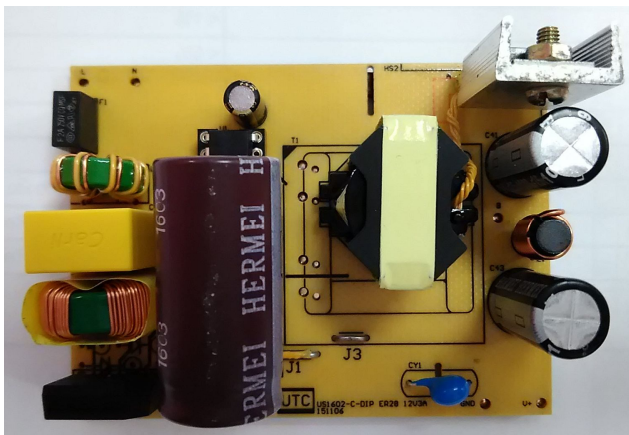




30W Open Frame Module Using UCS1655S

UCS1655S 30W / 12V_2.5A Demo Board Manual



Key features:

- AC Input Full Range 90Vac~264Vac
- DC Output 12Vdc 2.5A
- Average Efficiency >86.95% (meet level 6)
- No load Power <100mW (meet level 6)
- OCP/OVP/OLP/SCP Protection

Revision History

Revise Date	Version	Reason/Issue	Remark
2017/9/26	A		S6003



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30W Open Frame Module Using UCS1655S

1. Adapter Module Specification

1.1. Input Characteristics

● AC input voltage range	90Vac ~ 264Vac
● AC input voltage rating	100Vac ~ 240Vac
● AC input frequency range	47Hz ~ 63Hz
● Input current	1A (rms)max. @ 90Vac/60Hz

1.2. Output Characteristics

● Output Voltage	12V
● Output Tolerance	< ±5%
● Min. load current	0A
● Max. load current	2.5A

1.3. Performance Specifications

● Maximum Output Power	30W
● Standby Power	<100mW (meet level 6)
● Average Efficiency	>86.95% (meet level 6)
● Line Regulation	< 1%
● Ripple & Noise	< 1%

1.4. Protection Function

● Short Circuit Protection	Shut down and auto recovery
● Over Voltage Protection	Shut down and auto recovery
● Over Load Protection	Shut down and auto recovery

1.5. Environment

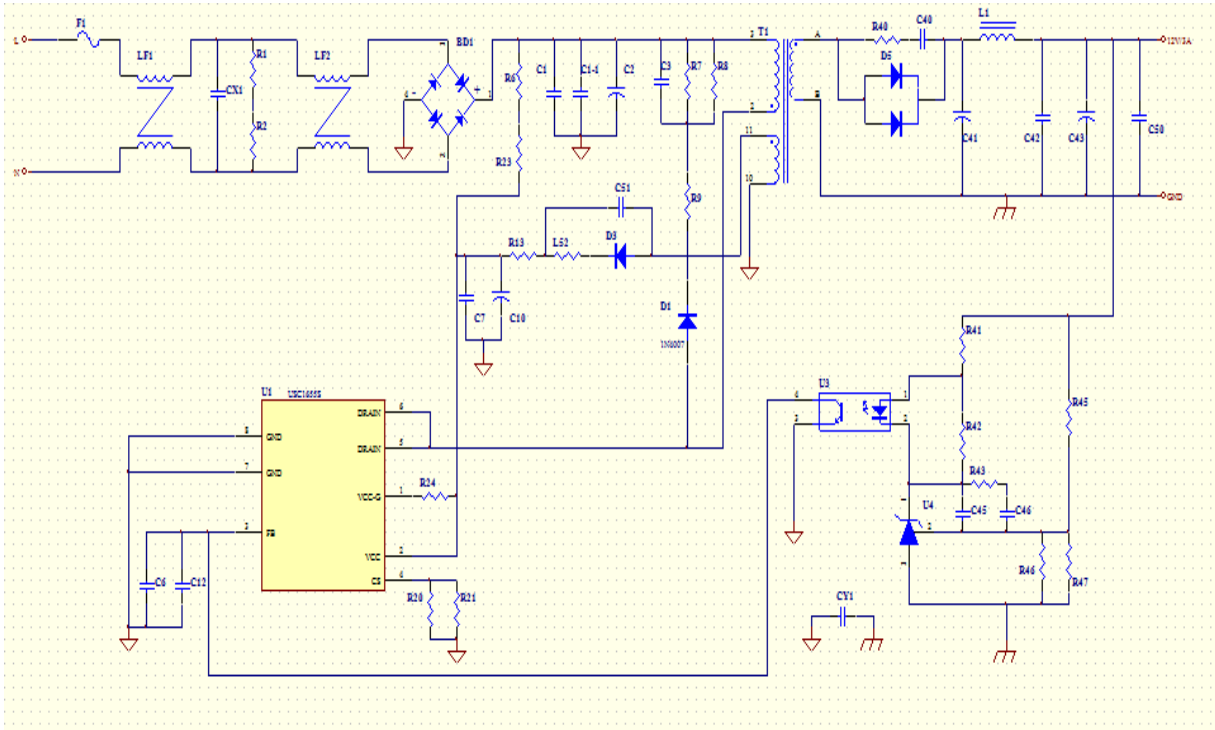
● Operation Temperature	0°C to 40 °C
● Operation Humidity	20% to 90% R.H
● Storage Temperature	-40°C to 60 °C
● Storage Humidity	0% to 90% R.H



30W Open Frame Module Using UCS1655S

2. Open Frame Module Information

2.1. Schematic



2.2. BOM

1	BD1	KBP208, 2A_800V	1
2	C1,C1-1	Capacitor, chip 10nF/1KV, NPO, SMD1206	2
3	C2	Capacitor, aluminum electrolytic, 68uF/400V, 105°C,±20%, 合美, BL Type	1
4	C3	Capacitor, chip, 1nF/1KV, NPO, SMD1206	1
5	C6,C12	Capacitor, chip, 1nF/50V, X7R, SMD 0805	2
6	C7	Capacitor, chip, 0.1uF/50V, X7R, SMD 1206	1
7	C7	22V Zener Diode	1
8	C10	Capacitor, aluminum electrolytic, 10uF/63V; 105°C,±20%, 合美, LE Type	1
9	C41,C43	Capacitor, aluminum electrolytic 1000uF/25V, 105°C,±20%, 合美, LH Type	2
10	C45	Capacitor, chip, 10nF/50V, X7R, SMD 0603	1
11	C46	Capacitor, chip, 0.22uF/25V, X7R, SMD 0603	1
12	C50	Capacitor, chip, 0.1uF/50V, X7R, SMD 0805	1
13	CX1	Capacitor, X2, 0.33uF/275VAC, 105°C, ±20%	1
14	CY1	Capacitor, Y1, 1000pF/400V, 105°C,±20%	1
15	D1	Diode ,standard recovery, 1N4007, 1.0A/1000V SMA	1
16	D3	Diode ,fast recovery, BAV20WG ,1A/200V SOD-123	1
17	D5	Diode, dual Schottky, TGBR20U80C, 20A/80V, TO-220	1
18	F1	2.0A / 250V MST TIME-LAG RADIAL LEAD MICRO FUSE (Conquer)	1
19	LF1	320uH MIN 10Ts Φ0.5*1P 2UEW-B T12*6*4C JPZ1K	1



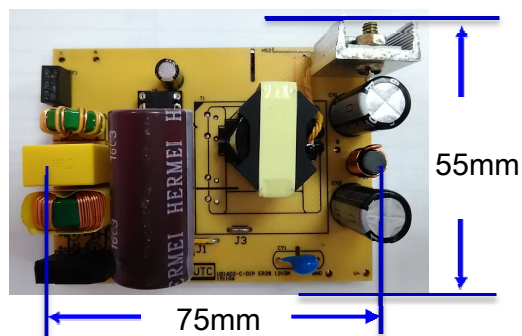
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20	LF2	8.7mH MIN 56Ts ϕ 0.45*1P 2UEW-B T14*9*5C JPH-10F	1
21	T1	Transformer, RM-8, L=680uH, 50:8:10	1
22	J1,J3	Jump wire ϕ 0.8	2
23	R1,R2	Resistor, chip,1.5M, 1/4W, \pm 1%, SMD 1206	2
24	R7,R8	Resistor, chip,750K, 1/4W, \pm 1%, SMD 1206	2
25	R9,R24,J2	Resistor, chip,0 Ω , 1/4W, \pm 1%, SMD 1206	3
26	R13	Resistor, chip,1 Ω , 1/4W, \pm 1%, SMD 1206	1
27	R20,R21	Resistor, chip, 1.5 Ω //1.5 Ω //6.2 Ω , 1/4W, \pm 1%, SMD 1206	3
28	R41	Resistor, chip,680 Ω , 1/10W, \pm 1%, SMD 0603	1
29	R42	Resistor, chip,2.2K, 1/10W, \pm 1%, SMD 0603	1
30	R43	Resistor, chip,1K Ω , 1/10W, \pm 1%, SMD 0603	1
31	R45	Resistor, chip,39K, 1/10W, \pm 1%, SMD 0603	1
32	R46	Resistor, chip,10K, 1/10W, \pm 1%, SMD 0603	1
33	L1	R core, 1uH, ϕ 0.8	1
34	L52	Resistor, chip,0 Ω , 1/8W, \pm 1%, SMD 0805	1
35	U1	IC, PWM controller, UTC UCS1655S, DIP-7A (D/C: UHRA 06)	1
36	U3	IC, Opto-Coupler, LTV-357-T-B , SMD , LITE-ON	1
37	U4	IC, TL431 2.495V \pm 0.5% SOT-23	1
38	No Component	R6,R23,R47,C42,C51,R40,C40	7
: The Yellow color block means the parts that UTC can provide.			

2.3. Open frame Module Snapshot



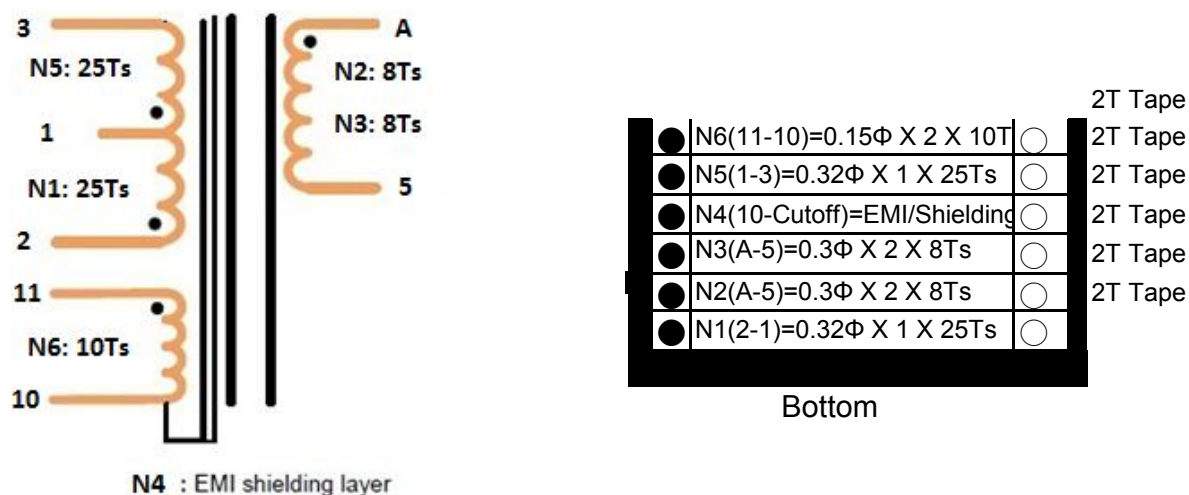
30W Open Frame Module Using UCS1655S

2.4. Transformer Design

2.4.1. Transformer Specification

- 1) Bobbin: RM-8
- 2) Core material : PC41 (越峯) or equivalent.
- 3) Lm 2-3: 680uH, ±10% (65KHz)

2.4.2. Transformer Diagram



Transformer Winding Data

Layer No.	Winding	Material	Start	Turns	Finish	Note
1	N1	0.32ΦX1 2 UEW	2	25	1	
2	Tape	Tape		2		
3	N2	Triple Insulated Wire 0.3ΦX2	A	8	5	
4	Tape	Tape		2		
5	N3	Triple Insulated Wire 0.3ΦX2	A	8	5	
6	Tape	Tape		2		
7	N4	0.15ΦX1 2 UEW	10	繞滿	Cut-off	
8	Tape	Tape		2		
9	N5	0.32ΦX1 2 UEW	1	25	3	
10	Tape	Tape		2		
11	N6	0.15ΦX2 2 UEW	11	10	10	中間密繞 檔牆 上下各2mm
12	Tape	Tape		2		



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30W Open Frame Module Using UCS1655S

3. Performance Evaluation

This document presented here is to describe the open frame Module performance.

The Summarized Result :

Item	Test result
1. Input Characteristics	
Input Current (90V/60Hz, full load)	716mA
Standby Power at No Load	<100mW (meet level 6)
Averaged Efficiency (@115/230Vac, 25%~100% Load ,On PCB End)	89.03% Meet level 6 >86.95% @115VAC 88.69% Meet level 6 >86.95% @230VAC
2. Output characteristics	
Output Tolerance	<5%
Line Regulation	≅ 1%
Ripple & Noise	< 1%
Overshoot	≤ 5%
Ripple of DynamicTest	< 5%
3. Protection	
Short Circuit Protection	Shut Down and Auto Recovery
Over Voltage Protection	Shut Down and Auto Recovery
Over Load Protection	Shut Down and Auto Recovery

Test Equipment:

Item	Vendor	Model No:
1.AC Source	Chroma	61602
2.Digital Power meter	Chroma	66202
3.Electronic Load	Chroma	63102
4.Digital Oscilloscope	Tektronics	DPO3014
5.Multi-meter	Keithley	2000
6.Thermal meter	Opex	PT-3S



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30W Open Frame Module Using UCS1655S

3.1. Input Characteristics

3.1.1 Full Load Efficiency :

Table 1 Full Load Efficiency :

Input	I _{rms} (mA)	P _{in} (W)	V _o (V)	I _o (A)	Eff(%)
90Vac/60Hz	716	34.325	12.102	2.5	88.14
115Vac/60Hz	615	33.97	12.103		89.07
230Vac/50Hz	396	33.747	12.103		89.66
264Vac/50Hz	357	33.793	12.103		89.54

3.1.2 Efficiency:

BVO : PCB side measured 12V output. B.Eff :PCB side measured Efficiency.

Table 3 Efficiency(Test On PCB END) :

Input Voltage	25%(0.625A)			50%(1.25A)		
	Pi(W)	B.Vo(V)	B.Eff(%)	Pi(W)	B.Vo(V)	B.Eff(%)
115Vac/60Hz	8.358	12.116	90.60	16.763	12.112	90.32
230Vac/50Hz	8.493	12.116	89.16	16.898	12.112	89.60
Input Voltage	75%(1.875A)			100%(2.5A)		
	Pi(W)	B.Vo(V)	B.Eff(%)	Pi(W)	B.Vo(V)	B.Eff(%)
115Vac/60Hz	25.31	12.108	89.70	33.97	12.103	89.07
230Vac/50Hz	25.259	12.108	89.88	33.747	12.103	89.66

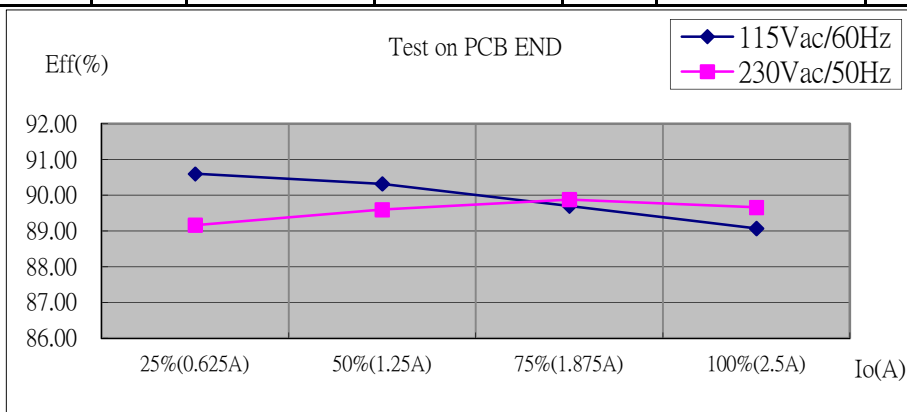


Fig.1 Efficiency VS Load



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Table 3 Efficiency(Calculate On Cable END_18AWG/ 1.5m) :

Input Voltage	25%(0.625A)			50%(1.25A)		
	Pi(W)	Cable.Vo(V)	Cable.Eff(%)	Pi(W)	Cable.Vo(V)	Cable.Eff(%)
115Vac/60Hz	8.358	12.068	90.24	16.763	12.016	89.60
230Vac/50Hz	8.493	12.068	88.81	16.898	12.016	88.89
Input Voltage	75%(1.875A)			100%(2.5A)		
	Pi(W)	Cable.Vo(V)	Cable.Eff(%)	Pi(W)	Cable.Vo(V)	Cable.Eff(%)
115Vac/60Hz	25.31	11.964	88.63	33.97	11.911	87.66
230Vac/50Hz	25.259	11.964	88.81	33.747	11.911	88.24

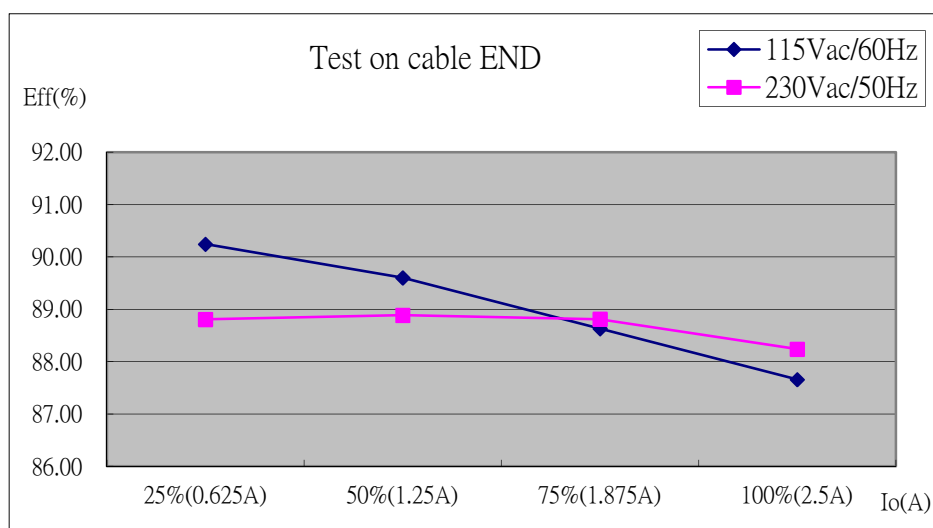


Fig.1 -1 Efficiency VS Load



30W Open Frame Module Using UCS1655S

Table 4 Average Efficiency (PCB End) :

Input Voltage	Average	Remark	Result
	B.Aver. Eff.(%)		
115Vac/60Hz	89.92	Level 6 >86.95%	PASS
230Vac/50Hz	89.57		

Table 5 Average Efficiency(Calculate On Cable_18AWG/ 1.5m) :

Input Voltage	Average	Remark	Result
	Cable.Aver. Eff.(%)		
115Vac/60Hz	89.03	Level 6 >86.95%	PASS
230Vac/50Hz	88.69		



30W Open Frame Module Using UCS1655S

3.1.3 Standby power

3.1.3.1

Table 5 Standby Power Test Data

Input Voltage	Stand by power			
	Pin(mW)	Vo(V)	Remark	Result
90Vac/60Hz	32	12.121	DOE LV6 <100mW	PASS
115Vac/60Hz	34	12.121		
230Vac/50Hz	54	12.121		
240Vac/50Hz	56	12.121		
264Vac/50Hz	70	12.121		



30W Open Frame Module Using UCS1655S

3.2 Output Characteristics

3.2.1 Line Regulation & Load Regulation

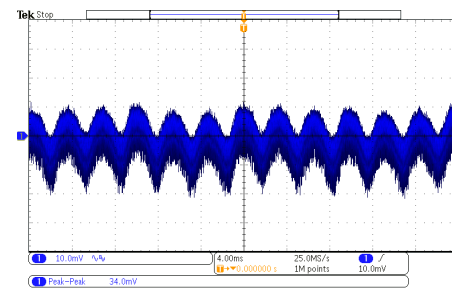
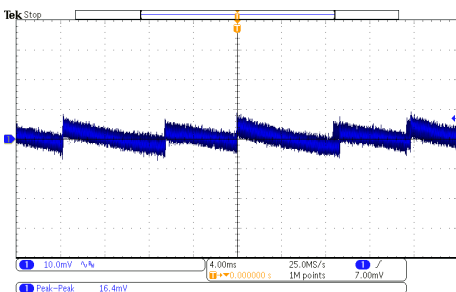
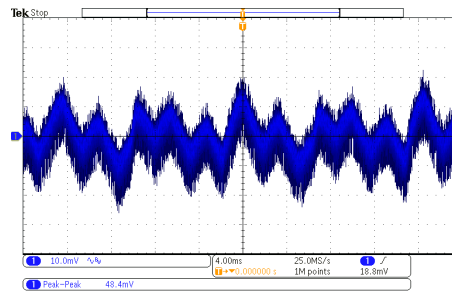
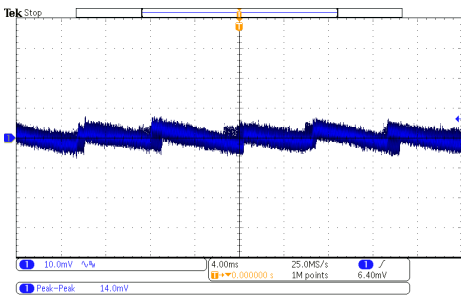
Table 6 Line Regulation & Load Regulation

Input Voltage	Load			Load Regulation%	Remark	Result
	No Load (V)	Half Load	Full Load			
90Vac/60Hz	12.121	12.11	12.102	0.16%		PASS
115Vac/60Hz	12.121	12.11	12.112	0.08%		
Line Regulation%	0.00%	0.00%	0.00%			
Input Voltage	Load			Load Regulation%	Remark	Result
	No Load (V)	Half Load	Full Load			
230Vac/50Hz	12.121	12.11	12.112	0.08%		PASS
264Vac/50Hz	12.121	12.11	12.103	0.15%		
Line Regulation%	0.00%	0.00%	0.00%			

3.2.2 Ripple & Noise

Table 8 Ripple & Noise

Input Voltage	Ripple & Noise(mV)				Remark	Result
	No. Load		Full Load			
90Vac/60Hz	14.0	Fig 4	48.4	Fig 5	<120mV	PASS
115Vac/60Hz	13.6	—	43.2	—		PASS
230Vac/50Hz	16.4	—	32.4	—		PASS
264Vac/50Hz	16.4	Fig 6	34.0	Fig 7		PASS



30W Open Frame Module Using UCS1655S

3.2.3 Overshoot

AC Power switch ON for overshoot, and switch OFF for undershoot.

Table 9 Overshoot

Input Voltage	Load Condition	Over shoot	Data (%)	Remark
90Vac/60Hz	No Load	Overshoot	1.987	Fig. 8
	Full Load	Overshoot	1.987	Fig. 9
264Vac/50Hz	No Load	Overshoot	1.987	Fig.10
	Full Load	Overshoot	1.987	Fig.11

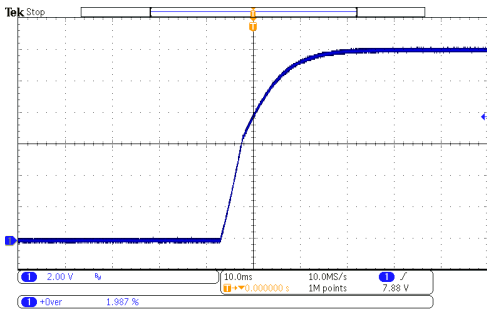


Fig.8 90Vac / 60Hz, Overshoot @ No Load

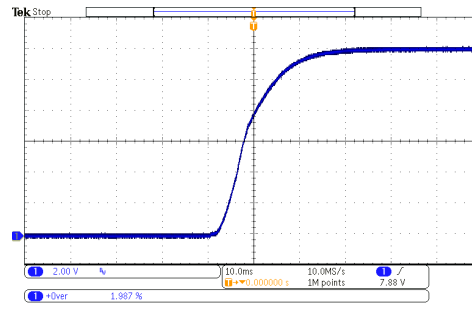


Fig.9 90Vac / 60Hz, Overshoot @ Full Load

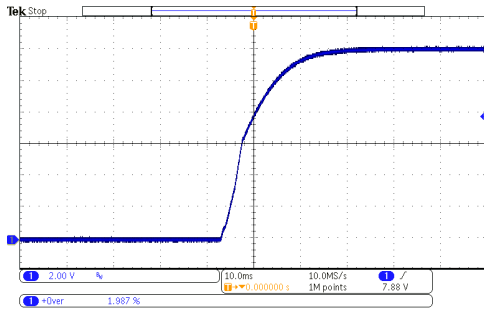


Fig.10 264Vac/50Hz, Overshoot @ No Load

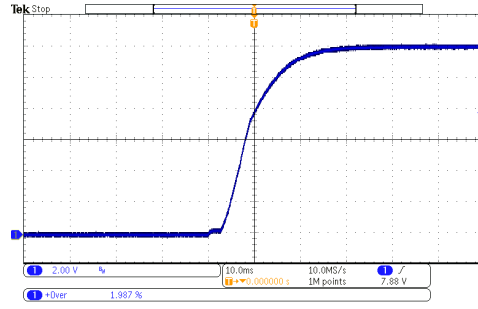


Fig.11 264Vac/50Hz, Overshoot @ Full Load



30W Open Frame Module Using UCS1655S

3.2.4 Dynamic Test

The High Level ;Low level switching time is set to 1ms each, slew rate of load change: 500mA/us

Table 10 Dynamic Test

Input Voltage	Output (V)	Io(A):Low-High	Remark
90Vac/60Hz	12.0~12.4	0-1.25	Fig.13
90Vac/60Hz	12.0~12.4	1.25-2.5	Fig.14
264Vac/50Hz	12.0~12.3	0-1.25	Fig.15
264Vac/50Hz	12.0~12.3	1.25-2.5	Fig.16

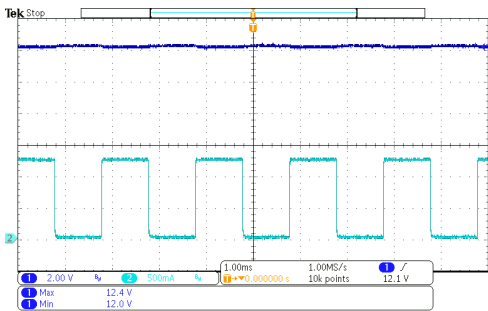


Fig. 13 90Vac / 60Hz Dynamic Test

CH1:Vo, CH4:Io

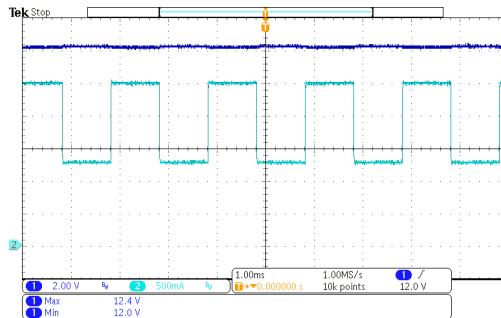


Fig. 14 90Vac / 60Hz Dynamic Test

CH1:Vo, CH4:Io

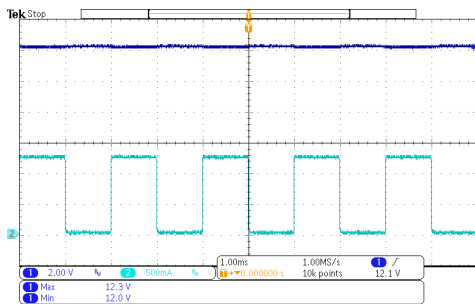


Fig. 15 264Vac / 50Hz Dynamic Test

CH1:Vo, CH4:Io

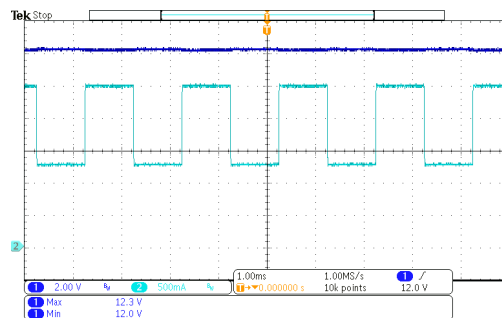


Fig. 16 264Vac / 50Hz Dynamic Test

CH1:Vo, CH4:Io

3.2.5 Time Sequence

Table 11 Time Sequence (Test at full load)

Item	Input Voltage	Meas. Data	Remark	Result
Turn on Delay Time	90Vac/60Hz	324ms	Fig. 15	Ref
	180Vac/50Hz	329ms	Fig. 16	Ref
Hold-UpTime	100Vac/60Hz	10ms	Fig. 17	Ref
	240Vac/50Hz	135.2ms	Fig. 18	Ref
Rise Time	100Vac/60Hz	14.17ms	Fig. 19	Ref
	240Vac/50Hz	14.02ms	Fig. 20	Ref
Falling Time	100Vac/60Hz	8.379ms	Fig. 21	Ref
	240Vac/50Hz	8.579ms	Fig. 22	Ref



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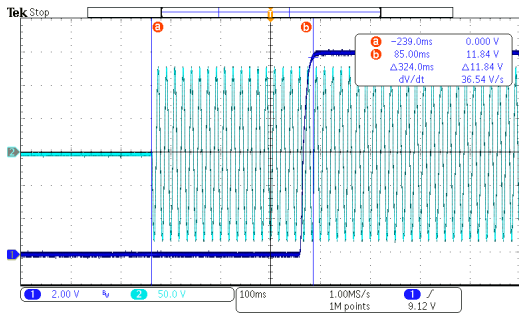


Fig. 15 90Vac/60Hz, Full Load Turn-on Delay Time
CH1=Vout, CH2=AC Input

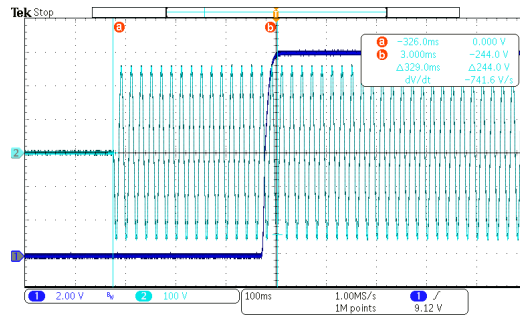


Fig. 16 180Vac/50Hz, Full load Turn-on Delay Time
CH1=Vout, CH2=AC Input

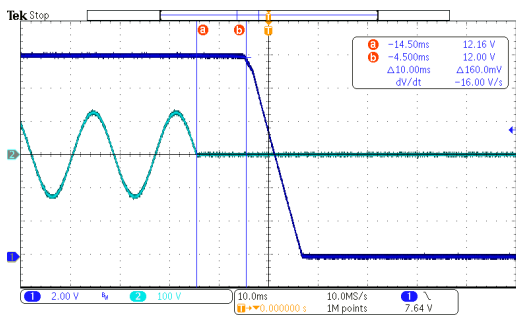


Fig. 17 100Vac / 60Hz, Full Load Hold-Up Time
CH1=Vout, CH2=AC Input

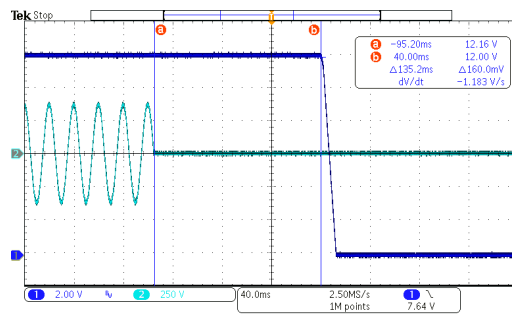


Fig. 18 240Vac / 50Hz, Full Load Hold-Up Time
CH1=Vout, CH2=AC Input

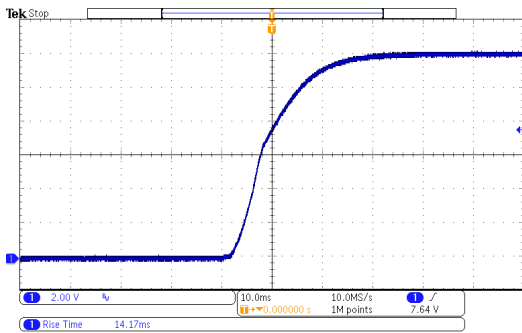


Fig. 19 100Vac/60Hz, Full Load Rising Time

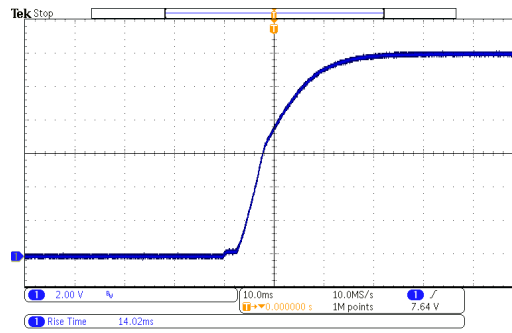


Fig. 20 240Vac/50Hz, Full load Rising Time



30W Open Frame Module Using UCS1655S

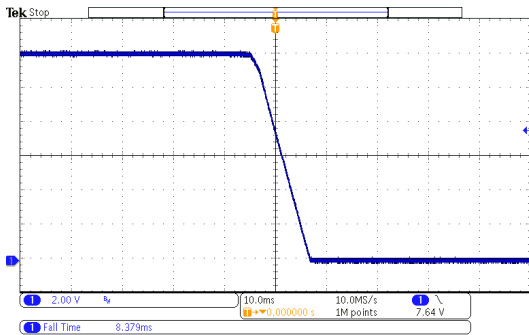


Fig. 21 100Vac/60Hz Full load FallingTime

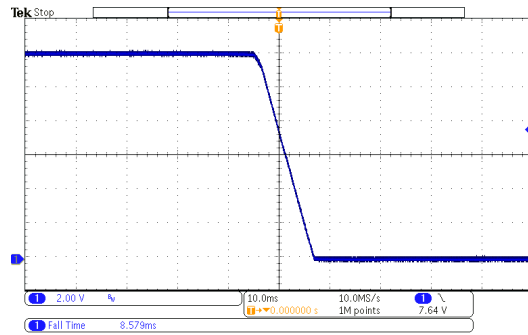


Fig. 22 240Vac/50Hz Full load Falling Time

3.3 Protection

3.3.1 Short Circuit Protection

When short the output voltage, and no parts are damaged. Once Short Circuit condition is removed and the power should recover automatically.

Table 12 Short Circuit Protection

Input Voltage	Protection Mode	Result
90Vac/60Hz	Auto Recovery	PASS
264Vac/50Hz	Auto Recovery	PASS

3.3.2. Over Voltage Protection (OVP)

When Over Voltage Protection condition is removed and the power automatically recover.

Table 13 OVP

Input Voltage	Protection Mode	Vcc	Remark	Test condition
90Vac/60Hz	Auto Recovery	26.9V	Fig. 23	U3(Pin1-Pin2) to short
264Vac/50Hz	Auto Recovery	26.9V	Fig. 24	

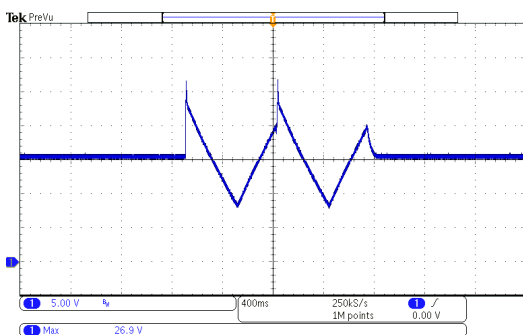


Fig 23. 90Vac/60Hz OVP (Load=0.1A)

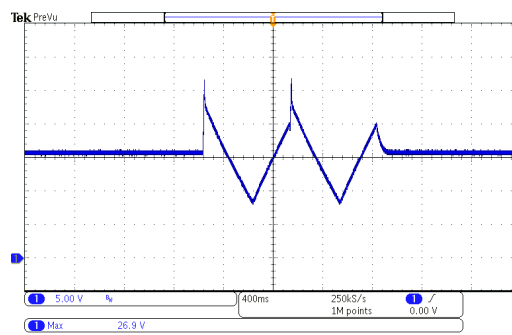


Fig 24 264Vac/50Hz OVP (Load=0.1A)



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3.3.3 Over load Protection

When over load condition is removed and the power automatically recover.

3.3.3.1 Over load Protection

Table 14 OLP

Input Voltage	OLP(A)	Over Rating	Remark
90Vac/60Hz	3.27	131%	130%~150% 3.25A~3.75A
115Vac/60Hz	3.56	142%	
230Vac/50Hz	3.41	136%	
264Vac/50Hz	3.38	135%	

3.3.4 Thermal Testing

90Vin Burn in 2.5hr, 264Vin Burn in 1hr @openframe, EN=25°C

Table 15 Thermal Testing

Input Voltage	U1(°C)	D5(°C)	T1 Wire(°C)	T1 Core(°C)	BD1(°C)
90Vac/60Hz	82	72	66	60	54
264Vac/50Hz	78	72	71	66	36



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4.1. Waveform at Full Load, Operating Start / Normal to Ground .

Table 26 Measuring Data at Full Load, Operating Start/ Normal Test.

Test Item	Input voltage	U1,Vds(Max)	D5(Max)	Remark
Start at full load	264V/50HZ	516	74.4	Fig 30/31
Normal at full load	264V/50HZ	500	74.4	Fig 32/33

4.1.1. Start up at Full Load Waveform : U1,Vds(Max)

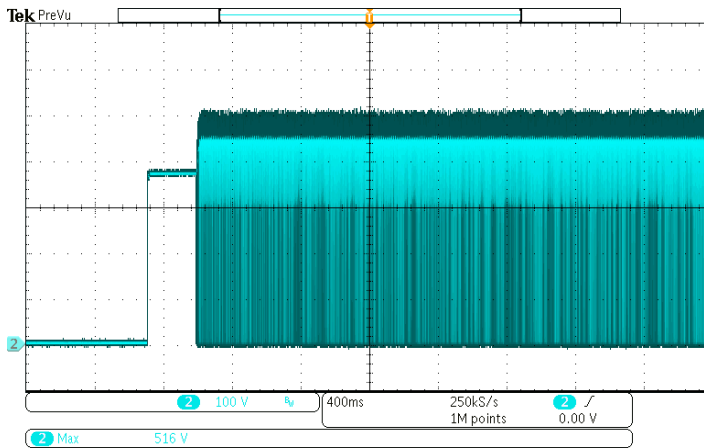


Fig.30 264Vac / 50Hz, Start up at Full load. U1,Vds(max)

4.1.2. Start up at Full Load Waveform : D5,(Max)

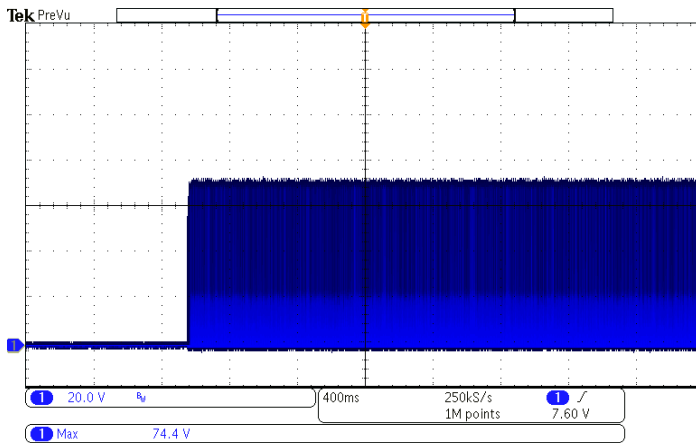


Fig.31 264Vac / 50Hz, Start up at Full load. D5(Vmax)



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4.1.3 Normal Full Load Waveform : U1, Vds(Max)

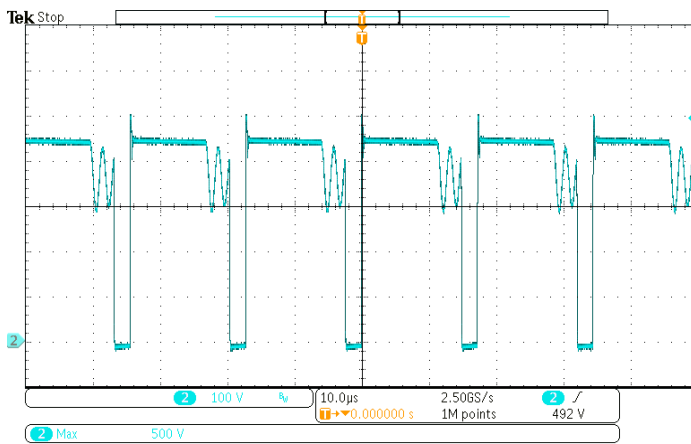


Fig.32 264Vac / 50Hz, Normal at full load . U1,Vds(Max)

4.1.4 Normal Full Load Waveform : D5,(Max)

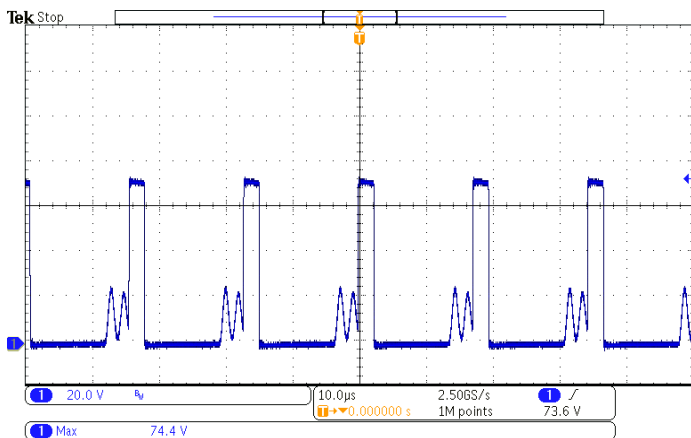


Fig.32 264Vac / 50Hz, Normal at full load . D5,(Max)

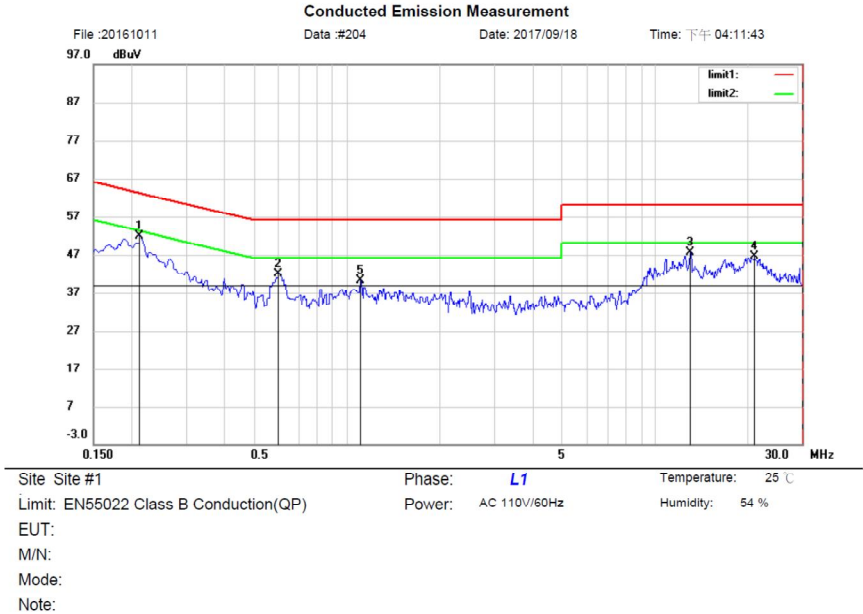


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5. EMI test

5.1 Conduction

5.1.1 input 115VAC/60HZ Line



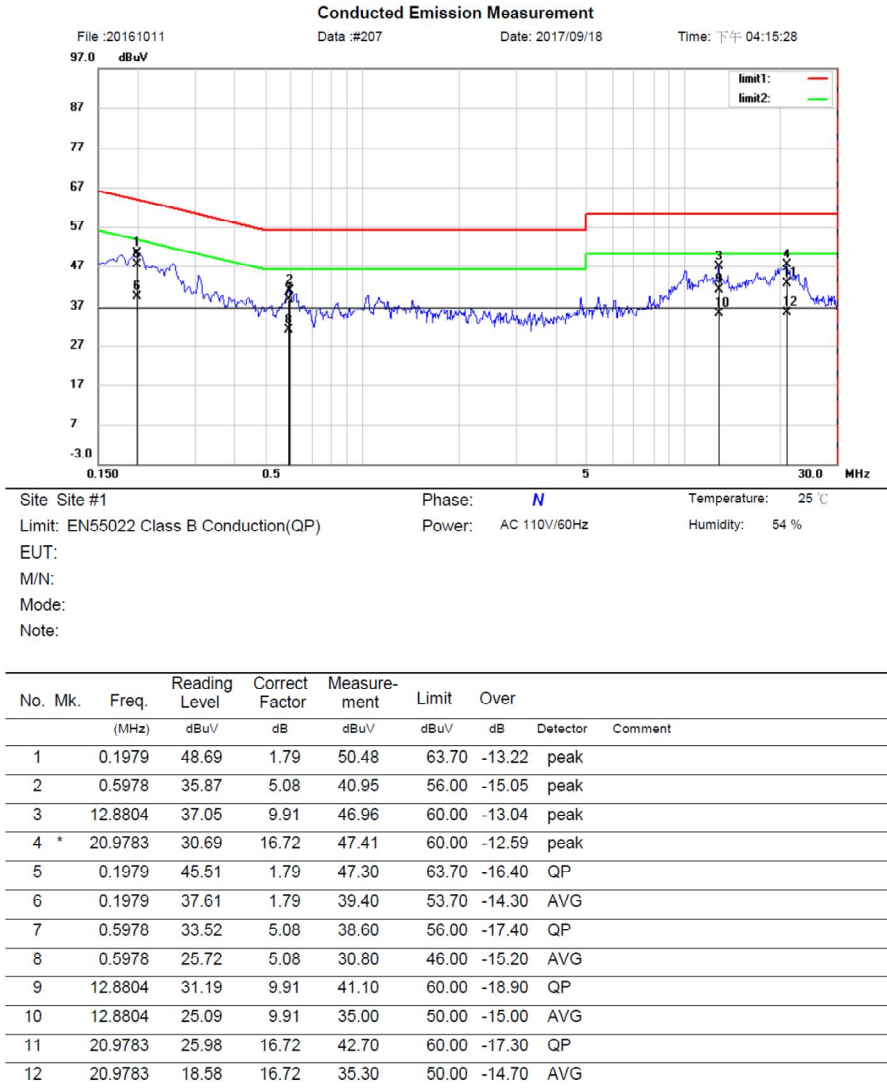
No.	Mk.	Freq. (MHz)	Reading Level dBuV	Correct Factor dB	Measurement dBuV	Limit dBuV	Over dB	Detector	Comment
1	*	0.2124	50.01	1.79	51.80	63.11	-11.31	peak	
2		0.6076	36.72	5.24	41.96	56.00	-14.04	peak	
3		12.9891	37.62	9.91	47.53	60.00	-12.47	peak	
4		21.0326	29.99	16.72	46.71	60.00	-13.29	peak	
5		1.1065	28.61	11.60	40.21	56.00	-15.79	peak	
6		0.2124	44.61	1.79	46.40	63.11	-16.71	QP	
7		0.2124	36.81	1.79	38.60	53.11	-14.51	AVG	
8		0.6076	33.46	5.24	38.70	56.00	-17.30	QP	
9		0.6076	25.76	5.24	31.00	46.00	-15.00	AVG	
10		12.9891	31.59	9.91	41.50	60.00	-18.50	QP	
11		12.9891	25.19	9.91	35.10	50.00	-14.90	AVG	
12		21.0326	26.48	16.72	43.20	60.00	-16.80	QP	

No.	Mk.	Freq. (MHz)	Reading Level dBuV	Correct Factor dB	Measurement dBuV	Limit dBuV	Over dB	Detector	Comment
13		21.0326	19.18	16.72	35.90	50.00	-14.10	AVG	
14		1.1065	23.70	11.60	35.30	56.00	-20.70	QP	
15		1.1065	15.70	11.60	27.30	46.00	-18.70	AVG	



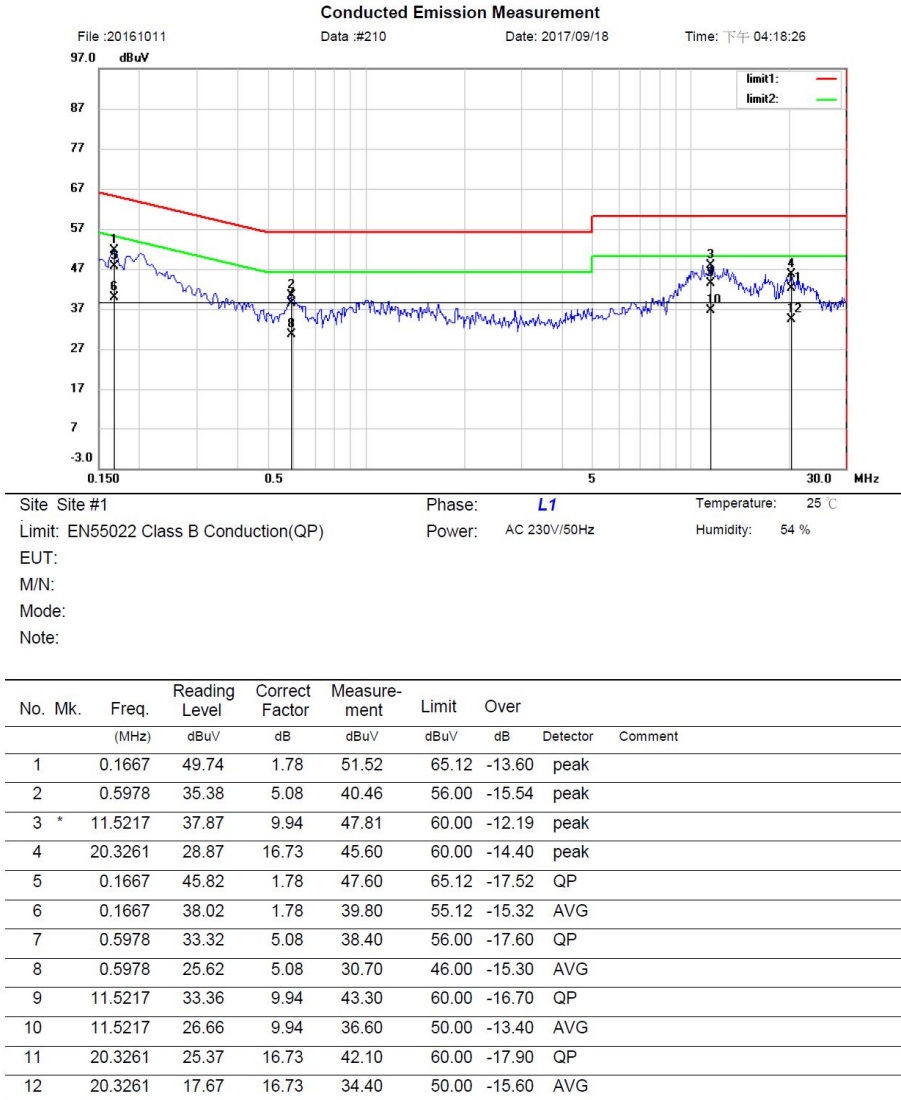
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5.1.2 input 115VAC/60HZ Neutral



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5.1.3 input 230VAC/50HZ Line



30W Open Frame Module Using UCS1655S

5.1.4 input 230VAC/50HZ Neutral

