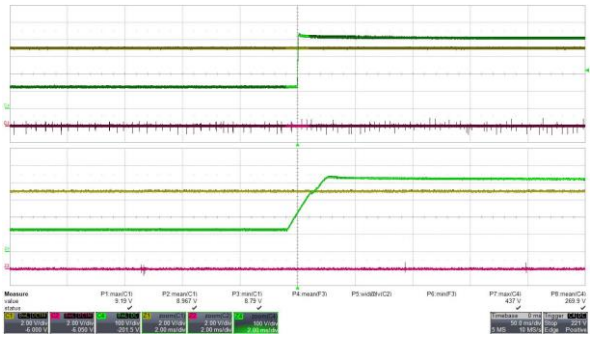
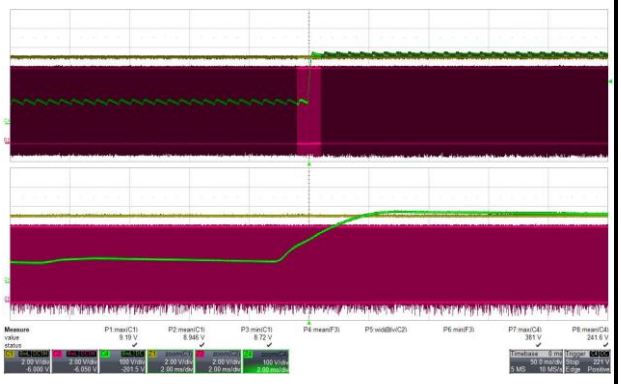
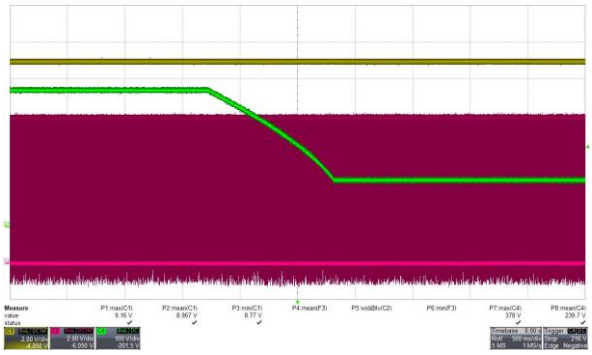
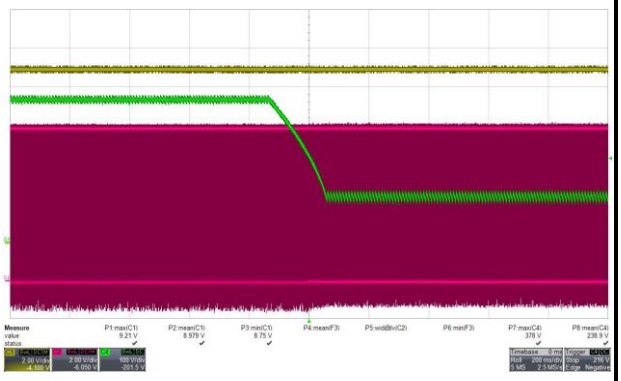
90Vac/60Hz ; 15V ; 10%⇔90%Load	90Vac/60Hz ; 20V ; 10%⇔90%Load
	
CH1:V_{BUS} CH4:I_{OUT}	

265Vac/50Hz ; 5V ; 10%⇔90%Load	265Vac/50Hz ; 9V ; 10%⇔90%Load
	
265Vac/50Hz ; 15V ; 10%⇔90%Load	**265Vac/50Hz ; 20V ; 10%⇔90%Load**
	
CH1:V_{BUS} CH4:I_{OUT}	

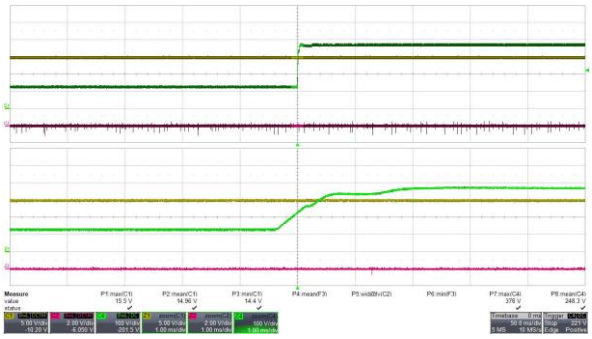
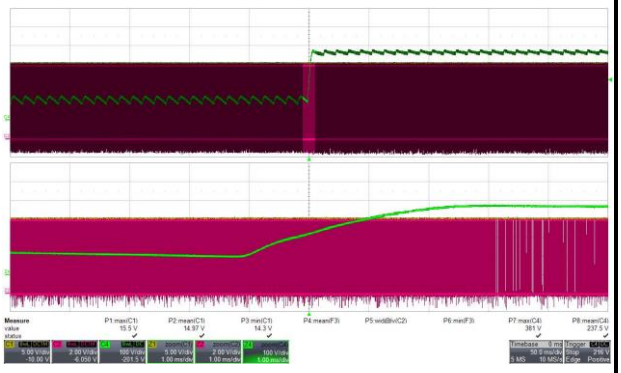
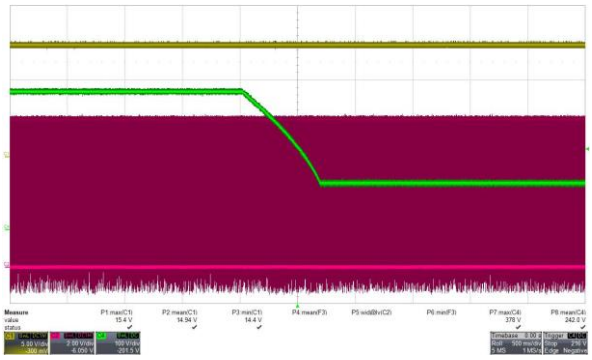
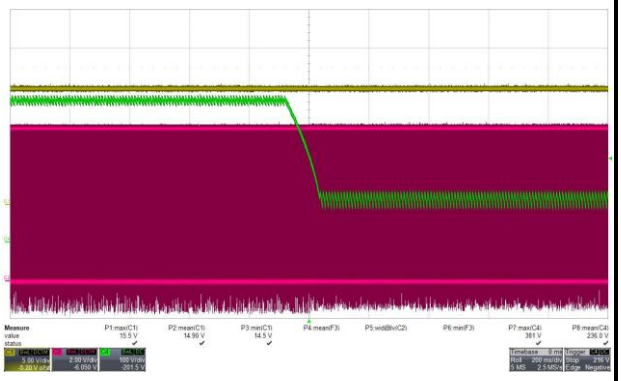
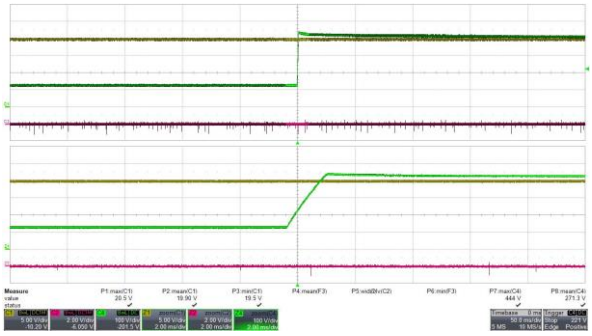
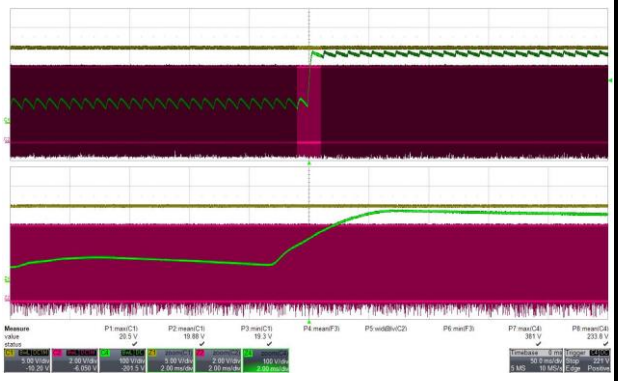
5.2.7 Line Transient

Input Voltage	Output Voltage	0A	3A (3.25A for 20V)
90Vac/60Hz ↓ 265Vac/50Hz	5V	4.976	4.949
	9V	8.967	8.946
	15V	14.96	14.97
	20V	19.90	19.88
Input Voltage	**Output Voltage**	**0.5A**	**3A (3.25A for 20V)**
265Vac/50Hz ↓ 90Vac/60Hz	5V	5.012	4.962
	9V	8.967	8.979
	15V	14.94	14.90
	20V	19.93	19.91
Specification		V_{OUT} ± 1%	
Test Result		Pass	Pass

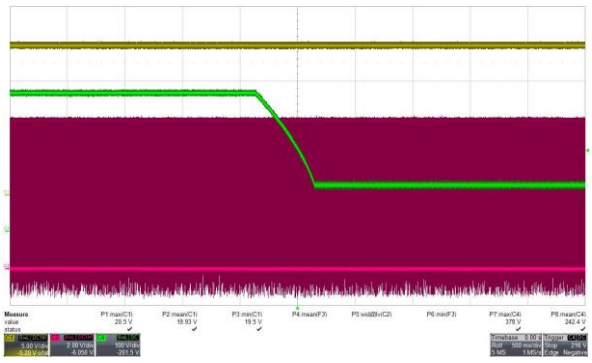
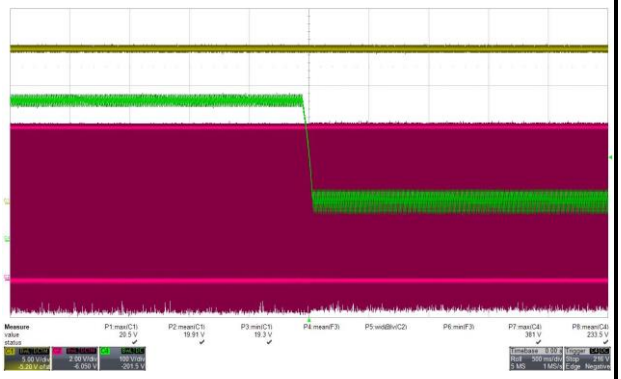
90Vac/60Hz⇨265Vac/50Hz ; 5V ; 0A	90Vac/60Hz⇨265Vac/50Hz ; 5V ; 3A
	
CH1:V_{OUT} CH2:V_{GS_SR} CH4:V_{bulk}	

265Vac/50Hz⇨90Vac/60Hz ; 5V ; 0.5A	265Vac/50Hz⇨90Vac/60Hz ; 5V ; 3A
	
90Vac/60Hz⇨265Vac/50Hz ; 9V ; 0A	**90Vac/60Hz⇨265Vac/50Hz ; 9V ; 3A**
	
265Vac/50Hz⇨90Vac/60Hz ; 9V ; 0.5A	**265Vac/50Hz⇨90Vac/60Hz ; 9V ; 3A**
	

CH1:V_{OUT} CH2:V_{GS_SR} CH3:V_{TR} CH4:V_{AC}

90Vac/60Hz⇨265Vac/50Hz ; 15V ; 0A	90Vac/60Hz⇨265Vac/50Hz ; 15V ; 3A
	
265Vac/50Hz⇨90Vac/60Hz ; 15V ; 0.5A	**265Vac/50Hz⇨90Vac/60Hz ; 15V ; 3A**
	
90Vac/60Hz⇨265Vac/50Hz ; 20V ; 0.5A	**90Vac/60Hz⇨265Vac/50Hz ; 20V ; 3.25A**
	

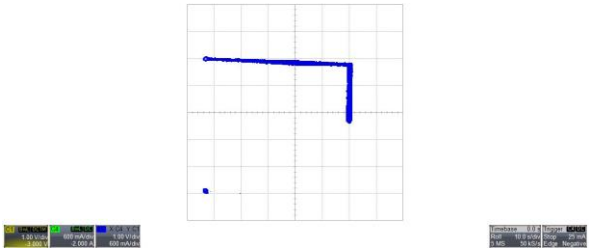
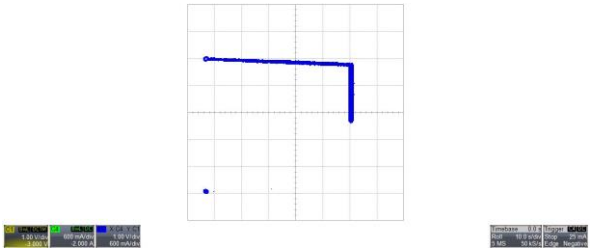
CH1:V_{OUT} CH2:V_{GS_SR} CH4:V_{AC}

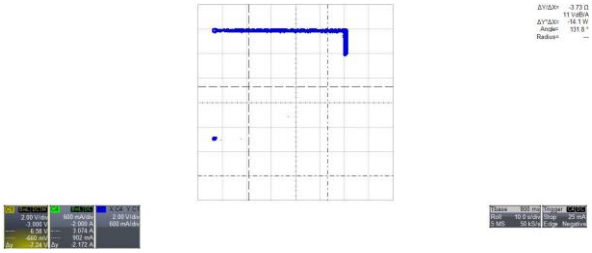
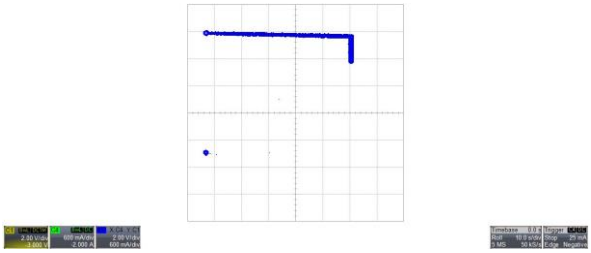
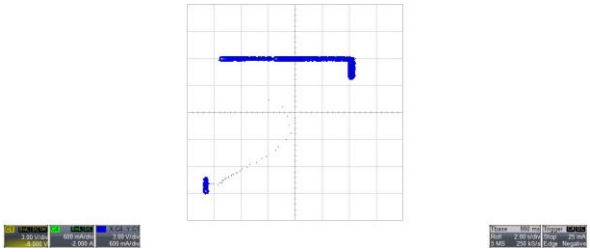
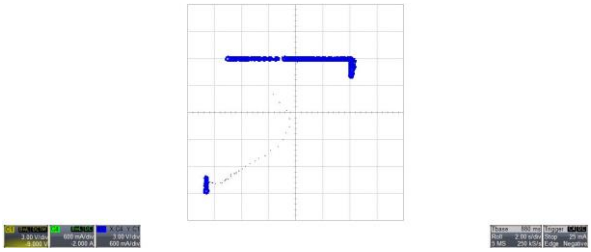
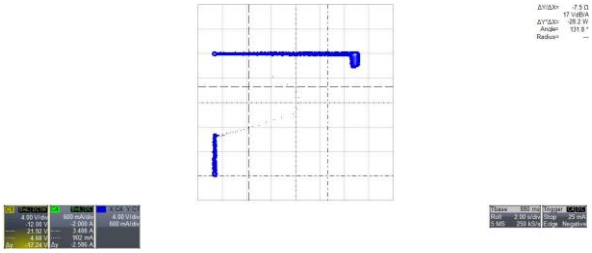
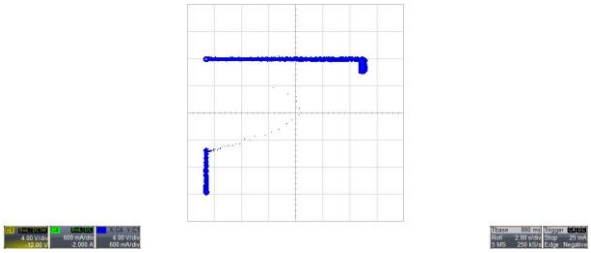
265Vac/50Hz⇨90Vac/60Hz ; 20V ; 0.5A	265Vac/50Hz⇨90Vac/60Hz ; 20V ; 3.25A
	
CH1:V_{OUT} CH2:V_{GS_SR} CH4:V_{AC}	

5.3 Protections

5.3.1 Constant Current

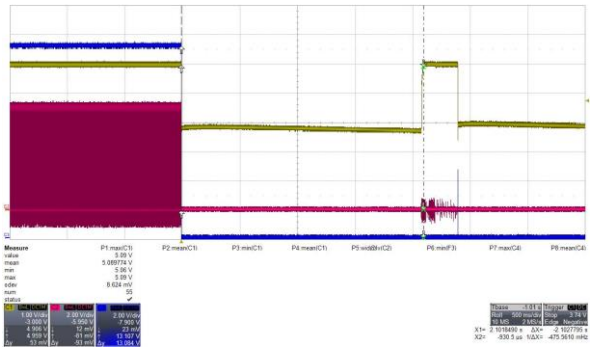
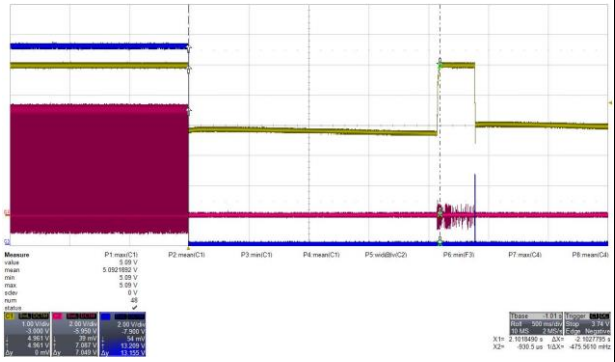
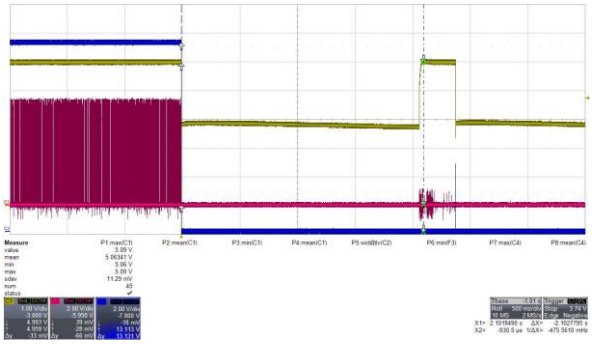
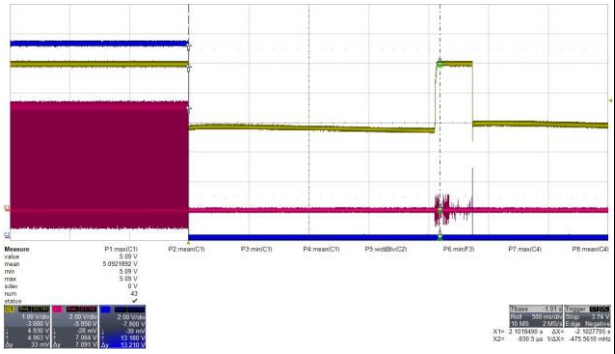
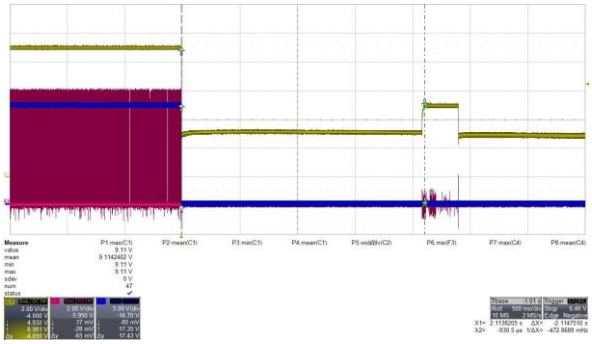
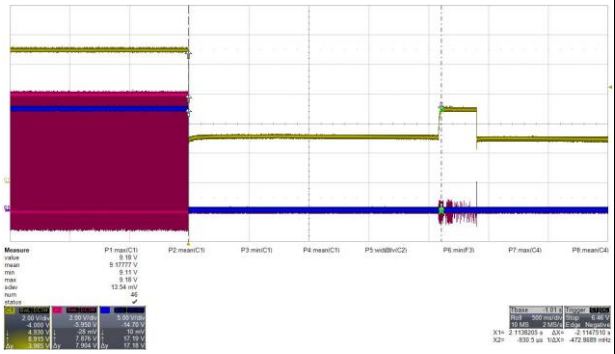
Input Voltage	Output Voltage	Max. Output Current I_{OUT_MAX}	Constant Current I_{OUT_CC}	$\lvert I_{OUT_CC}-I_{OUT_MAX}\rvert \div I_{OUT_MAX}$ (%)	CC Shutdown Voltage	Test Result
90Vac/60Hz	5V	3A	3.258A	8.60%	2.76V	Pass
265Vac/50Hz			3.230A	7.67%	2.75V	Pass
90Vac/60Hz	9V	3A	3.250A	8.33%	6.76V	Pass
265Vac/50Hz			3.255A	8.50%	6.78V	Pass
90Vac/60Hz	15V	3A	3.250A	8.33%	12.96V	Pass
265Vac/50Hz			3.250A	8.33%	12.96V	Pass
90Vac/60Hz	20V	3.25A	3.500A	7.69%	17.91V	Pass
265Vac/50Hz			3.520A	8.31%	17.95V	Pass
Specification	$I_{OUT_CC} < I_{OUT_MAX} + 10\%$					

90Vac/60Hz ; 5V	265Vac/50Hz ; 5V
	
$X: I_{OUT}$ $Y: V_{BUS}$	

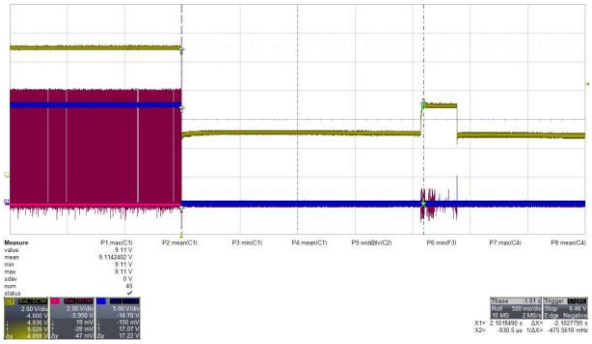
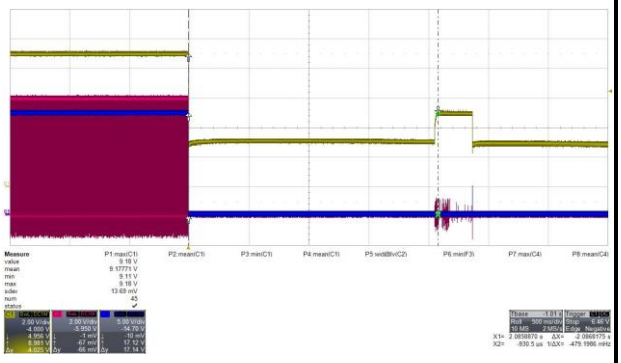
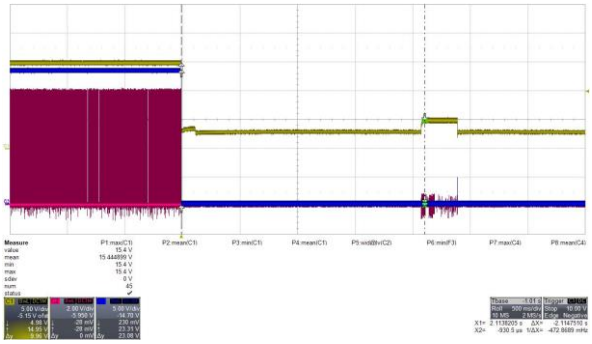
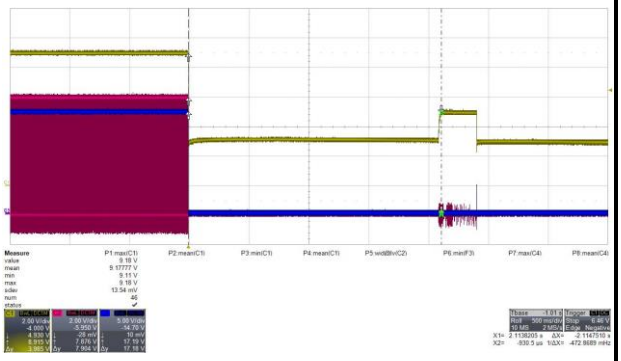
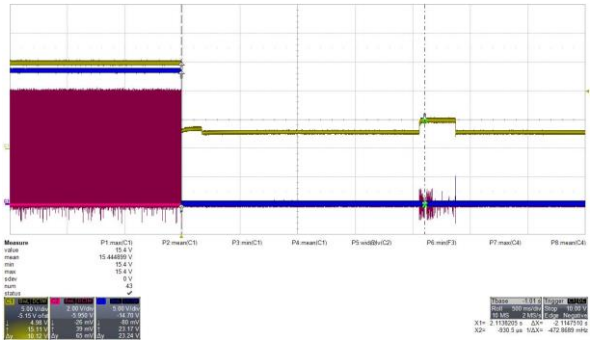
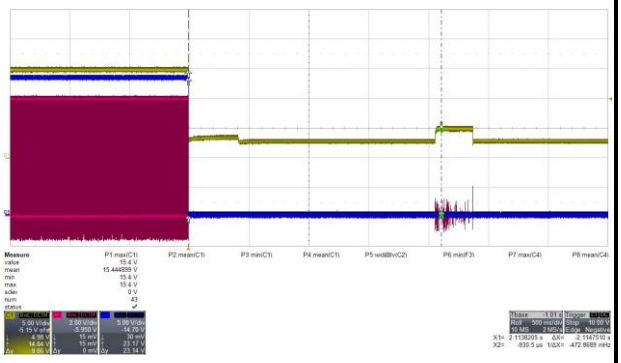
90Vac/60Hz ; 9V	265Vac/50Hz ; 9V
	
90Vac/60Hz ; 15V	**265Vac/50Hz ; 15V**
	
90Vac/60Hz ; 20V	**265Vac/50Hz ; 20V**
	
X:I_{OUT} Y:V_{BUS}	

5.3.2 Output Short

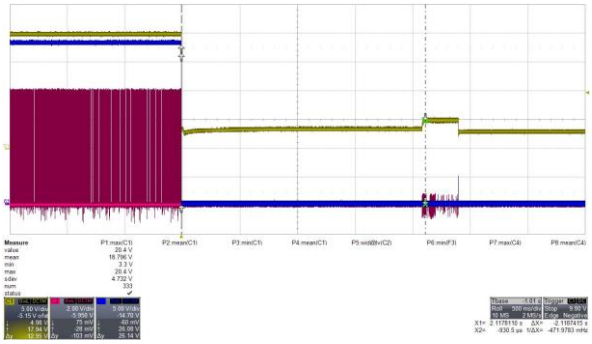
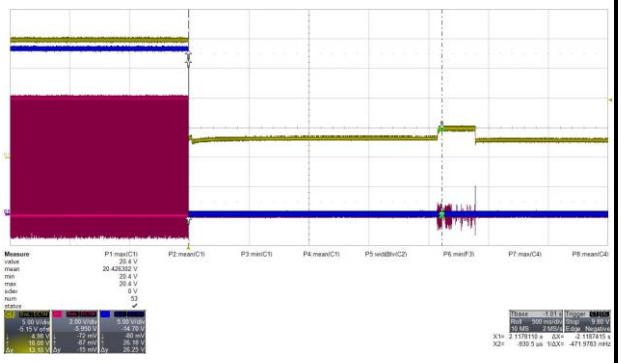
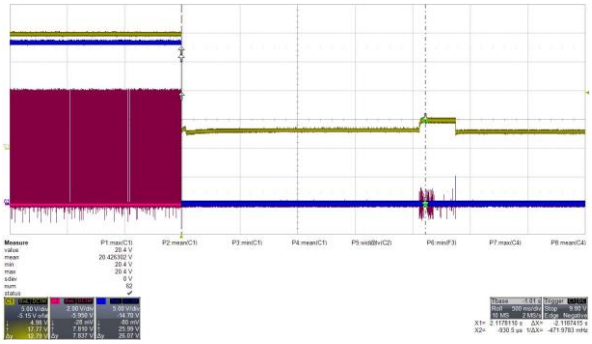
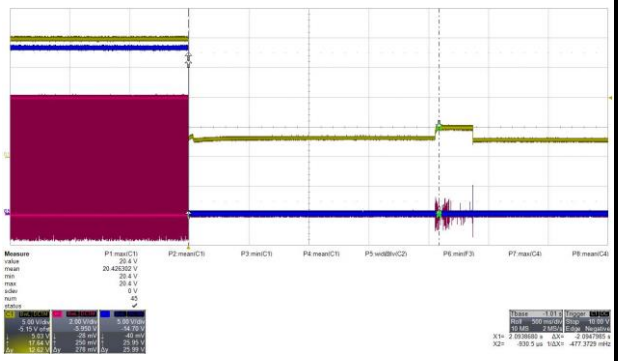
Input Voltage	Output Voltage	Output Current	Input Power	Specification	Test Result
90Vac/60Hz	5V	0A	74.15mW	Auto Recovery P_{IN}＜150mW	Pass
	9V		69.98mW		Pass
	15V		72.22 mW		Pass
	20V		72.66 mW		Pass
	5V	3A	74.18 mW		Pass
	9V		72.07 mW		Pass
	15V		71.82 mW		Pass
	20V	3.25A	74.22 mW		Pass
265Vac/50Hz	5V	0A	148.5 mW		Pass
	9V		147.8 mW		Pass
	15V		149.4 mW		Pass
	20V		148.9 mW		Pass
	5V	3A	147.9 mW		Pass
	9V		147.1 mW		Pass
	15V		149.6 mW		Pass
	20V	3.25A	148.7 mW		Pass

90Vac/60Hz ; 5V ; 0A	90Vac/60Hz ; 5V ; 3A
	
265Vac/50Hz ; 5V ; 0A	**265Vac/50Hz ; 5V ; 3A**
	
90Vac/60Hz ; 9V ; 0A	**90Vac/60Hz ; 9V ; 3A**
	

CH1:V_{OUT} CH2:V_{GS_SR} CH3:V_{USBP}

265Vac/50Hz ; 9V ; 0A	265Vac/50Hz ; 9V ; 3A
	
90Vac/60Hz ; 15V ; 0A	**90Vac/60Hz ; 15V ; 3A**
	
265Vac/50Hz ; 15V ; 0A	**265Vac/50Hz ; 15V ; 3A**
	

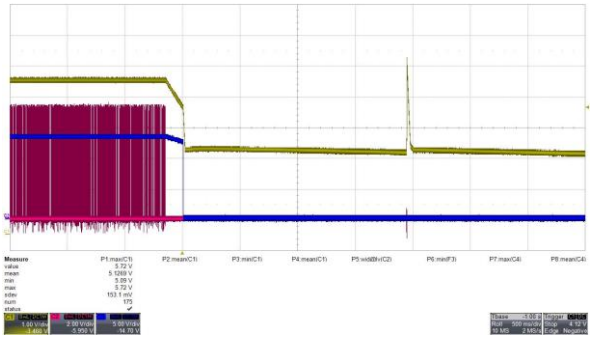
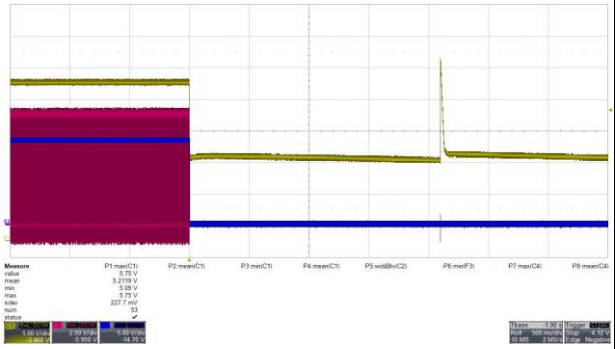
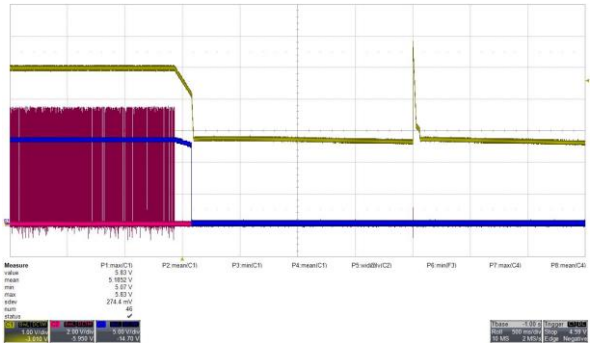
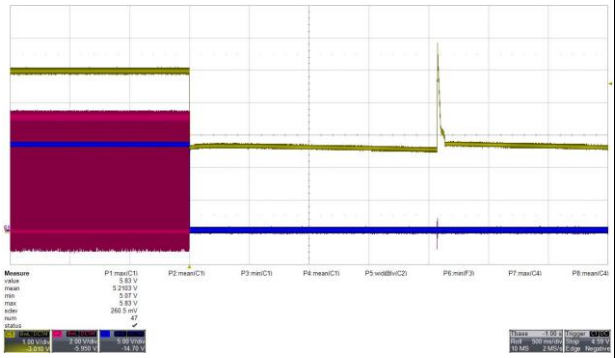
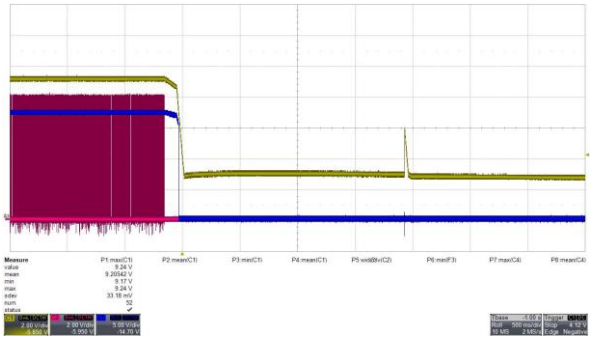
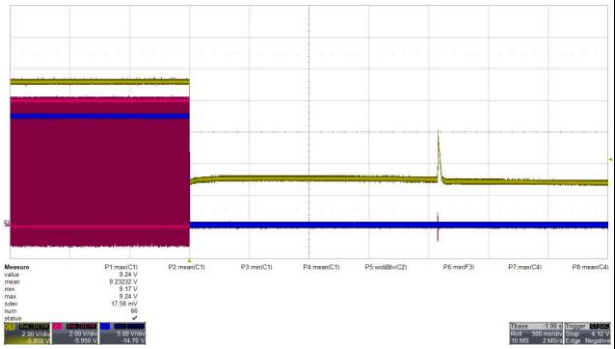
CH1:V_{OUT} CH2:V_{GS_SR} CH3:V_{USBP}

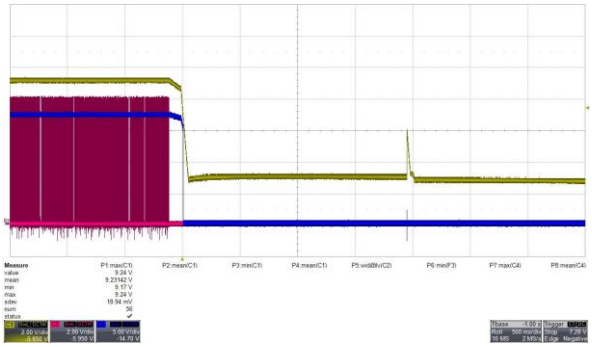
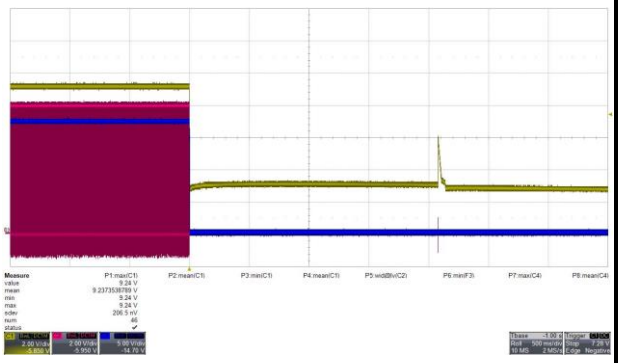
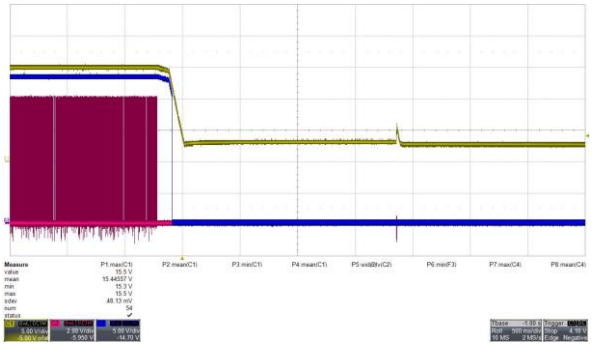
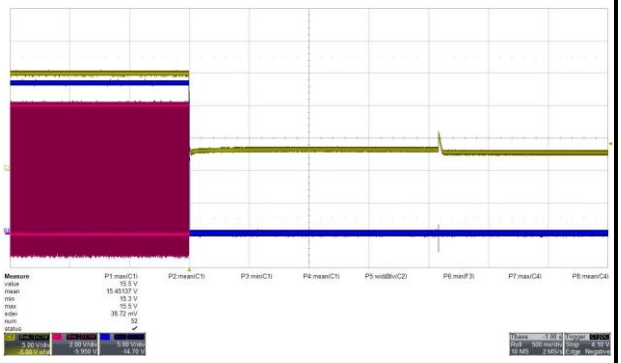
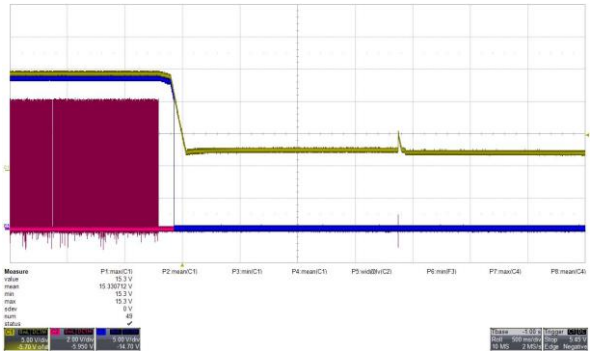
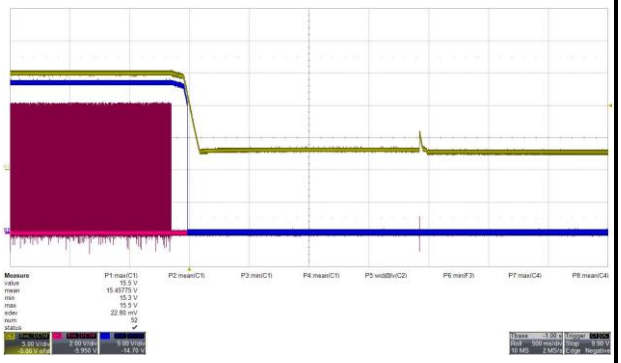
90Vac/60Hz ; 20V ; 0A	90Vac/60Hz ; 20V ; 3.25A
	
265Vac/50Hz ; 20V ; 0A	**265Vac/50Hz ; 20V ; 3.25A**
	

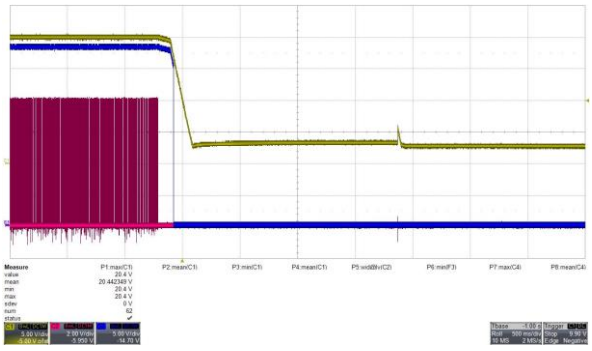
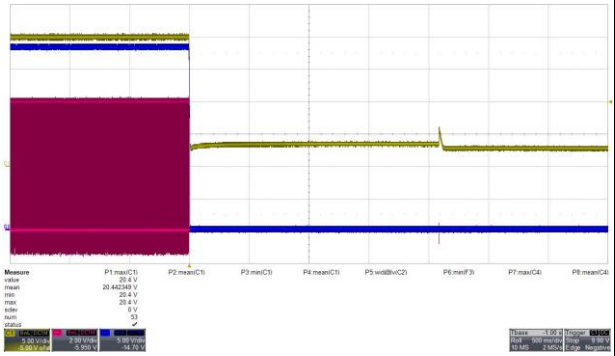
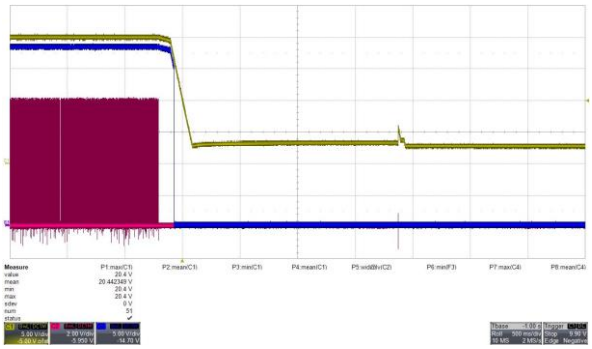
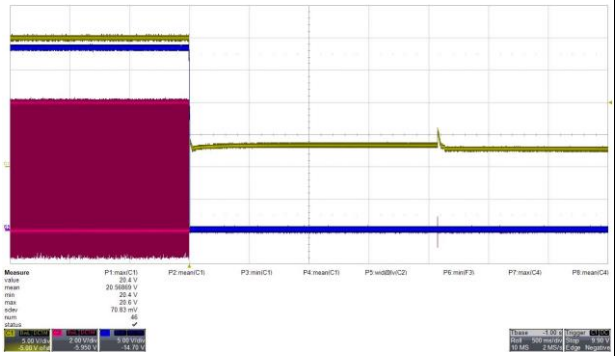
CH1:V_{OUT} CH2:V_{GS_SR} CH3:V_{USBP}

5.3.3 Photo-Coupler Short (V_{OUT} OVP)

Input Voltage	Output Voltage	Output Current	OVP Level	Input Power	Specification	Test Result
90Vac/60Hz	5V	0A	5.72	47.8	Auto Recovery $V_{OUT_OVP} < 1.2V_{OUT}$ $P_{IN} < 150mW$	PASS
	9V		9.24	47.99		PASS
	15V		15.5	47.88		PASS
	20V		20.4	48.21		PASS
	5V	3A	5.75	47.33		PASS
	9V		9.24	48.12		PASS
	15V		15.5	48.01		PASS
	20V	3.25A	20.4	48.31		PASS
265Vac/50Hz	5V	0A	5.83	121.7		PASS
	9V		9.24	122.8		PASS
	15V		15.5	130.1		PASS
	20V		20.4	125.8		PASS
	5V	3A	5.83	124.7		PASS
	9V		9.24	123.1		PASS
	15V		15.5	127.4		PASS
	20V	3.25A	20.4	127.2		PASS

90Vac/60Hz ; 5V ; 0A	90Vac/60Hz ; 5V ; 3A
	
265Vac/50Hz ; 5V ; 0A	**265Vac/50Hz ; 5V ; 3A**
	
90Vac/60Hz ; 9V ; 0A	**90Vac/60Hz ; 9V ; 3A**
	
CH1:V_{OUT} CH2:V_{GS_SR} CH3: V_{USBP}	

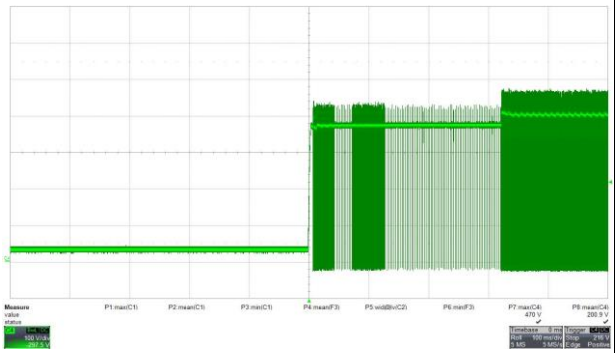
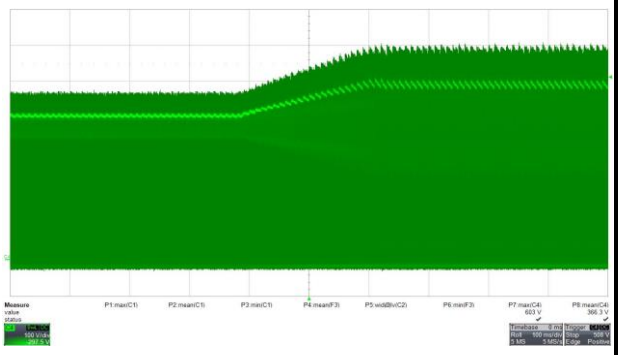
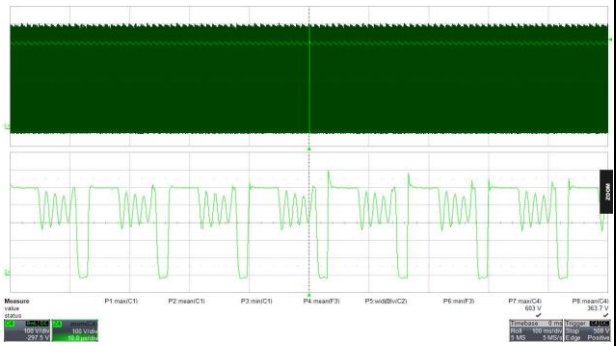
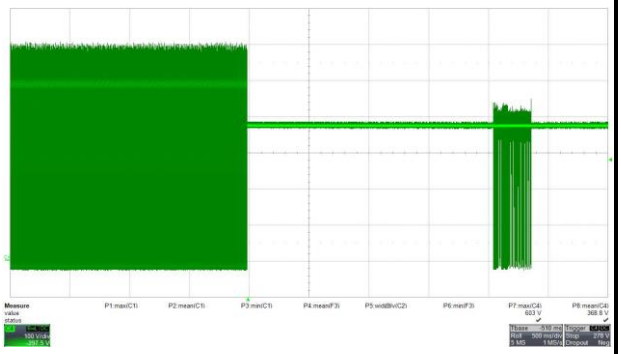
265Vac/50Hz ; 9V ; 0A	265Vac/50Hz ; 9V ; 3A
	
90Vac/60Hz ; 15V ; 0A	**90Vac/60Hz ; 15V ; 3A**
	
265Vac/50Hz ; 15V ; 0A	**265Vac/50Hz ; 15V ; 3A**
	
CH1:V_{OUT} CH2:V_{GS_SR} CH3: V_{USBP}	

90Vac/60Hz ; 20V ; 0A	90Vac/60Hz ; 20V ; 3.25A
	
265Vac/50Hz ; 20V ; 0A	**265Vac/50Hz ; 20V ; 3.25A**
	
CH1:V_{OUT} CH2:V_{GS_SR} CH3:V_{USBP}	

5.4 Key Component Waveforms

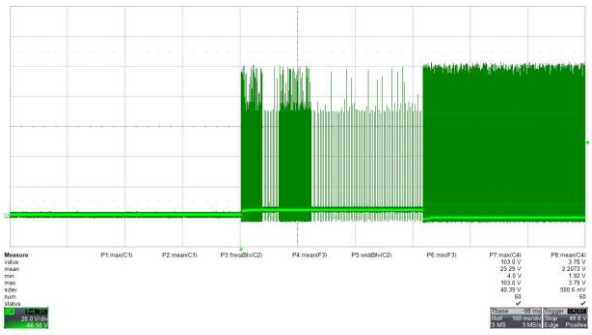
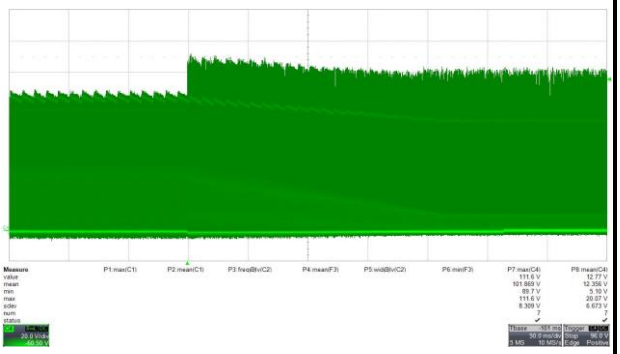
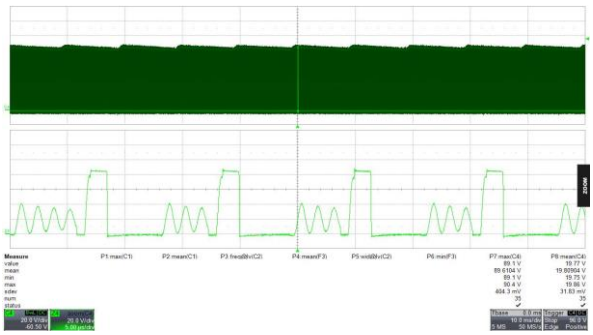
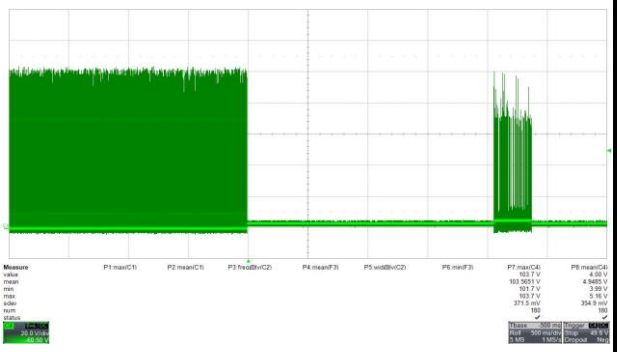
5.4.1 Voltage Stress on Primary Side MOSFET

Input Voltage	Output Voltage	Output Current	Test Condition	Stress on Primary Side MOSFET	Test Result
265Vac/50Hz	5V	3A	Start-up	470V	Pass
	5V⇨20V	3A	Output Voltage Step-up	603V	Pass
	20V	3.25A	Normal Operation	603V	Pass
			Output Short	603V	Pass
Primary Side MOSFET Rating	650V				

265Vac/50Hz ; 5V ; 3A ; Start-up	265Vac/50Hz ; 5V⇨20V ; 3A ; Step-up
	
265Vac/50Hz ; 20V ; 3.25A; Normal	**265Vac/50Hz ; 20V ; 3.25A ; Short**
	

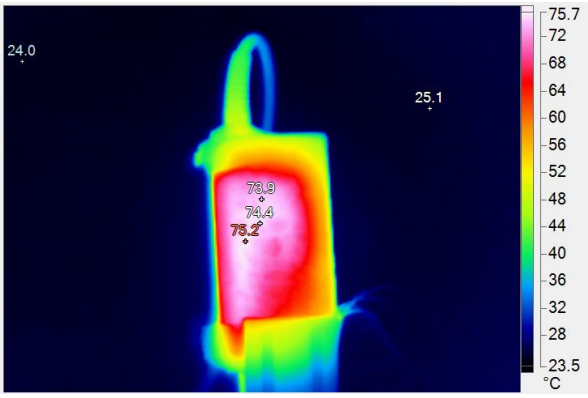
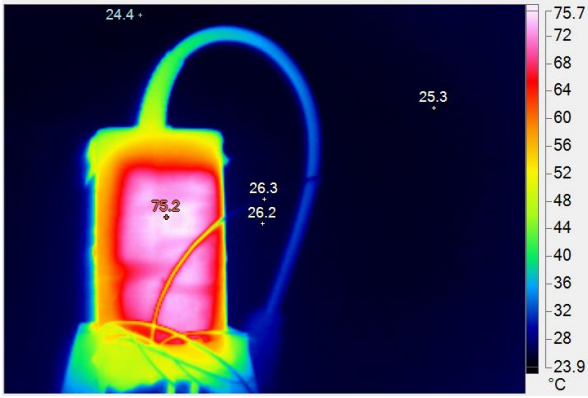
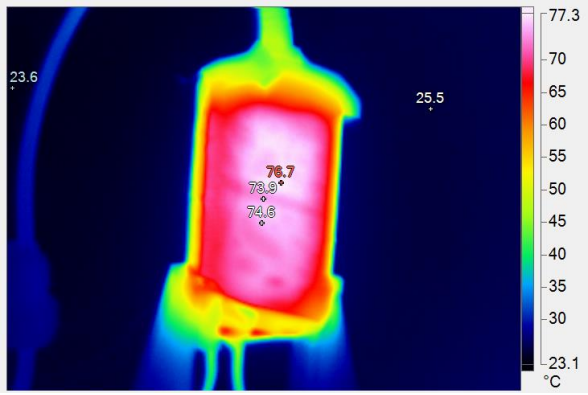
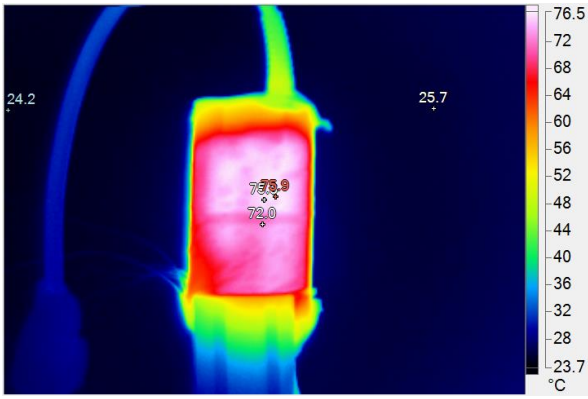
5.4.2 Voltage Stress on SR MOSFET

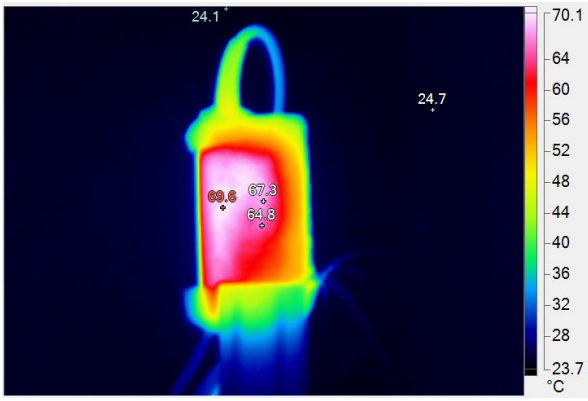
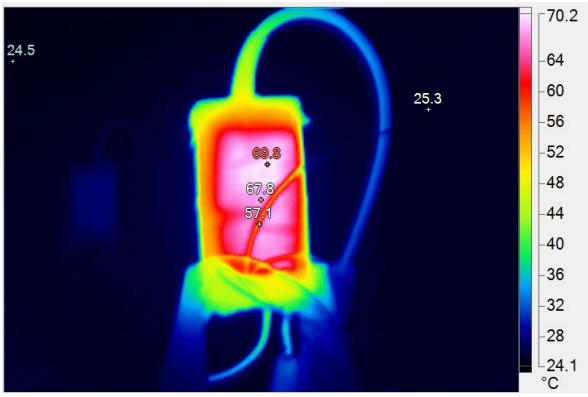
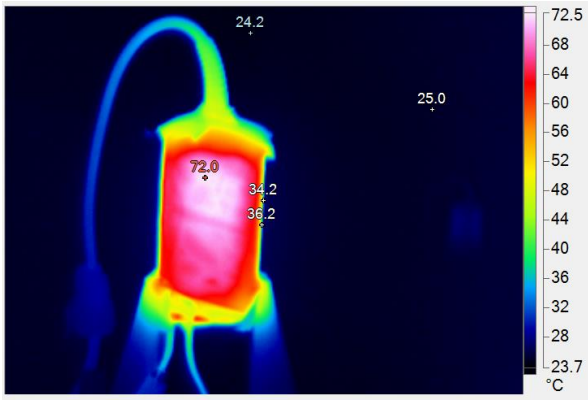
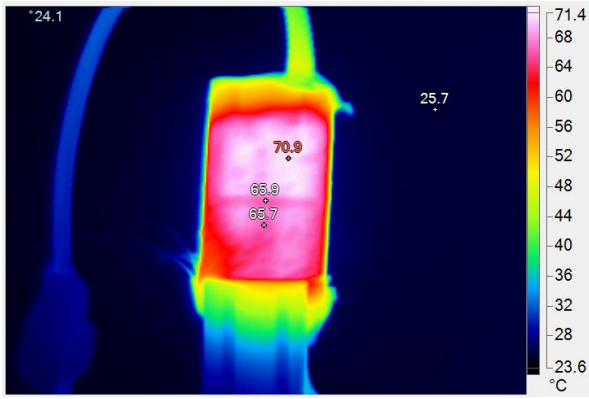
Input Voltage	Output Voltage	Output Current	Test Condition	Stress on SR MOSFET	Test Result
265Vac/50Hz	5V	3A	Start-up	103V	Pass
	5V⇨20V	3A	Output Voltage Step-up	111V	Pass
	20V	3.25A	Normal Operation	89V	Pass
			Output Short	103V	Pass
SR MOSFET Rating	150V				

265Vac/50Hz ; 5V ; 3A ; Start-up	265Vac/50Hz ; 5V⇨20V ; 3A ; Step-up
	
265Vac/50Hz ; 20V ; 3.25A; Normal	**265Vac/50Hz ; 20V ; 3.25A ; Short**
	

5.5 Others

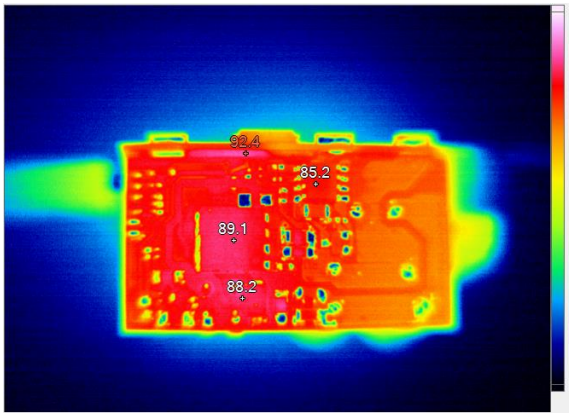
5.5.1 Thermal

90Vac/60Hz ; 20V ; 3.25A ; with Case	
Output Cap. & DM Choke Side	**Transformer Side**
	
SR MOSFET Side	**Primary MOSFET Side**
	

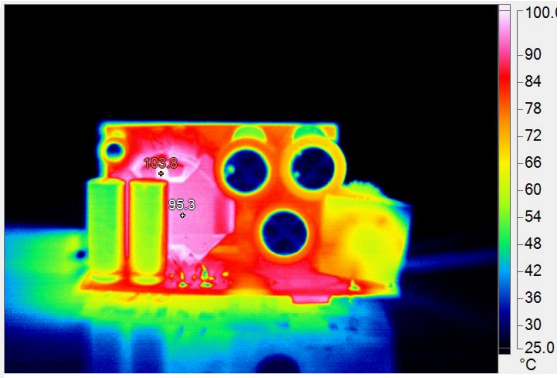
265Vac/50Hz ; 20V ; 3.25A ; with Case	
Output Cap. & DM Choke Side	**Transformer Side**
	
SR MOSFET Side	**Primary MOSFET Side**
	

90Vac/60Hz ; 20V ; 3.25A ; open frame

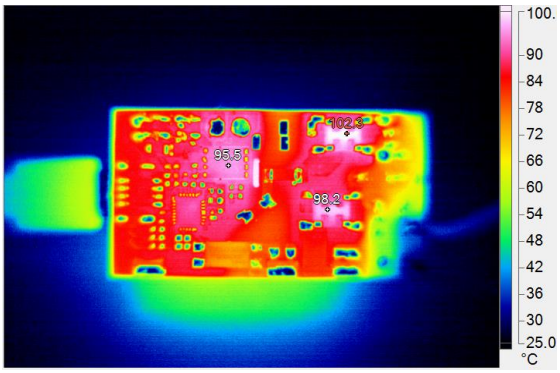
Primary MOSFET Side



Transformer Side



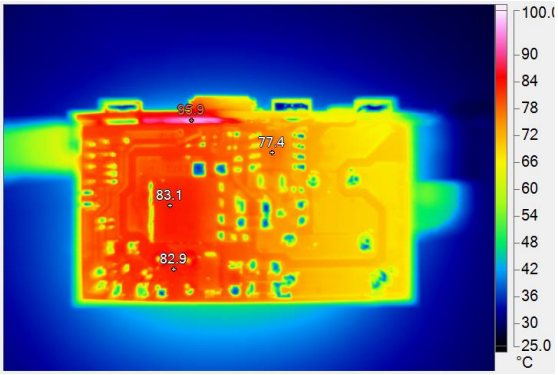
SR MOSFET Side



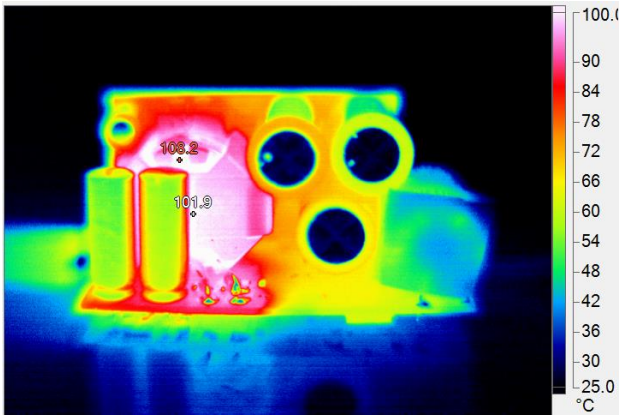
Thermal	90Vac	265Vac
PWM MOS	89.1	83.1
SR MOS	95.5	103.1
Tr / Wire	95.5 / 103.8	101.9 / 108.2
Bridge 1	102.3	68.6
Bridge 2	98.2	67.4
Sunbber diode	88.2	82.9
RT7790	85.2	77.4

265Vac/50Hz ; 20V ; 3.25A ; open frame

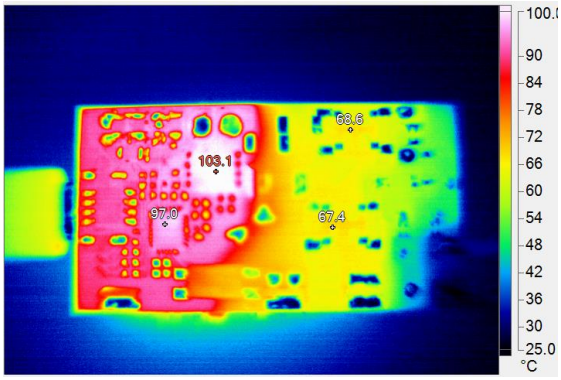
Primary MOSFET Side



Transformer Side



SR MOSFET Side



Thermal	90Vac	265Vac
PWM MOS	89.1	83.1
SR MOS	95.5	103.1
Tr / Wire	95.5 / 103.8	101.9 / 108.2
Bridge 1	102.3	68.6
Bridge 2	98.2	67.4
Sunbber diode	88.2	82.9
RT7790	85.2	77.4

5.5.2 ESD

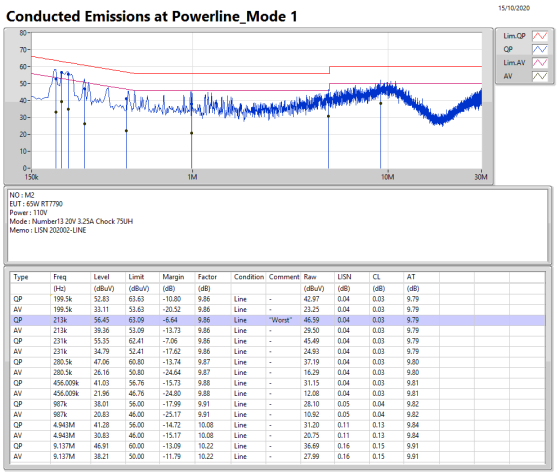
IEC61000-4-2 ESD			
ESD Level	**Contact Mode(kV)**	**Air Mode(kV)**	**Test Result**
1	2	2	PASS
2	4	4	PASS
3	6	8	PASS
4	8	16	PASS

5.5.3 SURGE

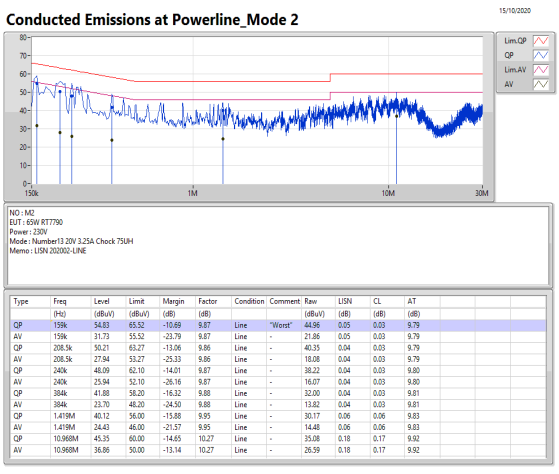
IEC61000-4-5 SURGE		
L-FG; N-FG; L-N-FG Test Volt.(kV)	**L-N Test Volt.(kV)**	**Test Result**
2	1	PASS
2.2	1.1	PASS

5.5.4 Conducted EMI

Conducted EMI	
110Vac/60Hz ; 20V ; 3.25A	**230Vac/50Hz ; 20V ; 3.25A**



Type	Freq	Level	Limit	Margin	Factor	Condition	Comment	Raw	LISN	CL	AT
	(Hz)	(dBuV)	(dBuV)	(dB)	(dB)			(dBuV)	(dB)	(dB)	(dB)
QP	199.5k	52.83	63.63	-10.80	9.86	Line	-	42.97	0.04	0.03	9.79
AV	199.5k	33.11	53.63	-20.52	9.86	Line	-	23.25	0.04	0.03	9.79
QP	213k	56.45	63.09	-6.64	9.86	Line	"Worst"	46.59	0.04	0.03	9.79
AV	213k	39.36	53.09	-13.73	9.86	Line	-	29.50	0.04	0.03	9.79
QP	231k	55.35	62.41	-7.06	9.86	Line	-	45.49	0.04	0.03	9.79
AV	231k	34.79	52.41	-17.62	9.86	Line	-	24.93	0.04	0.03	9.79
QP	280.5k	47.06	60.80	-13.74	9.87	Line	-	37.19	0.04	0.03	9.80
AV	280.5k	26.16	50.80	-24.64	9.87	Line	-	16.29	0.04	0.03	9.80
QP	456.009k	41.03	56.76	-15.73	9.88	Line	-	31.15	0.04	0.03	9.81
AV	456.009k	21.96	46.76	-24.80	9.88	Line	-	12.08	0.04	0.03	9.81
QP	987k	38.01	56.00	-17.99	9.91	Line	-	28.10	0.05	0.04	9.82
AV	987k	20.83	46.00	-25.17	9.91	Line	-	10.92	0.05	0.04	9.82
QP	4.943M	41.28	56.00	-14.72	10.08	Line	-	31.20	0.11	0.13	9.84
AV	4.943M	30.83	46.00	-15.17	10.08	Line	-	20.75	0.11	0.13	9.84
QP	9.137M	46.91	60.00	-13.09	10.22	Line	-	36.69	0.16	0.15	9.91
AV	9.137M	38.21	50.00	-11.79	10.22	Line	-	27.99	0.16	0.15	9.91



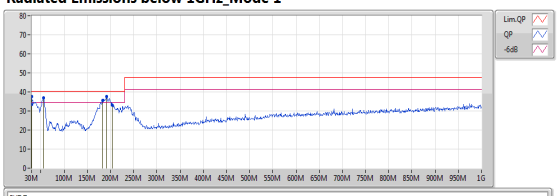
Type	Freq	Level	Limit	Margin	Factor	Condition	Comment	Raw	LISN	CL	AT
	(Hz)	(dBuV)	(dBuV)	(dB)	(dB)			(dBuV)	(dB)	(dB)	(dB)
QP	159k	54.83	65.52	-10.69	9.87	Line	"Worst"	44.96	0.05	0.03	9.79
AV	159k	31.73	55.52	-23.79	9.87	Line	-	21.86	0.05	0.03	9.79
QP	208.5k	50.21	63.27	-13.06	9.86	Line	-	40.35	0.04	0.03	9.79
AV	208.5k	27.94	53.27	-25.33	9.86	Line	-	18.08	0.04	0.03	9.79
QP	240k	48.09	62.10	-14.01	9.87	Line	-	38.22	0.04	0.03	9.80
AV	240k	25.94	52.10	-26.16	9.87	Line	-	16.07	0.04	0.03	9.80
QP	384k	41.88	58.20	-16.32	9.88	Line	-	32.00	0.04	0.03	9.81
AV	384k	23.70	48.20	-24.50	9.88	Line	-	13.82	0.04	0.03	9.81
QP	1.419M	40.12	56.00	-15.88	9.95	Line	-	30.17	0.06	0.06	9.83
AV	1.419M	24.43	46.00	-21.57	9.95	Line	-	14.48	0.06	0.06	9.83
QP	10.968M	45.35	60.00	-14.65	10.27	Line	-	35.08	0.18	0.17	9.92
AV	10.968M	36.86	50.00	-13.14	10.27	Line	-	26.59	0.18	0.17	9.92

5.5.5 Radiated EMI

Radiated EMI	
110Vac/60Hz ; 20V ; 3.25A	**230Vac/50Hz ; 20V ; 3.25A**

Radiated Emissions below 1GHz_Mode 1

15/10/2020

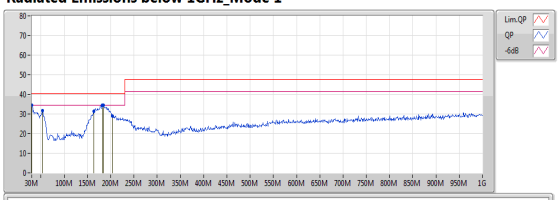


EUT Z
Power AC110V/60Hz
65W RT7790
NO13
AC+core
choc6=75UH
05-M-B-4

Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)		(dBuV/m)	(dB/m)	(dB)	(dB)
PK	30M	37.52	40.46	-2.94	-6.97	3	Vertical	308	1.00	"Worst"	44.49	24.19	0.40	31.56
QP	30M	33.53	40.46	-6.93	-6.97	3	Vertical	308	1.00	-	40.50	24.19	0.40	31.56
PK	55.22M	36.96	40.46	-3.50	-17.93	3	Vertical	215	1.00	-	54.89	13.12	0.70	31.75
PK	183.26M	35.45	40.46	-5.01	-15.40	3	Vertical	349	1.00	-	50.85	15.01	1.53	31.94
PK	191.02M	37.49	40.46	-2.97	-15.30	3	Vertical	269	1.00	-	52.79	14.96	1.61	31.87
PK	203.63M	33.12	40.46	-7.34	-15.15	3	Vertical	276	1.00	-	48.27	14.93	1.71	31.79

Radiated Emissions below 1GHz_Mode 1

15/10/2020



EUT Z
Power AC230V/50Hz
65W RT7790
NO13
AC+core
choc6=75UH
05-M-B-4

Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)		(dBuV/m)	(dB/m)	(dB)	(dB)
PK	30M	34.61	40.46	-5.85	-6.97	3	Vertical	238	1.00	"Worst"	41.58	24.19	0.40	31.56
PK	53.28M	31.73	40.46	-8.73	-17.50	3	Vertical	176	1.00	-	49.23	13.53	0.67	31.70
PK	163.86M	31.42	40.46	-9.04	-14.46	3	Vertical	360	1.00	-	45.88	15.86	1.42	31.74
PK	182.29M	34.41	40.46	-6.05	-15.34	3	Vertical	289	1.00	-	49.75	15.09	1.52	31.85
PK	184.23M	34.53	40.46	-5.93	-15.44	3	Vertical	307	1.00	-	49.97	14.95	1.54	31.93
PK	203.63M	29.09	40.46	-11.37	-15.15	3	Vertical	175	1.00	-	44.24	14.93	1.71	31.79

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